2015 International Mock Board Exam Coalition

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| Pacific Northwest | University of Washington  Seattle, WA | 3/7/15 |
| West Coast (Southern CA) | City of Hope/Beckman Research Institute  Duarte, CA | 3/28/15 |
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| Asia | Singapore | 6/6/15 |
| Europe | Trinity College Dublin  Dublin, Ireland (mock ECLAM exam) | 10/30/15 |

Written Section – 230 Questions

**Referenced Answers – 76 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.** Which of the following blood parameters were the best indicators of diabetes in sooty mangabeys?

a. Fructosamine and triglyceride levels

b. Glycalated hemoglobin and fructosamine

c. Triglyceride levels, glycalated hemoglobin and total cholesterol

d. Total, cholesterol, glycalated hemoglobin, fructosamine and triglyceride levels

e. Total cholesterol and triglyceride levels

**Answer: a. Fructosamine and triglyceride levels**

**Reference:** Jones et al. 2014. Clinicopathologic characteristics, prevalence, and risk factors of spontaneous diabetes in sooty mangabeys (*Cercocebus atys*). Comparative Medicine 64(3):200-210

**Domain 1; Tertiary Species – Other Nonhuman Primates**

**2.** Which of the following is a highly selective and specific α2-adrenoreceptor antagonist?

1. Atipamazole
2. Dexmedetomidine
3. Guanfacine
4. Flumazenil
5. Medetomidine

**Answer: a. Atipamazole**

**References:**

1. Wellington et al. 2013. Comparison of ketamine–xylazine and ketamine–dexmedetomidine anesthesia and intraperitoneal tolerance in rats. JAALAS 52(4):481-487
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 2 – Pharmacology of Injectable Anesthetics, Sedatives, and Tranquilizers, pp. 50-54.

**Domain 2**

**3.** Which of these induced models can be used for Reye’s syndrome research?

1. C.B-17 SCID mice infected with MAd-1
2. A/J Cr mice infected with helicobacter
3. SCID mice infected with MHV
4. C57BL/10 mice infected with helicobacter

**Answer: a. C.B-17 SCID mice infected with MAd-1**

**References:**

1. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 1 – Mouse, p. 96
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 2 – Mouse Adenoviruses, p. 59

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

**4.** Which of the following disinfection methods for nets used to collect zebrafish resulted in a 90% reduction in the bacterial growth based on ATP detection?

1. Rinsing and air drying for 30 minutes
2. Soaking in sodium hypochlorite for 30 minutes
3. Soaking in sodium hypochlorite for 5 minutes
4. Soaking in chlorine dioxide for 5 minutes
5. Soaking with chlorine dioxide for 30 minutes

**Answer: b. Soaking in sodium hypochlorite for 30 minutes**

**References:**

1. Collymore et al. 2014. Evaluation of 4 cleaning and disinfection methods for nets used to collect zebrafish. JAALAS 53(6): 657-660.
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine. 2nd edition. Academic Press: San Diego, CA. Chapter 19 – Biology and Management of the Zebrafish, p. 877.

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

**5.** According to the Animal Welfare Act and its regulations, how often must dogs less than 16 weeks of age be offered potable water?

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)**

**6.** The Council for Certified Professional IACUC Administrators is an affiliate of which of the following agencies?

1. AWIC
2. NCATS
3. PRIMR
4. USDA

**Answer: c. PRIMR**

**References:**

1. http://www.primr.org/Subpage.aspx?id=1588
2. http://www.primr.org/subpage.aspx?id=1572

**Domain 6**

**7.** Which of the following is a feature of wasting marmoset syndrome?

* 1. Primary vitamin C deficiency and protein deficiency secondary to glomerulonephropathy have been postulated as potential etiologies for this disease
  2. Microflora in infected animals has revealed an increase in lactobacilli and a decrease in bacteroides
  3. Disease is associated with chronic diarrhea, colitis, and hemolytic anemia
  4. Histology of the skeletal muscle reveals extensive atrophy of type I fibers

**Answer: c.** **Disease is associated with chronic diarrhea, colitis, and hemolytic anemia**

**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 13 – Arthritis, Muscle, Adipose Tissue, and Bone Diseases of Nonhuman Primates, p. 654.
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 16 – Nonhuman Primates, p. 775.
3. Wolfe-Coote S, ed. 2005. The Laboratory Primate. Academic Press, San Diego, CA. Chapter 10 – Husbandry and Management of New World Species: Marmosets and Tamarins, pp. 159-160

**Domain 1; Secondary Species – Marmoset/Tamarins (Callitrichidae)**

**8.** Which of the following animals is commonly used to study circadian rhythm?

a. *Capra hircus*

b. *Cavia porcellus*

c. *Chinchilla chinchilla*

d.  *Octodon degus*

e.  *Peromyscus leucopus*

**Answer:  d. *Octodon degus***

**References**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 7 – Biology and Disease of Other Rodents, p. 284
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 44 - Degu, p. 1032.

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

**9.** All of the following apply to swine SPF colonies **EXCEPT**?

1. Animals to be admitted into SPF colonies don’t need to be pathogen-screened if they come from a reputable vendor
2. Breeding swine are tested for agents like pseudorabies and *Brucella* spp
3. They are typically cesarean or hysterectomy derived
4. Vendors of SPF swine have their facilities inspected by organizations such as the National SPF Agency to ensure they maintain their SPF status

**Answer: a. Animals to be admitted into SPF colonies don’t need to be pathogen-screened if they come from a reputable vendor**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine. 2nd edition. Academic Press: San Diego, CA. Chapter 15 – Biology and Diseases of Swine, pp. 615-616.
2. http://www.nationalspf.org

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

**10.** According to the most recent version of the Guide for the Care and Use of Laboratory Animals, all of the following meet the criteria for public member(s) of an IACUC **EXCEPT**?

1. Must not receive any form of compensation to avoid compromising the member’s association with the community and public at large
2. Should not be laboratory animal users
3. Should not be affiliated in any way with the institution
4. Should not be affiliated with the immediate family of a person who is affiliated with the institution

**Answer: a. Must not receive any form of compensation to avoid compromising the member’s association with the community and public at large**

**Reference:** Institute for Laboratory Animal Resources. 2011. Guide for the Care and Use of Laboratory Animals. National Academy Press, Washington, D.C. Chapter2 – Animal Care and Use Program, pp. 24-25.

**Domain 5**

**11.** All of the following statements apply to nasal dermatitis in *Meriones unguiculatus* **EXCEPT**?

* 1. Condition is most common in young weanlings
  2. Successful treatments include sand baths and Harderian gland removal
  3. Low humidity is a contributing factor in pathogenesis
  4. Staphylococcus spp. are the most commonly cultured bacterial pathogen in this condition

**Answer:** **c. Low humidity is a contributing factor in pathogenesis**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 7 – Biology and Diseases of Other Rodents, p. 277.
2. Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Elsevier: San Diego, CA. Section VI - Other Rodents, Chapter 52 – Gerbils, p. 1145.
3. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 4 – Gerbil, pp. 210-211

**Domain 1; Secondary Species – Gerbil (Meriones spp.)**

1. Which of the following analgesics **DOES NOT** appear to alter infarction volume in the C57BL/6 mouse model of middle cerebral artery occlusion?
2. Buprenorphine
3. Butorphenol
4. Carprofen
5. Meloxicam

**Answer: a. Buprenorphine**

**Reference:** Jacobsen et al. 2013. Effects of buprenorphine and meloxicam analgesia on induced cerebral ischemia in C57BL/6 male mice. Comparative Medicine 63(2):105-113.

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

**13.** The altered Shaedler flora consists of all of the following bacteria **EXCEPT**?

1. *Clostridium spp.*
2. *Enterococcus sp.*
3. *Eubacterium plexicaudatum*
4. *Lactobacillus spp.*
5. *Mucispirllium shaedleri*

**Answer: b. *Enterococcus sp.***

**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. 229.
2. Suckow MA, Weisbroth SH, Franklin CL, eds. 2006. The Laboratory Rat, 2nd edition. Elsevier Academic Press: San Diego, CA. Chapter 22 – Gnotobiotics, p. 699

**Domain 3**

**14.** Which of the following types of valves, when placed within an automatic watering system for rodents, provides a means of computer controlled, higher-pressure water flushing to reduce microbial biofilm production?

1. Flutter
2. Lixit
3. Schrader
4. Solenoid
5. Venturi

**Answer: d. Solenoid**

**References:**

1) Hessler JR, Lehner NDM, eds. 2009. Planning and Designing Research Animal Facilities. Academic Press, San Diego, CA. Chapter 32 – Plumbing: Special Considerations, pp. 434, 438, 444-445.

2) Molk et al. 2013. Sanitization of an automatic reverse-osmosis watering system: removal of a clinically significant biofilm. JAALAS 52(2):197-205.

3) Hau J and Schapiro SJ, eds. 2010. Handbook of Laboratory Animal Science, Volume I, 3rd Edition. CRC Press: Boca Raton, FL. Chapter 8 – Laboratory Animal Facilities and Equipment, p. 192.

**Domain 4**

**15.** Facilities must use biosafety containment level-3-Agriculture (BSL-3-Ag) under which of the following situations?

* 1. Studying highly pathogenic avian influenza virus in chickens that are housed in a primary containment device with the room serving as a secondary barrier.
  2. Studying *Lymphocytic Choriomeningitis Virus* in hamsters housed in individually ventilated cages.
  3. Studying *Rickettsia spp.* in horses regardless of housing conditions.
  4. Studying African swine fever in pigs where they are loose in the room and the room housing the pigs provides the primary containment.

**Answer: d. Studying African swine fever in pigs where they are loose in the room and the room housing the pigs provides the primary containment.**

**References:**

1. U. S. Department of Health and Human Services, Public Health Service, Centers 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. Appendix D – Agriculture Pathogen Biosafety, pp. 343-344, 352-353

(http://www.cdc.gov/biosafety/publications/bmbl5/BMBL5\_appendixD.pdf)

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 3 - Husbandry, Housing, and Biosecurity, pp. 26-27

(http://www.fass.org/docs/agguide3rd/Ag\_Guide\_3rd\_ed.pdf)

**Domain 5; Primary Species - Swine (Sus scrofa)**

**16.** Infection with which of the following viruses is asymptomatic in Patas monkeys but can cause fulminant and fatal infection in macaques?

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

**Answer: b. 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. 6-13, 33, 47-49
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 16 – Nonhuman Primates, pp. 748-750, 752

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

**17.** If you are working in an ABSL-3 facility with chickens infected with virulent Newcastle Disease, which of the following is the most likely manifestation of a zoonotic exposure to this virus?

1. Conjunctivitis
2. Cutaneous petechial hemorrhages
3. Diarrhea
4. Encephalitis
5. Mucosal hemorrhages

**Answer:** **a. Conjunctivitis**

**References:**

1. U. S. Department of Health and Human Services, Public Health Service, Centers 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. Appendix D – Agriculture Pathogen Biosafety, p. 367 **(**http://www.cdc.gov/biosafety/publications/bmbl5/BMBL5\_appendixD.pdf)

2) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 25 – Selected Zoonoses, p. 1074

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

**18.** What is the ideal floor slope to a drain within an animal room?

1. 1/2 - 3/4 inch/foot
2. 1/2 - 3/4 inch/yard
3. 1/8 - 1/4 inch/yard
4. 1/8 - 1/4 inch/foot
5. 1/4 - 1/2 inch/yard

**Answer: d. 1/8 – 1/4 inch/foot**

**References:**

1) Hessler JR, Lehner NDM, eds. 2009. Planning and Designing Research Animal Facilities. Academic Press, San Diego, CA. Chapter 32 – Plumbing: Special Considerations, pp. 430-431.

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 21 – Animal Facilities, pp. 919, 927.
2. Institute of Laboratory Animal Resources. 2011. Guide for the Care and Use of Laboratory Animals. National Academy Press: Washington, D.C. Chapter 5 – Physical Plant, p. 138.

**Domain 4**

**19.** Which of the following changes in animal use can be approved administratively without an IACUC designated member or full committee review?

a. A request to perform craniotomies in *Rattus norvegicus* as already approved in *Mus musculus*

b. A request to change the Principal Investigator on an approved protocol

c. A request for an exemption from the use of protective eyewear when performing a previously approved microsurgical procedure on *Macaca fascicularis*

d. A request to change surgical personnel performing a previously approved thoracotomy in *Sus scrofa*

e. A request for laboratory housing of *Danio rerio* for 48 hours

**Answer: d. A request to change surgical personnel performing a previously approved thoracotomy in *Sus scrofa***

**References:**

1. Guidance on Significant Changes to Animal Activities http://grants.nih.gov/grants/guide/notice-files/NOT-OD-14-126.html
2. Silverman J, Suckow MA, Murthy S, eds. 2014. The IACUC Handbook, 3rd edition. CRC Press: Boca Raton, FL. Chapter 9 - General Concepts of Protocol Review, pp. 155-156.

