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Written Section – 230 Questions

**Referenced Answers – 85 Pages**

***This examination is meant to be used as a study tool when preparing for the ACLAM or ECLAM Certifying Examinations. The material presented in this mock examination follows the ACLAM role delineation document, but is not necessarily reflective of the ACLAM or ECLAM Certifying Examinations.***

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**1.** Neonatal cross-fostering has been used to remove which of the following etiologic agents from *Peromyscus* *spp.*?

1. *Corynebacterium* *spp.*
2. *Helicobacter* *spp.*
3. Murine parvoviruses
4. *Pasteurella* *spp.*

**Answer: b. *Helicobacter* *spp.***

**References:**

1. Pritchett-Corning et al. 2015. Use of neonatal fostering to remove *Helicobacter spp.* from Deer Mice (*Peromyscus maniculatus*). JAALAS 54(4):439-444
2. Dyson et al. 2009. *Helicobacter spp.* in wild mice (*Peromyscus leucopus*) found in laboratory animal facilities. JAALAS 48(6):754-756

**Domain 1; Tertiary Species – Other Rodents**

**2.** Ketamine is combined with xylazine to reduce what common side effect that occurs when ketamine is used as the sole agent for anesthesia?

* 1. Cardiovascular depression
	2. Hyperacusia
	3. Hypothermia
	4. Muscle rigidity

e. Respiratory depression

**Answer: d. Muscle rigidity**

**References:**

1. Fish RE, Brown MJ, Danneman PJ, Karas AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals, 2nd ed. Academic Press, San Diego, CA. Chapter 10 – Anesthesia and Analgesia for Laboratory Rodents, pp. 257- 258.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 24 – Preanesthesia, Anesthesia, Analgesia, and Euthanasia, p. 1140.

**Domain 2**

1. PCR of the SRY gene in macaque serum can be used to do which of the following?
2. Screen for simian retrovirus infection
3. Screen for simian rhadinovirus infection
4. Determine fetal sex in pregnant animals
5. Determine gestational age of fetus in pregnant animals

**Answer: c. Determine fetal sex in pregnant animals**

**Reference:** Yasmin et al. 2015. Detection and quantification of male-specific fetal DNA in the serum of pregnant cynomolgus monkeys (*Macaca fascicularis*). [Comparative](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4396932/) Medicine 65(1):70–76

**Domain 3; Primary Species - Macaques (*Macaca spp.*)**

**4.** Which of the following species requires exposure to “winter light” (6 weeks per year of 14 h of dark daily) to enhance breeding and maintain physiologic normalcy?

1. Cat
2. Cotton rat
3. Ferret
4. Gerbil
5. Rabbit

**Answer: c. Ferret**

**References:**

1)Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 7 – Biology and Diseases of Other Rodents, pp. 312, 317-318; Chapter 10 – Biology and Diseases of Rabbits, p. 419-420; Chapter 13 – Biology and Diseases of Cats, p. 564; and Chapter 14 – Biology and Diseases of Ferrets, p. 579.

2) Fox JG, Marini RP, eds. 2014 Biology and Diseases of the Ferret, 3rd edition. Wiley-Blackwell: San Diego, CA. Chapter 8 – Growth and Reproduction, p. 311.

**Domain 4; Secondary Species – Ferret (*Mustela putorius furo*)**

**5.** What is the minimum length that a class B dealer must hold adult dogs acquired from a private shelter prior to subsequently selling them to an academic institution?

1. 3 days
2. 5 days
3. 7 days
4. 10 days
5. 14 days

**Answer: d. 10 days**

**Reference:** Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 2 – Regulations, Subpart H – Compliance with Standards and Holding Period, §2.101 (a)(1) Holding Period (11-6-13 Edition, p. 50)

 (http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

**Domain 5; Primary Species – Dog (*Canis familiaris*)**

**6.** Which of the following national agencies “strives to develop innovations to reduce, remove or bypass costly and time-consuming bottlenecks in the translational research pipeline in an effort to speed the delivery of new drugs, diagnostics and medical devices to patients?”

1. OPRR
2. NCATS
3. NIDDK
4. NIA

**Answer: b. NCATS (National Center for Advancing Translational Sciences)**

**References:**

1. https://ncats.nih.gov/about/center
2. https://www.niddk.nih.gov/about-niddk/Pages/default.aspx
3. https://www.nia.nih.gov/about/mission

**Domain 6**

**7.** What is the most common type of craniofacial trauma associated with epilepsy in baboons?

1. Facial
2. Muzzle
3. Periorbital
4. Scalp
5. Tooth

**Answer: c. Periorbital**

**References:**

1) Szabó et al. 2014. Craniofacial trauma as a clinical marker of seizures in a baboon colony. Comparative Medicine 64(2):135-139

2) Szabó et al. 2012. Epidemiology and characterization of seizures in a pedigreed baboon colony. Comparative Medicine 62(6):535-538

**Domain 1; Secondary Species – Baboon (*Papio spp.*)**

**8.** In a recent study, chimpanzees were trained to urinate into a collection device. Trainers offered a food reward to chimpanzees that showed a fear response to the collection device. This is an example of what type of training?

a. Classical conditioning

b. Counter-conditioning

c. Negative-reinforcement training

d. Operant conditioning

e. Positive-reinforcement training

**Answer: b. Counter conditioning**

**References:**

1. Bloomsmith et al. 2015. Positive reinforcement methods to train chimpanzees to cooperate with urine collection. JAALAS54(1):66-69
2. McMillan et al. 2014. Refining the pole-and-collar method of restraint: emphasizing the use of positive training techniques with rhesus macaques (*Macaca mulatta*). JAALAS 53(1):61-68

**Domain 3; Tertiary Species – Other Nonhuman Primates**

**9.** All of the following arerecommended as flooring substrate for swine **EXCEPT**?

a. Fiberglass slatted flooring

b. Plastic coated metal grids

c. Rubber mats

d. Seamless epoxy

e. Straw bedding

**Answer: d. Seamless epoxy**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 16 – Biology and Diseases of Swine, p. 697
2. Committees to Revise the Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching. 2010. GUIDE For the Care and Use of Agricultural Animals in Research and Teaching. 3rd Edition. Federation of Animal Science Societies, Savoy, IL. Chapter 5 – Animal Handling and Transport, p. 49

 (https://www.aaalac.org/about/Ag\_Guide\_3rd\_ed.pdf)

**Domain 4; Primary Species – Pig (*Sus scrofa*)**

**10.** Schedule \_\_\_\_\_\_\_\_\_ drugs, substances, or chemicals are defined as drugs with a low potential for abuse and low risk of dependence?

 a. I

 b. II

c. III

d. IV

 e. V

**Answer: d. IV**

**References:**

1. Fish RE, Brown MJ, Danneman PJ, Karas AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals, 2nd ed. Academic Press, San Diego, CA. Chapter 25 – Regulatory Issues, p. 574 (Table 25-1).
2. https://www.dea.gov/druginfo/ds.shtml
3. http://www.deadiversion.usdoj.gov/schedules/index.html
4. http://www.deadiversion.usdoj.gov/fed\_regs/rules/2014/fr0702.htm

**Domain 5**

**11.** You’re called to see a *Xenopus laevis* that was reported for a bite wound that is now covered in what looks like tufts of cotton. Which of these would be the least appropriate treatment to initiate for this frog?

1. Benzalkonium chloride in the water
2. Immersion in potassium permanganate
3. Malachite green bath
4. Sodium chloride bath
5. Topical ivermectin

**Answer: e. Topical ivermectin**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 18 – Biology and Diseases of Amphibians, pp. 958-959.
2. Green SL. 2010. The Laboratory *Xenopus* sp. CRC Press: Boca Raton, FL. Chapter 4 – Veterinary Care, p. 89

**Domain 1; Secondary Species – South African Clawed Frog (*Xenopus laevis* and *Xenopus tropicalis*)**

**12.** Which of the following statements best describes anesthetic use in small ruminants?

* 1. Diazepamis best given IV as it is a tissue irritant and its absorption is unpredictable following IM administration
	2. Opioids such as buprenorphine and butorphanol provide reliable sedation in sheep
	3. Xylazine-ketamine-diazepam combinations are rarely used in sheep and goats because ruminants are known to be very sensitive to the effects of xylazine
	4. Nasotracheal intubation is an easy and recommended method of intubation for small ruminants

**Answer: a. Diazepam is best given IV as it is a tissue irritant and its absorption is unpredictable following IM administration**

**References:**

1) Fish RE, Brown MJ, Danneman PJ, Karas AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals, 2nd ed. Academic Press, San Diego, CA. Chapter 2 – Pharmacology of Injectable Anesthetics, Sedatives, and Tranquilizers, pp. 44-46 and Chapter 14 – Anesthesia and Analgesia of Ruminants, pp. 394, 397, 399

2) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 24 – Preanesthesia, Anesthesia, Analgesia, and Euthanasia, p. 1174

**Domain 2; Secondary Species – Sheep (*Ovis aries*) and Goats (*Capra hircus*)**

**13.** When creating different levels of vibration to test effects on animals, frequency (Hz) as well as what other parameter is manipulated?

a. Acceleration (m/s2)

b. Atmospheric pressure (mm Hg)

c. Coefficient of friction (μ)

d. Density (g/cm3)

**Answer: a. Acceleration**

**References:**

1. Atanasov et al. 2015. Characterization of train-induced vibration and its effect on fecal corticosterone metabolites in mice. JAALAS 54(6):737–744
2. Li et al. 2015. Characteristics of vibration that alter cardiovascular parameters in mice. JAALAS 54(4):372–377

**Domain 3**

**14.** Which one of the following methods would be most effective in eliminating all bacteria from rodent rack water lines and watering valves?

* 1. Rack-washer sanitation alone
	2. Flush lines and valves during sanitation through rack washer
	3. Removal of biofilm
	4. Rack washer-sanitation followed by autoclave sterilization
	5. Treatment of waterlines and valves with ultraviolet light

**Answer: d. Rack washer-sanitation followed by autoclave sterilization**

**References:**

1. [Meier](http://www.ncbi.nlm.nih.gov/pubmed/?term=Meier%20TR%5Bauth%5D) et al. 2008. Quantification, distribution, and possible source of bacterial biofilm in mouse automated watering systems. JAALAS47(2):63–70
2. Hessler JR, Lehner NDM, eds. 2009. Planning and Designing Research Animal Facilities. Academic Press, San Diego, CA. Chapter 32 - Plumbing: Special Considerations, pp. 437-439, 441-445
3. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 3 – Normative Biology, Husbandry, and Models. Academic Press: San Diego, CA. Chapter 12 - Environmental and Equipment Monitoring, pp. 419-420

**Domain 4**

1. Which publication should be used to determine the square footage needed for swine used to study gestational diabetes in an NIH funded study?
	1. The Guide for Care and Use of Laboratory Animals, even though these animals are maintained in a typical farm setting
	2. The Guide for Care and Use of Agricultural Animals as swine are agricultural animals
	3. The Guide for Care and Use of Laboratory Animals, only when the swine are housed indoors in a biomedical research setting
	4. Neither are required for swine used in NIH funded studies, only the AWA applies

**Answer: a. The Guide for Care and Use of Laboratory Animals, even though these animals are maintained in a typical farm setting**

**References:**

1. National Research Council. 2011. Guide for the Care and Use of Laboratory Animals, 8th ed. National Academies Press, Washington D.C. Chapter 3 – Environment, Housing, and Management, pp. 60-63
2. OLAW Frequently Asked Questions, G. Institutional Responsibilities, Question 7. https://grants.nih.gov/grants/olaw/faqs.htm#685

**Domain 5; Primary Species – Pig (*Sus scrofa*)**

**16.** Which of the following viruses has been shown to naturally infect African green monkeys but when transmitted to rhesus macaques can cause a fulminant and fatal infection?

1. African green monkey polyomavirus
2. Macacine herpesvirus 1
3. Simian hemorrhagic fever virus
4. Yaba monkey tumor virus

**Answer: c. Simian Hemorrhagic Fever Virus**

**References:**

1. Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 2 – Diseases. Academic Press: San Diego, CA. Chapter 1 – Viral Diseases of Nonhuman Primates, pp. 6-9, 33, 47-48
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 17 – Nonhuman Primates, pp. 864-866, 869-875 and Chapter 26 – Selected Zoonoses, p. 1316.

**Domain 1; Primary Species – Macaques (*Macaca spp.*) and Tertiary Species – Other Nonhuman Primates**

**17.** Which of the following is the most frequently used song bird in the laboratory?

 a. *Columba livia domestica*

 b. *Gallus domesticus*

c. *Serinus canaries*

 d. *Sturnus vulgaris*

 e. *Taenopygia guttata*

**Answer: e. *Taenopygia guttata* (Zebra finch)**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 23 – Zebra Finches in Biomedical Research, p. 1110.
2. Snyder et al. 2013. Increased mortality in a colony of zebra finches exposed to continuous light. JAALAS 52(3):301-307

**Domain 3; Tertiary Species – Other Birds**

**18.** Aside from red lamps, what other kind of lamp emits light at 589 nm and can be used during the dark phase when working with rodents?

* + - * 1. Bromine
				2. Carbon

c. Nickle

d. Sodium

**Answer: d. Sodium**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 36 – Design and Management of Research Facilities, p. 1567.
2. Hessler JR, Lehner NDM, eds. 2009. Planning and Designing Research Animal Facilities. Academic Press, San Diego, CA. Chapter 7 – Environmental Considerations for Research Animals, p. 69

**Domain 4**

**19.** According to the Animal Welfare Act and its regulations, how often must the attending veterinarian review canine exercise exemptions if the basis for such an exemption is not a permanent condition?

1. At least every 15 days
2. At least every 30 days
3. At least every 60 days
4. At least every 90 days
5. At least every 6 months

**Answer: b. At least every 30 days**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 2 – Laws, Regulations, and Policies Affecting the Use of Laboratory Animals, pp. 28-29.
2. Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 3 – Standards, Subpart A – Specifications for the Humane Handling, Care, Treatment, and Transportation of Dogs and Cats, §3.8 Exercise for dogs, (d)(1) Exemptions (11-6-13 Edition, p. 67)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

**Domain 5; Primary Species – Dog (*Canis familiaris*)**

1. Which of the following species has a unipapillate kidney?
	1. *Canis familiaris*
	2. *Chrysemys picta*
	3. *Mustela putorius furo*
	4. *Oryctolagus cuniculus*

e. *Sus scrofa*

**Answer: d. *Oryctolagus cuniculus***

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 10 – Biology and Diseases of Rabbits, p. 416;
2. Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press: San Diego, CA. Section IV – Other Rodents, Chapter 8 – Anatomy, Physiology, and Behavior, p. 203.

**Domain 1; Primary Species – Rabbit (*Oryctolagus cuniculus*)**

**21.** Which of the following provides analgesia?

a. Acepromazine

b. Medetomidine

c. Metomidate

d. Midazolam

**Answer: b. Medetomidine**

**References:**

1) Fish RE, Brown MJ, Danneman PJ, Karas AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals, 2nd ed. Academic Press, San Diego, CA. Chapter 2 – Pharmacology of Injectable Anesthetics, Sedatives, and Tranquilizers, pp. 37, 44, 52-53.

2) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 24 – Preanesthesia, Anesthesia, Analgesia, and Euthanasia, p. 1143.

**Domain 2**

**22.** Which of the following best describes counter-conditioning in training of nonhuman primates?

1. Loss of response to a stimulus after the animal’s repeated exposure to it
2. Process of actively pairing something positive (i.e. a secondary and primary reinforcer) with an aversive stimulus
3. Removal of an unpleasant action or aversive stimulus immediately after the desired behavior occurs
4. Something that the animal finds inherently rewarding

**Answer: b. Process of actively pairing something positive (i.e. a secondary and primary reinforcer) with an aversive stimulus**

**References:**

1. McMillan et al. 2014. Refining the pole-and-collar method of restraint: emphasizing the use of positive training techniques with rhesus macaques (*Macaca mulatta*). JAALAS 53(1):61–68
2. [Bloomsmith](https://www.ncbi.nlm.nih.gov/pubmed/?term=Bloomsmith%20M%5BAuthor%5D&cauthor=true&cauthor_uid=25651093) et al. 2015. Positive reinforcement methods to train chimpanzees to cooperate with urine collection. JAALAS 54(1):66–69

**Domain 3**

**23.** What level of gamma irradiation is generally used by feed manufacturers to achieve reduced levels of microbiological contamination?

a. 3-5 Kgrey

b. 10-40 Kgrey

c. 55-90 Kgrey

d. 100-130 Kgrey

**Answer: b. 10-40 Kgrey**

**Reference:** Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 36 – Design and Management of Research Facilities, p. 1578.

**Domain 4**

**24.** According to the Animal Welfare Act and its regulations, the minimum interior height of rabbit primary enclosures is \_\_\_ inches; this differs from the 8th Edition of the Guide for the Care and Use of Laboratory Animals which stipulates a minimum of \_\_\_ inches.

a. 10, 12

b. 12, 14

c. 14, 16

d. 16, 18

**Answer: c. 14, 16**

**References:**

1) National Research Council. 2011. Guide for the Care and Use of Laboratory Animals, 8th ed. National Academies Press, Washington D.C. Chapter 3 – Environment, Housing, and Management, pp. 58-59.

2) Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 3 – Standards, Subpart C – Specifications for the Humane Handling, Care, Treatment, and Transportation of Rabbits, §3.53 Primary enclosures, (c) Space requirements for primary enclosures acquired on or after August 15, 1990. (11-6-13 Edition, p. 87)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf**)**

**Domain 5; Primary Species – Rabbit (*Oryctolagus cuniculus*)**

**25.** All of the following are accomplishments of Dr. Nathan R. Brewer **EXCEPT**?

1. First president of AALAS
2. Pioneered the concept of “disease free” animal colonies
3. Chairman of the Committee on the Medical Care of Laboratory Animals
4. One of the founders of the Animal Care Panel
5. One of the incorporating members of the American Board of Laboratory Animal Medicine

**Answer: b. Pioneered the concept of “disease free” animal colonies**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 1 – Laboratory Animal Medicine: Historical Perspectives, pp. 5, 7, 13.

2) American College of Laboratory Animal Medicine. [Internet]. 2016. College History. [Cited 29 December 2016]. Available at: https://www.aclam.org/about-us/college-history.

**Domain 6**

**26.** Which of the following conditions may be associated with pitted and sometimes irregular renal cortices in a 1 year old male rat?

a. Chronic progressive nephropathy

b. Hydronephrosis

c. Nephrocalcinosis

d. Renal papillary hyperplasia

**Answer: a. Chronic progressive nephropathy**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 4 – Biology and Diseases of Rats, pp. 193-195.

2) Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 2 – Rat, pp. 161-163

**Domain 1; Primary Species – Rat (*Rattus norvegicus*)**

**27.** In addition to the Mouse Genome Database, laboratory codes are also assigned by which of the following organizations?

1. AALAS
2. ILAR
3. Jackson Laboratory

d. NIH

**Answer: b. ILAR**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine. 3rd edition. Academic Press: San Diego, CA. Chapter 3 – Biology and Diseases of Mice, p. 51.
2. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 1 – History, Wild Mice, and Genetics. Academic Press: San Diego, CA. Chapter 5 – Mouse Strain and Genetic Nomenclature: An Abbreviated Guide, p. 84.
3. http://dels.nas.edu/global/ilar/Lab-Codes

**Domain 3; Primary Species – Mouse (*Mus musculus*)**

**28.** In general, when placed into an empty cage, guinea pigs tend to spend more time in which areas of the cage?

a. Center of the cage

b. Front of the cage

c. Rear of the cage

d. Periphery of the cage

e. No preference for any particular part of the cage

**Answer: d. Periphery of the cage**

**References:**

1) Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press: San Diego, CA. Section III – Guinea Pigs, Chapter 21 – Management, Husbandry and Colony Health, pp. 608-609.

2) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 6 – Biology and Diseases of Guinea Pigs, p. 253.

**Domain 4; Secondary Species – Guinea pig (*Cavia porcellus*)**

**29.** What government agency provides guidance on hazard control and assessment?

a. AALAS

b. DHHS

c. NIOSH

d. USDA

**Answer: c. NIOSH**

**References:**

1) Committee on Occupational Safety and Health in Research Animal Facilities, Institute of Laboratory Animal Resources, Commission on Life Sciences, National Research Council. 1997. Occupational Health and Safety in the Care and Use of Research Animals. National Academy Press, DC. Chapter 2 – Program Design and Management, pp. 24-25.

2) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine. 3rd edition. Academic Press: San Diego, CA. Chapter 2 – Laws, Regulations, and Policies Affecting the Use of Laboratory Animals, p. 40.

**Domain 5**

**30.** Which of the following best describes the rabbit heterophil?

a. Equivalent to the eosinophil in other species

b. Also referred to as a pseudoeosinophil

c. Contains large, azuric granules

d. Comprises 1.0 – 9.0% of the leukocyte population in a typical healthy rabbit

e. Characterized by a horseshoe-shaped nucleus

**Answer: b: Also referred to as a pseudoeosinophil**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 10 – Biology and Diseases of Rabbits, p. 417.

2) Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 6 – Rabbit, p. 253

3) Quesenberry KE, Carpenter JW, Eds. 2012. Ferrets, Rabbits, and rodents: Clinical Medicine and Surgery. Elsevier: St. Louis, MO. Chapter 12 – Rabbits: Basic Anatomy, Physiology and Husbandry, p. 164, and Chapter 36 – Hematology and Cytology of Small Mammals, p. 514.