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

**20.** What derangement may be evident on the CBC of a rabbit with a nephroblastoma?

1. Anemia
2. Eosinophilia
3. Heterophilia
4. Lymphopenia
5. Polycythemia

**Answer: e. Polycythemia**

**References:** 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 16 – Rabbit Neoplasia, pp. 466-467.

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

**21.** Mu receptors are primarily located in the \_\_\_\_\_\_\_\_\_\_\_\_ and kappa receptors are primarily located in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

1. Cerebellum, neuronal-axon interface
2. Cerebral cortex, spinal cord
3. Efferent dorsal horn, cerebral cortex
4. Somatosensory cortex, spinal cord
5. Spinal cord, cerebellum

**Answer: b. Cerebral cortex, spinal cord**

**References:**

1. Kendal et al. 2014. Pharmacokinetics of sustained-release analgesics in mice. JAALAS 53(5):478-484.
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 4 – Pharmacology of Analgesics, pp. 110-113

**Domain 2**

**22.** Which of the following describes the chance of obtaining a false-positive result due to sampling error which results in the rejection of the tested hypothesis?

1. Power
2. Significance level
3. Standard Deviation
4. Type II error

**Answer: b. Significance level**

**Reference:** Festing and Altman. 2002. Guidelines for the design and statistical analysis of experiments using laboratory animals. ILAR J 43(4):244-258

**Domain 3**

**23.** Sodium thiosulfate can be used to neutralize which of the following compounds to help maintain proper water quality for aquatic species?

1. Ammonia
2. Chlorine
3. Nitrate
4. Nitrite
5. Organophosphates

**Answer: b. Chlorine**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 17 – Biology and Diseases of Amphibians, p. 797 and Chapter 20 – Biology and Health of Laboratory Fishes, p. 890.
2. Green SL. 2010. The Laboratory Xenopus sp. CRC Press: Boca Raton, FL. Chapter 2 – Husbandry, p. 43.
3. Harper C and Lawrence C. 2011. The Laboratory Zebrafish. CRC Press: Boca Raton, FL. Chapter 5 – Veterinary Care, p. 165.

**Domain 4**

**24.** According to the Guide for the Care and Use of Laboratory Animals and the Animal Welfare Act and its Recommendations, rhesus macaques weighing less than 10 kg are classified under which of the following groups?

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

**Answer: c. Group 3**

**References:**

1. Institute for Laboratory Animal Research. 2011. Guide for the Care and Use of Laboratory Animals The National Academies Press: Washington, D.C. Chapter 3 – Environment, Housing, and Management, p. 61.
2. 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, §3.80 Primary enclosures, (b) Minimum space requirements. (11-6-13 Edition, p. 99)

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

**Domain 5; Primary Species – Macaques (Macaca spp.)**

**25.** Which of the following types of NIH funding mechanisms enhance predoctoral and postdoctoral research training, including short-term research training, and help ensure that a diverse and highly trained workforce is available to meet the needs of the Nation’s biomedical, behavioral, and clinical research agenda?

1. T15
2. T32
3. F32
4. K01
5. R01

**Answer: b. T32**

**Reference:** http://grants1.nih.gov/grants/funding/funding\_program.htm

**Domain 6**

**26.** All of the following statements apply to the practice of adding antibiotics to the drinking water of mice **EXCEPT**?

1. Antibiotic administration by drinking water reduces the stress that is associated with handling and parenteral or enteral bolus antibiotic administration
2. Antibiotic must remain stable in the drinking water and remain available for consumption by the mouse
3. Majority of the antibiotics currently used in water for mice have been demonstrated to reach plasma therapeutic concentrations quickly and efficiently
4. Mice must drink predictable volumes of the treated water in order to receive an adequate dose
5. Provision of antibiotics in water is time-efficient for lab animal personnel and thought to be of added therapeutic benefit as it provides continuous accessibility to antibiotics

**Answer: c. Majority of the antibiotics currently used in water for mice have been demonstrated to reach plasma therapeutic concentrations quickly and efficiently**

**References:**

1. Marx et al. 2014. Antibiotic administration in the drinking water of mice. JAALAS 53(3):301-306
2. Slate et al. 2014. Efficacy of enrofloxacin in a mouse model of sepsis. JAALAS 53(4):381-386

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

**27.** The J wave commonly seen in mouse and rat ECG recordings is due to the repolarization of what two potassium channels?

1. Transient outward K+ channel (ItO) and slow activating delayed rectifier channel (IK,slow)
2. Rapid (IK,rapid) and slow (IK, slow) activating delayed rectifier channels
3. Acetylcholine-activated inward rectifying (IKAch) channel and rapid activating delayed rectified channel (IK,rapid)
4. Transient outward K+ channel (ItO) and Acetylcholine-activated inward rectifying (IKAch) channel

**Answer: a. Transient outward K+ channel (ItO) and slow activating delayed rectifier channel (IK,slow)**

**References:** Kobayashi et al. 2012. Electrocardiograms corresponding to the development of myocardial infarction in anesthetized WHHLMI rabbits (Oryctolagus cuniculus), an animal model for familial hypercholesterolemia. Comparative Medicine 62(5):409-418

**Domain 3; Primary Species – Mouse (Mus musculus) and Rat (Rattus norvegicus)**

**28.** As the breeding season begins one of the animal caretakers for a colony of *Saimiri sciureus* has reported that one of the males in his group is suddenly gaining weight. Which of the following would be an appropriate response?

1. Ration the feed of the animal to prevent further weight gain
2. Remove the male from the social group as he may be dominating the available rations
3. Request that the animal be sedated for blood glucose testing as this species is predisposed to diabetes mellitus
4. It is normal for males of this species to undergo increases in body weight entering the breeding season

**Answer: d. It is normal for males of this species to undergo increases in body weight entering the breeding season**

**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 8 – Reproduction and Breeding of Nonhuman Primates, p. 216.
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 16 – Nonhuman Primates, p. 695.

**Domain 4; Secondary Species – Squirrel Monkey (Saimiri scuireus)**

**29.** The Animal Enterprise Terrorism Act was passed for what purpose?

1. To protect those who legally and nonviolently protest against the use of animals in research
2. To expand the criminal prohibitions against the use of force, violence, and threats involving animal enterprises, and increase the penalties for violations of these prohibitions
3. To provide legal anonymity for individuals using animals in research, teaching, or testing.
4. To protect animals used for food from agroterrorist acts

**Answer: b. To expand the criminal prohibitions against the use of force, violence, and threats involving animal enterprises, and increase the penalties for violations of these prohibitions**

**References:**

1. http://www.nabr.org/animal-enterprise-terrorism-act-aeta/
2. <https://www.govtrack.us/congress/bills/109/s3880/text>

**Domain 5**

**30.** Which statement best describes retinal vasculature and its categorization in specific animal species?

1. Anangiotic; absence of blood vessels in the sensory retina as seen in ungulates
2. Holangiotic; most of the sensory retina receives a direct blood supply as seen in mice and rats
3. Merangiotic; blood vessels are localized to a region of the retina as seen in horses
4. Paurangiotic; blood vessels occur only near the optic disc as seen in rabbits

**Answer: b. Holangiotic; most of the sensory retina receives a direct blood supply as seen in mice and rats**

**References:**

1. Harkness JE, Turner PV, VandeWoude S, Wheler CL. 2010. Harkness and Wagner’s Biology and Medicine of Rabbits and Rodents, 5th ed. Wiley-Blackwell: Ames, IA. Chapter 3 - Clinical Procedures, p. 139
2. [De Schaepdrijver](http://www.ncbi.nlm.nih.gov/pubmed/?term=De%20Schaepdrijver%20L%5BAuthor%5D&cauthor=true&cauthor_uid=2772405)  et al. 1989. Retinal vascular patterns in domestic animals. [Res Vet Sci](http://www.ncbi.nlm.nih.gov/pubmed/2772405) 47(1):34-42.

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

**31.** Which of the following is **TRUE** regarding anesthesia in *Xenopus laevis*?

* 1. When dissolved, MS222 creates a basic solution that must be buffered to lower the pH
  2. Benzocaine produces rapid induction of anesthesia, has a wider margin of safety, and is considered less potent than MS222
  3. The mechanism of action for MS222 is through blocking calcium channels
  4. Recommended fasting time for frogs is 4 hours for frogs weighing < 20 g, 48 hours for medium-sized frogs, and 7 days for larger frogs

**Answer: d.** **Recommended fasting time for frogs is 4 hours for frogs weighing < 20 g, 48 hours for medium-sized frogs, and 7 days for larger frogs**

**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 20 – Anesthesia and Analgesia in Amphibians, pp. 513-517.
2. Lalonde-Robert et al. 2012. Pharmacologic parameters of MS222 and physiologic changes in frogs (*Xenopus* laevis) after immersion at anesthetic doses. JAALAS 51(4): 464-468.

**Domain 2; Secondary Species – African Clawed Frog (*Xenopus* spp.)**

**32.** Which of the following is an important laboratory animal model for the study of the hepatitis B virus of humans?

1. *Dipodomys spectabilis*
2. *Marmota monax*
3. *Meriones unguiculatus*
4. *Sigmodon hispidus*

**Answer: b. *Marmota monax***

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 8 – Woodchucks as Laboratory Animals, p. 309.
2. Carminato et al. 2012. Adenocarcinoma of the dorsal glands in 2 European ground squirrels (Spermophilus citellus). Comparative Medicine 62(4):279-281.
3. McKenzie et al. 2006. Chronic care and monitoring of woodchucks (*Marmota monax*) during repeated magnetic resonance imaging of the liver. JAALAS 45(2):26-30.

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

**33.** In animal health monitoring programs, which of the following is a limitation of direct sampling by PCR?

a. False negative results in immune compromised animals.

b. Inability to determine if the organism is present in an infectious form

c. Lack of transmission via dirty bedding sentinels

d. Time lag between infection and positive results

**Answer: b. Inability to determine if the organism is present in an infectious form**

**References:**

1. Pritchett-Corning et al. 2014. AALAS/FELASA Working Group on Health Monitoring of Rodents for Animal Transfer. JAALAS53(6):633-640
2. Henderson et al. 2013. Efficacy of direct detection of pathogens in naturally infected mice by using a high-density PCR array. JAALAS52(6):763-772

**Domain 4**

**34.** What is the maximum amount of ammonia exposure permitted in people working with rodents by the Occupational Safety and Health Administration in an 8-hour time period?

a. 10 ppm

b. 25 ppm

c. 45 ppm

d. 85 ppm

**Answer: b. 25 ppm**

**Reference:**

1) Creamer et al. 2014. Implications of natural occlusion of ventilated racks on ammonia and sanitation practices. JAALAS 53(2):174-179

2) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 29 - Factors That May Influence Animal Research, p. 1149.

**Domain 5**

**35.** All of the following statements describe pancreatic islet cell tumors in ferrets **EXCEPT**?

* 1. If the patient is stable, surgical debulking is the treatment of choice
  2. Clinical signs are intermittent and may include ptyalism
  3. Metastasis rates are high, usually greater than 50%.
  4. Disease is usually later onset, with most cases occurring in 4-5 year old animals

**Answer: c. Metastasis rates are high, usually greater than 50%**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 13 – Biology and Diseases of Ferrets, pp. 507-508.
2. Quesenberry KE, Carpenter JW, Eds. 2012. Ferrets, Rabbits, and rodents: Clinical Medicine and Surgery. Elsevier: St. Louis, MO. Chapter 7 - Endocrine Diseases, pp. 92-99.

**Domain 1; Secondary Species - Ferret (*Mustela putorius furo*)**

**36.** Which of the following **MAY NOT** influence the results of PET/CT imaging study using FDG?

* 1. Body temperature
  2. Body weight
  3. Handling/restraining technique
  4. Period of fasting
  5. Type of anesthetic

**Answer: b. Body weight**

**Reference:** Isabel et al. 2008. Anesthesia and other considerations for in vivo imaging of small animals. ILAR J 49(1):17-26

**Domain 3**

**37.** Although rarely a limiting factor in zebrafish systems, low levels of which of the following water quality parameters is responsible for more mortalities than any other parameter in aquaculture?

1. Dissolved oxygen
2. pH
3. Temperature
4. Total gas pressure

**Answer: a. Dissolved oxygen**

**References:**

1) Lawrence and Mason. 2012. Zebrafish housing systems: a review of basic operating principles and considerations for design and functionality. ILAR J 53(2):179-191.

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. 78-79.

3) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 19 - Zebrafish, pp. 866-869.

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

**38.** Which of the following are classified by APHIS and CDC as select agents category A, B, C respectively?

a. Francisella tularensis, Burkholderia pseudomallei, Hantavirus

b. Hantavirus, Burkholderia pseudomallei, Francisella tularensis

c. Machupo, Lassa, Francisella tularensis

d. Ricin toxin, Burkholderia pseudomallei, Francisella tularensis

e. Yersinia pestis, Burkholderia pseudomallei, Clostridium perfringens (epsilon toxin).

**Answer: a. Francisella tularensis, Burkholderia pseudomallei, Hantavirus**

**Reference:** 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

**Domain 5**

**39.** Which of the following retroviruses in macaques are considered zoonotic?

* 1. SIV
  2. SFV
  3. SRV
  4. STLV
  5. All of the above

**Answer: e. All of the above**

**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. 56-70
2. OIE Terrestrial Animal Health Standards Commission February 2013 Report. Chapter 6.11 Zoonoses Transmissible from Non-Human Primates, Article 6.11.

http://www.aphis.usda.gov/import\_export/animals/oie/downloads/tahc\_feb13/tahc\_zoonoses\_transmit\_from\_non\_human\_primates\_82\_feb13\_rpt.pdf

**Domain 1; Primary Species – Macaques**

**40.** According to the AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, it may take neonatal mice up to how many minutes to die from CO2 exposure as a means of euthanasia?

a. 20

b. 30

c. 40

d 50

**Answer: d. 50**

**References:**

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).

1. Pritchett et al. 2005. Euthanasia of neonatal mice with carbon dioxide. Comparative Medicine55(3):275–281

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

**41.** The RITARD model has been developed for which of the following applications?

1. Allow temporary occlusion of a section of the bowel for bacterial colonization
2. Chemically ablate the pancreatic islets
3. Create vascular access ports to the gastrointestinal tract
4. Partially obstruct the bile duct

**Answer: a. Allow temporary occlusion of a section of the bowel for bacterial colonization**

**References:**

1) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine. 2nd edition. Academic Press: San Diego, CA. Chapter 23 – Techniques of Experimentation, p. 1019.

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 18 – The Rabbit as an Experimental Model, p. 546

**Domain 3; Primary Species – Rabbit (Oryctolagus cuniculus)**

**42.** Which of the following laboratory animal species is most sensitive to the toxic effects of phenolic disinfectants?

1. *Cavia porcellus*
2. *Meriones unguiculatus*
3. *Mus musculus*
4. *Sus scrofus*
5. *Xenopus laevis*

**Answer: e. *Xenopus laevis***

**References:**

1) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 17 – Biology and Diseases of Amphibians, p. 799.

2) Green SL. 2010. The Laboratory Xenopus sp. CRC Press: Boca Raton, FL. Chapter 2 – Husbandry, p.54

**Domain 4; Secondary Species – African Clawed Frog (*Xenopus laevis*)**

**43.** Official identification tags for cats held in research facilities can be made of all of the following materials **EXCEPT**?

1. Aluminum
2. Brass
3. Bronze
4. Nickel
5. Plastic

**Answer: d. Nickel**

**Reference:** Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 2 – Regulations, Subpart C – Research facilities, §2.38 (g)(4) - Miscellaneous (11-06-13 Edition, p. 40)

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

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

**44.** Which of the following statements best describes myxoma virus infection in rabbits?

1. *Sylvilagus spp.* often develop fibroadenomas
2. *Orcytolagus cuniculus* often experience severe disease with high mortality
3. *Orcytolagus cuniculus* typically develop proliferative skin nodules
4. *Sylvilagus spp.* often develop acute systemic disease and rarely develop skin nodules

**Answer: b. *Orcytolagus cuniculus* often experience severe disease with high mortality**

**Reference:**

1. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 6 – Rabbit, pp. 256-258
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 14 – Viral Diseases, p. 371

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

**45.** Compared to cerebrospinal fluid (CSF) drawn from the cisterna magna, which of the following best describes CSF drawn from the lumbar region of a rhesus macaque?

1. Concentrations of total protein, albumin, and IgG are greater in the CSF from the lumbar; concentrations of glucose and potassium are lower in the CSF of the lumbar
2. Concentrations of total protein, albumin, and IgG are lower in the CSF from the lumbar; concentrations of glucose and potassium are lower in the CSF of the lumbar
3. Concentrations of total protein, albumin, and IgG are greater in the CSF from the lumbar; concentrations of glucose and potassium are greater in the CSF of the lumbar
4. Concentrations of protein, albumin, and IgG are lower in the CSF from the lumbar; concentrations of glucose and potassium are greater in the CSF of the lumbar

**Answer: a. Concentrations of total protein, albumin, and IgG are greater in the CSF from the lumbar; concentrations of glucose and potassium are lower in the CSF of the lumbar**

**Reference:** Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine. 2nd edition. Academic Press: San Diego, CA. Chapter 16 – Nonhuman Primates, p. 728.

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

**46.** All of the following apply to the reproductive biology of the Syrian hamster **EXCEPT**?

1. Females have a 5-day estrus cycle
2. It is recommended that animals be allowed to mature to 90-100 g body weight before breeding
3. Reproductive senescence occurs at approximately 14 months in both sexes
4. The end of ovulation can be recognized by the appearance of a post-ovulatory vaginal discharge

**Answer: a. Females have a 5-day estrus cycle**

**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 IV – Hamsters, Chapter 28 – Management, Husbandry and Colony Health, p. 770
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 5 – Biology and Diseases of Hamsters, p. 177

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

**47.** What is the short-term exposure limit for carbon dioxide for employees exposed in a 15-min time interval?

a. 500 ppm

b. 5,000 ppm

c. 30,000 ppm

d. 40,000 ppm

**Answer: c. 30,000 ppm**

**References:**

1) Amparan et al. 2014. Exposure of research personnel to carbon dioxide during euthanasia procedures. JAALAS 53(4):376-380.

2) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 29 - Factors That May Influence Animal Research, p. 1149.

3) https://www.osha.gov/dts/sltc/methods/inorganic/id172/id172.html

**Domain 5**

**48.** Outbreaks of which of the following viruses can be most commonly attributed to contamination of mouse serum, tissue, or products?

1. ECTV
2. EDIM
3. MHV
4. MPV

**Answer: a. ECTV**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 1 – Biology and Diseases of Mice, p. 56.
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. 85.
3. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 1 – Mouse, p. 26

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

**49.** Tramadol is classified as which of the following controlled substance schedules?

1. I
2. II
3. III
4. IV

e. Non-controlled substance

**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. http://www.deadiversion.usdoj.gov/schedules/index.html
3. https://www.nabp.net/news/dea-classifies-tramadol-a-controlled-substance
4. http://www.deadiversion.usdoj.gov/fed\_regs/rules/2014/fr0702.htm

**Domain 5**

**50.** All of the following have been used as an animal model to study acute Q fever **EXCEPT**?

1. A/J mouse
2. BALB/c mouse
3. Cynomolgus macaque
4. Guinea pig

**Answer: b. BALB/c mouse**

**Reference:** Bewley. 2013. Animal models of Q fever (*Coxiella burnetii*). Comparative Medicine 63(6):469-476

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

**51.** According to the Guide for the Care and Use of Agricultural Animals in Research and Teaching, what is the recommended space for a 1,200 lb cow in lairage (e.g. awaiting transport to a slaughterhouse)?

1. 20 ft2
2. 50 ft2
3. 70 ft2
4. 110 ft2

**Answer: a. 20 ft2**

**Reference:** 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. 56. (http://www.fass.org/docs/agguide3rd/Ag\_Guide\_3rd\_ed.pdf)

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

**52.** According to the Animal Welfare Act and its regulations, the ambient temperature in the sheltered part of the facility for nonhuman primates must not fall below what temperature or above what temperature for more than four consecutive hours?

1. 32°F/75°F
2. 45°F/75°F
3. 45°F/85°F
4. 40°F/80°F

**Answer: c. 45°F/85°F**

**Reference:** Animal Welfare Act, 9 CFR Part 3 – Standards, Subpart D – Specifications for the Human Handling, Care, Treatment and Transportation of Nonhuman Primates, §3.77 (a) Sheltered housing facilities. (1-1-00 Edition, p. 78)

**Domain 5**

**53.** Which species of hamster is most likely to develop spontaneous diabetes mellitus?

1. *Mesocricetus* *auratus*
2. *Cricetulus* *griseus*
3. *Cricetulus* *migratorius*
4. *Cricetus* *cricetus*
5. *Phodopus* *campbelli*

**Answer: b. *Cricetulus griseus***

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 5 – Biology and Diseases of Hamsters, p. 192.
2. Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press: San Diego, CA. Chapter 35 – The Chinese or Striped-Back Hamster, p. 914.

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

**54.** IL-10-/- mice are a commonly used model for what disease?

1. Alzheimer’s
2. Arthritis
3. Autoimmune cardiomyopathy
4. Diabetes
5. Inflammatory bowel disease

**Answer: e. Inflammatory bowel disease**

1. Hsu et al. 2014. Infection with murine norovirus 4 does not alter Helicobacter-induced inflammatory bowel disease in IL10-/- mice. Comparative Medicine 64(4):256-263.
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 17 – Helicobacter Infections in Mice, p. 423.

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

**55.** All of the following are considered to be wild-type zebrafish strains **EXCEPT**?

1. AB
2. TU
3. Tupfel long fin
4. WIK
5. ZIRC

**Answer: e. ZIRC**

**Reference:** Nasiadka and Clark. 2012. Zebrafish Breeding in the Laboratory Environment. ILAR J 53(2):161-168.

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

**56.** What is the minimum amount of light exposure during the dark phase (12 h) that has been reported to disrupt circadian rhythms of plasma measures of endocrine physiology and metabolism in rats?

1. 0.2 lux
2. 2 lux
3. 20 lux
4. 200 lux

**Answer: a. 0.2 lux**

**References:**

1. Dauchy et al. 2013. Effects of spectral transmittance through standard laboratory cages on circadian metabolism and physiology in nude rats. JAALAS 52(2):146-156
2. Dauchy et al. 2013. Effect of spectral transmittance through red-tinted rodent cages on circadian metabolism and physiology in nude rats. JAALAS 52(6):745-755

**Domain 4; Primary Species – Rats (Rattus norvegicus)**

**57.** All of the following apply to murine mammary tumor virus (MMTV) **EXCEPT**?

* 1. There are only exogenous strains of the tumor virus
  2. Transmission is via the milk and to a lesser extent the saliva
  3. Cesarean rederivation and foster nursing may eliminate horizontal transmission
  4. C3H mice have a high susceptibility to MMTV induced mammary tumors
  5. MMTV-s (standard) is also known as the Bittner agent or virus

**Answer: a. There are only exogenous strains of the tumor virus**

**References:**

1) Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 1- Mouse, pp. 48-49.

2) 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, pp. 111-112.

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 10 – Retroelements in the Mouse, pp. 274-275

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

**58.** All of the following are modes of action of ketamine as an anesthetic agent **EXCEPT**?

a. Agonist at alpha and beta adrenergic receptors

b. Agonist at Opioid receptor

c. Antagonist of NMDA receptor

d. Inhibits GABA receptor

**Answer: d. Inhibits GABA receptor**

**References:**

1) Martin et al. 2014. Effects of anesthesia with isoflurane, ketamine, or propofol on physiologic parameters in neonatal rhesus macaques (*Macaca mulatta*). JAALAS 53(3):290-300.

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 2 – Pharmacology of Injectable Anesthetics, Sedatives, and Tranquilizers, pp. 47-50

**Domain 2**

**59.** Which of the following describes positive predictive value?

1. True Negative\_\_\_\_\_\_\_ x 100

True Negative + False Positive

1. True Positive\_\_\_\_\_\_\_ x 100

True Positive + False Positive

1. True Positive\_\_\_\_\_\_\_ x 100

True Positive + False Negative

1. True Negative\_\_\_\_\_\_\_ x 100

True Negative + False Negative

**Answer: b. True Positive\_\_\_\_\_\_\_\_ x 100**

**True Positive + False Positive**

**Reference:** Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 10 - Microbiological Quality Control for Laboratory Rodents and Lagomorphs, pp. 385-386.

**Domain 3**

**60.** Which of the following chemical sterilants **IS NOT** considered a carcinogen by the Environmental Protection Agency or the Occupational Safety and Health administration but has been shown to be a tumor promoter?