**Domain 1; Primary Species – Rabbit (*Oryctolagus cuniculus)***

**31.** Care should be exercised when using opioid analgesics in *Xenopus laevis* because of which of the following potential adverse outcomes?

1. Dysphoria and risk of self-trauma
2. Impaired motor functions and risk of drowning
3. Muscle necrosis and skin sloughing at injection site
4. Severe allergic reactions
5. Vomiting and risk of aspiration pneumonia

**Answer: b. Impaired motor functions and risk of drowning**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA Chapter 18 – Biology and Disease of Amphibians, p. 947.
2. Fish RE, Brown MJ, Danneman PJ, Karas AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals, 2nd ed. Academic Press, San Diego, CA. Chapter 20 – Anesthesia and Analgesia in Amphibians, pp. 517
3. Greene SL, 2010. The Laboratory Xenopus sp, 1st edition. CRC Press: Boca Raton, FL. Chapter 4 – Veterinary Care, p.114.
4. Green. 2003. Postoperative analgesia in South African Clawed frogs (*Xenopus laevis*) after surgical harvest of oocytes. Comparative Medicine 53(3):244-247

**Domain 2; Secondary Species – African Clawed Frog (*Xenopus laevis* and *Xenopus tropicalis*)**

1. Coturnix japonica has been used as a model in biomedical research for all of the following types of studies **EXCEPT**?
	1. Aging studies due to their predictable aging patterns that is comparable to senescence in mammals
	2. Embryogenesis studies using advanced imaging techniques
	3. Hepatotoxicity studies for drugs like acetaminophen and ketoconazole
	4. Studies of the visual system, including research on glaucoma and pathology of the retina and optic nerve
	5. Understanding of pathogens such as Salmonella spp. and Mycobacterium spp.

**Answer: c. Hepatotoxicity studies for drugs like acetaminophen and ketoconazole**

# Reference: Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 22 – Japanese Quail as a Laboratory Animal Model, pp. 1088-1089.

**Domain 3; Tertiary Species – Other Birds**

**33.** Which of the following would you use to disinfect a gnotobiotic isolater?

* 1. 70% ethanol
	2. Peracetic acid
	3. Paraformaldehyde gas
	4. Quatricide

**Answer: b. Peracetic acid**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 36 – Design and Management of Research Facilities, p. 1585
2. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 3 – Normative Biology, Husbandry, and Models. Academic Press: San Diego, CA. Chapter 7 – Gnotobiotics, p. 223

**Domain 4**

**34.** An IACUC, through the Institutional Official, shall report in writing to OLAW at least once every 12 months which of the following?

a. Number of minority opinions submitted by IACUC members, even if the number is zero

b. Notice of the dates of three-year de novo reviews of animal use protocols

c. Confirmation of an institution’s continued categorization as specified in the Assurance

d. Any change in the description of the institution’s program for animal care and use

**Answer: d. Any change in the description of the institution’s program for animal care and use**

**Reference:** Office of Laboratory Animal Welfare. 2015. Public Health Service Policy on Humane Care and Use of Laboratory Animals, p. 17 (http://grants.nih.gov/grants/OLAW/references/PHSPolicyLabAnimals.pdf**)**

**Domain 5**

**35.** In a sheep long bone, the length of a critical-sized defect, which is an intraosseous defect that will not heal spontaneously, typically exceeds the diameter of the long bone by how many times?

1. 1 - 1.5
2. 2 - 2.5
3. 3 - 3.5
4. 4 - 4.5
5. 5 - 5.5

**Answer: b. 2 – 2.5**

**Reference:** Christou et al. 2014. Ovine model for critical-size tibial segmental defects. Comparative Medicine 64(5):377-385

**Domain 1; Secondary Species – Sheep (*Ovis aries*)**

**36.** All of the following applies to CRISPR/Cas9 technology **EXCEPT**?

1. Genomes of mice, rats, rabbits, frogs, zebrafish, and pigs have all been successfully modified using the CRISPR/Cas9 system
2. CRISPR gRNA guides Cas9 to the DNA to bind at a stretch of complementary target sequence in the DNA
3. The Cas9 endonuclease creates the double-stranded break in the target DNA, allowing a gene to be knocked out or replaced by different DNA
4. CRISPRs are efficient enough that multiple alleles can be targeted simultaneously, making it possible to induce multiple mutations in a single generation
5. The system is known for its high specificity and almost never induces off-target cleavage events

**Answer: e. The system is known for its high specificity and almost never induces off-target cleavage events**

|  |  |
| --- | --- |
|  |  |

**References:** Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 32 - Genetically Modified Animals, pp. 1426-1427.

**Domain 3**

**37.** Environmental enrichment may benefit zebrafish in all of the following situations **EXCEPT**?

a. Increase embryo production

b. Prevent fighting among pair-housed zebrafish

c. Provide habitat control for single-housed zebrafish

d. Prevent fighting in group-housed zebrafish

**Answer: d. Prevent fighting in group-housed zebrafish**

**References:**

1. Collymore et al. 2015. The behavioral effects of single housing and environmental enrichment on adult zebrafish (*Danio rerio*). JAALAS 54(3):280-285
2. Keck et al. 2015. Effects of habitat complexity on pair-housed zebrafish. JAALAS 54(4):378-383
3. Wafer et al. 2016. Effects of environmental enrichment on the fertility and fecundity of zebrafish (*Danio rerio*). JAALAS 55(3): 291-294

**Domain 4; Secondary Species – Zebrafish (*Danio rerio*)**

1. Which of the following best describes deferred accreditation status for an institution recently reviewed by AAALAC, International?
	1. Accredited but mandatory issues must be corrected within 2 months
	2. Accredited but correction of mandatory items must be reported in the next annual report or at the discretion of the council
	3. Not accredited but if mandatory issues are corrected within 2 months accreditation will be restored
	4. Not accredited but if mandatory issues are corrected within 12 months accreditation will be restored

**Answer: a. Accredited but mandatory issues must be corrected within 2 months**

**Reference:** http://www.aaalac.org/accreditation/categories.cfm

**Domain 5**

1. Which of these following best describes anatomical and physiological features of mice?
	1. Cardiac muscle surrounds major branches of pulmonary veins
	2. Cell lining in renal glomeruli is cuboidal in female and squamous in males
	3. Proteinuria is normal, with tryptophan being present and taurine being absent
	4. X zone of the adrenal gland shows marked vacuolization during involution in males

**Answer: a. Cardiac muscle surrounds major branch of pulmonary veins**

**References:**

1. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 1 - Mouse, pp. 10-14.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 – Biology and Diseases of Mice, pp. 60, 62
3. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 3 – Normative Biology, Husbandry, and Models. Academic Press: San Diego, CA. Chapter 2 – Mouse Physiology, pp. 52, 71

**Domain 1; Primary Species – Mouse (*Mus musculus*)**

**40.** According to the literature, how long does sustained-release buprenorphine used in a hind paw incisional pain model in rats attenuate both mechanical and thermal hypersensitivity?

a. 12 hours

b. 24 hours

c. 36 hours

d. 48 hours

**Answer: d. 48 hours**

**References:**

1. Chum et al. 2014. Antinociceptive effects of sustained-release buprenorphine in a model of incisional pain in rats (*Rattus norvegicus*). JAALAS 53(2):193–197
2. Seymour et al. 2016. Postoperative analgesia due to sustained-release buprenorphine, sustained-release meloxicam, and carprofen gel in a model of incisional pain in rats (*Rattus norvegicus*). JAALAS 55(3):300–305

**Domain 2; Primary Species – Rat (*Rattus norvegicus*)**

**41.** Which of the following best describes what doxycycline is used for in genetically engineered mice?

1. Create a model of splenic atrophy
2. Induce RNA interference to produce gene knock-down mice
3. Induce upregulation or downregulation of a specific transgene
4. Integrate genetic material by homologous recombination
5. Treat mouse colonies infected with *Syphacia* species

**Answer: c. Induce upregulation or downregulation of a specific transgene**

**References:**

1. Redelsperger et al. 2016. Stability of doxycycline in feed and water and minimal effective doses in tetracycline-inducible systems. JAALAS 55(4):467-474
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 – Biology and Disease of Mice, p. 49.

**Domain 3; Primary Species - Mouse (*Mus musculus*)**

**42.** According to the Animal Welfare Act and its regulations, which of the following applies to elevated resting surfaces in primary enclosures for cats?

a. Primary enclosures for cats do not need resting surfaces

b. Resting surfaces need to be sized to hold only one cat at a time

c. Resting surfaces that do not allow space under them to be comfortably occupied by cats will count as floor space

d. If multiple cats are in a primary enclosure, resting surfaces must be placed at different heights

**Answer: c. Resting surfaces that do not allow space under them to be comfortably occupied by cats will count as floor space**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine. 3rd edition. Academic Press: San Diego, CA. Chapter 13 – Biology and Diseases of Cats, pp. 560-561
2. Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 3 – Standards, Subpart A – Specifications for the Humane Handling, Care, Treatment, and Transportation of Dogs and Cats, §3.6 Primary enclosures, (b) Additional requirements for cats, (4) Resting surfaces (11-6-13 Edition, p. 65)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf**)**

**Domain 5; Secondary Species – Cat (*Felis domestica*)**

**43.** According to the 8th Edition of the Guide for the Care and Use of Laboratory Animals, how many *Xenopus laevis* adults may be housed in 2 liters of water?

1. 1
2. 2
3. 3
4. 4
5. 5

**Answer: a. 1**

**Reference:** National Research Council. 2011. Guide for the Care and Use of Laboratory Animals, 8th ed. National Academies Press, Washington D.C. Chapter 3 – Environment, Housing, and Management, p. 83.

**Domain 5; Secondary Species – African Clawed Frog (*Xenopus laevis* and *Xenopus tropicalis*)**

**44.** All of the following are characteristic of multicentric high-grade lymphoma in dogs **EXCEPT**?

1. Generally present with painless enlarged lymph node(s)
2. Known etiology is a retrovirus or pesticide exposure
3. May palpate hepatomegaly and splenomegaly
4. Median survival <12 months even with aggressive treatment
5. Most common in middle aged or older dogs

**Answer: b. Known etiology is a retrovirus or pesticide exposure**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 12 - Biology and Diseases of Dogs, pp. 542-543.
2. O’Connor et al. 2014. Developing T cell cancer immunotherapy in the dog with lymphoma. ILAR Journal 55(1):169-181.

**Domain 1; Primary Species – Dog (*Canis familiaris*)**

**45.** Which anesthetic regimen may induce marked hyperglycemia in mice and should therefore be used with caution when performing 18F-labeled fluorodeoxyglucose positron emission in this species?

1. Isoflurane
2. Ketamine/xylazine
3. Tiletamine-zolazepam
4. Urethane

**Answer: b. Ketamine/xylazine**

**References:**

1. Fish RE, Brown MJ, Danneman PJ, Karas AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals, 2nd ed. Academic Press, San Diego, CA. Chapter 2 – Pharmacology of Injectable Anesthetics, Sedatives, and Tranquilizers, p. 65 and Chapter 10 – Anesthesia and Analgesia for Laboratory Rodents, pp. 257-258
2. Gargiulo et al. 2012. Mice anesthesia, analgesia, and care, part II: anesthetic considerations in preclinical imaging studies. ILAR Journal 53(1):E70-E81

**Domain 3; Primary Species – Mouse (*Mus musculus*)**

**46.** Which of the following animals can be housed together in the same secondary enclosure without significant alterations in breeding, behavior or health status?

* 1. *Mesocricetus auratus* and *Meriones unguiculatus*
	2. *Mesocricetus auratus* and *Mus musculus*
	3. *Oryctolagus cuniculus* and *Cavia porcellus*
	4. *Saimiri sciureus* and *Aotus trivirgatus*

**Answer: a. *Mesocricetus auratus* and *Meriones unguiculatus***

**References:**

1. Pritchett-Corning and Gaskill. 2015. Lack of negative effects on Syrian hamsters and Mongolian gerbils house in the same secondary enclosure. JAALAS 54(3):261-266.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 – Biology and Diseases of Mice, p. 85, Chapter 5 – Biology and Diseases of Hamsters, p. 224, and Chapter 6 – Biology and Diseases of Guinea Pigs, p. 256
3. Institute for Laboratory Animal Research. 2011. Guide for the Care and Use of Laboratory Animals The National Academies Press: Washington, D.C. Chapter 4 – Veterinary Care, p. 112

**Domain 4; Secondary Species – Syrian Hamster (*Mesocricetus auratus*) and Gerbil (*Meriones spp*.)**

**47.** Foreign Assurances are approved for a period of up to how many years by the Office of Laboratory Animal Welfare?

1. 3
2. 4
3. 5
4. For the duration of the grant/contract
5. Foreign institutions are not eligible for an Assurance

**Answer: c. 5**

**References:**

1. https://grants.nih.gov/grants/olaw/obtain\_assurance.htm
2. https://grants.nih.gov/grants/foreign/animal\_welfare.htm

**Domain 5**

**48.** Which of the following parasites in rats has a direct life cycle?

1. *Calodium hepaticum*
2. *Gongylonema neoplasticum*
3. *Hammondia hammondi*
4. *Hymenolepis diminuta*
5. *Sacrocystis singaporensis*

**Answer: a. *Calodium hepaticum***

**References:**

1. Suckow MA, Weisbroth SH, Franklin CL, eds. 2006. The Laboratory Rat, 2nd edition. Elsevier Academic Press: San Diego, CA. Chapter 13 – Parasitic Diseases, pp. 458-459, 461-463, 471-472.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 4 – Biology and Diseases of Rats, pp. 184-185

3) Baker DG, ed. 2007. Flynn’s Parasites of Laboratory Animals, 2nd edition. Blackwell Publishing, Iowa, USA. Chapter 11 – Parasites of Rats and Mice, pp. 320, 325-326, 330-331, 344.

**Domain 1; Primary Species - Rat (*Rattus norvegicus*)**

1. The Lacey Act authorizes which federal agency to regulate what activities?
2. CDC; Prohibit import, export, or interstate commerce of listed species
3. FWS; Transportation, importation, or sale or purchase of any fish, wildlife, or plant
4. PHS; Imported dogs and cats must be free of rabies
5. USDA; Transfer of toxins that have the potential to pose severe threat to animal health

**Answer: b. FWS; Transportation, importation, or sale or purchase of any fish, wildlife, or plant**

**References:**

1. U.S. Fish and Wildlife Service, Office of Law Enforcement. Title 18- Crimes and Criminal Procedure; 18 USC 42-43 16 USC 3371-3378. Lacey Act

https://www.fws.gov/le/pdffiles/Lacey.pdf

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 2 – Laws, Regulations, and Policies Affecting the Use of Laboratory Animals, p. 39.
2. https://www.fws.gov/international/laws-treaties-agreements/us-conservation-laws/lacey-act.html
3. https://www.aphis.usda.gov/aphis/ourfocus/planthealth/import-information/SA\_Lacey\_Act

**Domain 5**

**50.** A mouse is moved from isolator housing to a maximum barrier room. After the move the animal becomes colonized by additional organisms, but remains free of primary and opportunistic pathogens. What term best describes this animal’s microbial status?

1. Defined flora
2. Dixenic
3. Monoxenic
4. Restricted flora

**Answer: d. Restricted flora**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 26 – Gnotobiotics pp. 1264-1265.

2) Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 3 – Normative Biology, Husbandry, and Models. Academic Press: San Diego, CA. Chapter 7 – Gnotobiotics, p. 218.

**Domain 3; Primary Species – Mouse (*Mus musculus*)**

**51.** In which of the following species can short term individual housing (<4 weeks) followed by re-housing with littermates be used successfully?

1. *Geomys spp.*
2. *Mesocricetus auratus*
3. *Mus musculus*
4. *Octodon degus*

**Answer: d. *Octodon degus***

**References:**

1. Fox JG, Anderson LC, Otto C, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 – Biology and Diseases of Mice, pp. 53-54; Chapter 5 – Biology and Diseases of Hamsters, pp. 218-219; and Chapter 7 – Biology and Diseases of Other Rodents, pp. 298-299, 327.
2. Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press: San Diego, CA. Section IV – Hamsters, Chapter 28 – Management, Husbandry, and Colony Health, pp. 765-766 and Section VI – Other Rodents, Chapter 44 – Degu, pp. 1037-1039 and Chapter 50 – Pocket Gopher, pp. 1117-1118

**Domain 4; Tertiary Species – Other Rodents**

**52.** All of the following apply to membership requirements for the Institutional Biosafety Committee (IBC) **EXCEPT**?

a. The IBC must be comprised of at least five members

b. The IBC must have at least one member with animal containment expertise when the institution conducts recombinant research involving animals

c. The IBC must have at least one member who is not affiliated with the institution (community member)

d. A biological safety officer must be a member of the IBC when the institution conducts recombinant research at ASBL-3 or ASBL-4

**Answer: c. The IBC must have at least one member who is not affiliated with the institution (community member)**

**References:**

1. NIH Guidelines For Research Involving Recombinant DNA Molecules. 2013. Section IV-B-2-a. Membership and Procedures, p. 26

(http://oba.od.nih.gov/oba/rac/Guidelines/NIH\_Guidelines.pdf)

2) Silverman J, Suckow MA, Murthy S, eds. 2007. The IACUC Handbook, 2nd ed. CRC Press, Boca Raton, FL. Chapter 20 – Occupational Health and Safety, p. 370.

3) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 27 – Working Safely with Experimental Animals Exposed to Biohazards, pp. 1308

**Domain 5**

**53.** Which of the following neoplastic processes is a likely cause of upper airway obstruction in *Cynomys ludovicianus*?

1. Elodontoma
2. Lymphoma
3. Osteosarcoma
4. Squamous cell carcinoma

**Answer: a. Elodontoma**

**Reference:** Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: Oxford, UK.Chapter 7 – Biology and Diseases of Other Rodents, p. 296.

**Domain 1; Tertiary Species – Other Rodents**

**54.** Which of the following are recombinant inbred mice created from eight genetically disparate inbred strains though a funnel-breeding scheme in an effort to increase allelic diversity in laboratory mice?

1. Advanced intercross lines
2. Collaborative cross lines
3. Diversity outbred stock
4. Recombinant congenic strains
5. Segregating inbred strains

**Answer: b. Collaborative cross lines**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 – Biology and Diseases of Mice, p. 46 and Chapter 31 – Genetic Monitoring of Laboratory Mice and Rats, p. 1411
2. Threadgill et al. 2011. The collaborative cross: a recombinant inbred mouse population for the systems genetic era. ILAR Journal 52(1):24-41.

**Domain 3; Primary Species – Mouse (*Mus musculus*)**

**55.** The optimal temperature for growing and breeding laboratory zebrafish appears to be between \_\_\_\_\_ and \_\_\_\_\_?

1. 23 and 27°C
2. 23 and 28°C
3. 23 and 29°C
4. 24 and 27°C
5. 24 and 28°C

**Answer: e. 24 and 28°C**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 20 - The Biology and Management of the Zebrafish, p. 1024.

2) Harper C, Lawrence C. 2010. The Laboratory Zebrafish. CRC Press Boca Raton, FL. Chapter 3 – Life Support, p. 110.

**Domain 4; Secondary Species – Zebrafish (*Danio rerio*)**

**56.** Soiled bedding transfer as a method of health monitoring in mice colonies **WILL NOT** be as efficient for detection of which of the following agents?

a. Mouse hepatitis virus

b. Mouse parvovirus

c. *Pasteurella pneumotropica*

d. Pinworms

**Answer: c. *Pasteurella pneumotropica***

**References:**

1) Miller et al. 2016. Exhaust air dust monitoring is superior to soiled bedding sentinels for the detection of *Pasteurella pneumotropica* in individually ventilated cage systems. JAALAS 55(6):775-781.

2) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 - Biology and Diseases of Mice, pp. 78-81, 91-95, 106, 124-125.

**Domain 4; Primary Species – Mouse (*Mus musculus*)**

**57.** Which of the following best describes parasitic infections in rats?

1. *Rodentolepis nana* always has an indirect life cycle
2. *Trichosomoides crassicauda* infestation is diagnosed in live rats by fecal flotation for eggs
3. *Hymenolepis diminuta* always has an indirect life-cycle
4. *Entamoeba muris* is a highly pathogenic amoeba of rats
5. *Syphacia muris* are readily recognized by the four alae present at the anterior end of the body

**Answer: c. *Hymenolepis diminuta* always has an indirect life-cycle.**

**References:**

1. Fox JG, Anderson LC, Otto C, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 4 - Biology and Diseases of Rats, pp. 181-185.
2. Suckow MA, Weisbroth SH, Franklin CL, eds. 2006. The Laboratory Rat, 2nd edition. Elsevier Academic Press: San Diego, CA. Chapter 13 – Parasitic Diseases, pp. 467-471.

**Domain 1; Primary Species – Rats (*Rattus norvegicus)***

**58.**  Which of the following anesthetic agents provides minimal analgesic effect when used in rodents?

1. Fluanisone
2. Ketamine

c. Pentobarbital

d. Urethane

**Answer: c. Pentobarbital**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 24 - Preanesthesia, Anesthesia, Analgesia, and Euthanasia, pp. 1140-1141.

2) Fish RE, Brown MJ, Danneman PJ, Karas AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals, 2nd ed. Academic Press, San Diego, CA. Chapter 10 – Anesthesia and Analgesia in Laboratory Rodents, pp. 257-266.