1. Chlorine dioxide
2. Formaldehyde gas
3. Hydrogen peroxide
4. Peracetic acid

**Answer: d. Peracetic acid**

**References:** 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. 224.

**Domain 4**

**61.** Which of the following species would be regulated by the United States Department of Agriculture?

* 1. Meleagris gallopava as a model of dilated cardiomyopathy
  2. Aplysia californica in a behavior study for memory learning
  3. Equis caballus in an undergraduate class teaching handling techniques
  4. Suncus murinus in testing the efficacy of novel antiemetics
  5. Capra hircus in evaluating the feed efficiency of a new maintenance diet

**Answer: d. Suncus murinus in testing the efficacy of novel antiemetics**

**References:**

1. Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 1 – Definition of Terms, §1.1 Definitions (11-06-13 Edition, p. 17)

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

1. Animal Care. January 2002. APHIS Fact Sheet: The Animal Welfare Act. (http://www.ca-biomed.org/pdf/media-kit/oversight/USDAAWA.pdf)

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

**62.** Which of the following haplotypes of the major histocompatibility complex makes mice more susceptible to tumor induction by polyoma virus infection?

1. H-2a
2. H-2b
3. H-2d
4. H-2e
5. H-2k

**Answer: e. H-2k**

**References:**

1) Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd edition. Blackwell Publishing: Ames, Iowa. Chapter 1 – Mouse, p. 22.

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 5 – Polyoma Viruses, pp. 124-125.

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

**63.** Which of the following microsporidia is the most prevalent pathogen in zebrafish colonies associated with poor fecundity, reduced growth, emaciation, and musculoskeletal deformities??

1. *Mycobacterium fortuitum*
2. *Mycobacterium marinum*

c. *Pseudoloma neurophilia*

d. *Pseudocapillaria tormentosa*

**Answer: c. *Pseudoloma neurophilia***

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002 Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 19 – Biology and Management of Zebrafish, p. 876-880.
2. Murray et al. 2011. Transmission, diagnosis, and recommendations for control of Pseudoloma neurophilia infections in laboratory zebrafish (Danio rerio) facilities*.* Comparative Medicine 61(4):322-329

**Domain 1; Secondary Species – Zebrafish (*Danio rerio*)**

**64.** What disease is a unique natural comparative model for retroviral-associated lung cancer?

* 1. Type C retrovirus in guinea pigs
  2. *Jaagsiekte* sheep retrovirus
  3. Caprine arthritis encephalitis virus
  4. Feline foamy virus
  5. Simian type D retrovirus

**Answer: b. *Jaagsiekte* sheep retrovirus**

**Reference:** Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 22 - Preanesthesia, Anesthesia, and Analgesia, pp. 521, 577-578.

**Domain 3; Secondary Species – Sheep (*Ovis aries*)**

**65.** Which of the following types of bedding **IS NOT** appropriate for controlling ammonia levels in mouse caging and produces pathologic changes in the nares of mice housed in them?

1. Aspen wood chip
2. Corncob

c. Recycled newspaper

d. Reclaimed wood pulp

**Answer: d. Reclaimed wood pulp**

**Reference:** Ferrecchia et al. 2014. Intracage ammonia levels in static and individually ventilated cages housing C57BL/6 mice on 4 bedding substrates. JAALAS 53(2):146-151

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

**66.** Which of the following requires review and approval by the Institutional Biosafety Committee, Recombinant DNA Advisory Committee and the NIH Director?

* 1. Experiments with a recombinant DNA (rDNA) modified restricted agent in a whole animal
  2. Experiments that deliberately transfer drug resistance traits
  3. Creating stable germ line alterations of rodents using rDNA that require BSL-1 containment
  4. Purchase or transfer of transgenic rodents

**Answer: b. Experiments that deliberately transfer drug resistance traits**

**Reference:** NIH Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules. 2013. Section III-A. Experiments that Require Institutional Biosafety Committee Approval, RAC Review, and NIH Director Approval Before Initiation, p. 16.

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

**Domain 5**

**67.** All of the following can be fed to zebrafish (*Danio rerio*) larvae aged 5-10 days post-fertilization **EXCEPT**?

* 1. Freshly-hatched *Artemia* nauplii
  2. *Paramecium* spp.
  3. Processed feed with a particle size of 250 µm
  4. Rotifers

**Answer: c. Processed feed with a particle size of 250 µm**

**References:**

1. Wilson. 2012. Aspects of larval rearing. ILAR J 53(2):169-178.
2. Harper C and Lawrence C. 2011. The Laboratory Zebrafish. CRC Press: Boca Raton, FL. Chapter 2 – Husbandry, pp. 40-41.
3. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 19 – Biology and Management of the Zebrafish, p. 874.
4. Koerber and Kalishman. 2009. Preparing for a semiannual IACUC inspection of a satellite zebrafish (*Danio rerio*) facility. JAALAS 48(1):65-75.

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

**68.** An intraperitoneal anesthetic mixture consisting of fentanyl, medetomidine and midazolam can be completely reversed by which of the following combinations?

1. Butorphanol, atipamezole and flumazenil respectively
2. Butorphanol, yohimbine and flumazenil respectively
3. Naloxone, atipamezole and flumazenil respectively
4. Naloxone, flumazenil and yohimbine respectively

**Answer: c. Naloxone, atipamezole and flumazenil respectively**

**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. 44-57, 52-54 AND Chapter 4 – Pharmacology of Analgesics, pp. 114-115
2. Albrecht et al. 2014. Effects of isoflurane, ketamine-xylazine and a combination of medetomidine, midazolam and fentanyl on physiological variables continuously measured by telemetry in Wistar rats. BMC Veterinary Research 10(1):198.

**Domain 2**

**69.** The common marmoset isa model for all of the following **EXCEPT**?

1. Experimental allergic encephalitis of multiple sclerosis and Parkinson’s disease
2. Gammaherpesvirus models of acute oncogenesis and persistent viral infections and The GB virus B model of hepatitis
3. Macacine Herpesvirus 1 (formerly known as Cercopithecine Herpesvirus 1, AKA Herpes B virus) infection
4. Regulation of reproductive behavior and models of anxiety and stress
5. Reproductive toxicology and reproductive biology

**Answer: c. Macacine Herpesvirus 1 (formerly known as Cercopithecine Herpesvirus 1, AKA Herpes B virus) infection**

**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. 7-9
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 16 - Nonhuman Primates, pp. 685-686.

**Domain 3; Secondary Species – Marmosets (*Callithrix jacchus*)**

**70.** How often should UV lights in biosafety cabinets be cleaned to remove any dust and dirt that may block the germicidal effectiveness?

* 1. Daily
  2. Weekly
  3. Monthly
  4. Yearly

**Answer: b. Weekly**

**References:**

1. U. S. Department of Health and Human Services, Public Health Service, Centers 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. Appendix A – Primary Containment for Biohazards: Selection, Installation and Use of Biological Safety Cabinets, p. 306

(http://www.cdc.gov/biosafety/publications/bmbl5/BMBL5\_appendixA.pdf).

1. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention & National Institutes of Health. 2007. Primary Containment for Biohazards: Selection, Installation and Use of Biological Safety Cabinets, 3rd ed. L.C. Chosewood & D.E. Wilson, eds: Washington, DC, p. 26.

**Domain 4**

**71.** Which of the following statements best describes oversight of controlled substances?

1. A DEA registrant may authorize others to issue orders for Schedule I and II controlled substances by executing a power of attorney
2. Every inventory and other records must be kept by the registrant and be available, for at least 5 years from the date of such inventory or record
3. Schedule II drug is a drug or other substances that has a high potential for abuse and has no currently accepted medical use in treatment in US
4. You may not maintain electronic prescriptions for controlled substances

**Answer: a. A DEA registrant may authorize others to issue orders for Schedule I and II controlled substances by executing a power of attorney**

**References:**

1. Controlled Substances Act, USC Title 21, Chapter 13, Subchapter I – Control and Enforcement, Part B – Authority to Control; Standards and Schedules, §812 Schedules of controlled substances (b) (1) Schedule I.

http://www.deadiversion.usdoj.gov/21cfr/21usc/index.html

1. Controlled Substances Act, USC Title 21, Part 1305 – Orders for Schedule I and II Controlled Substances, Subpart A – General Requirements, §1305.05 Power of attorney, (a).
2. Controlled Substances Act, USC Title 21, Part 1304 – Records and Reports of Registrants, §1304.04 Maintenance of records and inventories. (a).
3. Controlled Substances Act, USC Title 21, Section 831, Subchapter I – Control and Enforcement, Part C – Registration of Manufacturers, Distributors, and Dispensers of Controlled Substances. §813 Additional requirements relating to online pharmacies and telemedicine.
4. 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, pp. 573-575.

**Domain 5**

**72.** A 17 year old female *Macaca nemastrina* presented for chronic intermittent abdominal discomfort and prostration. Laparoscopic biopsy of the abdominal cavity revealed the presence of extrauterine endometrial glands and stroma. All of the following could be used as an effective pharmacological treatment to manage this condition **EXCEPT**?

1. Danazol

b. Dinoprost tromethamine

c. Leuprolide

d. Medroxyprogesterone

**Answer: b. Dinoprost tromethamine**

**Reference:** 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 10 – Urogenital System, pp. 510-514.

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

**73.** What term defines an inbred strain that contains a single entire chromosome from another strain?

1. Coisogenic
2. Congenic
3. Conplastic
4. Consomic
5. Isogenic

**Answer: d. 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. October 2011.

http://www.informatics.jax.org/mgihome/nomen/strains.shtml#consomic

**Domain 3**

**74.** With regard to individually ventilated caging units, which of the following best describes intracage supply/perimeter capture exhaust systems?

* 1. HEPA-filtered air is supplied directly, at the level of the cage, resulting in its pressurization
  2. Air is supplied directly to the cage lid or bottom and exhausted directly from the lid or from a plenum beneath the cage
  3. It provides supply air and removes exhaust through a filter in the cage lid which resides directly below a positive and negative plenum or duct
  4. Contains optional valves on its isolator top that is actuated when the cage is placed on the rack and closed when the cage is removed

**Answer: a. HEPA-filtered air is supplied directly, at the level of the cage, resulting in its pressurization**

**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 9 – Design and Management of Research Facilities for Mice, p. 295.
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 24 – Control of Biohazards Associated with the Use of Experimental Animals, p. 1050.
3. Hessler JR, Lehner NDM, eds. 2009. Planning and Designing Research Animal Facilities. Academic Press, San Diego, CA. Chapter 20 – Rodent Facilities and Caging Systems, pp. 272-274

**Domain 4**

**75.** All of the following statements apply to research involving recombinant or synthetic nucleic acid molecules **EXCEPT**?

1. Institutional Biosafety Committee (IBC) must be comprised of no fewer than five members
2. Recombinant DNA Advisory Committee (RAC) will consist of not less than 15 voting members
3. Experiments involving influenza virus containing a majority of gene segments from HPAI H5N1 influenza virus shall be conducted in Biosafety Level 3 enhanced containment
4. It is IBC’s responsibility to report any significant problems with or violation of the NIH Guidelines and any significant research-related accident or illnesses to the appropriate Institutional official and NIH/OBA within 60 days
5. Experiments involving the cloning of toxin molecules with LD50 of less than 100 ng/kg body weight cannot be initiated without submission of relevant information on the proposed experiment to NIH/OBA

**Answer: d. It is IBC’s responsibility to report any significant problems with or violation of the NIH Guidelines and any significant research-related accident or illnesses to the appropriate Institutional official and NIH/OBA within 60 days**

**References:**

1. DHHS and NIH. 2013. NIH Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules (NIH Guidelines). Section IV-B-7-a: General Responsibilities, p. 29 (http://osp.od.nih.gov/sites/default/files/NIH\_Guidelines\_0.pdf**)**
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002 Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 2 – Laws, Regulations, and Policies Affecting the Use of Laboratory Animals, pp. 31-32.

**Domain 5**

**76.** All of the following strains of mice are susceptible to Helicobacter-associated gastrointestinal disease and may develop chronic enterohepatic disease **EXCEPT**?

a. A/JCr

b. B6C3F1

c. BALB/cAnNCr

d. C3H/HeNCr

e. SJL/NCr

**Answer: b. B6C3F1**

**References:**

1) Garrett et al. 2014. Effects of medicated diet to eradicate *Helicobacter* spp. on growth, pathology, and infection status in Rag1-/- and nude mice. JAALAS 53(3):238-245

2) Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 1 - Mice, p. 59.

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

**77.** Which of the following agents is an anti-epileptic drug that is has a non-opioid mechanism of action and has been used with other analgesics to provide chronic pain management in veterinary species?

1. Butorphanol
2. Gabapentin
3. Ketamine
4. Tramadol

**Answer: b. Gabapentin**

**References:**

1. Committee on Recognition and Alleviation of Pain in Laboratory Animals, National Research Council. 2009. Recognition and Alleviation of Pain in Laboratory Animals. National Academies Press: Washington, DC. Chapter 4, p. 87.
2. McKeon et al. 2011. [Analgesic effects of tramadol, tramadol-gabapentin, and buprenorphine in an incisional model of pain in rats (Rattus norvegicus)](http://aalas.publisher.ingentaconnect.com/search/article?option1=tka&value1=tramadol&operator9=AND&option9=publications&value9=aalas&pageSize=10&index=1). JAALAS 50(2):192-197

**Domain 2**

**78.** How many"normal" or autochthonous (naturally occurring) bacteria make up the altered Schaedler’s flora used as microbiota for colonizing germfree rodents?

1. 5
2. 6
3. 7
4. 8
5. 10

**Answer: d. 8**

**References:**

1. http://www.taconic.com/wmspage.cfm%3Fparm1=288
2. http://www.taconic.com/wmspage.cfm?parm1=325
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 7 - Gnotobiotics, pp. 228-229
4. 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. 46.

**Domain 3**

**79.** All of the following medications have been used in medicated feed to eradicate *Helicobacter* spp. in Rag1-/- and nude mice **EXCEPT**?

a. Amoxicillin

b. Bismuth

c. Clarithormycin

d. Metronidazole

e. Omeprazole

**Answer: b. Bismuth**

**References:**

1) Garrett et al. 2014. Effects of medicated diet to eradicate *Helicobacter* spp. on growth, pathology, and infection status in Rag1-/- and nude mice. JAALAS 53(3):238-245

2) Sharp et al. 2008. Helicobacter infection decreases reproductive performance of IL10-deficient mice. Comparative Medicine 58:447–453.

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

**80.** A DEA Form 222 is used to order which schedules of controlled substances?

1. I
2. II
3. III through V
4. I and II

**Answer: d. I and II**

**References:**

1) Drug Enforcement Agency Controlled Substances Act and Scheduling Actions, 2013. http://www.deadiversion.usdoj.gov/schedules/orangebook/a\_sched\_alpha.pdf

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. http://www.deadiversion.usdoj.gov/schedules/index.html

**Domain 5**

**81.** Which of the following strategies would count as “Replacement” according to the Russell and Burch concept?

1. Application of newer technologies
2. Better analysis of experimental design
3. Control of environmental-related variability
4. Use of appropriate statistical methods
5. Use of computer simulations

**Answer: e. Use of computer simulations**

**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 I – General, Chapter 1 – Ethical Considerations and Regulatory Issues, pp. 8-10.

2) 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, pp. 4-5.

**Domain 6**

**82.** A rhesus macaque has severe anaplastic anemia following a recent organ transplantation. Bone marrow biopsy revealed numerous intranuclear inclusions in the erythroid precursor cells and marked erythroid hypoplasia. Which of the following viruses is the most likely etiologic agent?

a. Adenovirus

b. Arenavirus

c. Filovirus

d. Flavavirus

e. Parvovirus

**Answer: e. Parvovirus**

**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. 35-36

2) Simon. 2008. [Simian parvoviruses: biology and implications for research](http://www.ncbi.nlm.nih.gov/pubmed/19793456). Comparative Medicine 58(1):47-50.

3) [Bailey and](http://www.ncbi.nlm.nih.gov/pubmed/?term=Bailey%20C%5BAuthor%5D&cauthor=true&cauthor_uid=20472806) Mansfield. 2010. Emerging and reemerging infectious diseases of nonhuman primates in the laboratory setting. [Vet Pathol](http://www.ncbi.nlm.nih.gov/pubmed/?term=bailey+mansfiled++nonhuman+primates) 47(3):462-481.

**Domain 1; Primary Species - Rhesus (*Macaca mulatta*)**

**83.** Bioluminescence imaging captures which protein that creates the light transmission detected by this technique?

a. Green fluorescent protein

b. Luciferase

c. Protease

d. Yellow producing protein

**Answer: b. Luciferase**

**References:**

1) Slate et al. 2014. Efficacy of enrofloxacin in a mouse model of sepsis. JAALAS 53(4):381-386.

2) http://physrev.physiology.org/content/90/3/1103

**Domain 3**

**84.** Which of the following most accurately characterizes quaternary ammonium compounds?

* 1. Not sporicidal and most are not tuberculocidal
  2. Harsh cationic chemicals active against enveloped viruses
  3. Low detergent capabilities on their own
  4. Less effective against gram-positive organisms than against gram-negative organisms

**Answer: a. Not sporicidal and most are not tuberculocidal**

**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 12 – Environmental and Equipment Monitoring, p. 425.
2. Harkness JE, Turner PV, VandeWoude S, Wheler CL. 2010. Harkness and Wagner’s Biology and Medicine of Rabbits and Rodents, 5th ed. Wiley-Blackwell: Ames, IA. Chapter 1 – Introduction, General Husbandry, and Disease Prevention, p. 16.

**Domain 4**

**85.** According to the 8th Edition of the Guide for the Care and Use of Laboratory Animals, which one of the following is an important guideline concerning restraint of animals?

* 1. Animals that fail to adapt to restraint devices should be removed from the study
  2. It is not necessary to consider alternatives to physical restraint
  3. Restraint devices should be used simply as a convenience in handling and managing animals
  4. Restraint should be considered a normal method of housing
  5. Training of animals to adapt to restraint equipment is not recommended

**Answer: a. Animals that fail to adapt to restraint devices should be removed from the study**

**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. 29.

**Domain 3**

**86.** Which of the following applies to *Xenopus laevis*?

1. Adults spontaneously develop Lucke herpesvirus tumors
2. It is a member of the family Ranidae
3. It is the only diploid Xenopus species
4. Pseudocapillaroides xenopi is a common skin nematode and can be diagnosed via detection of DNA in aquarium sediment

e. Tadpoles eat only live prey

**Answer: d. Pseudocapillaroides xenopi is a common skin nematode and can be diagnosed via detection of DNA in aquarium sediment**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 17 – Biology and Diseases of Amphibians, p. 808-812, 817, 820.
2. Densmore and Green. 2007. Diseases of amphibians. ILAR Journal 48(3): 235-254.
3. Feldman and Ramirez. 2014. Molecular phylogeny of pseudocapillaroides xenopi and development of a quantitative PCR assay for its detection in aquarium sediment. JAALAS 53(6):668-674.

**Domain 1; Secondary Species – African Clawed Frog (Xenopus spp)**

**87.** Which of the following informational databases is published by the National Agricultural Library?

1. AWIC
2. AGRICOLA
3. AltWeb
4. ToxNet
5. Go3R.org

**Answer: b. AGRICOLA**

**References:**

1)http://agricola.nal.usda.gov

2) USDA Animal and Plant Health Inspection Service Animal Care Policy Manual. Policy # 12: Consideration of Alternatives To Painful/Distressful Procedures. March 25, 2011. (http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Policy%20Manual.pdf)

**Domain 5**

**88.** All of the following are characteristics of chlorine **EXCEPT**?

1. It is inactivated by light
2. It becomes less biocidal with increased temperature
3. It is more biocidal with increasing pH
4. It is an oxidant

**Answer: c. It is more biocidal with increasing pH**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 10 - Microbiological Quality Control for Laboratory Rodents and Lagomorphs, p. 370.
2. U. S. Department of Health and Human Services, Public Health Service, Centers 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. Appendix B - Decontamination and Disinfection**,** p. 333.

(http://www.cdc.gov/biosafety/publications/bmbl5/BMBL5\_appendixB.pdf)

**Domain 4**

**89.** According tothe Public Health Service Policy on Humane Care and Use of Laboratory Animals, who shall report in writing to OLAW at least once every 12 months?

a. Attending veterinarian

b. IACUC

c. Institutional Official

d. A board-certified laboratory animal veterinarian

**Answer: c. Institutional Official**

**References:**

1. Office of Laboratory Animal Welfare. 2002. Public Health Service Policy on Humane Care and Use of Laboratory Animals, p. 18
2. http://grants.nih.gov/grants/olaw/tutorial/terms.htm#3b

**Domain 5**

**90.** Which of the following statements best describes the nutritional requirements in *Macaca nemastrina* and *Saimiri sciureus*?

a. *Saimiri sciureus* require dietary cholecalciferol whereas *Macaca nemastrina* do not

b. *Macaca nemastrina* require dietary cholecalciferol whereas *Saimiri sciureus* do not

c. *Saimiri sciureus* require dietary ascorbic acid whereas *Macaca nemastrina* do not

d. *Macaca nemastrina* require ascorbic acid whereas *Saimiri sciureus* do not

e. *Macaca nemastrina* and *Saimiri sciureus* require both dietary cholecalciferol and ascorbic acid

**Answer: a. *Saimiri sciureus* require dietary cholecalciferol whereas *Macaca nemastrina* do not**

**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 10 – Nutrient Requirements and Husbandry Principles for Nonhuman Primates, pp. 277-279.
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 16 – Nonhuman Primates, p. 773.

**Domain 4; Primary Species – Macaques (Macaca spp.) and Secondary Species – Squirrel Monkey (Saimiri sciureus)**

**91.** Which of the following best describes simian hemorrhagic fever in nonhuman primates?

1. Highly contagious, fatal viral disease of macaques caused by a flavivirus
2. Causes fatal hemorrhagic fever in a number of African primates, principally the Patas monkey
3. Causes hemorrhage and necrosis of the proximal duodenum in macaques
4. Lesions differ from those seen in Ebola due to the involvement of the spleen and kidney

**Answer: c. Causes hemorrhage and necrosis of the proximal duodenum**

**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. 47-49

2) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 16 – Nonhuman Primates, p. 751

**Domain 1; Primary Species - Macaque (*Macacca* spp.**)

**92.** The compound 4-vinlycyclohexene diepoxide is used in research to induce which of the following physiological or disease processes in mammals?

1. Diabetes
2. Multiple sclerosis
3. Obesity
4. Peripheral neuropathy
5. Regression of primordial and primary ovarian follicles

**Answer: e. Regression of primordial and primary ovarian follicles**

**References:**

1. Perez et al. 2013. Effects of chemically induced ovarian failure on voluntary wheel-running exercise and cardiac adaptation in mice. Comparative Medicine 63(3):233-243
2. Appt et al. 2010. Experimental induction of reduced ovarian reserve in a nonhuman primate model (Macaca fascicularis).Comparative Medicine 60(5):380-388
3. Muhammad et al. 2009. Effects of 4-vinylcyclohexene diepoxide on peripubertal and adult Sprague Dawley rats: ovarian, clinical, and pathologic outcomes. Comparative Medicine 59(1):46-59
4. Marion et al. 2013. 7,12-dimethylbenzanthracene-induced malignancies in a mouse model of menopause. Comparative Medicine63(1):6-12

**Domain 3**

**93.** Which of the following nonhuman primate species is monogamous?

1. Aotus lemurinus
2. Callithrix jacchus
3. Pan paniscus
4. Papio anubis
5. Saimiri boliviensis

**Answer: a. Aotus lemurinus**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 16 - Nonhuman Primates, pp. 683, 686, 694, 706, 713.
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 8 – Reproduction and Breeding of Nonhuman Primates, pp. 215-218
3. Bardi et al. 2014. Parity modifies endocrine hormones in urine and problem-solving strategies of captive owl monkeys *(Aotus spp.)*. Comparative Medicine 64(6):486-495

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

**94.** The responsibilities of the PHS for preventing the introduction of communicable disease into the USA by importation of nonhuman primates have been assigned to which of the following organizations?

1. AAALAC
2. CDC
3. IATA
4. ILAR
5. USDA

**Answer: b. CDC**

**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, p. 50.
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 2 – Laws, Regulations, and Policies Affecting the Use of Laboratory Animals, p. 30.
3. Roberts and Andrews. 2008. Nonhuman primate quarantine: its evolution and practice. ILAR J 49(2):145-156.

**Domain 5**

**95.** All of the following statements apply to *Trichuris suis* **EXCEPT***?*

1. Can infect primates and humans
2. May cause a fibrinonecrotic membranes and bloody scours
3. Eggs are shed persistently in the feces
4. May decrease mucosal immunity to resident bacteria
5. Effective anthelmintics include fenbendazole and dichlorvos

**Answer: c. Eggs are shed persistently in the feces**

**References:**

1) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 15 - Biology and Diseases of Swine, pp. 652-653.