**Domain 2**

**59.** All of the following can be used to test spatial learning and memory in rodents **EXCEPT**?

1. Elevated plus maze
2. Hole-board maze
3. Morris water maze
4. Radial-arm maze

**Answer: a. Elevated plus maze**

**References:**

1) National Research Council. 2003. Guidelines for the Use of Mammals in Neuroscience and Behavior Research. National Academy of Sciences, Washington, D.C. Behavioral Studies, pp. 128 and 135

2) Vorhees and Williams. 2014. Assessing spatial learning and memory in rodents. ILAR Journal 55(2):310–332.

3) Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 3 – Normative Biology, Husbandry, and Models. Academic Press: San Diego, CA. Chapter 15 – Behavioral Testing, pp. 518-520.

**Domain 3**

**60.** Heating, ventilation and air conditioning systems in animal housing facilities should be able to maintain dry-bulb temperatures within \_\_\_\_\_\_\_\_\_ of the set point?

a. ± 0.5 ºC

b. ± 2 ºC

c. ± 2 ºF

d. ± 4 ºF

e. ± 4 ºC

**Answer: c. ±2ºF**

**References:**

1. Institute for Laboratory Animal Resources. 2011. Guide for the Care and Use of Laboratory Animals. National Academy Press, Washington, D.C. Chapter 5 – Physical Plant, p. 139.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 36 - Design and Management of Research Facilities, p. 1566.
3. Hessler JR, Lehner NDM, eds. 2009. Planning and Designing Research Animal Facilities. Academic Press, San Diego, CA. Chapter 34 - Heating, Ventilation and Air Conditioning (HVAC): Special Considerations, p. 472.

**Domain 4**

**61.** All of the following are appropriate combinations of infectious agent, animal species, and level of containment **EXCEPT**?

1. *Francisella tularensis*, rabbit, ABSL-3
2. Lymphocytic choriomeningitis virus, hamster, ABSL-2
3. *Mycobacterium tuberculosis*, guinea pig, ABSL-2
4. Nipah virus, macaque, ABSL-4
5. West Nile virus, mouse, ABSL-3

**Answer: b. Lymphocytic choriomeningitis virus, hamster, ABSL-2**

**References:**

1. U. S. Department of Health and Human Services, Public Health Service, Center for Disease Control and Prevention, and National Institutes of Health. 2009. Biosafety in Microbiological and Biomedical Laboratories. 5th ed. U.S. Government Printing Office, Washington, D. C. Section VII – A: Bacterial Agents, pp. 139, 146; Section VIII – E: Viral Agents, pp. 202, 216; and Section VIII – F: Arboviruses and Related Zoonotic Viruses, p. 241 (https://www.cdc.gov/biosafety/publications/bmbl5/bmbl5\_sect\_viii.pdf)
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 5 - Biology and Diseases of Hamsters, p. 224.

**Domain 5; Secondary Species – Syrian Hamster (*Mesocricetus auratus*) and Tertiary Species – Other Rodents**

**62.** Which of the following is the most effective treatment for oral lesions due to candidiasis in nonhuman primates?

* 1. Albendazole
	2. Griseofulvin
	3. Ketoconazole
	4. Nystatin
	5. Posconazole

**Answer: d. Nystatin**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 17 – Nonhuman Primates, p. 863.
2. Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 2 – Diseases. Academic Press: San Diego, CA. Chapter 2 – Bacterial and Mycotic Diseases of Nonhuman Primates, p. 155.

**Domain 1**

1. Eosinophilic intracytoplasmic inclusion bodies of skin epithelial cells found in mousepoxare of what type?
	1. Type A
	2. Type B
	3. Type I
	4. Type II

**Answer: a. Type A**

**Reference:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 - Biology and Disease of Mice, p. 75.
2. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 2 – Diseases. Academic Press: San Diego, CA. Chapter 3 – Mousepox, p. 71.

**Domain 1; Primary Species - Mouse (*Mus* *musculus*)**

**64.** Gnotobiotic female mice are generally known to reproduce poorly, in part, by elongation of which stage of their estrus cycle?

1. Diestrus

b. Estrus

c. Metestrus

d. Proestrus

**Answer: a. Diestrus**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 26 – Gnotobiotics, p. 1287
2. Werner et al. 2015. Maintaining and monitoring the defined microbiota status of gnotobiotic rodents. ILAR Journal 56(2):241-249.

**Domain 3; Primary Species – Mouse (*Mus musculus*)**

**65.** Which one of the murine agents listed below cannot be reliably detected from testing of environmental samples obtained from IVC racks (e.g. exhaust debris or exhaust air dust in racks, swabs from exhaust plenum)?

1. *Helicobacter muridarum*
2. *Mycoplasma pulmonis*
3. *Pasteurella pneumotropica*
4. *Radfordia affinis*

**Answer: b. *Mycoplasma pulmonis***

**References:**

1. Miller et al. 2016. Exhaust air dust monitoring is superior to soiled bedding sentinels for the detection of *Pasteurella pneumotropica* in individually ventilated cage systems. JAALAS 55(6):775-781
2. Bauer et al. 2016. Influence of rack design and disease prevalence on detection of rodent pathogens in exhaust debris samples from individually ventilated caging systems. JAALAS 55(6):782-788

**Domain 4; Primary Species – Mouse (*Mus muculus*)**

**66.** According to the Animal Welfare Act and its regulations, **f**or how long must records of IACUC-approved activities be kept?

1. As long as the protocol is active
2. For the duration of the activity and for 3 years following
3. For 3 years, or for as long as the activity is ongoing
4. For 7 years
5. There is no requirement for the number of years records must be maintained

**Answer: b. For the duration of the activity and for 3 years following**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 2 – Laws, Regulations, and Policies Affecting the Use of Laboratory Animals, p. 28.
2. Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 2 – Regulations, Subpart C – Research facilities, §2.35 (f) Recordkeeping Requirement (11-06-13 Edition, p. 38)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

**Domain 5**

**67.** Which environmental conditions are inappropriate for *Meriones unguiculatus* and likely related to problems with dirty, ungroomed coats and nasal dermatitis?

1. 10-15 air changes per hour

b. 12-h light: 12-h dark cycle

c. Relative humidity > 50%

d. Temperature range of 68-79ºF (20-26ºC)

**Answer: c. Relative humidity > 50%**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 7 – Biology and Diseases of Other Rodents, pp. 317-318.

2) Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press: San Diego, CA. Section VI – Other Rodents, Chapter 52 - Gerbils, pp. 1138-1139, 1144.

3) National Research Council. 2011. Guide for the Care and Use of Laboratory Animals, 8th ed. National Academies Press, Washington D.C. Chapter 3 - Environment, Housing, and Management, pp. 43-49.

**Domain 4; Secondary Species - Gerbil (*Meriones spp.*)**

1. When using carbon dioxide euthanasia for small rodents, which of the following applies?
2. Addition of oxygen will provide the advantage of shortening the time to death
3. No need to confirm death in individual animals
4. Optimal flow rate should displace 10% to 30% of the chamber volume per minute
5. Should not be conducted in the home cage

**Answer: c. Optimal flow rate should displace 10% to 30% of the chamber per minute**

**References:**

1. American Veterinary Medical Association. 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, p. 49

(https://www.avma.org/KB/Policies/Documents/euthanasia.pdf)

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 24 – Preanesthesia, Anesthesia, Analgesia and Euthanasia, pp. 1148-1149

**Domain 2**

**69.** Which of the following **IS NOT** a site of blood collection in the zebrafish?

1. Caudal Vein
2. Dorsal aorta
3. Heart
4. Ventral abdominal vein

**Answer: d. Ventral abdominal vein**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 20 – The Biology and Management of Zebrafish, pp. 1034-1035.
2. Harper C & Lawrence C. 2010. The Laboratory Zebrafish, 1st ed, CRC Press: Boca Raton, FL. Chapter 6 – Experimental methodology, pp. 180-181.

**Domain 3; Secondary Species – Zebrafish (*Danio rerio*)**

**70.** According to the 8th Edition of the Guide for the Care and Use of Laboratory Animals, which of the following substances used for pest control has been shown to be abrasive to workers and can damage equipment?

1. Diatomaceous earth
2. Dipel

c. Permethrins

d. Pheromones

**Answer: a. Diatomaceous earth**

**References:**

1) Clemmons et. al. 2016. Booklice (*Liposcelis spp.*), grain mites (*Acarus siro*), and flour beetles (*Tribolium spp.*): ‘other pests’ occasionally found in laboratory animal facilities. JAALAS 55(6):737-743

2) National Research Council. 2011. Guide for the Care and Use of Laboratory Animals, 8th ed. National Academies Press, Washington D.C. Chapter 3 - Environment, Housing, and Management, p. 74.

**Domain 5**

**71.** Workers importing live nonhuman primates must wear disposable NIOSH-approved N95 respirators and either face shields or eye protection if the worker’s face comes within what distance of a nonhuman primate?

a. 1 foot

b. 5 feet

c. 10 feet

d. 15 feet

e. Within the same room as a nonhuman primate

**Answer: b. 5 feet**

**References:**

1. 42 CFR, Part 71 – Foreign Quarantine, Subpart F – Importations, §71.53 Requirements for importers of nonhuman primates, p. 503

(https://www.gpo.gov/fdsys/pkg/CFR-2014-title42-vol1/pdf/CFR-2014-title42-vol1-part71.pdf)

1. http://www.cdc.gov/animalimportation/lawsregulations/nonhuman-primates/nprm/questions-answers-importers.html

**Domain 5**

**72.** All of the following are the most common tumors identified in female A/J mice **EXCEPT**?

1. Granulosa cell tumor
2. Lipoma
3. Myoepthelioma
4. Pulmonary adenoma
5. Rhabdomyosarcoma

**Answer: a. Granulosa cell tumor**

**References:**

1. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 2 – Diseases. Academic Press: San Diego, CA. Chapter 25 - Spontaneous Disease on Commonly Used Mouse Strains, pp. 637-638.
2. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 1 – Mouse, pp. 116-118, 120-121.
3. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 – Biology and Diseases of Mice, pp. 135-137.

**Domain 1; Primary Species – Mouse (*Mus musculus*)**

**73.** Which of the following techniques would be the most appropriate method for characterizing the composition of the microbiome of an animal model?

1. 16s rRNA analysis
2. Fecal culture
3. Fluorescent in situ hybridization
4. Genome wide association study
5. Single nucleotide polymorphism

**Answer: a. 16s rRNA analysis**

**References:**

1. Hiergeist et al. 2015. Analyses of intestinal microbiota: culture versus sequencing. ILAR Journal 56(2):228-240.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 26 - Gnotobiotics, p. 1284.

**Domain 3**

1. Which of the following is a mechanical device used to maintain a constant air flow independent of duct and room air pressure?
2. Diaphragm valve
3. Gate valve
4. Globe valve
5. Venturi or Phoenix valve

**Answer: d. Venturi or phoenix valve**

**Reference:** Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 36 - Design and Management of Research Facilities, p. 1565**.**

**Domain 4**

**75.** According to the National Fire Protection Association, which of the following materials would cause a Class D fire?

1. Combustible metal
2. Exposed electrical wire from lab equipment

c. Flammable solvent

d. Wooden pallet on the floor

**Answer: a. Combustible metal**

**Reference:** Committee on Occupational Safety and Health in Research Animal Facilities, Institute of Laboratory Animal Resources, Commission on Life Sciences, National Research Council. 1997. Occupational Health and Safety in the Care and Use of Research Animals. National Academy Press, DC. Chapter 3 - Physical, Chemical, and Protocol Related Hazards, p. 35.

**Domain 5**

**76.** Which of the following statements best describes ceftiofur crystalline-free acid?

* 1. It is short-acting first generation cephalosporin, labeled for use in swine, cattle, and horses
	2. It is a sustained release first generation cephalosporin, labeled for use in swine, cattle, and horses
	3. It is a sustained release third generation cephalosporin, labeled for use in dogs, cats and rhesus macaques
	4. It is a sustained release third generation cephalosporin, labeled for use in swine, cattle, and horses

**Answer: d. It is a sustained release third generation cephalosporin, labeled for use in swine, cattle, and horses**

**References**

1. Hooper et al. 2016. *P*harmacokinetics of ceftiofur crystalline-free acid in clinically healthy dogs (*Canis lupus familiaris*). JAALAS 55(2):224-229
2. Salyards et al. 2015.Pharmacokinetics of ceftiofur crystalline free acid in male rhesus macaques (*Macaca mulatta*) after subcutaneous administration. JAALAS 54(5):557-563

**Domain 1; Primary Species – Dog (*Canis familiaris*) and Macaques (*Macaca spp.*)**

**77.** All of the following statements apply to tramadol **EXCEPT**?

a. Centrally-acting, weak μ opioid agonist that has few of the adverse side effects common to other opioids

b. Documented to provide pain relief in some mouse and rat models in pain

c. Not classified as a scheduled substance under the Controlled Substances Act

d. Synthetic opioid similar in structure to codeine and morphine

e. Used successfully as a sole analgesic for perioperative pain in dogs and cat

**Answer: c. Not classified as a scheduled substance under the Controlled Substances Act**

**References:**

1. Wolfe. 2015. Efficacy of tramadol as a sole analgesic for postoperative pain in male and female mice. JAALAS 54(4):411-419
2. Taylor et al. 2016. Analgesic activity of tramadol and buprenorphine after voluntary ingestion by rats (Rattus norvegicus). JAALAS 55(1):74-82
3. Fish RE, Brown MJ, Danneman PJ, Karas AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals, 2nd ed. Academic Press, San Diego, CA. Chapter 2 – Pharmacology of Injectable Anesthetics, p. 114

**Domain 2**

**78.** What instrument is most commonly used to test a gnotobiotic isolator for leakage prior to use?

* 1. Balometer
	2. Gas detector
	3. Geiger counter
	4. Hygrometer
	5. Particle detector

**Answer: b. Gas detector**

**References:**

1. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 3 – Normative Biology, Husbandry, and Models. Academic Press: San Diego, CA. Chapter 7 – Gnotobiotics, p. 223.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 26 – Gnotobiotics, p. 1277.

**Domain 3**

**79.** Indoor rabbit facilities **DO NOT** require which of the following according to the Animal Welfare Act and its regulations?

a. Appropriate ventilation and air conditioning when the ambient temperature is above 85°F

b. Ample artificial or natural light

c. Heated facility to keep the temperature between 75-80°F

d. Surfaces that are impervious to moisture

**Answer: c. Heated facility to keep the temperature between 75-80°F**

**Reference:** Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 3 – Standards, Subpart C – Specifications for the Humane Handling, Care, Treatment, and Transportation of Rabbits, §3.51 Facilities, indoor (a-d) (11-6-13 Edition, p. 85)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf**)**

**Domain 5; Primary Species – Rabbit (*Oryctolagus cuniculus*)**

**80.** According to the FDA Good Laboratory Practice Regulations for Nonclinical Laboratory Studies, animals used in a GLP study are referred to as \_\_\_\_\_\_\_\_\_?

a. Specimen

b. Study subject

c. Study system

d. Test subject

e. Test system

**Answer: e. Test system**

**Reference:** 21CFR PART 58—Good Laboratory Practice for Nonclinical Laboratory Studies, Subpart A – General Provisions, § 58.3 Definitions

 https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?CFRPart=58&showFR=1

**Domain 5**

**81.** Which of the following is a "nonprofit organization dedicated solely to advocating for sound public policy that recognizes the vital role animals play in biomedical research?"

1. Americans for Medical Progress
2. Association for Assessment and Accreditation of Laboratory Animal Care International
3. Foundation for Biomedical Research
4. National Association for Biomedical Research

e. Speaking of Research

**Answer: d. National Association for Biomedical Research**

**References:**

1. https://www.amprogress.org/about/mission/
2. https://aaalac.org/about/mission.cfm
3. https://fbresearch.org/experienced-biomedical-research/
4. www.nabr.org
5. https://speakingofresearch.com/about/

**Domain 6**

**82.** Survival of pigs undergoing post-infarction mitral valve repair was enhanced by all of the following **EXCEPT**?

1. Hyperkalemic cardioplegic solutions
2. Postoperative hypothermia
3. Postoperative opioid treatment
4. Rate of progression of heart failure

**Answer: b. Postoperative hypothermia**

**Reference:** Sarin et al. 2016. Swine (Sus scrofa) as a model of postinfarction mitral regurgitation and techniques to accommodate its effects during surgical repair. Comparative Medicine 66(4):290-299.

**Domain 1; Primary Species - Pig (*Sus scrofa*)**

**83.** Acute allograft rejection is mediated by cells expressing which of the following?

a. CD20 and CD79a

b. CD68 and CD20

c. CD4 and CD8

d. CD79a and CD68

**Answer: c. CD4 and CD8**

**Reference:** Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 34 – Animal Models in Biomedical Research, p. 1511.

**Domain 3**

**84.** Sodium hypochlorite, added to the drinking water of mice to control *Pseudomonas aeruginosa* and other gram negative microorganisms, is most effective between what pH values?

1. 1-3
2. 2-4
3. 4-6
4. 5-7

e. 7-9

**Answer: d. 5-7**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 36 – Design and Management of Research Facilities, p. 1581.
2. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 3 – Normative Biology, Husbandry, and Models. Academic Press: San Diego, CA. Chapter 12 – Environmental and Equipment Monitoring, p. 418.

**Domain 4**

**85.** The noninvasive imaging modality 18F-labeled fluorodeoxyglucose positron emission tomography–computed tomography, which is used primarily for the detection and staging of cancer may also be used for all of the following conditions **EXCEPT**?

1. Assessment of therapeutic responses
2. Diagnosis of type 1 diabetes mellitus
3. Identification of inflammatory diseases
4. Identification of infectious diseases

**Answer: b. Diagnosis of type 1 diabetes mellitus**

**References:**

1. Caprorizzo et al. 2014. Use of 18F-fluorodeoxyglucose positron emission tomography–computed tomography to aid in diagnosing intestinal adenocarcinoma in 2 rhesus macaques (*Macaca mulatta*). Comparative Medicine 64(3):211–220
2. Kim et al. 2012. Use of 18F-fluorodeoxyglucose positron emission tomography–computed tomography in a miniature pig (*Sus scrofa domestica*) with pneumonia. Comparative Medicine 62(3):203–208.

**Domain 3**

**86.** Which of the following malarial parasites is indigenous to new world monkeys?

a. *P. knowlesi*

b. *P. pitheci*

c. *P. reichenowi*

d. *P. schwetzi*

e. *P. simium*

**Answer: e. *P. simium***

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 17 – Nonhuman Primates, p. 882.
2. Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 2 – Diseases. Academic Press: San Diego, CA. Chapter 5 – Nonhuman Primate Models for Human Malaria Research, pp. 310-311.

**Domain 1; Secondary Species – Squirrel Monkey (*Saimiri sciureus*) and Marmoset/Tamarins (Callitrichidae)**

**87.** What group shall an institution establish to assure compliance with the NIH Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules?

1. Institutional Animal Care and Use Committee
2. Institutional Biosafety Committee
3. Institutional Health & Safety Committee
4. Institutional Review Board
5. Office of Institutional Compliance

**Answer: b. Institutional Biosafety Committee**

**References:**

1. NIH Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules (NIH Guidelines) – April 2016; Section IV-B-2, p. 25

(http://osp.od.nih.gov/sites/default/files/resources/NIH\_Guidelines.pdf)

1. NIH – Office of Biotechnology Activities (OBA) – Frequently Asked Questions (FAQs) on Interest to IBCs (http://osp.od.nih.gov/sites/default/files/IBC\_FAQs.pdf)

**Domain 5**

1. The CDC requires how many days for quarantine of nonhuman primates shipped domestically?
	1. 0
	2. 10
	3. 31
	4. 60
	5. 90

**Answer: a. 0**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 2 - Laws, Regulations, and Policies Affecting the Use of Laboratory Animals, p. 38
2. Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 1 - Biology and Management, Academic Press: San Diego, CA. Chapter 2 – Laws, Regulations and Policies Relating to the Care and Use of Nonhuman Primates, pp. 50-51
3. Importations, CFR, Title 42, Chapter I, Subchapter F, Part 17 Subchapter F §71.53 Nonhuman primates.

http://www.cdc.gov/importation/laws-and-regulations/nonhuman-primates/nprm/qa-importers.html#table-quarantined

**Domain 4**

**89.** According to the 8th Edition of the Guide for the Care and Use of Laboratory Animals and the Animal Welfare Act and its regulations, the floor space requirement for guinea pigs in the United States is \_\_\_\_\_\_ in2 for animals weighing 350 g or less and \_\_\_\_\_\_ in2 for animals weighing more than 350 g?

1. 50 and 100
2. 75 and 151
3. 60 and 101
4. 71 and 111

**Answer: c. 60 and 101**

**References:**

1. National Research Council. 2011. Guide for the Care and Use of Laboratory Animals, 8th ed. National Academies Press, Washington D.C. Chapter 3 – Environment, Housing, and Management, p. 57.
2. Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 3 – Standards, Subpart B – Specifications for the Humane Handling, Care, Treatment, and Transportation of Guinea Pigs and Hamsters, §3.28 Primary enclosures, (c)(1)(iii) (Edition, p. 77)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

1. Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press/Elsevier: San Diego, CA. Section III – Guinea Pigs, Chapter 21 – Management, Husbandry, and Colony Health, p. 608 and Section IV – Hamsters, Chapter 28 – Management, Husbandry, and Colony Health, p. 766.