2) Baker DG, ed. 2007. Flynn’s Parasites of Laboratory Animals, 2nd edition. Blackwell Publishing, Iowa, USA. Chapter 19 - Parasites of Swine, p. 628

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

**96.** Which of the following organizations enforces the Endangered Species Act?

1. Centers for Disease Control
2. Convention on International Trade in Endangered Species of Wild Fauna and Flora
3. Environmental Protection Agency
4. Interior Department’s U.S. Fish and Wildlife Service and the Commerce Department’s National Marine Fisheries Service
5. United States Department of Agriculture

**Answer: d. Interior Department’s U.S. Fish and Wildlife Service and the Commerce Department’s National Marine Fisheries Service**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press, San Diego, CA. Chapter 2 – Laws, Regulations, and Policies Affecting the Use of Laboratory Animals, p. 30
2. http://www.fws.gov/endangered/laws-policies/

**Domain 5**

**97.** Which of the following is the correct nomenclature for a mouse on a C57BL/6 background expressing the *Axinfu* mutant allele transferred from an unknown strain?

a. B6.Cg- *Axinfu*/J

b. C57BL/6J- *Axinfu*/J

c. C57BL/6J;Unk-futm*Axin*

d. C57BL/6J;Unk-Axintm*fu*

e. C57BL/6J-Tg-*Axinfu*(Unk)

**Answer: a. B6.Cg- *Axinfu*/J**

**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 5 – Mouse Strain and Genetic Nomenclature: An Abbreviated Guide, pp. 81-87.
2. International Committee on Standardized Genetic Nomenclature for Mice and Rat Genome and Nomenclature Committee. Guidelines for Nomenclature of Mouse and Rat Strains. October 2013.

http://www.informatics.jax.org/mgihome/nomen/strains.shtml#congenic

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

**98.** Which of the following species is nocturnal and should be provided a 12:12 light-dark cycle that is offset from the normal day so the animals can be observed during the active “night” cycle?

1. Aotus vociferans
2. Callithrix jacchus
3. Saguinus oedipus
4. Saimiri sciureus

**Answer: a. Aotus vociferans**

**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 9 – Laboratory Housing of Nonhuman Primates, p. 255.
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 16 – Nonhuman Primates, p. 690.

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

**99.** All of the following statements apply to biosafety cabinets (BSC) **EXCEPT**?

1. Class III BSC is safe to use for procedures using volatile chemicals
2. Class III BSC has a gas tight enclosure with a non-opening view window that is designed for work with highly infectious microbiological agents
3. Class I BSC provides personnel and environmental protection but no product protection
4. Class II (Types A1, A2, B1 and B2) BSC provide personnel, environmental and product protection
5. Class II, Type B2 BSC is a total-exhaust cabinet and no air is recirculated within it

**Answer: a. Class III BSC is safe to use for procedures using volatile chemicals**

**Reference:** U. S. Department of Health and Human Services, Public Health Service, Centers 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. Appendix A – Primary Containment for Biohazards: Selection, Installation and Use of Biological Safety Cabinets, pp. 311-312.

http://www.cdc.gov/biosafety/publications/bmbl5/BMBL5\_appendixA.pdf

**Domain 5**

**100.** Which of the following housing situations would require the most amount of floor space according to the Guide for the Care and Use of Laboratory Animals and/or the Animal Welfare Act and its regulations?

a. Female rat with litter

b. Female guinea pig with litter

c. Female mouse with litter

d. Female hamster with litter

**Answer: a. Female rat with litter**

**References:**

1. 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. 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 (c) – Primary enclosures (11-6-13 Edition, pp. 77-78)

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

**Domain 4; Primary Species – Rat (Rattus norvegicus)**

**101.** Which of the following applies to rat parvoviruses?

1. Enveloped, double stranded DNA viruses that are relatively resistant and remain infectious at room temperature for long periods of time
2. Excreted in the urine and milk and transmission is primarily by oronasal contact with infected animals or fomites
3. ELISA and/or IFA used to differentiate which rat parvovirus antibody exists
4. Characterized as being highly pathogenic causing severe clinical signs

**Answer: b. Excreted in the urine and milk and transmission is primarily by oronasal contact with infected animals or fomites**

**References:**

1) Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 2 - Rat, pp. 127-129.

2) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 4 - Biology and Disease of Rats, p. 146.

3) Suckow MA, Weisbroth SH, Franklin CL, eds. 2006. The Laboratory Rat, 2nd edition. Elsevier Academic Press: San Diego, CA. Chapter 12 – Viral Disease, pp. 426-434

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

**102.** Which bacteria is a commensal organism that has recently been demonstrated to alter animal disease models, such as diabetes mellitus in NOD mice?

a. Cilia associated respiratory bacillus

b. *Clostridium difficile*

c. *Escherichia coli*

d. Segmented filamentous bacteria

**Answer: d. Segmented filamentous bacteria**

**Reference:** Ericsson et al. 2014. Segmented filamentous bacteria: commensal microbes with potential effects on research. Comparative Medicine 64(2):90-98

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

**103.** 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**

**104.** According to the Animal Welfare Act and its regulations, all of the following statements apply to identification of dogs and cats **EXCEPT**?

1. All official tags removed and retained by a dealer or exhibitor shall be held until called for by an APHIS official or for a period of 1 year
2. Each official tag shall have the letters USDA, numbers identifying the state and dealer exhibitor or research facility and numbers identifying the animal
3. No animal identification number shall be used within any 5 year period following its previous use
4. Unweaned puppies or kittens need to be individually identified with the official tags
5. The official tag shall be circular in shape and not less than 1 and ¼ inches in diameter or oblong and flat in shape, not less than 2 x ¾ inches

**Answer: d. Unweaned puppies or kittens need to be individually identified with the official tags**

**Reference:** Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 2 – Regulations, Subpart E – Identification of Animals, §2.50 Time and method of identification (d) (11-6-13 Edition, p. 44); §2.51 Form of official tag (a) (11-6-13 Edition, p. 45); and §2.55 Removal and disposal of tags (b) (11-6-13 Edition, p. 45) (http://www.aphis.usda.gov/animal\_welfare/downloads/Animal%20Care%20Blue%20Book%20-%202013%20-%20FINAL.pdf)

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

**105.** According to the Guide for the Care and Use of Agricultural Animals in Research and Teaching, what is the minimum ambient temperature range recommended for poults?

a. 32-35°C (90-95°F)

b. 35-38°C (95-100°F)

c. 26.5-29.5°C (80-85°F)

d. 22-24°C (72-75°F)

**Answer: b. 35-38°C (95-100°F)**

**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 9 – Poultry, p. 116

(http://www.fass.org/docs/agguide3rd/Ag\_Guide\_3rd\_ed.pdf)

1. Shuster et al. 2012. Polytetrafluoroethylene toxicosis in recently hatched chickens (*Gallus domesticus*). Comparative Medicine 62(1):49-52.

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

**106.** Which of the following best describes the actions of buprenorphine HCl when used in rodents?

1. Associated with minimal respiratory depression
2. Effective control of severe pain
3. Given only via the intraperitoneal route
4. Low therapeutic index
5. Opioid with both partial μ receptor antagonistic and κ and δ receptor agonistic activities

**Answer: a. Associated with minimal respiratory depression**

**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. Cotroneo et al. 2012. Effects of buprenorphine on a cecal ligation and puncture model in C57BL/6 mice.JAALAS 51(3):357-365
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 4 – Pharmacology of Analgesics, pp. 114-115

**Domain 2**

**107.** Which region of the rhesus macaque genome has been associated with phenotypic protection from simian AIDS following SIV infection?

* 1. ABO region
  2. Major histocompatibility region
  3. MAM-domain containing region
  4. Toll-like receptor region

**Answer: b. Major histocompatibility region**

**References:**

1. Wiseman et al. 2013. Haplessly hoping: macaque major histocompatibility complex made easy. ILAR J 54(2):196-210.
2. Vallender and Miller. 2013. Nonhuman primate models in the genomic era: a paradigm shift. ILAR J 54(2):154-165.

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

**108.** In recirculating water systems housing zebrafish, the development and maintenance of a biofilter is critical for which of the following?

* 1. Limiting ammonia and nitrite accumulation
  2. Maintaining adequate salinity
  3. Preventing gas bubble disease
  4. Removing sediments and sanitizing the water

**Answer: a. Limiting ammonia and nitrite accumulation**

**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. 80
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 19 - Biology and Management of Zebrafish, p. 869

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

**109.** According to Good Laboratory Practice for conducting nonclinical laboratory studies, which of the following best describes what a sponsor is?

1. Any person or organizational element, except the study director, designated by testing facility management to perform the duties relating to quality assurance of nonclinical laboratory studies.
2. Individual responsible for the overall conduct of a nonclinical laboratory study
3. Person who submits a nonclinical study to the Food and Drug Administration in support of an application for a research or marketing permit
4. Test site manager who supports the study by provision of financial or other resources

**Answer: c. Person who submits a nonclinical study to the Food and Drug Administration in support of an application for a research or marketing permit**

**Reference:** 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

**Domain 5**

**110.** A ring-tailed lemur is presented for treatment of renal failure characterized by a BUN of 120 mg/dl, a creatinine of 1.4 mg/dl, and a hematocrit of 35%. What concerns should you have in providing appropriate treatment for anemia?

1. Lemurs normally have lower hematocrit values than other species (less than 40%) so this animal is not anemic
2. Iron supplementation in lemurs can cause liver damage due to hemosiderosis
3. Iron supplementation in lemurs can exacerbate oral and gastric ulceration that can occur with renal failure
4. Iron absorption is inhibited by the high level of vitamin C in primate diets making oral iron supplementation less effective than injectable

**Answer: b. Iron supplementation in lemurs can cause liver damage due to hemosiderosis**

**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 10 – Nutrient Requirements and Dietary Husbandry Principles for Captive Nonhuman Primates, p. 280.
2. Anderson and Wolf. 2014. Iron deficiency anemia in a ring-tailed lemur (*Lemur catta*) with concurrent chronic renal failure. JAVMA244(4):471-475.

**Domain 1; Tertiary Species – Other Nonhuman Primate**

**111.** All of the following apply to the use of rabbits in polyclonal antibody production **EXCEPT**?

1. Vast amount of information is available on the purification of rabbit immunoglobulins
2. Presence of a single primary immunoglobulin A isotype in rabbits
3. Rabbits are ideal due to their large body size and blood volume
4. Most rabbit B cells have the same VH gene

**Answer: b. Presence of a single primary immunoglobulin A isotype in rabbits**

**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 11 - Polyclonal Antibody Production, pp. 259-260.

2) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 9 - Biology and Diseases of Rabbits, p. 331.

**Domain 3; Primary Species - Rabbit (*Oryctolagus cuniculus*)**

**112.** What percentage of the total volume of water in a zebrafish recirculating water system should be drained off and replaced each day?

* 1. 0-5%
  2. 5-10%
  3. 10-15%
  4. 20-25%

**Answer: b. 5-10%**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 19 – Biology and Management of the Zebrafish, p. 873.
2. Lawrence and Mason. 2012. Zebrafish housing systems: a review of basic operating principles and considerations for design and functionality. ILAR J 53(2):179-191

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

**113.** Which of the following **IS NOT** required in the annual review to OLAW?

1. Minority views filed by IACUC members
2. Any change in the description of the institution’s program for animal care as outlined in the institution’s current Assurance
3. Any changes in IACUC membership
4. Dates the IACUC conducted its semiannual evaluation of institution’s program
5. Names of all IACUC members

**Answer: e. Names of all IACUC members**

**Reference:** Office of Laboratory Animal Welfare. 2002. Public Health Service Policy on Humane Care and Use of Laboratory Animals. National Institutes of Health, Bethesda, MD, pp. 17-18

**Domain 5**

**114.**  Which of the following best describes a dixenic animal?

a. Animal that has two cervices

b. Animal that has received a transplanted organ from another species

c. Gnotobiotic animal that has been raised in association with two microbial species

d. Chimeric animal

e. Hybrid of two species

**Answer: c. Gnotobiotic animal that has been raised in association with two microbial species**

**Reference:** 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 1**

**115.** Euthanasia of female mice via carbon dioxide asphyxiation compared with cervical dislocation resulted in which of the following changes?

* 1. Higher pH, higher pCO2 and higher oocyte fertilization rate
  2. Higher pH, higher pCO2 and lower oocyte fertilization rate
  3. Higher pH, lower pCO2 and higher oocyte fertilization rate
  4. Lower pH, higher pCO2 and lower oocyte fertilization rate
  5. Lower pH, higher pCO2 and higher oocyte fertilization rate

**Answer: d. Lower pH, higher pCO2 and lower oocyte fertilization rate**

**References:**

1. Hazzard et al. 2014. Method of euthanasia influences the oocyte fertilization rate with fresh mouse sperm. JAALAS 53(6):641-646
2. American Veterinary Medical Association. 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, pp. 48-49

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

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

**116.** Which of the following hybrid crosses develops an autoimmune disease resembling human lupus erythematosus?

1. B6 X C3H
2. NZB X NZW
3. FVB X BALB/c
4. DBA X AKR

**Answer: b. NZB X NZW**

**References**

1) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 10 - Microbiological Quality Control for Laboratory Rodents and Lagomorphs, p. 109.

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 6 – Clinical Chemistry of the Laboratory Mouse, p. 191.