**Domain 5; Secondary Species – Guinea pigs (*Cavia porcellus*)**

**90.** Which of the following statements best applies to a request to use compacted earth rather than hard sanitizable surfaces for a new sheltered outdoor housing facility for a colony of research dogs?

a. This is an unacceptable housing surface as it is not impervious to moisture and cannot be easily sanitized

b. This is discouraged but acceptable as a surface without conditional provisions

c. This is discouraged but acceptable as long as the surface is exposed to direct sunlight

d. There is no restrictions regarding surfaces for outdoor housing

**Answer: c. This is discouraged but acceptable as a surface as long as it is exposed to direct sunlight**

**References:**

1. Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 3 – Standards, Subpart A – Specifications for the Humane Handling, Care, Treatment, and Transportation of Dogs and Cats, §3.3 (e) Surfaces (11-6-13 Edition, p. 62)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf**)**

1. National Research Council. 2011. Guide for the Care and Use of Laboratory Animals, 8th ed. National Academies Press, Washington D.C. Chapter 3 – Environment, Housing and Management, pp. 54-55

**Domain 4; Primary Species – Dog (*Canis familiaris*)**

**91.** What is the most common neoplasia found in older rhesus macaques with anorexia and weight loss?

1. Ileocecocolic adenocarcinoma

b. Liver carcinoma

c. Renal carcinoma

d. Uterine carcinoma

**Answer: a. Ileocecocolic adeocarcinoma**

**References:**

1)Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 2 – Diseases. Academic Press: San Diego, CA. Chapter 6 – Neoplasia and Proliferative Disorders of Nonhuman Primates, p. 334.

2)Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 17 - Nonhuman Primates, pp. 897-898.

**Domain 1; Primary Species - Macaques (*Macaca spp.*)**

**92.** N-ethyl-N-nitrosurea is used for which of the following?

1. Induction of colonic inflammation
2. Induction of random mutations in large-scale mouse mutagenesis projects
3. Rapid analysis of single nucleotide polymorphism
4. Site-specific transgene insertion
5. Sterilization of gnotobiotic isolators

**Answer:** **b.** **Induction of random mutations in large-scale mouse mutagenesis projects**

**References**

1. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 1 – History, Wild Mice, and Genetics. Academic Press: San Diego, CA. Chapter 12 - Chemical Mutagenesis in Mice, pp. 226, 229, 232-255.
2. Hedrich HJ. 2012. The Laboratory Mouse, 2nd edition. Academic Press: London. Chapter 1.5 - Generation of Mouse Mutants by Genotype-Driven Mutagenesis, p. 92.

**Domain 3**

**93.** All of the following apply to handling crocodilians **EXCEPT**?

a. Rough scales and dermal bones can abrade handlers’ hands

b. Crocodilians will attempt to roll when restrained

c. Tape can be wrapped round the snout if the nares are not covered

d. Tail restraint may lead to detachment of the tail at the fracture plane

e. Crocodilians can slap handlers with their tails

**Answer: d. Tail restraint may lead to detachment of the tail at the fracture plane**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 19 – Biology and Diseases of Reptiles, p. 973.

2) Fish RE, Brown MJ, Danneman PJ, Karas AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals, 2nd ed. Academic Press, San Diego, CA. Chapter 19 – Anesthesia and Analgesia in Reptiles, p. 503.

**Domain 4; Tertiary Species – Reptiles**

**94.** According to the Animal Welfare Act and its regulations, all of the following is required by the USDA regarding IACUC meeting recordkeeping **EXCEPT**?

a. Minutes of each IACUC meeting

b. Written transcripts or tape recordings of meetings

c. Each proposed activity involving animals and whether IACUC approval was given or withheld

d. Semiannual IACUC reports and recommendations

**Answer: b. Written transcripts or tape recordings of meetings**

**References:**

1. Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 2 – Regulations, Subpart C – Research facilities, §2.35 Recordkeeping Requirement (a)(1-3) (11-06-13 Edition, p. 36)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

1. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 3 – Normative Biology, Husbandry, and Models. Academic Press: San Diego, CA. Chapter 2 – Laws, Regulations, and Policies Affecting the Use of Laboratory Animals, p. 28.
2. Applied Research Ethics National Association (ARENA) and Office of Laboratory Animal Welfare (OLAW). 2002. Institutional Animal Care and Use Committee Guidebook. 2nd Edition. OLAW, Bethesda, MD. E.1. Recordkeeping and Reporting, pp. 169-170.

(http://grants.nih.gov/grants/olaw/guidebook.pdf)

**Domain 5**

**95.** Which porcine virus causes both porcine dermatitis and nephropathy syndrome and porcine respiratory disease complex?

a. Alphacoronavirus 1

b. Porcine circovirus 2

c. Porcine epidemic diarrhea virus

d. Pseudorabies virus

**Answer b. Porcine circovirus 2**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine. 3rd edition. Academic Press: San Diego, CA. Chapter 16 – Biology and Diseases of Swine, pp. 709-713, 718-719, 737-738

2) [Wei](https://www.ncbi.nlm.nih.gov/pubmed/?term=Wei%20H%5BAuthor%5D&cauthor=true&cauthor_uid=20158948) et al. 2010. Infection of cesarean-derived colostrum-deprived pigs with porcine circovirus type 2 and swine influenza virus. Comparative Medicine 60(1):45–50.

**Domain 1; Primary Species – Pig (*Sus scrofa*)**

**96.** Which of the following statements applies to the Health Research Extension Act of 1985?

1. Governs the use of all animals (invertebrate and vertebrate) in research, research training, or testing that is funded by the Public Health Service
2. Governs the use of all vertebrate animals in research, research training, or testing that is funded by the Public Health Service
3. Governs the use of all animals (invertebrate and vertebrate) in research, research training, or testing regardless of funding source
4. Governs the use of all vertebrate animals in research, research training, or testing regardless of funding source

**Answer: b. Governs the use of all vertebrate animals in research, research training, or testing that is funded by the Public Health Service**

**References:**

1. Silverman et al. 2015. Decision making and the IACUC: part 1 – protocol information discussed at full-committee reviews. JAALAS 54(4):745-755.
2. Office of Laboratory Animal Welfare. 2015. Public Health Service Policy on Humane Care and Use of Laboratory Animals. National Institutes of Health, Bethesda, MD, pp. 1-3.

(http://grants.nih.gov/grants/olaw/references/PHSPolicyLabAnimals.pdf)

1. Fox JG LC, Anderson, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 2 – Laws, Regulations, and Policies Affecting the Use of Laboratory Animals, p. 30.

**Domain 5**

**97.** According to the International Committee on Standardized Genetic Nomenclature for Mice, which of the following represents the fourth and final part of the transgene symbol?

a. Letters Tg and the mode of DNA insertion

b. Unique laboratory registration code

c. Specific DNA insertion information

d. Laboratory-assigned number, assigned by the laboratory of origin

e. Strain of the donor mouse

**Answer: b. Unique laboratory registration code**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 – Biology and Diseases of Mice, p. 53.

2) Nomenclature for Mouse Strains. 2017. The Jackson Laboratory. https://www.jax.org/jax-mice-and-services/customer-support/technical-support/genetics-and-nomenclature

1. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 1 – History, Wild Mice, and Genetics. Academic Press: San Diego, CA. Chapter 5 – Mouse Strain and Genetic Nomenclature: An Abbreviated Guide, pp. 5 – Mouse Strain and Genetic Nomenclature: An Abbreviated Guide, pp. 84, 92-93.
2. International Committee on Standardized Genetic Nomenclature for Mice and Rat Genome and Nomenclature Committee. Guidelines for Nomenclature of Genes, Genetic Markers, Alleles, and Mutations in Mouse and Rat. December 2015.

http://www.informatics.jax.org/mgihome/nomen/gene.shtml#tgsymbol

**Domain 3; Primary Species – Mouse (*Mus musculus*)**

**98.** Which of the following species **DOES NOT** require a source of water to be provided as the water requirements of this species are met in the food supplied?

1. *Heterocephalus glaber*
2. *Meriones unguiculatus*
3. *Mystromys albicaudatus*
4. *Peromyscus maniculatus*
5. *Signodon hispidus*

**Answer: a. *Heterocephalus glaber***

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 7 - Biology and Diseases of Other Rodents, pp. 307-308, 312, 315, 317-318, 330.
2. Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press: San Diego, CA. Section VI – Other Rodents, Chapter 45 – Naked Mole Rat, pp. 1066-1067; Chapter 46 – Deer Mice, White-Footed Mice, and their Relatives, pp. 1080-1081; Chapter 49 – Cotton Rat, pp. 1108-1109; Chapter 51 – White-Tailed Rat, p. 1127; and Chapter 52 – Gerbils, pp. 1138-1139

**Domain 4; Tertiary Species – Other Rodents**

**99.** Which of the following best describes the requirements of the Public Health Service Policy on Humane Care and Use of Laboratory Animals regarding inspections by the IACUC?

1. All animal facilities be inspected at least once every 6 months using the Guide as a basis of evaluation
2. All animal facilities be inspected at least once every 6 months using the Animal Welfare and its regulations as a basis for evaluation
3. Satellite holding facilities holding animals for more than 12 hours be inspected at least once every 6 months
4. Study areas holding animals for less than 24 hours be inspected at least once every 6 months

**Answer: a. All animal facilities be inspected at least once every 6 months using the Guide as a basis of evaluation.**

**References:**

1. Office of Laboratory Animal Welfare. 2015. Public Health Service Policy on Humane Care and Use of Laboratory Animals, pp. 8, 12

(<http://grants.nih.gov/grants/OLAW/references/PHSPolicyLabAnimals.pdf> )

1. National Research Council. 2011. Guide for the Care and Use of Laboratory Animals, 8th ed. National Academies Press, Washington D.C. Chapter 2 – Animal Care and Use Program, Program Oversight, pp. 24 – 26.
2. Applied Research Ethics National Association (ARENA) and Office of Laboratory Animal Welfare (OLAW). 2002. Institutional Animal Care and Use Committee Guidebook. 2nd Edition. OLAW, Bethesda, MD. A.2. Authority, Composition and Functions, pp. 12-14, 17-18

(http://grants.nih.gov/grants/olaw/guidebook.pdf)

**Domain 5**

**100.** Which of the following husbandry practices **IS NOT** recommended during farrowing?

* 1. Frequent cleaning of the enclosure after farrowing
	2. Increasing environmental temperature to 85-95ºF and providing a supplemental heat source
	3. Minimizing noise disturbances prior to and during farrowing
	4. Providing sows with bedding and nesting material

**Answer: a. Frequent cleaning of the enclosure after farrowing**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 16 – Biology and Diseases of Swine, pp. 703-704.
2. Committees to Revise the Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching. 2010. GUIDE For the Care and Use of Agricultural Animals in Research and Teaching. 3rd Edition. Federation of Animal Science Societies, Savoy, IL. Chapter 4 – Environmental Enrichment, p. 37.

 (https://aaalac.org/about/Ag\_Guide\_3rd\_ed.pdf)

**Domain 4; Primary Species – Pig *(Sus scrofa)***

**101.** What is the histologic hallmark of *Mycobacterium lepraemurium* in mice?

a. Foamy macrophages around the alveoli

b. Granulomatous pneumonia generalized

c. Perivascular granulomatosis with accumulation of foamy epitheloid macrophages

d. Thickening of the epithelium and ulceration of the skin

**Answer: c. Perivascular granulomatosis with accumulation of foamy epitheloid macrophages**

**Reference:** Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 - Biology and Diseases of Mice, p. 118.

**Domain 1; Primary Species – Mouse (*Mus musculus*)**

**102.** Ethyl carbamate is experimentally administered to A/J mice intraperitoneally to induce the development of \_\_\_\_\_?

a. Inflammatory colitis

b. Lymphoma

c. Peripheral neuropathy

d. Pulmonary adenocarcinoma

**Answer: d. Pulmonary adenocarcinoma**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 - Biology and Diseases of Mice, p. 137.
2. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 1 – Mouse, pp. 114-115, 117-118.

**Domain 3; Primary Species – Mouse (*Mus musculus*)**

**103.** What is the maximum recommended storage temperature for natural ingredient feed?

1. 18°C (64°F)
2. 20°C (68°F)
3. 21°C (70°F)
4. 24°C (75°F)

**Answer: c. 21°C (70°F)**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 36 – Design and Management of Research Facilities, p. 1579.
2. Institute for Laboratory Animal Resources. 2011. Guide for the Care and Use of Laboratory Animals. National Academy Press, Washington, D.C. Chapter 3 – Environment, Housing and Management, p. 66.

**Domain 4**

**104.** \_\_\_\_\_\_ is a neurotoxin which induces \_\_\_\_\_\_\_\_\_\_ in nonhuman primates, cats and mice?

a. 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP); cerebellar hypoplasia

b. MPTP; Parkinson’s disease

c. Tetrodotoxin (TTX); paraesthesia

d. TTX; Parkinson’s disease

e. Conotoxin; nerve function interruption

**Answer: b. MPTP; Parkinson’s disease**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 13 – Biology and Diseases of Cats, p. 558
2. Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 2 – Diseases. Academic Press: San Diego, CA. Chapter 15 – Nervous System Disorders of Nonhuman Primates and Research Models, pp. 765-766

**Domain 1; Primary Species – Mouse (*Mus musculus*), Secondary Species – Cat (*Felis domesticus*)**

**105.** Laboratory management should include visual barriers between family groups as intergroup aggression is common for which of the following nonhuman primates?

1. *Aotus spp.*
2. *Chlorocebus spp.*
3. *Pan spp.*

d. *Papio spp.*

e. *Saimiri spp.*

**Answer: a. *Aotus* *spp.***

**Reference:** Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 17 – Nonhuman Primates, pp. 788-789, 795-796, 810, 816, 821

**Domain 4; Tertiary Species – Other Nonhuman Primates**

**106.** In the nervous system, \_\_\_\_\_\_ is the primary excitatory neurotransmitter, and \_\_\_\_\_ is the primary inhibitory neurotransmitter.

a. Glutamate; gamma-amino-butyric acid (GABA)

b. Glutamate; glycine

c. GABA; glutamate

d. Glycine; glutamate

e. GABA; glycine

**Answer: a. Glutamate; gamma-amino-butyric acid (GABA)**

**Reference:** Fish RE, Brown MJ, Danneman PJ, Karas AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals, 2nd ed. Academic Press, San Diego, CA. Chapter 1 – Anatomy, Physiology, and Effects of Pain, p. 9 and Chapter 2 – Pharmacology of Injectable Anesthetics, Sedatives, and Tranquilizers, p. 29

**Domain 2**

**107.** What natural DNA repair process required for immune system function is deficient in Prkdc knockout mice?

1. Homologous recombination
2. Microhomology mediated end joining
3. Non-homologous end joining
4. Nucleotide excision

**Answer: c. Non-homologous end joining**

**References:**

1. Fox JG LC, Anderson, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 – Biology and Diseases of Mice, p. 72
2. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 4 – Immunology. Academic Press: San Diego, CA. Chapter 13 – Mouse Models of Immunodeficiency, p. 278

**Domain 3; Primary Species – Mouse (*Mus musculus*)**

**108.** When utilizing a recirculating water system to maintain *Danio rerio*, all of the following assist with the removal of nitrogenous waste **EXCEPT**?

1. Biologic filtration
2. Carbon filtration
3. Mechanical filtration
4. Nitrifying bacteria
5. Water exchanges

**Answer: b. Carbon filtration**

**References:**

1. Harper C, Lawrence C. 2011. The Laboratory Zebrafish. CRC Press: Boca Raton, FL. Chapter 3- Life Support, pp. 99-105.
2. Fox JG, Anderson LC, Otto GM, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 20 - The Biology and Management of the Zebrafish, pp. 1025-1030.
3. National Research Council. 2011. Guide for the Care and Use of Laboratory Animals, 8th ed. National Academies Press, Washington D.C. Chapter 3 – Environment, Housing and Management, pp. 79-80

**Domain 4; Secondary Species – Zebrafish (*Danio rerio)***

**109.** Which of the following best describes the hierarchical structure of measures (first to last) used to control exposures to occupational hazards?

1. Engineering controls, use of PPE, work practices
2. Engineering controls, work practices, use of PPE
3. Use of PPE, engineering controls, work practices
4. Use of PPE, work practices, engineering controls
5. Work practices, use of PPE, engineering controls

**Answer: b. Engineering controls, work practices, use of PPE**

**Reference:** Committee on Occupational Safety and Health in Research Animal Facilities, Institute of Laboratory Animal Resources, Commission on Life Sciences, National Research Council. 1997. Occupational Health and Safety in the Care and Use of Research Animals. National Academy Press, DC. Chapter 6 – Principal Elements of an Occupational Health and Safety Program, p. 108.

**Domain 5**

1. Which of the following species develop a hepatocellular carcinoma due to a virus related to hepadnavirus hepatitis B virus?
2. *Dipodomys spectabilis*
3. *Neotoma floridana*
4. *Onychomys torridus*
5. *Peromyscus leucopus*
6. *Spermophilus beecheyi*

**Answer: e. *Spermophilus beecheyi***

**Reference:** Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 7 –Biology and Diseases of Other Rodents, p. 292.

**Domain 1; Tertiary Species – Other Rodents**

**111.** What is the recommended maximal amount of total blood volume that can be safely collected weekly in healthy adult male and female cynomolgus macaques for 4 consecutive weeks with minimal effect on animal wellbeing?

* 1. 7.5 %
	2. 10%
	3. 12.5%
	4. 15%
	5. 17.5%

**Answer: d. 15% total blood volume weekly**

**References:**

1. Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 1 - Biology and Management, Academic Press: San Diego, CA. Chapter 13 - Clinical Techniques Used for Nonhuman Primates, p. 331.
2. Adams et al. 2014. Effects of weekly blood collection in male and female cynomolgus macaques (*Macaca fascicularis*). JAALAS 53(1):81-88.

**Domain 3; Primary Species – Macaques (*Macaca* *spp*.)**

**112.** In which of the following species is it permissible to provide pelleted feed directly on the floor of the enclosure as the primary feeding method?

1. *Cavia porcellus*
2. *Mesocricetus auratus*
3. *Sigmodon hispidus*
4. *Sus scrofa*

**Answer: b. *Mesocricetus auratus***

**References:**

1. Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 3 – Standards, Subpart C – Specifications for the Humane Handling, Care, Treatment, and Transportation of Guinea Pigs and Hamsters, §3.29 (d) Feeding (11-6-13 Edition, p. 79)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 5 – Biology and Diseases of Hamsters, p. 216.

**Domain 4; Secondary Species – Syrian Hamster (*Mesocricetus auratus*)**

**113.** According to the Animal Welfare Act and its regulations, all of the following identification information is a recordkeeping requirement concerning live dogs or cats purchased, owned, held, transported, euthanized, or sold EXCEPT?

a. Species and breed or type of animal

b. Sex of the animal

c. Reproductive status

d. Color and any distinctive markings

**Answer: c. Reproductive status**

**References:**

1. Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 2 – Regulations, Subpart C – Research facilities, §2.35 Recordkeeping Requirement (b)(6)(i-iv) (11-06-13 Edition, p. 38)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

1. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 3 – Normative Biology, Husbandry, and Models. Academic Press: San Diego, CA. Chapter 2 – Laws, Regulations, and Policies Affecting the Use of Laboratory Animals, p. 28.

**Domain 5**

**114.** All of the following describe tuberculin tests in nonhuman primates **EXCEPT**?

1. Animals with early or advanced disease may give false-negative reactions
2. Concomitant measles infection, or a recent history of measles vaccination, may result in a false-positive reaction
3. Tuberculin skin testing remains the gold standard for tuberculosis screening despite a sensitivity and specificity of approximately 85% each.
4. Animals exposed to Freund’s Complete Adjuvant may have false-positive reactions

**Answer: b. Concomitant measles infection, or a recent history of measles vaccination, may result in a false-positive reaction**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 17. Nonhuman primates. p. 857.
2. Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 2 – Diseases. Academic Press: San Diego, CA. Chapter 2 - Bacterial and Mycotic Diseases of Nonhuman Primates, pp. 114-115

**Domain 1**

**115.** Which of the following mouse strains have a high incidence of marked pulmonary hemorrhage when euthanized with CO2 via the slow-filled chamber method?

a. A/J

b. BALB/c

c. C3H/HeJ

d. C57BL/6

e. FVB/N

**Answer: b. BALB/c**

**Reference:** Fisher et al. 2016. Interstrain differences in CO2-induced pulmonary hemorrhage in mice. JAALAS 55(6): 811-815

**Domain 3; Primary Species – Mouse (*Mus musculus*)**

**116.** Which of the following is a characteristic of dystrophic cardiac calcinosis in BALB/c mice?

1. It affects the myocardium
2. Prevalence is not influenced by dietary, environmental, and endocrine-related factors
3. It is found in the right ventricular free wall
4. Calcinosis is not correlated with the degree of cardiac involvement
5. Male mice are more at risk

**Answer: c. It is found in the right ventricle**

**References:**

1) Glass et al. 2013. Spontaneous cardiac calcinosis in BALB/cByJ mice. Comparative Medicine 63(1):29-37.

2) Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 1 - Mice, pp. 94-95.

**Domain 3; Primary Species – Mouse (*Mus musculus*)**

**117.** Which of the following disinfectants **SHOULD NOT** be used for sanitation of amphibian enclosures?

* 1. Oxidizing agents
	2. Phenolics
	3. Quaternary agents
	4. Steam

**Answer: b. Phenolics**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 18 – Biology and Disease of Amphibians, p. 937.
2. Green, SL. 2010. The Laboratory Xenopus sp. CRC Press, Boca Raton, FL, p. 54.

**Domain 4**

**118.** Which organization ruled to classify all chimpanzees, both wild and captive, as endangered under the Endangered Species Act?

1. Convention on International Trade in Endangered Species of Wild Fauna and Flora
2. International Air Transport Association
3. National Institutes of Health
4. U.S. Fish and Wildlife Service
5. World Organization for Animal Health

**Answer: d. U.S. Fish and Wildlife Service**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 2 – Laws, Regulations, and Policies Affecting the Use of Laboratory Animals, pp. 33-34
2. https://www.fws.gov/endangered/what-we-do/chimpanzee.html

**Domain 5; Tertiary Species - Other Nonhuman Primates**

**119.** All of the following meet the LATG eligibility requirements **EXCEPT**?

1. Achievement of LAT certification, HS/GED degree, and 0.5 years of lab animal work experience
2. HS/GED degree and 5 years of lab animal work experience
3. AA/AS degree and 4 years of lab animal work experience
4. BA/BS degree and 2 years of lab animal work experience

**Answer: d. BA/BS degree and 2 years of lab animal work experience**

**Reference:**  Technician Certification Handbook (p. 3)

https://www.aalas.org/certification/technician-certification/technician-certification-resources

**Domain 6**

**120.** All of the following pathogens have been shown to cause abortions in guinea pigs **EXCEPT**?

1. *Bordetella bronchiseptica*
2. *Chlamydophila caviae*
3. *Listeria monocytogenes*
4. *Pasteurella multocida*
5. *Streptococcus pneumoniae*

**Answer: d. *Pasteurella multocida***

**References:**

1. Barthold SW, Griffey SM, Percy DH. 2016. Pathology of Laboratory Rabbits and Rodents, 4th Edition. Blackwell Publishing: Ames, IA. Chapter 5 – Guinea Pig, pp. 222-230.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 6 – Biology and Diseases of Guinea Pigs, pp. 256-261.

**Domain 1; Secondary Species – Guinea pig (*Cavia porcellus*)**

**121.** All of the following are necessary types of mouse colonies required to produce transgenic mice **EXCEPT**?

1. Chimeric mouse pups
2. Embryo donor female
3. Embryo transfer recipient female
4. Fertile stud male

e. Sterile stud male

**Answer: a. Chimeric mouse pups**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 32 – Genetically Modified Animals, p. 1427-1433.

2) Parker et al. 2011. Effects of multimodal analgesia on the success of mouse embryo transfer surgery. JAALAS 50(4):466-470

**Domain 3; Primary Species – Mice (*Mus musculus*)**

**122.** What cells are damaged by topical application of gentamicin in guinea pigs?

a. Cone cells

b. Rod cells

c. Spiral ganglion

d. Spiral limbus

**Answer: c. Spiral ganglion**

**References:**

1. Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press: San Diego, CA. Section III – Guinea Pigs, Chapter 25 – Guinea Pigs as Experimental Models, p. 706.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 6 – Biology and Diseases of Guinea Pigs, p. 274

**Domain 3; Secondary Species - Guinea Pig (*Cavia porcellus*)**

**123.** Which of the following are classified by both HHS and USDA as select agents and toxins?

a. *Burkholderia pseudomallei*

b. *Francisella tularensis*

c. Lassa fever virus

d. *Mycoplasm mycoides*

e. Ricin toxin

**Answer: a. *Burkholderia pseudomallei***

**References:**

1. Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 1 - Biology and Management, Academic Press: San Diego, CA. Chapter 18 – Biosafety in Laboratories using Nonhuman Primates, pp. 441-444
2. https://www.selectagents.gov/SelectAgentsandToxinsList.html

**Domain 5**

**124.** All of the following applies to Chagas disease in nonhuman primates **EXCEPT**?

a. Parasitemia can be transient which may cause false negative results

b. In chronic disease, viable organisms can be detected frequently in tissue sections

c. Clinical signs are not specific and include lethargy, anorexia, and depression

d. Clinical signs are usually secondary to cardiovascular involvement

**Answer: b. In chronic disease, viable organisms can be detected frequently in tissue sections**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 17 – Nonhuman Primates, p. 884.

2) Rybak et al. 2016. Clinical *Trypanosoma cruzi* disease after cardiac transplantation in a cynomolgus macaque (*Macaca fascicularis*). Comparative Medicine 66(6):494-498.

3) Fong et al. 2014. Transmission of chagas disease via blood transfusions in 2 immunosuppressed pigtailed macaques (*Macaca nemestrina*). Comparative Medicine 64(1):63–67

**Domain 3; Primary Species – Macaques (*Macaque spp.*)**

**125.** Propofol’s anesthetic effects result predominately from interactions at which receptor?

1. Alpha2-adrenoreceptor
2. GABAA

c. GABAB

d. NMDA

**Answer: b. GABAA**

**References:**

1) Fish RE, Brown MJ, Danneman PJ, Karas AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals, 2nd ed. Academic Press, San Diego, CA. Chapter 2 – Pharmacology of Injectable Anesthetics, Sedatives, and Tranquilizers, pp. 38-42.

2) Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 1 - Biology and Management, Academic Press: San Diego, CA. Chapter 17 - Anesthesia and Analgesia in Nonhuman Primates, p. 411.

**Domain 2**

**126.** Which of the following strain or stock of rat will have a close to 100% incidence of eosinophilic granulomatous pneumonia by 3-4 months of age?

1. Brown Norway
2. Long Evans
3. Sprague-Dawley
4. Wistar

**Answer: a. Brown Norway**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 4 – Biology and Diseases of Rats, p. 189.
2. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 2 – Rat, pp. 155-156.

**Domain 3; Primary Species – Rat (*Rattus norvegicus*)**

**127.** Inspired air within a rodent cage should contain no more than how many ppm of NH3?

 a. 8

 b. 12

c. 18

d. 25

e. 32

**Answer: d. 25**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 36 – Design and Management of Research Facilities, p. 1569.
2. Hessler JR, Lehner NDM, eds. 2009. Planning and Designing Research Animal Facilities. Academic Press, San Diego, CA. Chapter 7 – Environmental Considerations for Research Animals, p. 63 and Chapter 35 – Using CFD in Laboratory Animal Facilities, p. 485

**Domain 4**

**128.** Which of the following best describes surgical requirements provided for USDA-covered species, including covered rodent species?

a. All major operative procedures must be performed only in facilities intended for that purpose

b. Animals may be used for more than two major operative survival procedures only if scientifically justified

c. Aseptic technique must be maintained for all major operative procedures

d. Surgeries performed as part of routine veterinary procedures are considered minor surgical procedures

**Answer: c. Aseptic technique must be maintained for all major operative procedures**

**References:**

1. Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 2 – Regulations, Subpart C – Research Facilities, §2.31 (d)(1)(ix) Institutional Animal Care and Use Committee (IACUC) (11-6-13 Edition, p. 33-34)

 (http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

1. USDA Animal and Plant Health Inspection Service Animal Care Policy Manual. Policy # 14: Major Survival Surgery, Dealers Selling Surgically-Altered Animals to Research. March 25, 2011.

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Policy%20Manual.pdf)

**Domain 5; Tertiary Species - Other Rodents**

1. Which of the following is the most likely cause for bilaterally symmetric alopecia in an aged guinea pig?
2. *Chirodiscoides caviae*
3. Cushing’s disease
4. Granulosa cell tumor
5. Ovarian cysts
6. *Trixacarus caviae*

**Answer: d. Ovarian cysts**

**References:**

1. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 5 – Guinea Pig, pp. 234-235, 247-248.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 6 – Biology and Diseases of Guinea Pigs, pp. 264-265, 276.
3. Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press: San Diego, CA. Section III – Guinea Pigs, Chapter 23 – Infectious Diseases, pp. 671-674 and Chapter 24 – Non-Infectious Diseases, pp. 693-696

**Domain 1; Secondary Species – Guinea Pig (*Cavia porcellus*)**

**130.** Which of the following mouse strains is the most frequent source of embryonic stem cells, from which most targeted mutant mice are derived?

a. 129

b. BALB/c

c. C57BL/6

d. FVB

**Answer: a. 129**

**References:**

1)Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 1 – Mouse, p. 5

2) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 32 – Genetically Modified Animals, p. 1429.

**Domain 3; Primary Species - Mouse (*Mus musculus)***

**131.** All of the following infectious agents have been recognized to be inefficiently transmitted to sentinel animals through contact with soiled bedding **EXCEPT**?

1. *Helicobacter* spp.
2. Mouse hepatitis virus
3. *Myocoptes musculinus*
4. *Pasteurella pneumotropica*
5. Sendai virus

**Answer: b. Mouse hepatitis virus**

**References:**

1. Bauer et al. 2016. Influence of rack design and disease prevalence on detection of rodent pathogens in exhaust debris samples from individually ventilated caging systems. JAALAS 55(6):782-788
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 11 – Microbiological QC for Laboratory Rodents and Lagomorphs. p. 494.

**Domain 4; Primary Species - Mouse (*Mus musculus*)**

**132.** According to Good Laboratory Practice for Conducting Nonclinical Laboratory Studies, the final report for each nonclinical study wouldcontain all of the following **EXCEPT**?

1. Description of all circumstances that may have affected the quality or integrity of the data
2. Description of the methods used
3. Objectives and procedures stated in the approved protocol, including any changes in the original protocol
4. Signature and date of the Test Facility Manager
5. Statistical methods employed for analysing the data

**Answer: d. Signature and date of the Test Facility Manager**

**References:**

1. 21CFR PART 58—Good Laboratory Practice for Nonclinical Laboratory Studies, Subpart A – General Provisions, §58.185 Reporting of nonclinical laboratory study results

 http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?fr=58.185

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 2 – Laws, Regulations, and Policies Affecting the Use of Laboratory Animals, pp. 31-32

**Domain 5**

1. All of the following describes *Myocoptes musculinus* infection in mice **EXCEPT**?
	1. Burden and disease severity decreases with age
	2. Detection by dirty bedding sentinels has been shown to be unreliable
	3. Mouse pups as young as 4-5 days can become infested
	4. Rag1-/- mice have been shown to have a higher burden than B6
	5. TH1 response has been associated with controlling burden over time

**Answer: e. TH1 response has been associated with controlling burden over time**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 - Biology and Diseases of Mice, pp. 125-128
2. Moats et al. 2016. Ectoparasitic burden, clinical disease, and immune responses throughout fur mite (*Myocoptes musculinus*) infestation in C57BL/6 and Rag1-/- Mice. Comparative Medicine 66(3):197-207

**Domain 1; Primary Species – Mouse (*Mus musculus*)**

**134.** In addition to the Animal Welfare Act and its regulations, Institutional Animal Care and Use Committee (IACUC) authority is mandated by which of the following laws?

a. Humane Methods of Research Act

b. Research Modernization Act

c. Health Research Extension Act of 1985

d. Protection of Animals in Research Act

**Answer: c. Health Research Extension Act of 1985**

**References:**

1. Applied Research Ethics National Association (ARENA) and Office of Laboratory Animal Welfare (OLAW). 2002. Institutional Animal Care and Use Committee Guidebook. 2nd Edition. OLAW, Bethesda, MD. A.2. Authority, Composition and Functions, p. 11.

(http://grants.nih.gov/grants/olaw/guidebook.pdf)

1. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 3 – Normative Biology, Husbandry, and Models. Academic Press: San Diego, CA. Chapter 2 – Laws, Regulations, and Policies Affecting the Use of Laboratory Animals, pp. 26, 30.

**Domain 5**

**135.** Examples of effective post-approval monitoring strategies include all of the following **EXCEPT**?

a. Examination of surgical areas, including anesthetic equipment, use of appropriate aseptic technique, and handling and use of controlled substances

b. Observation of laboratory practices and procedures and comparison with approved protocols

c. Regular review of adverse or unexpected experimental outcomes affecting the animals

d. Review of protocol-related health and safety issues

e. Review of surgical records, but not anesthesia records

**Answer: e. Review of surgical records, but not anesthesia records
Reference:** National Research Council. 2011. Guide for the Care and Use of Laboratory Animals, 8th ed. National Academies Press, Washington D.C. Chapter 1 – Key Concepts: Animal Care and Use Program, p. 34.

**Domain 4**

1. Which of the following stereotypic behaviors is most commonly seen in laboratory-housed Mongolian gerbils?
	1. Compulsive digging
	2. Elaborate nest building
	3. Ingestion of substrate
	4. Territorial urine marking
	5. Thumping of hind legs

**Answer: a. Compulsive digging**

**References:**

1) Moons et al. 2012. The effect of different working definitions on behavioral research involving stereotypies in Mongolian gerbils (*Meriones unguiculatus*). JAALAS 51(2):170–176

2) Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press: San Diego, CA. Section VI – Other Rodents, Chapter 52 - Gerbils, p. 1136-1137.

**Domain 4; Secondary Species - Gerbil (*Meriones spp.*)**

**137.** According to the AVMA Guidelines for Euthanasia of Animals (2013 Edition), which of the following methods for rabbit euthanasia is considered **UNACCEPTABLE** as a primary method of euthanasia?

1. CO2 if administered using an appropriate pressure reducing regulator and flow meter or equivalent equipment with the capability for generating the recommended displacement rates for the size container being utilized
2. Potassium chloride, exsanguination, or bilateral thoracotomy
3. Rabbit-sized penetrating captive bolts if maintained in clean working order, positioned correctly, and operated safely by trained personnel
4. Cervical dislocation when performed by individuals with a high degree of technical proficiency
5. Barbiturates given IV via the ear veins

**Answer: b. Potassium chloride, exsanguination, or bilateral thoracotomy**

**Reference:** American Veterinary Medical Association. 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, pp. 50-51, 99, 102

(https://www.avma.org/KB/Policies/Documents/euthanasia.pdf)

**Domain 2; Primary Species - Rabbit (*Oryctolagus cuniculus*)**

**138.**  Which of the following is the correct requirements for a CMAR candidate with an AA or AS degree?

a. 10 years lab animal experience and 5 years lab animal managerial experience

b. 5 years lab animal experience and 3 years lab animal managerial experience

c. 10 years lab animal experience and 3 years lab animal managerial experience

d. 8 years lab animal experience and 3 years lab animal managerial experience

e. 8 years lab animal experience and 5 years lab animal managerial experience

**Answer: d. 8 years lab animal experience and 3 years lab animal managerial experience**

**References:**

1. CMAR Eligibility Requirements. American Association for Laboratory Animal Science. https://www.aalas.org/certification/management-certification/eligibility-requirements
2. https://www.aalas.org/certification/management-certification/cmar-faq

**Domain 6**

**139.** Which of the following parasites found in sheep and goats is of primary economic importance and may lead to increased morbidity and mortality if not excluded prior to beginning protocol-related procedures?

a. *Bunostomum trigoncephalum*

b. *Dictyocaulus filaria*

c. *Haemonchus contortus*

d. *Ostertagia ostertagi*

e. *Trichostrongylus vitrinus*

**Answer: c. *Haemonchus contortus***

**References:**

1. Committees to Revise the Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching. 2010. GUIDE For the Care and Use of Agricultural Animals in Research and Teaching. 3rd Edition. Federation of Animal Science Societies, Savoy, IL. Chapter 10 – Sheep and Goats, p. 134

(https://aaalac.org/about/Ag\_Guide\_3rd\_ed.pdf)

2) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 15 – Biology and Diseases of Sheep, Goats, and Cattle, pp. 674-675.

**Domain 1; Secondary Species – Sheep (*Ovis ares*) and Goat (*Capra hircus*)**

**140.** For which of the following diseases does the viral etiologic agent **DOES NOT** require BSL-3 containment practices in studies involving the use of animals?

1. Eastern equine encephalitis
2. Monkeypox
3. Poliovirus
4. Venezuelan equine encephalitis
5. Yellow fever

**Answer: c. Poliovirus**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 17 – Nonhuman Primates, p. 830.
2. U. S. Department of Health and Human Services, Public Health Service, Center for Disease Control and Prevention, and National Institutes of Health. 2009. Biosafety in Microbiological and Biomedical Laboratories. 5th ed. U.S. Government Printing Office, Washington, D. C. Section VIII-E: Viral Agents, pp. 217, 219 and Section VIII-F: Arboviruses and Related Zoonotic Viruses, pp. 236-237, 243, 265

(https://www.cdc.gov/biosafety/publications/bmbl5/bmbl5\_sect\_viii.pdf)

**Domain 5**

1. Which of the following is recommended for pre-surgical skin preparation in *Xenopus laevis*?
2. Chlorhexidine
3. Isopropyl alcohol
4. Povidone-iodine scrub
5. Sterile saline

**Answer: d. Sterile saline**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 18 – Biology and Diseases of Amphibians, p. 947.
2. Philips et al. 2015.Evaluation of presurgical skin preparation agents in African Clawed Frogs (*Xenopus laevis*). JAALAS 54(6):788-798

**Domain 3; Secondary Species – African Clawed Frog (*Xenopus laevis* and *Xenopus tropicalis*)**

**142.** All of the following describe the effects of environmental enrichment on the fertility and fecundity of *Danio rerio* from a recent study **EXCEPT**?

a. Zebrafish fertility is greater in a breeding tank containing environmental enrichment than in bare tank

b. Zebrafish fecundity is greater in a breeding tank containing environmental enrichment than in bare tank

c. Enrichment type affected the fry survivability

d. Total egg count after 3 h was greater for zebrafish spawning in the grass environment than in the leaf or control environments

**Answer: c. Enrichment type affected the fry survivability**

**References:**

1) [Lemnique et al. 2016.](https://www.ncbi.nlm.nih.gov/pubmed/?term=Wafer%20LN%5BAuthor%5D&cauthor=true&cauthor_uid=27177561) Effects of environmental enrichment on the fertility and fecundity of zebrafish (*Danio rerio*). JAALAS 55(3):291–294

2) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 20 – The Biology and Management of the Zebrafish, p. 1023.

**Domain 4; Secondary Species - Zebrafish (*Danio rerio*)**

**143.** According to the Animal Welfare Act and its regulations, all primary enclosures used to transport live dogs and cats that are not permanently affixed to the conveyance must have which of the following?

1. Must be clearly marked on top and one or more sides with the words “Live Animal” at least 2.5 inches high
2. Ventilation openings located on two opposing walls and openings must be at least 16% of the surface area of each wall with combined surface area of 14% of total surface area of all walls
3. Ventilation openings on all 4 walls, with each being 14% of the surface area of the wall and total combined surface area of 26% of the total walls
4. No more than 4 live dogs or cats 6 weeks or older of comparable size contained within the primary enclosure

**Answer: b. Ventilation openings located on two opposing walls and openings must be at least 16% of the surface area of each wall with combined surface area of 14% of total surface area of all walls.**

**Reference:** Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 3 – Standards, Subpart A – Specifications for the Humane Handling, Care, Treatment, and Transportation of Dogs and Cats, §3.14 Primary enclosures used to transport live dogs and cats (a) Construction of primary enclosures, (c) Ventilation and (d) Compatibility (11-6-13 Edition, pp. 70-71)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf**)**

**Domain 5; Primary Species – Dog (*Canis familiaris*) and Cat (*Felis domestica*)**

**144.** Which of the following conditions may result from housing guinea pigs on wire flooring?

1. Blepharitis
2. Glomerulonephritis
3. Ovarian cysts
4. Rhabdomyomatosis
5. Splenic amyloidosis

**Answer: e. Splenic amyloidosis**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 6 – Biology and Diseases of Guinea Pigs, pp. 249, 277.
2. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 5 – Guinea Pig, p. 229.
3. Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press: San Diego, CA. Section III – Guinea Pigs, Chapter 23 – Infectious Diseases, pp. 647-648.

**Domain 1; Secondary Species – Guinea Pig (*Cavia porcellus*)**

**145.** Which mouse strain spontaneously develops autoimmune abnormalities and is utilized in models of systemic lupus erythematosus and immune-mediated hemolytic anemia?

a. BALB/c

b. C57BL/6

c. CBA/J

d. NZB/BINJ

**Answer: d. NZB/BINJ**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 – Biology and Diseases of Mice, p. 133.

2) Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 3 – Normative Biology, Husbandry, and Models. Academic Press: San Diego, CA. Chapter 2 – Mouse Physiology, p. 74.

**Domain 3; Primary Species - Mouse (*Mus musculus)***

1. *Taenopygia guttata* is known by what common name and physical feature?
	1. Zebra finch; juveniles have black beaks
	2. Zebra finch; adult females do not have orange beaks
	3. Zebrafish; juveniles are all black
	4. Zebrafish; adult females do not have orange stripes
	5. Zebra; each animal's stripes are as unique as a human fingerprint

**Answer: a. Zebra finch; juveniles have black beaks**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 23 – Zebra Finces in Biomedical Research, p. 1112
2. Hubrecht, R, Kirkwood J, eds. 2010. The UFAW Handbook on the Care and Management of Laboratory Animals, 8th edition. Wiley-Blackwell. Chapter 43 - The Zebra Finch, p. 682.

**Domain 4; Tertiary Species – Other Birds**

**147.** According to the Animal Welfare Act and its regulations, how often must dogs less than 16 weeks of age be offered potable water, starting from the time the dog was last offered potable water before transportation was begun?