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

**117.** At what decibel noise level exposure do exposed employees need to participate in a hearing-conservation program that includes monitoring, audiometric testing, hearing protection, training, and record-keeping?

1. > 70 dB
2. > 85 dB
3. > 90 dB
4. > 95 dB

**Answer: b. >85 dB**

**Reference:**

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. 49-50.
2. 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. 41.

**Domain 4**

**118.** According to the Animal Welfare Act and its Regulations, the litter pan may be considered part of the minimum floor space required for cats if which of the following criteria are met?

* 1. Litter pan is kept cleaned and sanitized
  2. Litter pan is never considered part of the minimum floor space under any circumstances
  3. Litter pan is placed on a perch within the enclosure
  4. Sides of the litter pan are less than 6 inches

**Answer: a. Litter pan is kept cleaned and sanitized**

**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, §3.6 Primary enclosures (11-6-13 Edition, pp. 64-65)

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

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

**119.** Which of the following national agencies has a mission “to catalyze the generation of innovative methods and technologies that will enhance the development, testing, and implementation of diagnostics and therapeutics across a wide range of human diseases and conditions”?

1. HRPP
2. ORIP
3. NCATS
4. NIA
5. NIDDK

**Answer: c. NCATS**

**References:**

1. http://ohsr.od.nih.gov/OHSR/index.php
2. http://www.ncats.nih.gov/about/mission.html
3. http://dpcpsi.nih.gov/orip/index
4. http://www.nia.nih.gov/about/mission
5. http://www.niddk.nih.gov/about-niddk/meet-the-director/mission-vision/Pages/mission-vision.aspx

**Domain 6**

**120.** Which of the following measures may be helpful in preventing pregnancy toxemia in pregnant ewes?

1. Decreasing access to forage in late gestation
2. Keeping ewes in non-fat body condition throughout gestation
3. Providing free-feed grain throughout gestation
4. Removing mineral licks 2 weeks prior to parturition

**Answer: b. Keeping ewes in non-fat body condition throughout gestation**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 14 – Biology and Diseases of Ruminants: Sheep, Goats, and Cattle, pp. 602-603.
2. Pugh DG, Baird AN, eds. 2012. Sheep and Goat Medicine, 2nd edition. Elsevier Saunders: Maryland Heights, MO. Chapter 8 – Theriogenology of Sheep and Goats, pp. 200-201.

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

**121.** 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.)**

**122.** Which of the following sites is the preferable location of venipuncture to collect large amounts of blood from a sedated *Cavia porcellus*?

1. Orbital sinus
2. Anterior vena cava
3. Jugular vein
4. Medial saphenous vein

**Answer: b. Anterior vena cava**

**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 22 – Basic Experimental Methods, p. 662
2. Dang et al. 2008. Efficacy and safety of five injectable anesthetic regimens for chronic blood collection from the anterior vena cava of guinea pigs. JAALAS 47(6): 56-60.

2) Harkness JE, Turner PV, VandeWoude S, Wheler CL. 2010. Harkness and Wagner's Biology and Medicine of Rabbits and Rodents. 5th edition. Wiley-Blackwell: Ames, IA. Chapter 3 – Clinical Procedures, pp.111-112.

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

**123.** Preventive medicine programs, conducted under the guidance of the veterinarian, are important for maintenance of healthy animals and may include all of the following **EXCEPT?**

1. Disease prophylaxis utilizing pharmaceutical agents
2. Isolation and quarantine of incoming animals
3. Random submission of designated samples from healthy animals to a dedicated animal diagnostic laboratory
4. Separate housing of animals according to species, source or different background microbial floras
5. Surveillance of colonies for specific infectious microbial agents

**Answer: c. Random submission of designated animal samples to a dedicated animal diagnostic laboratory**

**Reference:** 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. B.3. Role of the Veterinarian, pp. 54-55 http://grants.nih.gov/grants/olaw/guidebook.pdf

**Domain 5**

**124.** All of the following are potentially transmitted by blood transfusion in nonhuman primates **EXCEPT**?

1. Chagas Disease
2. Cytomegalovirus
3. Malaria
4. Simian retrovirus
5. Trichomoniasis

**Answer: e. Trichomoniasis**

**References:**

1. Fong et al. 2014. Transmission of Chagas disease via blood transfusions in 2 immunosuppressed pigtailed macaques (*Macaca nemestrina*). Comparative Medicine 64(1):63-67.
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 4 - Parasitic Diseases of Nonhuman Primates, pp. 202-206.

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

**125.**  In which of the following amphibians has the acetic acid wiping response been used as a model to evaluate analgesic compounds and to better understand opioid receptor function in amphibians?

1. *Ambystoma tigrinum*
2. *Rana catesbeiana*
3. *Rana pipiens*
4. *Testudo hermanni*
5. *Xenopus laevis*

**Answer:** **c. *Rana pipiens***

**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 20 – Anesthesia and Analgesia in Amphibians, p. 517.
2. O’Rourke D. 2007. Amphibians used in research and teaching. ILAR J48(3):183-187.

**Domain 2; Tertiary Species – Other Amphibians**

**126.** Which of the following anatomical differences is unique to the pig compared to humans?

1. Coronary circulation has few subepicardial collateral anastomoses
2. Myocardial blood supply from the coronary artery is right-side dominant
3. Left azygous vein drains into the coronary sinus
4. Aorta has a true vaso vasorum

**Answer: c. Left azygous vein drains into the coronary sinus**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 15 - Biology and Diseases of Swine, p. 618
2. Harig et al. 2010. Refinement of pig retroperfusion technique: global retroperfusion with ligation of the azygos connection preserves hemodynamic function in an acute infarction model in pigs (Sus scrofa domestica). Comparative Medicine 60(1):38-44

**Domain 3; Primary Species – Swine (Sus scrofa)**

**127.** All of the following describes nutrition and protein in rodents **EXCEPT**?

* 1. Dietary protein-induced nephritis is rarely reported in mice
  2. Breeding diets need contain no more than 18-19% protein
  3. The amino acids D-cysteine and cystine inhibit growth in mice
  4. Tyrosine is considered an essential amino acid for the mouse

**Answer: d. Tyrosine is considered an essential amino acid for the mouse**

**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 10 – Nutrition, pp. 332-334.
2. Harkness JE, Turner PV, VandeWoude S, Wheler CL. 2010. Harkness and Wagner’s Biology and Medicine of Rabbits and Rodents, 5th ed. Wiley-Blackwell: Ames, IA. Chapter 2 – Biology and Husbandry, p. 90.

**Domain 4**

**128.** According to the Animal Welfare Act and its regulations, all of the following apply to outdoor housing facilities for marine mammals **EXCEPT**?

* 1. With regard to potentially dangerous animals, fences less than 8 feet high must be approved in writing by the APHIS Administrator
  2. Fences must be constructed so that they protect the animals in the facility by restricting outside animals and unauthorized persons from going through it or under it
  3. Fences must be of sufficient distance from the outside of a primary enclosure to prevent physical contact between animals inside the enclosure and animals or persons outside the perimeter fence
  4. Fences less than 5 feet in distance from the primary enclosure must be approved in writing by the APHIS Administrator

**Answer: d. Fences less than 5 feet in distance from the primary enclosure must be approved in writing by the APHIS Administrator**

**Reference:** Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 3 – Standards, Subpart E – Specifications for the Humane Handling, Care, Treatment, and Transportation of Marine Mammals, § 3.103 (c) Facilities, outdoor (11-6-13 Edition, pp. 111-112)

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

**Domain 5; Tertiary Species – Other Mammals**

**129.** What are the main concerns in terms of viral disease transmission between species when mixing African nonhuman primate species with Asian or new world nonhuman primate species?

1. Dengue Fever and Tanapox
2. SIV and SHFV
3. SRV/D and Hepatitis A
4. Yellow Fever and Monkey Pox

**Answer: b. SIV and SHFV**

**References:**

1. Gardner and Luciw. 2008. Macaque models of human infectious disease. ILAR J 49(2):220-255.
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 16 – Nonhuman Primates, pp. 751-753, 756
3. 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. 47-49, 62-70

**Domain 1**

**130.** Which of the following euthanasia methods is most commonly used and was shown in a recent study to improve fertilization rate in mouse embryos and reduced the number of egg-donor mice required?

a. Carbon dioxide inhalation

b. Cervical dislocation

c. Isoflurane inhalation overdose

d. Pentobarbital intraperitoneal

**Answer: b. Cervical dislocation**

**Reference:** Hazzard et al. 2014. Method of euthanasia influences the oocyte fertilization rate with fresh mouse sperm. JAALAS 53(6):641-646.

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

**131.** Ultrasonic vocalizations of rats that show a positive affective state can be measured at \_\_\_\_\_ KHz?

a. 10 KHz

b. 22 KHz

c. 50 KHz

d. 85 KHz

**Answer: c. 50 KHz**

**References:**

1) Cloutier et al. 2014. The social buffering effect of playful handling on responses to repeated intraperitoneal injections in laboratory rats. JAALAS 53(2):168-173.

2) Brudzynski. 2009. Communication of adult rats by ultrasonic vocalization: biological, sociobiological, and neuroscience approaches. ILAR J 50(1):43-50.

**Domain 4; Primary Species – Rats (Rattus norvegicus)**

**132.** According to the 8th Edition of the Guide for the Care and Use of Laboratory Animals, whether a laproscopic procedure should be classified as major or minor should be determined by which of the following?

1. On a case-by-case basis by either the researcher or veterinarian
2. For all laproscopic surgeries at a particular institution by an IACUC designated member reviewer, the IACUC, the attending veterinarian, or the researcher involved.
3. On a case-by-case basis by the researcher and IACUC
4. On a case-by-case basis by the IACUC and veterinarian

**Answer: d. On a case-by-case basis by the IACUC and veterinarian**

**References:**

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. 117-118.
2. http://grants.nih.gov/grants/olaw/faqs.htm

**Domain 5**

**133.** Which of the following best describes monocytic Ehrlichiosis in dogs?

1. Condition is caused by a gram-negative bacteria, *Ehrlichia platys*
2. Penicillins are the treatment of choice and can be given for up to a month
3. Thrombocytopenia is the most consistent laboratory abnormality during all disease stages
4. Primary vector is the American dog tick *(Dermacentor variabilis)*
5. Morulae can sometimes be demonstrated in circulating lymphocytes

**Answer: c. Thrombocytopenia is the most consistent laboratory abnormality during all disease stages**

**References:**

1) McQuiston et al. 2003. [Ehrlichiosis and related infections.](http://www.ncbi.nlm.nih.gov/pubmed/14690204) JAVMA 223(12):1750-1756

2) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 11 - Biology and Diseases of Dogs, pp. 409-411

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

**134.** All of the following agents are classified under Dual Use Research of Concern and regulated by the Select Agent Program under federal law and have the potential to pose a severe threat to human, animal, or plant health, or to animal and plant products **EXCEPT**?

1. Avian influenza virus (highly pathogenic)
2. Ebola virus
3. Foot-and-mouth disease
4. Swine vesicular disease

**Answer: d. Swine vesicular disease**

**References:**

1. United States Government Policy for Oversight of Life Sciences Dual Use Research of Concern http://www.phe.gov/s3/dualuse/documents/us-policy-durc-032812.pdf
2. The National Institutes of Health, Office of Science Policy <http://osp.od.nih.gov/office-biotechnology-activities/biosecurity/dual-use-research-concern>

**Domain 5**

**135.** Initial medical assessment after a suspected exposure to simian-immunodeficiency virus should include all of the following **EXCEPT?**

* 1. Baseline serology
  2. Complete blood count
  3. HIV ELISA test
  4. Pregnancy testing, when appropriate
  5. Serum chemistry panel

**Answer: c. HIV ELISA test**

**Reference:** Committee on Occupational Health and Safety in the Care and Use of Nonhuman Primates, Institute for Laboratory Animal Research, Division on Earth and Life Studies, National Research Council of the National Academies. 2003. Occupational Health and Safety in the Care and Use of nonhuman primates. The National Academies Press, Washington, D. C. Chapter 9 – Postexposure Medical Treatment in Nonhuman-Primate Facilities, p. 145.

**Domain 4**

**136.** What is the recommended number of days within milling for use of guinea pig commercial chows?

1. 30
2. 60
3. 90
4. 120
5. 180

**Answer: c. 90**

**References:**

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 24 – Non-Infectious Diseases, p. 697.

2) Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 5 – Guinea Pig, p. 239.

3) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 6 – Biology and Diseases of Guinea Pigs, p. 231

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

**137.** To provide regional analgesia to repair a femoral fracture in either a pig or a guinea pig, the local analgesic agent is infiltrated around which nerve(s)?