1. At least once every 6 hours
2. At least once every 12 hours
3. At least once every 24 hours
4. Ad libitum

**Answer: b. At least once every** **12 hours**

**Reference:** Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 3 – Standards, Subpart A – Specifications for the Humane Handling, Care, Treatment, and Transportation of Dogs and Cats, §3.16 (a) Food and water requirements (11-6-13 Edition, p. 73)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

**Domain 5; Primary Species – Dog (*Canis familiaris*)**

**148.** Which of the following species **WOULD NOT** likely benefit from a dust/sand bath?

1. *Chinchilla spp.*
2. *Dipodomys spp.*
3. *Octodon spp.*
4. *Sigmodon spp.*

**Answer: d. *Sigmodon* *spp.***

**References:**

1) Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press: San Diego, CA. Section V – Chinchillas, Chapter 39 – Anatomy, Physiology, and Behavior, p. 963; and Chapter 40 – Management, Husbandry, and Colony Health, pp. 968-969 and Section VI – Other Rodents, Chapter 44 – Degu, pp 1038-1039; Chapter 48 – Kangaroo Rat, p. 1102; and Chapter 49 – Cotton Rat, p. 1108-1109

2) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 7 – Biology and Diseases of Other Rodents, pp. 299-300, 311-312, 326-328 and Chapter 9 – Biology and Diseases of Chinchillas, p. 389.

**Domain 4; Tertiary Species – Other Rodents**

**149.** Non-maternal nest building behavior in mice is often impaired following painful procedures, but this deficit can be ameliorated in female mice by which of the following manipulations?

1. Increasing the ambient temperature above the thermoneutral zone
2. Social housing

c. Treatment with carprofen (5 mg/kg)

c. Treatment with kappa opioid agonists

**Answer: b. Social housing**

**References:**

1) Jrikof et al. 2013. Assessment of post-surgical distress and pain in laboratory mice by next complexity scoring. Lab Anim47:153-161.

2) Van Loo et al. 2007. Impact of ‘living apart together’ on postoperative recovery of mice compared with social and individual housing. Lab Anim41:441-455.

**Domain 2; Primary Species – Mouse (*Mus musculus*)**

**150.** Which of the following best describes the phenotype or immunodeficiency associated with the beige mouse?

1. Deficiency/ decrease NK cells activity
2. Deficiency/ impaired macrophage
3. Hypoplastic lymphoid tissue
4. No Ig or T cells
5. No T cell function

**Answer: a. Deficiency/ decrease NK cells activity**

 **References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 - Biology and Diseases of Mice, p. 72 [Table 3.12].
2. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 4 – Immunology. Academic Press: San Diego, CA. Chapter 13 – Mouse Models of Immunodeficiency, pp. 277-279.
3. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter1- Mouse, p. 13.

**Domain 3; Primary Species – Mouse (*Mus musculus*)**

**151.** Which of the following is the most important physical enrichment for laying hens?

1. Overhead cover
2. Nestbox
3. Foraging materials
4. Hanging strings
5. Dustbaths

**Answer: b. Nestbox**

**References:**

1. Committees to Revise the Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching. 2010. GUIDE For the Care and Use of Agricultural Animals in Research and Teaching. 3rd Edition. Federation of Animal Science Societies, Savoy, IL. Chapter 4 - Environmental Enrichment. pp. 33-34. (http://www.fass.org/docs/agguide3rd/Ag\_Guide\_3rd\_ed.pdf)
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 38 – Laboratory Animal Behavior, pp. 1638-1639.

**Domain 4; Tertiary Species – Chicken (*Gallus domesticus)***

1. All of following apply to the CDC guidelines for importation of nonhuman primates **EXCEPT**?
2. Workers in direct contact with imported NHPs must wear, at minimum, a N95 respirator for respiratory protection
3. The minimum quarantine period for imported NHPs is 31 days
4. Animals with suspect positive TST reactions must remain in quarantine and receive at least 3 additional TSTs, administered 2 weeks apart
5. An importer must notify the CDC within 24 hours if any NHP tests positive for filovirus antigen or antibody

**Answer: c. Animals with suspect positive TST reactions must remain in quarantine and receive at least 3 additional TSTs, administered 2 weeks apart**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 2 - Laws, Regulations, and Policies Affecting the Use of Laboratory Animals, pp. 38-39
2. Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 1 - Biology and Management, Academic Press: San Diego, CA. Chapter 2 – Laws, Regulations and Policies Relating to the Care and Use of Nonhuman Primates, p. 50.
3. 42 CFR, Part 71 – Foreign Quarantine, Subpart F – Importations, §71.53 Requirements for importers of nonhuman primates (https://www.law.cornell.edu/cfr/text/42/71.53)
4. Federal Register, Vol. 78, No. 32, Friday, February 15, 2013, Rules and Regulations p. 11542-11543. (https://www.gpo.gov/fdsys/pkg/FR-2013-02-15/pdf/2013-03064.pdf)

**Domain 5**

**153.** Which of the following statements best describes basophils in murine peripheral blood?

a. Most common leukocyte, contain lobulated nuclei, easily differentiated from mast cells

b. Most common leukocyte, contain ovoid nuclei, difficult to differentiate from mast cells

c. Least common leukocyte, contain lobulated nuclei, difficult to differentiate from mast cells

d. Least common leukocyte, contain lobulated nuclei, easily differentiated from mast cells

e. Least common leukocyte, contain ovoid nuclei, difficult to differentiate from mast cells

**Answer: c. Least common leukocyte, contain lobulated nuclei, difficult to differentiate from mast cells**

**References:**

1. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 3 – Normative Biology, Husbandry, and Models. Academic Press: San Diego, CA. Chapter 5 – Hematology of the Laboratory Mouse, p. 150.
2. O’Connell et al. 2015. Practical murine hematopathology: a comparative review and implications for research. Comparative Medicine 65(2):96-113

**Domain 1; Primary Species – Mouse (*Mus musculus*)**

**154.** Reye’s like syndrome is most likely found in which of the following strains of mice?

a. 129

b. BALB/cByJ

c. B6:129

d. C3H

**Answer: b. BALB/cByJ**

**Reference(s):**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 – Biology and Diseases of Mice, p. 129
2. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 1 – Mouse, p. 96
3. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 2 – Diseases. Academic Press: San Diego, CA. Chapter 2 – Mouse Adenoviruses, p. 59

**Domain 3; Primary Species - Mouse (*Mus musculus*)**

**155.** Which of the following species absorbs calcium in proportion to the amount in its diet?

* 1. Gerbil
	2. Hamster
	3. Mouse
	4. Rabbit
	5. Rat

**Answer: d. Rabbit**

**References:**

1) Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 6 - Rabbit, p. 254.

2) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 10 – Biology and Diseases of Rabbits, p. 419.

**Domain 4; Primary Species - Rabbit (*Oryctolagus cuniculus)***

**156.** According to Good Laboratory Practice for Conducting Nonclinical Laboratory Studies, all of the following items must be retained from a nonclinical laboratory study **EXCEPT**?

1. Documentation records
2. Protocols
3. Raw data
4. Records of quality assurance inspections
5. Specimens obtained from mutagenicity tests

**Answer: e. Specimens obtained from mutagenicity tests**

**References:**

1. 21CFR PART 58—Good Laboratory Practice for Nonclinical Laboratory Studies, Subpart A – General Provisions, § 58.195 Retention of Records

 http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?fr=58.195

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 2 – Laws, Regulations, and Policies Affecting the Use of Laboratory Animals, pp. 31-32

**Domain 5**

**157.** Which of the following is associated with an increased risk of ulcerative dermatitis in C57BL/6 mice?

* 1. Feeding a calorie restricted diet
	2. Feeding a creatinine supplemented diet
	3. Feeding a diet deficient in linoleic acid
	4. Feeding a lithium supplemented diet
	5. Feeding a low fat diet

**Answer: d. Feeding a lithium supplemented diet**

**References:**

1. Sargent et al. 2015. Systematic literature review of risk factors and treatments for ulcerative dermatitis in C57BL/6 mice. Comparative Medicine65(6):465–472.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 13 – Biology and Diseases of Mice, p. 130.

**Domain 1; Primary Species – Mouse (*Mus musculus*)**

1. Which of the following techniques can be utilized during anesthesia to reduce brain volume and facilitate neurosurgery in nonhuman primates?
2. Administration of ketamine to reduce intracranial pressure
3. Hyperventilation to induce hypocapnia
4. Hypoventilation to induce hypercapnia
5. Increasing volatile anesthetic dose

**Answer: b. Hyperventilation to induce hypocapnia**

**References:**

1. Tranquilli WJ, Thurmon JC, Grimm KA eds. 2007. Lumb and Jones’ Veterinary Anesthesia and Analgesia, 4th edition. Blackwell Publishing: Ames, IA. Chapter 38 - Neurologic Disease, pp. 902-904.
2. Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 1 - Biology and Management, Academic Press: San Diego, CA. Chapter 17 – Anesthesia and Analgesia in Nonhuman Primates, p. 429.

**Domain 2**

**159.** Which of the following is an operant-based assay for assessing pain in rats that relies on the heat sensitizing effects of capsaicin?

1. Hargreaves hyperalgesia assay
2. Orofacial pain assessment assay
3. Plantar incision assay
4. Tail flick assay
5. Von Frey assay

**Answer: b. Orofacial pain assessment assay**

**References:**

1. Ramirez et al. 2015. Assessment of an orofacial operant pain assay as a preclinical tool for evaluating analgesic efficacy in rodents. JAALAS 54(4):426-432
2. Taylor et al. 2016. Analgesic activity of tramadol and buprenorphine after voluntary ingestion by rats (*Rattus norvegicus*). JAALAS 55(1):74-82
3. Fish RE, Brown MJ, Danneman PJ, Karas AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals, 2nd ed. Academic Press, San Diego, CA. Chapter 23 – Pain Testing in the Laboratory Mouse, pp. 551-552

**Domain 2; Primary Species – Rat (*Rattus norvegicus*)**

**160.** What minimal contact time is considered adequate for sanitation using mechanical washers and water at a temperature of 61.7oC (143oF)?

a. 15 seconds

b. 30 seconds

c. 5 minutes

d. 15 minutes

e. 30 minutes

**Answer: e. 30 minutes**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 36 – Design and Management of Research Facilities, p. 1559
2. Compton and Macy. 2015. Effect of cage-wash temperature on the removal of infectious agents from caging and the detection of infectious agents on the filters of animal bedding-disposal cabinets by PCR analysis. JAALAS 54(6):745-755.

**Domain 4**

**161.** Individual animals in which anesthetics, analgesics, sedatives and/or tranquilizers are withheld when they are necessary to prevent pain or distress should be reported in which column of the annual report to the USDA (APHIS Form 7023)?

a. Column A

b. Column B

c. Column C

d. Column D

e. Column E

**Answer: e. Column E**

**Reference:** USDA, APHIS, Research Facility Annual Report. Modified Oct. 26, 2016. https://www.aphis.usda.gov/aphis/ourfocus/animalwelfare/SA\_Obtain\_Research\_Facility\_Annual\_Report

**Domain 5**

1. Which of the following may occur from inoculation of tumor cells contaminated with the indicated agent into a young athymic nude rat?
2. Corneal ulceration from Sendai Virus
3. Encephalitis from Murine Pneumonia Virus
4. Hemorrhagic enteritis from Rat Virus
5. Poliomyelitis from Lactate Dehydrogenase Elevating Virus
6. Splenomegaly from *Mycoplasma haemomuris*

**Answer: e. Splenomegaly from *Mycoplasma haemomuris***

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 4 – Biology and Diseases of Rats, pp. 175-176
2. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 2 - Rat, pp. 151-152

**Domain 1; Primary Species – Rat (*Rattus norvegicus*)**

**163.** All of the following statements apply to rabbit hemorrhagic disease **EXCEPT**?

* 1. It may be transmitted by direct contact, fomites and arthropods
	2. Rabbits younger than 8 weeks are most sensitive to the disease
	3. The virus replicates in hepatocytes and macrophages
	4. Adults are susceptible to the disease

**Answer: b. Rabbits younger than 8 weeks are most sensitive to the disease**

**References:**

1. Suckow MA, Stevens KA, Wilson RP. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. 2012 Academic Press; San Diego CA. Section II: Rabbits, Chapter 14 – Viral Diseases, pp. 394-395
2. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 6 – Rabbit , pp. 259-260
3. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 10 – Biology and Diseases of Rabbits, p. 436

**Domain 1; Primary Species - Rabbit (*Oryctolagus cuniculus)***

1. The pink-eyed dilution allele, represented historically as *e*, but renamed as *p*, can be found on which chromosome in mice?
	1. 6
	2. 7
	3. 8
	4. 9
	5. 10

**Answer: b. 7**

**Reference:** Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 1 – History, Wild Mice, and Genetics. Academic Press: San Diego, CA. Chapter 12 – Chemical Mutagenesis in Mice, p. 227.

**Domain 3; Primary Species - Mouse (*Mus musculus*)**

**165.**  All of the following are intrinsic factors that can influence animal research **EXCEPT**?

* 1. Age and sex
	2. Caging and housing-related issues
	3. Circadian rhythms
	4. Genetics
	5. Nutritional status

**Answer: b. Caging and housing-related issues**

**Reference:** Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 33 – Factors That Can Influence Animal Research, pp. 1441-1444, 1452-1452.

**Domain 4**

**166.** Which of the following organizations enforces CITES?

1. Animal Plant and Health Inspection Service
2. Centers for Disease Control
3. Environmental Protection Agency
4. National Institutes of Health
5. United States Fish and Wildlife Service

**Answer: e. United States Fish and Wildlife Service**

**References:**

1) Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 1 - Biology and Management, Academic Press: San Diego, CA. Chapter 2 – Laws, Regulations and Policies Relating to the Care and Use of Nonhuman Primates, pp. 51-52.

2) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 2 - Laws, Regulations, and Policies Affecting the Use of Laboratory Animals, p. 39.

**Domain 5**

**167.** A zebra finch colony has had a number of deaths. Clinical signs varied from none to death. Some birds had gross ulceration of the proventriculus and ventriculus. Histopathology and special stains revealed clumps of anamorphic ascomycetous yeast. What is the most likely genus and species?

1. *Albatrellus ovinus*
2. *Candida albicans*

c. *Macrorhabdus ornithogaster*

d. *Malassezia avies*

e. *Saccromyces cerevesiae*

**Answer: c. *Macrorhabdus ornithogaster***

**References:**

1) Snyder et al. 2013. Increased mortality in a colony of zebra finches exposed to continuous light. JAALAS 52(3):301–307.

2) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine. 3rd edition. Academic Press: San Diego, CA. Chapter 23 – Zebra Finches in Biomedical Research, p. 1127.

**Domain 1; Tertiary Species – Other Birds**

**168.** All of the following behaviors have been described as demonstrating aversive behavior in *Succinea putris* **EXCEPT**?

a. Bubble release

b. Excretion of feces

c. Mucous production

d. Retraction of body into shell

e. Seizures

**Answer: e. Seizures**

**Reference:** Gilbertson and Wyatt. 2016. Evaluation of euthanasia techniques for an invertebrate species, land snails (*Succinea putris*). JAALAS 55(5):577-581

**Domain 2; Tertiary Species – Invertebrates**

**169.** What novel genomic technique utilizes an RNA and protein complex to create targeted double stranded DNA breaks to create knockout zebrafish?

1. Clustered regularly interspaced palindromic repeats
2. Restriction enzyme digest
3. Transcription activator-like effector nucleases
4. Zinc finger nucleases

**Answer: a. Clustered regularly interspaced palindromic repeats**

**Reference:** Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 32 - Genetically Modified Animals, p. 1426

**Domain 3; Secondary Species – Zebrafish (*Danio rerio*)**

**170.** According to the Guide for the Care and Use of Laboratory Animals and the Animal Welfare Act and its regulations, nonhuman primate food receptacles must be sanitized at least how often?

1. Once daily
2. Once a week
3. Once every 2 weeks
4. Once a month

**Answer: c. Once every 2 weeks**

**References:**

1. Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 2 – Regulations, Subpart D – Specifications for the Humane Handling, Care, Treatment, and Transportation of Nonhuman Primates, §3.82 (d) Feeding (11-6-13 Edition, p. 102)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

1. Institute for Laboratory Animal Resources. 2011. Guide for the Care and Use of Laboratory Animals. National Academy Press, Washington, D.C. Chapter3 - Environment, Housing and Management, pp. 70-72.

**Domain 5**

**171.** Which of the following situations would allow for approval of a protocol being reviewed by Full Committee Review if a university has a 50 member IACUC?

a. 48 members return an "approval" vote via email.

b. All 24 members present at an IACUC meeting vote to approve.

c. The AV, IACUC chair, and community member all vote to approve.

d. 17 of the 31 members present at the IACUC meeting vote to approve.

**Answer: d. 17 of the 31 members present at the IACUC meeting vote to approve**

**References:**

1. Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 2 – Regulations, Subpart C – Research facilities, §2.31 (d)(2)(6) IACUC review of activities involving animals (11-06-13 Edition, pp. 34-35)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

2) Office of Laboratory Animal Welfare. 2015. Public Health Service Policy on Humane Care and Use of Laboratory Animals, pp. 8, 14-15

 (http://grants.nih.gov/grants/OLAW/references/PHSPolicyLabAnimals.pdf)

3) Applied Research Ethics National Association (ARENA) and Office of Laboratory Animal Welfare (OLAW). 2002. Institutional Animal Care and Use Committee Guidebook. 2nd Edition. OLAW, Bethesda, MD. A.2. Authority, Composition and Functions, pp. 15-16.

(http://grants.nih.gov/grants/olaw/guidebook.pdf)

**Domain 5**

**172.** Which of the following pathogens in zebrafish would be analogous to *Encephalitozoon cuniculi* in rabbits?

1. *Mycobacterium marinum*
2. *Myxidium spp.*
3. *Pseudocapillaria tomentosa*

 d. *Pseudoloma neurophila*

**Answer: d. *Pseudoloma neurophila***

**References:**

1. Kent et al. 2012. Documented and potential research impacts of subclinical diseases in zebrafish. ILAR J53(2):126-134.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 20 – The Biology and Management of the Zebrafish, p. 1045-1047.

**Domain 1; Primary Species – Rabbit (*Oryctolagus cuniculus*) and Secondary Species – Zebrafish (*Danio rerio*)**

**173.** All of the following avian species were used as one of the first animal models of atherosclerosis to be studied **EXCEPT**?

1. *Archilochus colubris*
2. *Columba livia domestica*
3. *Coturnix japonica*
4. *Gallus domesticus*
5. *Meleagris gallopavo*

**Answer: a. *Archilochus colubris***

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 22 – Japanese Quail as a Laboratory Animal Model, pp. 1088-1089; Chapter 23 – Zebra Finches in Biomedical Research, pp. 1010-1011; and Chapter 24 –Animal Models In Biomedical Research, pp. 1498-1499.
2. St. Clair. 1998.The contribution of avian models to our understanding of atherosclerosis and their promise for the future. Laboratory Animal Science 48(6):565-568

**Domain 3; Tertiary Species – Other Birds and Chicken (*Gallus domesticus*)**

**174.** Which of the following statements best describes the chemosensory signaling phenomena used to assist in induction of synchronized timed pregnancy in mice?

a. Group-housed females are separated from males to suppress estrus (Lee-Boot effect), and then are exposed to male urine to synchronize estrus (Whitten effect)

b. Group-housed females are separated from males to suppress estrus (Whitten effect), and then are exposed to male urine to synchronize estrus (Bruce effect)

c. Recently conceived females are exposed to strange males and resorb their fetuses (Bruce effect), and are then exposed to male urine to synchronize estrus (Whitten effect)

d. Recently conceived females are exposed to strange males and resorb their fetuses (Lee-Boot effect), and are then exposed to male urine to synchronize estrus (Bruce effect)

**Answer: a. Group-housed females are separated from males to suppress estrus (Lee-Boot effect), and then are exposed to male urine to synchronize estrus (Whitten effect)**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 – Biology and Diseases of Mice, p. 68.

2) Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 1 – History, Wild Mice, and Genetics. Academic Press: San Diego, CA. Chapter 4 – Breeding Systems: Considerations, Genetic Fundamentals, Genetic Background, and Strain Types, p. 54.

3) Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 3 – Normative Biology, Husbandry, and Models. Academic Press: San Diego, CA. Chapter 3 – Reproductive Biology of the Laboratory Mouse, pp. 108-109.

**Domain 4; Primary Species – Mouse (*Mus musculus*)**

**175.** Which of the following describes the Institutional Animal Care and Use Committee membership requirements according to the PHS Policy on Humane Care and Use of Laboratory Animals?

a. At least three members which includes a chairman, a veterinarian, and a non-affiliated individual

b. At least five members which includes chairman appointed by the attending veterinarian, a veterinarian, and a non-affiliated individual.

c. At least five members which includes a veterinarian, practicing scientist involving animals, nonscientific individual, and a non-affiliated individual

d. At least four members which includes a veterinarian, practicing scientist involving animals, nonscientific individual, and a non-affiliated individual

**Answer: c. At least five members: A veterinarian, practicing scientist involving animals, nonscientific individual, and a non-affiliated individual**

**References:**

1. Office of Laboratory Animal Welfare. 2015. Public Health Service Policy on Humane Care and Use of Laboratory Animals, p. 11

(http://grants.nih.gov/grants/OLAW/references/PHSPolicyLabAnimals.pdf)

1. Applied Research Ethics National Association (ARENA) and Office of Laboratory Animal Welfare (OLAW). 2002. Institutional Animal Care and Use Committee Guidebook. 2nd Edition. OLAW, Bethesda, MD. A.2. Authority, Composition and Functions, pp. 12-15.

(http://grants.nih.gov/grants/olaw/guidebook.pdf)

**Domain 5**

**176.** A rhesus macaque inoculated with simian immunodeficiency virus is found dead after a short course of neurologic clinical signs. Histopathologic examination of the brain reveals leukoencephalomalacia with demyelination and intranuclear inclusion bodies. Which of the following etiologic agents is compatible with the history and pathologic findings?

1. Cercopithecene herpes virus 2
2. Herpes simplex virus 1
3. Rhesus cytomegalovirus
4. Simian parvovirus
5. Simian virus 40

**Answer: e. Simian virus 40**

**References:**

1) Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 2 – Diseases. Academic Press: San Diego, CA. Chapter 1 – Viral Diseases of Nonhuman Primates, pp. 7-13, 15-16, 19-20, 31-32, 35-36.

2) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 17 – Nonhuman Primates, pp. 863-866, 869.

**Domain 1; Primary Species - Macaques (*Macaca spp.*)**

**177.** According to the AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, which of the following methods best describes euthanasia of rodents with ethanol (EtOH)?

1. IP administration of 70% EtOH is acceptable for mice and rats
2. IP administration of 70% EtOH is acceptable with conditions for mice and rats
3. IP administration of 100% EtOH n mice only while under anesthesia is conditionally acceptable
4. IP administration of 70% EtOH is acceptable with conditions for mice
5. IP administration of 70% EtOH in mice only while under anesthesia is conditionally acceptable

**Answer: d. IP administration of 70% ethanol is acceptable with conditions for mice**

**References:**

1. American Veterinary Medical Association. 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, pp. 49, 99

(https://www.avma.org/KB/Policies/Documents/euthanasia.pdf)

1. Allen-Worthington et al. 2015. Intraperitoneal injection of ethanol for the euthanasia of laboratory mice (*Mus musculus*) and rats (*Rattus norvegicus*). JAALAS 54(6):769-778.

**Domain 2**

**178.** What is the coloring of a mouse with genotype, *Aw/Aw Oca2p Tyrc/Oca2p Tyrc*?

1. Albino
2. White-bellied agouti
3. White-bellied, pink-eyed, light chinchilla
4. White with normal eyes

**Answer: a. Albino**

**References:**

1. Flurkey K, Currer JM, Leiter EH, Witham B, eds. 2009. The Jackson Laboratory Handbook on Genetically Standardized Mice, 6th ed. The Jackson Laboratory, Bar Harbor, ME. Section I: Introduction, 2: Some Basic Genetics of the Mouse, 2.G. Coat Color Genetics, p. 22.
2. Festing MW, Simpson EM, Davisson MT, Mobraaten LE. Mouse Strain 129 Substrain Nomenclature. Mouse Genome Informatics, The Jackson Laboratory: Bar Harbor, ME. Updated 2015. http://www.informatics.jax.org/mgihome/nomen/strain\_129.shtml.

**Domain 3; Primary Species – Mouse (*Mus musculus*)**

**179.** In the cage wash areas and animal rooms of research facilities, drains should be at least how many inches in diameter?

a. 2 inches

b. 4 inches

c. 6 inches

d. 8 inches

e. Floor drains are neither essential nor recommended

**Answer: b. 4 inches**

**References:**

# 1) Hessler JR, Lehner NDM, eds. 2009. Planning and Designing Research Animal Facilities. Academic Press, San Diego, CA. Chapter 6 – Regulatory Issues, pp. 54-55.

# 2) National Research Council. 2011. Guide for the Care and Use of Laboratory Animals, 8th ed. National Academies Press, Washington D.C. Chapter 5 – Physical Plant, p. 138.

# 3) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 36 – Design and Management of Research Facilities, p. 1558

# Domain 4

**180.** According to the Animal Welfare Act and its regulations, the Institutional Animal Care and Use Committee can have no more than how many members from the same administrative unit of the facility (Departmental level)?

a. 1

b. 2

c. 3

d. 4

e. There is no limit

**Answer: c. 3**

**References:**

1. Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 2 – Regulations, Subpart C – Research facilities, §2.31(b)(4) Institutional animal care and use committee (IACUC (11-06-13 Edition, p. 32)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

1. Applied Research Ethics National Association (ARENA) and Office of Laboratory Animal Welfare (OLAW). 2002. Institutional Animal Care and Use Committee Guidebook. 2nd Edition. OLAW, Bethesda, MD. Section A.2. Authority, Composition and Functions, p. 14.

**Domain 5**

**181.** Which of the following is a characteristic of juvenile polyarteritis syndrome in dogs?

1. Increased levels of cardiac troponin
2. Males more commonly affected than females
3. Marked subcutaneous edema
4. Mostly subclinical
5. Systemic necrotizing vasculitis

**Answer: e. Systemic necrotizing vasculitis**

**Reference:** Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 12 - Biology and Diseases of Dogs, pp. 547-548.

**Domain 1; Primary Species – Dog (*Canis familiaris*)**

1. Which of the following is a reason that pigs are an appropriate animal model for the human cardiovascular system?
2. The left azygous vein drains directly into the coronary sinus in both pigs and humans.
3. Both pigs and humans have extensive collateral circulation of the coronary vessels.
4. The aorta in both pigs and humans lacks a vaso vasorum.
5. Coronary blood flow is right-side dominant in both pigs and humans.
6. Conduction in both pig and human hearts is more neurogenic as opposed to myogenic.

**Answer: d. Coronary blood flow is right-side dominant in both pigs and humans**

**References**:

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 16 – Biology and Diseases of Swine, pp. 699-700.
2. Lelovas et al. 2014. A comparative anatomic and physiologic overview of the porcine heart. JAALAS 53(5):432–438

**Domain 3; Primary Species – Pig (*Sus scrofa*)**

**183.** Which of the following statements applies to both natural ingredient and purified diets?

1. Although nutrient ingredients are fixed bioavailability may be altered due to oxidation and nutrient interactions
2. Bioavailability of nutrients is limited in both diets due to the presence of tannins, lignins and phytates
3. Both are inexpensive to manufacture
4. Potential for contamination with pesticides is higher in natural ingredient diets compared to purified diets
5. Purified diets are prepared using elemental compounds

**Answer: d. Potential for contamination with pesticides is higher in natural ingredient diets compared to purified diets**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 12 – Biology and Diseases of Dogs, pp. 515-516.
2. National Research Council. 2011. Guide for the Care and Use of Laboratory Animals, 8th ed. National Academies Press, Washington D.C. Chapter 3 – Environment, Housing, and Management, pp. 65-67

**Domain 4**

1. According to the Animal Welfare Act and its regulations,what is the maximum number of guinea pigs that can be transported in the same primary enclosure?
2. 10
3. 15
4. 25
5. 30
6. 50

**Answer: b. 15**

**Reference:** Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 3 – Standards, Subpart B – Specifications for the Humane Handling, Care, Treatment, and Transportation of Guinea Pigs and Hamsters, §3.36 Primary enclosures (11-6-13 Edition, p. 82)

(http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

**Domain 5; Secondary Species – Guinea Pig (*Cavia porcellus*)**

1. Which of the following diagnostic tests would be most appropriate for a breeding rabbit buck presenting with erosions and ulcers of the prepuce?
2. Dark-field exam of scrapings from lesion
3. ELISA for LsaA-specific antibodies
4. Histologic exam of lesion biopsy using periodic acid Schiff stain
5. Swab lesions and culture on MacConkey agar
6. Wright-Giemsa stain of impression smear from lesion

**Answer: a. Dark-field exam of scrapings from lesion**

**References:**

* + 1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 10 – Biology and Diseases of Rabbits, pp. 428-429
		2. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 6 - Rabbit, pp. 282-283
		3. Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press: San Diego, CA. Section II - Rabbits, Chapter 13 - Bacterial Diseases, pp. 334-335.

**Domain 1; Primary Species – Rabbit (*Oryctolagus cuniculus*)**

1. Which statement best describes the effects of midazolam in swine?

a. Minimal cardiorespiratory depression with no analgesia

b. Good visceral analgesia with minimal sedation

c. Profound hemodynamic depression

d. Induces cardiac arrhythmias when used with ketamine

**Answer: a. Minimal cardiorespiratory depression with no analgesia**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 24 - Preanesthesia, Anesthesia, and Analgesia, pp. 1163-1165.

2) Swindle MM. 2007. Swine in the Laboratory: Surgery, Anesthesia, Imaging, and Experimental Techniques. CRC Press: Boca Raton, FL. Chapter 2 – Anesthesia, Analgesia, and Perioperative Care, pp. 53-54.

3) Fish RE, Brown MJ, Danneman PJ, Karas AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals, 2nd ed. Academic Press, San Diego, CA. Chapter 15 – Anesthesia and Analgesia in Swine, pp. 419-420

**Domain 2; Primary Species - Pig (*Sus scrofa*)**

1. Which of the following tumor types is experimentally induced in BALB/c mice using IP inoculation of pristane or mineral oil?

a. Histiocytic sarcoma

b. Mammary adenocarcinoma

c. Myeloid leukemia

d. Plasmacytoma

e. Hepatocellular carcinoma

**Answer: d. Plasmacytoma**

**References:**

1. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 1 – Mouse, p. 115.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 –Biology and Diseases of Mice, p. 136.

**Domain 3; Primary Species – Mouse (*Mus musculus*)**

**188.** Which animal biosafety level (ABSL) is applicable to clinical, diagnostic, teaching, research, or production facilities where work is performed with indigenous or exotic agents that may cause serious or potentially lethal disease through the inhalation route of exposure?

a. ABSL 1

b. ABSL 2

c. ABSL 3

d. ABSL 4

**Answer: c. ABSL 3**

**References:**

1. U. S. Department of Health and Human Services, Public Health Service, Center for Disease Control and Prevention, and National Institutes of Health. 2009. Biosafety in Microbiological and Biomedical Laboratories. 5th ed. U.S. Government Printing Office, Washington, D. C. Section V—Vertebrate Animal Biosafety Level Criteria for Vivarium Research Facilities, p. 75

(https://www.cdc.gov/biosafety/publications/bmbl5/)

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 27 – Working Safely with Experimental Animals Exposed to Biohazards, p. 1301.

**Domain 4**

**189.** Which of the following is a characteristic of *Salmonella* infection in mice?

1. 129S6/SvEv mice are more susceptible than other strains
2. Clinical signs of chronic disease are conjunctivitis and diarrhea
3. Hepatic lesions are typically nongranulomatous in nature
4. Initial replication in enterocytes is followed by multiplication in gut-associated lymphoid tissue and then spread to the systemic circulation
5. *Salmonella* organisms stimulate their own uptake by enterocytes, and continue to survive and replicate in neutrophils

**Answer: d. Initial replication in enterocytes is followed by multiplication in gut-associated lymphoid tissue and then spread to the systemic circulation**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 – Biology and Diseases of Mice, pp. 110-111.

2) Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 1 – Mouse, p. 62.

**Domain 1; Primary Species – Mouse (*Mus musculus*)**

**190.** Which of the following behaviors represents normal zebrafish behavior?

1. Bottom dwelling
2. Erratic swimming
3. Freezing
4. Loose shoaling

**Answer: d. Loose shoaling**

**References:**

1) Wafer et al. 2016. Effects of environmental enrichment on the fertility and fecundity of zebrafish (*Danio rerio*). JAALAS 55(3):291-294.

2) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 20 - The Biology and Management of the Zebrafish, p. 1023.

**Domain 1; Secondary Species – Zebrafish (*Danio rerio*)**

**191.** Which of the following is the first cardinal sign of malignant hyperthermia in swine?

1. Bradycardia
2. Elevated ETCO2
3. Hyperkalemia
4. Rhabdomyolysis

**Answer: b. Elevated ETCO2**

**References:**

1) Fish RE, Brown MJ, Danneman PJ, Karas AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals, 2nd ed. Academic Press, San Diego, CA. Chapter 15 – Anesthesia and Analgesia in Swine, pp. 425-426.

2) Swindle MM, AC Smith, eds. 2015. Swine in the Laboratory: Surgery, Anesthesia, Imaging, and Experimental Techniques, 3rd edition. CRC Press: Boca Raton, FL. Chapter 2 – Anesthesia, Analgesia and Perioperative Care, pp. 52-53.

**Domain 2; Primary Species – Pig (*Sus scrofa*)**

1. Ringtail, a condition of young rats characterized by the formation of prominent annular constrictions of the tail, can occur when room humidity reaches less than what percent?
	1. 20%
	2. 30%
	3. 40%
	4. 50%
	5. 60%

**Answer: c. 40%**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 4 – Biology and Diseases of Rats, p. 190
2. Suckow MA, Weisbroth SH, Franklin CL, eds. 2006. The Laboratory Rat, 2nd edition. Elsevier Academic Press: San Diego, CA. Chapter 10 – Housing and Environment, p. 308.

**Domain 4; Primary Species – Rat (*Rattus norvegicus*)**

**193.** Who is responsible for developing, reviewing, and overseeing medical and animal use records?

a. Attending veterinarian (AV)

b. IACUC

c. IACUC or AV, regulations are not specific

d. Investigative staff

**Answer: a. Attending veterinarian (AV)**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 17 – Nonhuman Primates, p. 829.

2) Institute for Laboratory Animal Resources. 2011. Guide for the Care and Use of Laboratory Animals. National Academy Press, Washington, D.C. Chapter4 – Veterinary Care, p. 115

3) Field et al. 2007. Medical records for animals used in research, teaching, and testing: public statement from the American College of Laboratory Animal Medicine. ILAR Journal 48(1):37-41.

**Domain 5**

**194.** What species of *Mycobacterium* can be found in birds?

1. *M. genavense*
2. *M. marinum*
3. *M. psittaci*
4. *M. tuberculosis*

**Answer: a. *M. genavense***

**References:**

1) Shientag et al. 2016. Amyloidosis in a captive zebra finch (*Taeniopygia guttata*) research colony. Comparative Medicine 66(3):225-234.

2) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 23 – Zebra Finches in Biomedical Research, p. 1124.

**Domain 1; Tertiary Species – Other Birds**

**195.** Which species is monogamous and has been used extensively in research investigating complex social behaviors such as pair-bonding and mate-guarding?

a. *Microtus ochrogaster*

b. *Microtus pennsylvanicus*

c. *Octodon degus*

d. *Oryzomys palustris*

e. *Sigmodon hispidus*

**Answer: a. *Microtus ochrogaster***

**References:** Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 7 – Biology and Diseases of Other Rodents, pp. 321-322.

**Domain 3; Tertiary Species - Other Rodents**

**196.** The small size, short lifespan, and early maturation of *Callithrix* *jacchus* make it a valuable model for the study of \_\_\_\_\_\_\_\_\_\_?

 a. Aging and chronic disease

 b. Behavior

 c. Gastrointestinal disease

 d. Vision

**Answer: a. Aging and chronic disease**

**References:**

1. Banton. 2016. Plasma metabolomics of common marmosets (*Callithrix jacchus*) to evaluate diet and feeding husbandry. JAALAS 55(2):137-146
2. Tardiff et al. 2015. The marmoset as a model of aging and age-related diseases. ILAR Journal 52(1):54-65

**Domain 3; Secondary Species – Marmoset/Tamarins (Callitrichidae)**

**197.** According to the Guide for the Care and Use of Laboratory Animals, who bears the responsibility for the overall animal research program?

1. Animal Care and Use Committee
2. Attending Veterinarian
3. CEO or University president
4. Institutional Official
5. Principle Investigator

**Answer: d. Institutional Official**

**Reference:**  Institute for Laboratory Animal Resources. 2011. Guide for the Care and Use of Laboratory Animals. National Academy Press, Washington, D.C. Chapter 2 – Animal Care and Use Program, p. 13

**Domain 5**

**198.** Extramedullary hematopoiesis is considered a normal finding in which of the following species?

a. *Canis familiaris*

b. *Cavia porcellus*

c. *Felis catus*

d. *Mus musculus*

**Answer: d. *Mus musculus***

**References:**

1) McInnes, EF. 2012. Background Lesions in Laboratory Animals – A Color Atlas. Saunders Elsevier: Edinburgh. Chapter 4 – Mouse, p. 54.

2) Johns and Christopher. 2012. Extramedullary hematopoiesis: a new look at the underlying stem cell niche, theories of development, and occurrence in animals. Vet Pathol 49(3):508-523.

3) Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 1 – Mouse, pp. 7-8, 10-12 and Chapter – Guinea Pig, p. 219

**Domain 1; Primary Species – Mouse (*Mus musculus*)**

**199.** It is critical that the 10%-10% rule (maximal sample volume allowed is 10% of the blood volume and the blood volume is estimated as 10% of the body weight or 100 ml/kg) be replaced with a new equation that includes which of the following factors in determining the animal’s total blood volume?

1. Age of animal
2. Animal blood type
3. Animal genotype
4. Body condition score
5. Sex of animal

**Answer: d. Body condition score**

**Reference:** Hobbs et al. 2015. Measurement of blood volume in adult rhesus macaques (*Macaca mulatta*). JAALAS54(6):687-693.

**Domain 3; Primary Species - Macaques *(Macaca spp.*)**

**200.** All of the following are reasons why soiled bedding sentinels may fail to detect an adventitious pathogen in a mouse facility **EXCEPT**?

1. Some parasites, host adapted or respiratory pathogens do not transmit well in soiled bedding
2. Intact immune system of the sentinel mouse destroys the infection and prevents disease detection
3. Isolation caging systems (individually ventilated caging) effectively limit spread between cages – the “dose” of pathogen delivered to the sentinel is too low to establish infection
4. Age and strain of the sentinel affect susceptibility to the pathogens in soiled bedding

**Answer: b. Intact immune system of the sentinel mouse destroys the infection and prevents disease detection**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 11 – Microbiological QC for Laboratory Rodents and Lagomorphs, pp. 493-494.
2. Henderson et al. 2013. Efficacy of direct detection of pathogens in naturally infected mice by using a high-density PCR array. JAALAS 52(6):763-772.

**Domain 4; Primary Species – Mouse (*Mus musculus*)**

**201.** Which of the following is exempt from coverage by the Animal Welfare Act and its regulations?

1. *Bos spp*. used as models for human subjects or non-agricultural animals
2. *Gallus domesticus* used in agricultural teaching, such as farm or ranch management procedures
3. *Mesocricetus auratus* used to manufacture or test biologics for possible use in either agricultural or nonagricultural species
4. *Ovis aries* used for biomedical teaching
5. *Sus scrofa domesticus* used to manufacture or test biologics for possible use in either agricultural or nonagricultural species

**Answer: b. *Gallus domesticus* used in agricultural teaching, such as farm or ranch management procedures**

**References:**

1. USDA Animal and Plant Health Inspection Service Animal Care Policy Manual. Policy # 17: Regulation of Agricultural Animals. March 25, 2011. https://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Policy%20Manual.pdf
2. https://www.aphis.usda.gov/publications/animal\_welfare/2012/animal\_welfare\_act\_english.pdf

**Domain 5; Tertiary Species - Chicken (*Gallus domesticus)***

**202.** All of the following apply to *Syphacia muris* in rats**EXCEPT**?

1. Eggs remain viable at rooms condition for weeks and months
2. Gaseous chlorine oxide was not effective ovicidal agent
3. Have a direct life-cycle
4. Neither cecal examination nor tape test alone reliable predicted infestation
5. Result of cecal and tape test did not necessarily coincide

**Answer: b. Gaseous chlorine oxide was not effective ovicidal agent**

**References:**

1. Meade and Watson. 2014. Characterization of rat pinworm (*Syphacia muris*) epidemiology as means to increase detection and elimination. JAALAS 53(6):661-667
2. Fox JG, Anderson LC, Otto C, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 4 - Biology and Diseases of Mice, pp. 182-183
3. Suckow MA, Weisbroth SH, Franklin CL, eds. 2006. The Laboratory Rat, 2nd edition. Elsevier Academic Press: San Diego, CA. Chapter 13 – Parasitic Diseases, pp. 467-469
4. Baker DG, ed. 2007. Flynn’s Parasites of Laboratory Animals, 2nd edition. Blackwell Publishing, Iowa, USA. Chapter 11 – Parasites of Rats and Mice, p. 339

**Domain 1; Primary Species – Rat (*Rattus Norvegicus*)**

**203.** Which of the following anesthetic agents is an effective neuroactive steroid agent for immobilizing macaques when given intramuscularly and has also been used to provide long-term anesthesia through continuous rate infusions in pigs, cats, and rodents?

1. Alphaxalone
2. Methohexital
3. Propofol
4. Thiopental
5. Tiletamine/zolazepam

**Answer: a. Alphaxalone**

**References:**

1. Flecknell P. 2016. Laboratory Animal Anaesthesia, 4th edition. Academic Press: Waltham, MA. Chapter 1 – Basic Principles of Anesthaesia, p. 64.
2. Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 1 - Biology and Management, Academic Press: San Diego, CA. Chapter 17 – Anesthesia and Analgesia in Nonhuman Primates, pp. 408, 411-414.

**Domain 2; Primary Species – Macaque (*Macaca* spp.) and Pig (*Sus scrofa*); Secondary Species - Cat (*Felis domesticus*)**

**204.** What is the recommended water temperature range for *Xenopus laevis*?

* 1. 12-16ºC (54-61ºF)
	2. 18-22ºC (64-72ºF)
	3. 24-28ºC (75-82ºF)
	4. 32-36ºC (90-97ºF)

**Answer: b. 18-22ºC (64-72ºF)**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 18 – Biology and disease of amphibians, p. 936.
2. Green, SL. 2010. The Laboratory Xenopus sp. CRC Press, Boca Raton, FL, p. 36.

**Domain 4; Secondary Species – African clawed frog (*Xenopus laevis* and *Xenopus tropicalis*)**

**205.** According to the Food and Drug Administration, the Study Director best fits which of the following definitions?

a. A person who submits a nonclinical study to the Food and Drug Administration in support of an application for a research or marketing permit

b. The individual responsible for the overall conduct of a nonclinical laboratory study

c. A person who initiates and supports a nonclinical laboratory

d. A person who performs the duties relating to quality assurance of nonclinical laboratory studies.

**Answer: b. The individual responsible for the overall conduct of a nonclinical laboratory study**

**References:**

1. 21CFR PART 58—Good Laboratory Practice for Nonclinical Laboratory Studies, Subpart A – General Provisions, § 58.3 Definitions

http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?fr=58.3

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 2 – Laws, Regulations, and Policies Affecting the Use of Laboratory Animals. pp. 31-32

**Domain 5**

**206.** Which of the following methods should be recommended for an investigator who needs to euthanize land snails in the field for tissue preservation?

a. One-step – immersion in 95% ethanol

b. One-step – immersion in 10% neutral buffered formalin

c. Two-step – immersion in 5% ethanol, followed by immersion in 95% ethanol

d. Two-step – immersion in 70% ethanol, followed by immersion in 10% neutral buffered formalin

e. One-step – immersion in 5% ethanol

**Answer: c. Two-step – immersion in 5% ethanol, followed by immersion in 95% ethanol**

**References:**

1) Gilbertson and Wyatt. 2016. Evaluation of euthanasia techniques for an invertebrate species, land snails (*Succinea putris*). JAALAS 55(5):577-581

2) Fish RE, Brown MJ, Danneman PJ, Karas AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals, 2nd ed. Academic Press, San Diego, CA. Chapter 22 – Anesthesia and Analgesia of Invertebrates, pp. 542-543.

**Domain 2; Tertiary Species – Invertebrates**

 **207.** Based on a recently published behavioral ethogram, what criteria was found to be most indicative of pain in guinea pigs following castration?

1. Chewing behavior
2. Open field assessment
3. Subtle body movements
4. Time to consumption of a food treat
5. Wound licking

**Answer: c. Subtle body movements**

**Reference:** Dunbar et al. 2016. Validation of a behavioral ethogram for assessing post-operative pain in guinea pigs. JAALAS 55(1):29-34

**Domain 2; Secondary Species – Guinea Pig (*Cavia porcellus*)**

**208.** C56BL/6J-Chr 1A/J Chr 3DBA/2J represents what type of strain?

a. Congenic

b. Coisogenic

c. Consomic

d. Conplastic

**Answer: c. Consomic**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 3 – Biology and Diseases of Mice, p. 37.
2. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 1 – History, Wild Mice, and Genetics. Academic Press: San Diego, CA. Chapter 4 – Breeding Systems: Considerations, Genetic Fundamentals, Genetic Background and Strain Types pp. 66-71; Chapter 5 – Mouse Strain and Genetic Nomenclature: An Abbreviated Guide, pp. 5 – Mouse Strain and Genetic Nomenclature: An Abbreviated Guide, pp. 81, 87-88.
3. International Committee on Standardized Genetic Nomenclature for Mice and Rat Genome and Nomenclature Committee. Guidelines for Nomenclature of Mouse and Rat Strains. January 2016.

http://www.informatics.jax.org/mgihome/nomen/strains.shtml#consomic\_strains

**Domain 3; Primary Species – Mouse (*Mus musculus*)**

**209.** Which of the following answers correctly lists the order of sensitivity of pathogens from least to highest to disinfectants?

1. Parasites, spores, hydrophilic nonenveloped viruses, partially lipophilic nonenveloped viruses, lipophilic or enveloped viruses
2. Spores, parasites, hydrophilic nonenveloped viruses, partially lipophilic nonenveloped viruses, lipophilic or enveloped viruses

c. Spores, parasites, lipophilic or enveloped viruses, partially lipophilic nonenveloped viruses, hydrophilic nonenveloped viruses

d. Spores, parasites, partially lipophilic nonenveloped viruses, lipophilic or enveloped viruses, hydrophilic nonenveloped viruses

**Answer: b. Spores, parasites, hydrophilic nonenveloped viruses, partially lipophilic nonenveloped viruses, lipophilic or enveloped viruses**

**Reference:** Campagna et al. 2016. Factors in the selection of surface disinfectants for use in a laboratory animal setting. JAALAS 55(2):175-181

**Domain 4**

**210.** According to the Animal Welfare Act and its regulations, all survival surgery conducted in non-rodent species within a research facility will be performed using aseptic procedures and include which of the following additional requirements?

a. Surgical gloves, mask, and aseptic technique

b. Surgical gloves, dedicated room, and mask

c. Dedicated room, surgical gloves, mask, sterilized instruments, and aseptic technique

d. Surgical gloves, mask, and sterilized instruments

**Answer: c. Dedicated room, surgical gloves, mask, sterilized instruments, and aseptic technique**

**References:**

1. Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 2 – Regulations, Subpart C – Research facilities, §2.31 – Institutional Animal Care and Use Committee (IACUC) (d) IACUC review of activities involving animals (1)(ix) (11-06-13 Edition, p. 34)

(<http://www.aphis.usda.gov/animal_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf> )

1. USDA Animal and Plant Health Inspection Service Animal Care Policy Manual. Policy #14: Major Survival Surgery; Dealers Selling Surgically Altered Animals to Research. March 25, 2011. (https://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Policy%20Manual.pdf)

**Domain 5**

**211.** What animal is the natural reservoir for lymphocytic choriomenigitis virus?

a. Dormouse

b. Mouse

c. Rabbit

d. Rat

e. Syrian hamster

**Answer: b. Mouse**

**References:**

1) Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 1 – Mice, p. 28

2) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 – Biology and Diseases of Mice, p. 84 and Chapter 28 – Selected Zoonoses, p. 1322

**Domain 1; Primary Species - Mouse (*Mus musculus*)**

**212.** According to the Animal Welfare Act and its regulations, what five considerations must be a part of an environment enhancement plan for a nonhuman primate?

1. Restraint devices, exemptions, social grouping, special considerations, and environmental enrichment
2. Behavior management, social grouping, food enrichment, psychological well-being, and health management
3. Behavior management, restraint devices, exemptions, social grouping, and special considerations
4. Exemptions, behavior management, social grouping, environmental enrichment, and special considerations

**Answer: a. Restraint devices, exemptions, social grouping, special considerations, and environmental enrichment**

**Reference:** Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 2 – Regulations, Subpart D – Specifications for the Humane Handling, Care, Treatment, and Transportation of Nonhuman Primates, §3.81 (a-e) Environment enhancement to promote psychological well-being (11-6-13 Edition, pp. 100-101)

 (http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

**Domain 5**

**213.** The ACLAM position on animal experimental reproducibility states that journal article reporting standards shall conform to which of the following standards?

1. ARRIVE
2. 3Rs
3. CIOMS
4. Guide for Reporting of Animal Subject Use in Experimental Studies

**Answer: a.** **ARRIVE (Animals in Research: Reporting In Vivo Experiments)**

**References:**

1. ACLAM. 2016. ACLAM Position Statement on Reproducibility. JAALAS 55(6):824-825
2. http://www.nc3rs.org.uk/arrive-guidelines

**Domain 6**

**214.** MMTV enters the gut epithelium via what type of cell?

1. Enterocytes
2. Goblet cells
3. M cells
4. Paneth cells

**Answer: c. M cells**

**References:**

1. Dudley et al. 2016. Lessons learned from mouse mammary tumor virus in animal models. ILAR Journal 57(1):12-23
2. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 2 – Diseases. Academic Press: San Diego, CA. Chapter 10 – Retroelements in the Mouse, p. 275.

**Domain 1; Primary Species – Mouse (*Mus musculus*)**

**215.**  Which of the following is the only acceptable method without conditions for euthanasia in laboratory rabbits?

1. Barbiturates
2. Carbon dioxide
3. Inhaled anesthetics
4. Penetrating captive bolt
5. Potassium chloride

**Answer: a. Barbiturates**

**References:**

1. American Veterinary Medical Association. 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, pp. 50, 99

(https://www.avma.org/KB/Policies/Documents/euthanasia.pdf)

1. National Research Council. 2011. Guide for the Care and Use of Laboratory Animals, 8th ed. National Academies Press, Washington D.C. Chapter 4 – Veterinary Care, pp. 123-124.

**Domain 5; Primary Species – Rabbit (*Oryctolagus cuniculus*)**

**216.** Testing rack exhaust debris from ventilated racks with unfiltered air flow has failed to reliably detect which rodent agent using PCR analysis?

1. Fur mites
2. *Helicobacter spp.*
3. Mouse hepatitis virus
4. Mouse norovirus
5. *Pasteurella pneumotropica*

**Answer: d. Mouse norovirus**

**Reference:** Bauer et al. 2016. Influence of rack design and disease prevalence on detection of rodent pathogens in exhaust debris samples from individually ventilated caging system. JAALAS 55(6):782-788

**Domain 4; Primary Species – Mouse (*Mus musculus*)**

**217.** A gene mutation in Battleboro rats results in a \_\_\_\_\_\_ form of \_\_\_\_\_\_\_\_?

a. Recessive; diabetes insipidus

b. Dominant; diabetes insipidus

c. Dominant; diabetes mellitus

d. Recessive; diabetes mellitus

**Answer: a. Recessive; diabetes insipidus**

**Reference:** Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 4 – Biology and Diseases of Rats, p. 152 and 34 – Animal Models in Biomedical Research, p. 1498.

**Domain 1; Primary Species – Rat (*Rattus norvegicus*)**

**218.** You notice a rabbit in your facility seems to be over grooming and there are chunks of her hair lining an area in the back of her cage. What is your first thought?

a. You worry about the presence of a trichobezoar and palpate her abdomen

b. You order blood work in order to test for complement 6 deficiency

c. She is most likely pruritic and you perform a skin scrape to look for *Cheyletiella*

d. She may be close to kindling and using her hair to build a nest

**Answer: d. She may be close to kindling and using her hair to build a nest**

**References:**

1. Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press: San Diego, CA. Section II - Rabbits, Chapter 9 – Rabbit Colony Management and Related Health Concerns, p. 231.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 10 – Biology and Diseases of Rabbits, pp. 420, 441, 444, 447.

**Domain 1; Primary Species – Rabbits (*Oryctolagus cuniculus*)**

**219.** What type of disinfectant is formaldehyde?

a. Denaturant

b. Oxidant

c. Reactant

d. Reductant

**Answer: c. Reactant**

**Reference:**  Campagna et al. 2016. Factors in the selection of surface disinfectants for use in a laboratory animal setting. JAALAS. 55(2):175-188

**Domain 4**

**220.** According to Good Laboratory Practice for Conducting Nonclinical Laboratory Studies, which of the following best describes how long records must be retained for a nonclinical laboratory study?

1. A period of at least 1 year following the date on which an application for a research or marketing permit, in support of which the results of the nonclinical laboratory study were submitted, is approved by the FDA
2. A period of at least 1 year following the date on which the results of the nonclinical laboratory study are submitted to the FDA in support of an application for a research or marketing permit
3. Where the nonclinical laboratory study does not result in the submission of the study in support of an application for a research or marketing permit, a period of at least 2 years following the date on which the study is completed, terminated, or discontinued
4. No record retention requirements are stipulated

**Answer: c. Where the nonclinical laboratory study does not result in the submission of the study in support of an application for a research or marketing permit, a period of at least 2 years following the date on which the study is completed, terminated, or discontinued**

**References:**

1. 21CFR PART 58—Good Laboratory Practice for Nonclinical Laboratory Studies, Subpart A – General Provisions, § 58.195 Retention of Records

 http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?fr=58.195

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 2 – Laws, Regulations, and Policies Affecting the Use of Laboratory Animals, pp. 31-32

**Domain 5**

1. Which of the following species lacks a distinct cecum?
2. *Mus musculus*
3. *Mustela putorius furo*
4. *Orytolagus cuniculus*
5. *Rattus norvegicus*
6. *Sus scrofa domestica*

**Answer: b. *Mustela putorius furo***

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 – Biology and Diseases of Mice, p. 60; Chapter 4 – Biology and Diseases of Rats, p. 154; Chapter 10 – Biology and Diseases of Rabbits, p. 415; Chapter 14 - Biology and Diseases of Ferrets, p. 580; and Chapter 16 – Biology and Diseases of Swine, p. 700.
2. Fox JG and Marini RP, eds. 2014. Biology and Diseases of the Ferret, 3rd edition. Wiley Blackwell: Ames, IA. Chapter 2 - Anatomy of the Ferret, p.47.

**Domain 1; Secondary Species – Ferret (*Mustela putorius furo*)**

**222.** All of the following statements apply to euthanasia of rodent fetuses **EXCEPT**?

* 1. When fetuses are not required for study, euthanasia of a pregnant dam should ensure rapid cerebral anoxia to the fetus with minimal disturbance to the uterine milieu minimizing fetal arousal
	2. When the dam is euthanized, the uterus with the pups or the pups with the amniotic sac intact can be removed from the dam; however, it may take up to 30 min before the fetuses are dead
	3. Hypothermia is an acceptable method of euthanasia for fetuses and altricial neonates up to 7 days of age as long as direct contact with ice/cold surfaces is avoided
	4. Altricial neonates <5 days of age may be quickly killed by rapidly freezing in liquid nitrogen but for neonates >5 days of age, immersion in liquid nitrogen may be used only if preceded by anesthesia
	5. Rodent fetuses are unconscious in utero and hypoxia does not evoke a response. Therefore, it is unnecessary to remove fetuses for euthanasia after the dam is euthanized

**Answer: b. When the dam is euthanized, the uterus with the pups or the pups with the amniotic sac intact can be removed from the dam; however, it may take up to 30 min before the fetuses are dead**

**References:**

1. Guidelines for Euthanasia of Rodent Fetuses and Neonates. 2016. Office of Animal Care and Use, NIH.

(https://oacu.oir.nih.gov/sites/default/files/uploads/arac-guidelines/rodent\_euthanasia\_pup.pdf)

1. American Veterinary Medical Association. 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, p. 50

(https://www.avma.org/KB/Policies/Documents/euthanasia.pdf)

**Domain 2**

**223.** Your institution is receiving cats from another research institution for use in a protocol. Who at the receiving institution should review health documentation from the shipping institution prior to transporting the cats?

1. The IACUC
2. The Institutional Official

c. A responsible and well-trained person

d. The veterinarian or veterinarian’s designee

**Answer: d. The veterinarian or veterinarian’s designee**

**References:** Institute for Laboratory Animal Resources. 2011. Guide for the Care and Use of Laboratory Animals. National Academy Press, Washington, D.C. Chapter 4 – Veterinary Care, p. 108.

**Domain 4; Secondary Species - Cat (*Felis domestica)***

**224.** All of the following applies to rabbit reproduction **EXCEPT**?

a. Impending kindling is often signaled by nest building and decreased food consumption

b. Both anterior and breech presentations are normal in the rabbit

c. The doe typically consumes the placenta

d. Vaginal cytology is the most accurate way of identifying estrus or receptivity

**Answer: d. Vaginal cytology is the most accurate way of identifying estrus or receptivity**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 10 – Biology and Diseases of Rabbits, pp. 419-420.

2) Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press: San Diego, CA. Section II – Rabbits, Chapter 9 – Rabbit Colony Management and Related Health Concerns, pp. 229-230

**Domain 4; Primary Species – Rabbit (*Oryctolagus cuniculus*)**

1. All of the following treatments have been used to manage adrenal cortical hyperplasia, with or without neoplasia, in aging ferrets **EXCEPT**?
2. Deslorelin acetate
3. Leuprolide acetate
4. Melatonin
5. Mitotane

**Answer: d. Mitotane**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 14 – Biology and Diseases of Ferrets, p. 608-610.
2. Quesenberry KE, Carpenter JW, Eds. 2012. Ferrets, Rabbits, and rodents: Clinical Medicine and Surgery. Elsevier: St. Louis, MO. Chapter 8, p. 15

**Domain 1; Secondary Species – Ferret (*Mustela putorius furo*)**

1. Which methods can be used to evaluate what parameters important for managing genetic diversity of an outbred macaque breeding colony?
2. Pedigree can be used to evaluate genome uniqueness and mean kinship. Microsatellite STRs can be used to evaluate observed heterozygosity and inbreeding coefficients
3. Pedigree can be used to evaluate genome uniqueness and inbreeding coefficients. Microsatellite STRs can be used to evaluate observed heterozygosity and mean kinship
4. Pedigree can be used to evaluate inbreeding coefficients and mean kinship. Microsatellite STRs can be used to evaluate observed heterozygosity and genome uniqueness
5. Pedigree can be used to evaluate observed heterozygosity and mean kinship. Microsatellite STRs can be used to evaluate genome uniqueness and inbreeding coefficients

**Answer: a. Pedigree can be used to evaluate genome uniqueness and mean kinship. Microsatellite STRs can be used to evaluate observed heterozygosity and inbreeding coefficients**

**References:**

1) Vinson and Raboin. 2015. A practical approach for designing breeding groups to maximize genetic diversity I a large colony of captive rhesus macaques (*Macaca mulatta*). JAALAS 54(6):700-707

2) Kanthaswamy et al. 2016. Mitigating Chinese–Indian rhesus macaque (*Macaca mulatta*) hybridity at the California National Primate Research Center (CNPRC). J Med Primatol 45:333-335

**Domain 4; Primary Species - Macaques (*Macaca spp.*)**

**227.** What document, drafted by a federal funding agency, provides guidance for the analysis of operational expenses of an animal research facility?

1. CARS Manual
2. CMAR Handbook
3. COST Manual of Laboratory Animal Care and Use
4. UFAW Handbook
5. VHA Handbook

**Answer: a. CARS Manual**

**References:**

1. National Center for Research Resources (NCRR). 2000. Cost Analysis and Rate Setting Manual for Animal Research Facilities. NCRR Office of Science Policy and Public Liaison: Bethesda, MD. Chapter 1 – Introduction, p. 7

(http://grants.nih.gov/grants/policy/air/rate\_setting\_manual\_2000.pdf)

**Domain 4**

**228.** All of the following have been documented as a method of transmission for *Psuedoloma neurophilia* in zebrafish (*Danio rerio*)**EXCEPT**?

1. Aerosolization of spores
2. Cannibalism of infected fish
3. Extraovum maternal transmission
4. Intra-ovum vertical transmission
5. Ingestion of mature infective spores in the environment

**Answer: a. Aerosolization of spores**

**References:**

1. Harper C, Lawrence C. 2011. The Laboratory Zebrafish. CRC Press: Boca Raton, FL. Chapter 5 - Veterinary Care, pp. 159-160.
2. Fox JG, Anderson LC, Otto GM, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 20 – The Biology and Management of the Zebrafish, p. 1045.
3. Sanders et al. 2012. Microsporidiosis in zebrafish research facilities. ILAR J 53(2):106-113.

**Domain 1; Secondary Species – Zebrafish (*Danio rerio*)**

**229.** Altered schaedler flora is an example of which of the following?

1. A pathobiont
2. Axenic mouse
3. Defined flora
4. Monoassociated flora
5. Specific pathogen free designation

**Answer: c. Defined flora**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 26 - Gnotobiotics, pp. 1287-1288.
2. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2007. The Mouse in Biomedical Research, 2nd edition, Volume 3 – Normative Biology, Husbandry, and Models. Academic Press: San Diego, CA. Chapter 7 – Gnotobiotics, pp. 228-229.
3. Suckow MA, Weisbroth SH, Franklin CL, eds. 2006. The Laboratory Rat, 2nd edition. Elsevier Academic Press: San Diego, CA. Chapter 22 – Gnotobiotics, p. 699
4. Wymore Brand et al. 2015. The altered schaedler flora: continued applications of a defined murine microbial community. ILAR Journal 56(2):169-178.

**Domain 3**

**230.** Which of the following correctly pairs the lesions associated with Saimiriine herpesvirus 1 (SaHV1) with the affected species?

a. *Aotus spp.*: asymptomatic carriers, no lesions

b. *Ateles spp.*: multifocal necrosis of the liver, spleen, lung, kidney, and adrenal gland

c. *Saimiri spp.*: acute hepatocellular necrosis with large numbers of Cowdry type A intranuclear inclusions

d. *Tamarin spp.*: full thickness epidermal necrosis, multinucleated giant cells with intranuclear inclusions

**Answer: d. *Tamarin spp.*: full thickness epidermal necrosis, multinucleated giant cells with intranuclear inclusions**

**References:**

1) Abee CR, Mansfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition, Volume 2 – Diseases. Academic Press: San Diego, CA. Chapter 1– Viral Diseases of Nonhuman Primates, pp. 14-15.

2) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 17 – Nonhuman Primates, pp. 864, 867 (Tables 17.48, 17.49).

**Domain 1; Secondary Species – Squirrel Monkey (*Saimiri sciureus*)**

END OF THE EXAM