1. Femoral
2. Femoral and sciatic
3. Perineal
4. Perineal and sciatic
5. Sciatic

**Answer: b. Femoral and sciatic**

**References:**

1. Royal et al. 2013. Assessment of postoperative analgesia after application of ultrasound-guided regional anesthesia for surgery in a swine femoral fracture model. JAALAS 52(3):265-276.
2. Aguiar et al. 2013. Femoral fracture repair and sciatic and femoral nerve blocks in a guinea pig. J Small Anim Pract 55(12):635-639.

**Domain 2; Primary Species – Pig (Sus scrofa) and Secondary Species – Guinea Pig (Cavia porcellus)**

**138.** Which of the following organizations provides a listserv to engage active conversation about all things training regarding the use of laboratory animals in research?

1. AWIC
2. ICLAS
3. LAWTE
4. NABR
5. SCAW

**Answer: c. LAWTE**

**References:**

1. http://www.lawte.org
2. http://www.nabr.org/about/
3. http://awic.nal.usda.gov/
4. http://www.scaw.com/about-scaw/

**Domain 6**

**139.** In sheep and goats, infection with *Dichelobacter nodosus* most commonly causes which of the following conditions?

1. Blue bag
2. Foot rot
3. Lumpy jaw
4. Sore mouth
5. Wooden tongue

**Answer: b. Foot rot**

**References:**

1) Hubrecht R, and Kirkwood J, eds. 2010. The Care and Management of Laboratory and Other Research Animals, 8th ed. Wiley-Blackwell: Ames, IA. Chapter 34 – Sheep and Goats, p. 522

2) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 14 - Biology and Diseases of Ruminants: Sheep, Goats, and Cattle, pp. 549-550.

**Domain 1; Secondary Species - Sheep (*Ovis aries*) and Goat (*Capra hircus*)**

**140.** Which of the following studies would be performed using Good Laboratory Practices for Nonclinical Laboratory Studies?

1. Bench tests, such as chemical or physical testing
2. Studies utilizing human subjects, human specimens, clinical studies
3. Field trials in animals (e.g., wildlife studies)
4. *In vivo* or *in vitro* experiment in which a test article is studied prospectively in a test system under laboratory conditions to determine its safety

**Answer: d. *In vivo* or *in vitro* experiment in which a test article is studied prospectively in a test system under laboratory conditions to determine its safety**

**Reference:** 21 CFR, Chapter 1 – Food and Drug Administration, Department of Health and Human Services, Subchapter A – General, Part 58 Good Laboratory Practice for Nonclinical Laboratory Studies, Subpart E--Testing Facilities Operation, §58.1 – Scope and §58.3 Definitions (http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?CFRPart=58&showFR=1)

**Domain 5**

**141.** Which of the following breeds of goat serves as a model of β-mannosidosis?

1. Fainting
2. La Mancha
3. Nubian
4. Pygmy
5. Saanen

**Answer: c. Nubian**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 14 - Biology and Diseases of Ruminants: Sheep, Goats, and Cattle, p. 522.
2. Smith MC and Sherman DM. 2009. Goat Medicine, 2nd edition. Wiley-Blackwell: Ames, IA. Chapter 5 – Neurologic Diseases, p. 238

**Domain 3; Secondary Species - Goat (Capra hircus)**

**142.** With a water temperature of28.5oC, how many minutes after fertilization does it take for the first embryo cleavage in zebrafish to occur?

1. 15
2. 30
3. 45
4. 60
5. 75

**Answer: c. 45**

**Reference:** Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 19 – Biology and Diseases of Zebrafish, p. 863.

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

**143.** According to the Animal Welfare Act and its regulations, a health certificate issued within how many days of shipment must accompany any dog or cat that is transported in commerce by a licensee or registrant?

1. 1
2. 3
3. 5
4. 10
5. 30

**Answer: d.** **10**

**References:**

1. Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 2 – Regulations, Subpart G – Records, §2.78 (a)(1) Health certification and identification (11-6-13 Edition, p. 48)

(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 # 18: Health Certificate for Dogs, Cats, and Nonhuman Primates. March 25, 2011.

(http://www.aphis.usda.gov/animal\_welfare/policy.php?policy=18)

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

**144.** Which of the following applies to the identification of Streptococcal infections in guinea pigs?

1. Lancefield group C, gram-negative, non-encapsulated coccus that produces beta hemolysis on blood agar plates
2. Lancefield group B, gram-positive encapsulated coccus that produces beta hemolysis on blood agar plates
3. Lancefield group A, gram-positive encapsulated coccus that produces beta hemolysis on blood agar plates
4. Lancefield group C, gram-positive encapsulated coccus that produces beta hemolysis on blood agar plates
5. Lancefield group B, gram-negative non-encapsulated coccus that produces beta hemolysis on blood agar plates

**Answer: d. Lancefield group C, gram-positive encapsulated coccus that produces beta hemolysis on blood agar plates**

**References:**

1) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 6 - Biology and Diseases of Guinea Pigs, p. 213

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. 648-650

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

**145.** Which of the following refers to the derivation of such an animal stock or strain in which all life forms have been completely defined?

1. Conventional animal
2. Gnotobiote
3. Restricted flora
4. Specific pathogen free

**Answer: b. Gnotobiote**

**Reference:** 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)**

**146.** Which of the following nonhuman primates would benefit most from alternating sanitation of enclosure areas and enrichment devices to maintain territorial scent markings?

1. *Aotus* spp.
2. *Chlorocebus* spp.
3. *Macaca nemestrina*
4. *Papio anubis*

**Answer: a. Aotus spp.**

**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 12 – Preventative Medicine in Nonhuman Primates, p. 304
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 16 – Nonhuman Primates, p. 690

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

**147.** According to Good Laboratory Practice for conducting nonclinical laboratory studies, all of the following statements describes the responsibilities of a study director **EXCEPT**?

1. Ensuring all applicable good laboratory practice regulations are followed
2. Ensuring all experimental data, including observations of unanticipated responses of the test system are accurately recorded and verified.
3. Ensuring only raw data is transferred to the archives during or at the close of the study
4. Ensuring protocol, including any change, is approved
5. Ensuring test systems are as specified in the protocol

**Answer: c. Ensuring only raw data is transferred to the archives during or at the close of the study**

**Reference:** 21CFR PART 58—Good Laboratory Practice for Nonclinical Laboratory Studies, Subpart B – Organization and Personnel, § 58.33 Study director

http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?fr=58.33

**Domain 5**

**148.** Which of the following laboratory animals can be fed with either a guinea pig or rabbit formulation?

a. Chinchilla

b. Cotton rats

c. Degus

d. Gerbils

**Answer: a. Chinchilla**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 7 – Biology and Diseases of Other Rodents, pp. 286-287.
2. 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 40 – Management, Husbandry, and Colony Health, p. 970

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

**149.** In a recent study it was shown that mice will emit vocalizations at frequencies higher than \_\_\_\_KHz when euthanized unanesthetized with CO2?

a. 5

b. 10.6

c. 12

d. 18.5

e. 26.5

**Answer: e. 26.5**

**References:**

1) Valentine et al. 2012. Sedation or inhalant anesthesia before euthanasia with CO2 does not reduce behavior or physiologic signs and stress in mice. JAALAS 51(1):50-57.

2) Williams et al. 2008. Ultrasonic sound as an indicator of acute pain in laboratory mice. JAALAS 47(1):8-10

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

**150.** Elevations in corticosterone levels in mice during gavage can be mitigated by dipping the gavage needle in what solution?

1. Citrate
2. Sodium chloride

c. Sucrose

d. Water

**Answer: c. Sucrose**

**References:**

1. Hoggatt et al. 2010. A spoonful of sugar helps the medicine go down: a novel technique to improve oral gavage in mice. JAALAS 49(3):329–334.
2. [Turner et](http://www.ncbi.nlm.nih.gov/pubmed/?term=Turner%20PV%5Bauth%5D) al. 2011. Administration of substances to laboratory animals: routes of administration and factors to consider. JAALAS50(5):600–613.

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

**151.** All of the following applies to snake housing **EXCEPT**?

1. Corn cob and calcium carbonate bedding substrates can lead to GI impaction
2. External heat sources are needed due to them being ectotherms
3. Humidity of 20% could lead to dysecdysis
4. Plastic is often used for primary enclosures
5. They need a UVB source in the 100-200 nm wavelength range to endogenously produce Vitamin D

**Answer: e. They need a UVB source in the 100-200 nm wavelength range to endogenously produce Vitamin D**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine. 2nd edition. Academic Press: San Diego, CA. Chapter 18 – Biology and Diseases of Reptiles, pp. 830-834.
2. Mitchell. 2004. Snake care and husbandry. Veterinary Clinics of North America: Exotic Animal Practice 7(2): 421-446.

**Domain 4; Tertiary Species – Reptiles**

**152.** According to the most recent edition of the Guide for the Care and Use of Laboratory Animals, what is the minimum recommended space per animal for two pigs weighing 40 and 50 kilograms?

a. 6.0 ft2

b. 10.0 ft2

c. 20.0 ft2

d. 40.0 ft2

**Answer: b. 10.0 ft2**

**Reference:** Institute for Laboratory Animal Research. 2011. Guide for the Care and Use of Laboratory Animals The National Academies Press: Washington, D.C. Chapter 3 – Environment, Housing and Management, p. 62.

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

**153.** When making a histological diagnosis of liver fibrosis, how do collagen fibers appear when stained with Masson Trichome?

1. Apple-green and birefringent under polarized light
2. Blue when viewed using bright-field microscopy
3. Dark brown when viewed using bright-field microscopy
4. Lemon yellow and birefringent under polarized light

**Answer: b. Blue when viewed using bright-field microscopy**

**References:**

1)Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 2 – Rat, p. 165.

2) Hu et al. 2010. Ligation of the left circumflex coronary artery with subsequent MRI and histopathology in rabbits. JAALAS 49(6):838-844

**Domain 1**

**154.** Parkinson’s disease-like symptoms develop in rhesus macaques following administration of which of the following substances?

1. 9-hydroxy-dopamine
2. 6-methyl-4-phenyl-1,2,3,6-tetrahydropyridine
3. 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine
4. 3-nitropropionic acid
5. Quinolinic acid

**Answer: c. 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine**

**References:**

1. Emborg. 2007. Nonhuman primate models of Parkinson’s disease. ILAR J 48(4):339-355.
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 30 – Animal Models in Biomedical Research, p. 1187.
3. Jakowec and Petzinger. 2005. 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine-lesioned model of Parkinson's disease, with emphasis on mice and nonhuman primates. Comparative Medicine 54(5): 497-513
4. 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 3; Primary Species – Macaques (Macaca spp.)**

**155.** Which of the following terms describe reduced food intake in rodents during water deprivation?

1. Behavioral anorexia
2. Compensatory feed reduction
3. Compensatory feed restriction
4. Compensatory feed/water ratio
5. Dehydration anorexia

**Answer: e. Dehydration anorexia**

**References:**

1. Bekkevold et al. 2013. Dehydration parameters and standards for laboratory mice. JAALAS 52(3):233-239.
2. Rowland. 2007. Food and fluid restriction in common laboratory animals: balancing welfare considerations with scientific inquiry. Comparative Medicine 57(2):149-160.

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

**156.** According to the Office of Laboratory Animal Welfare, which of the following individuals **IS NOT** qualified to be a non-affiliated member of an IACUC?

1. Daughter of a researcher at the same institution
2. Human resources specialist at another institution
3. Previous patient at the same institution if the institution is a hospital
4. Uncle of a researcher at the same institution

**Answer: a. Daughter of a researcher at the same institution**

**Resources:**

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, pp. 24-25
2. Office of Laboratory Animal Welfare. 2002. Public Health Service Policy on Humane Care and Use of Laboratory Animals. National Institutes of Health, Bethesda, MD, p. 11
3. http://grants.nih.gov/grants/olaw/faqs.htm#595

**Domain 5**

**157.** Sendai virus in mice is characterized by which of the following histopathological descriptions?

a. Disseminated liver and kidney lesions consisting of focal necrosis and inflammatory infiltrates

b. Immune-mediated necrosis of airways; may be preceded by hypertrophy and hyperplasia of the bronchiolar epithelium

c. Skin lesions consisting of focal epidermal hyperplasia, with hypertrophy and ballooning of epithelial cells

d. Vacuolation and intracytoplasmic inclusions of enterocytes at the tips of villi and large intestinal mucosa

**Answer: b. Immune-mediated necrosis of airways; may be preceded by hypertrophy and hyperplasia of the bronchiolar epithelium.**

**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, pp. 69-71.
2. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 1 – Mouse, p. 38.

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

**158.** Both injectable and transdermal preparations of which of the following sustained-released drugs have been associated with self-limiting skin reactions?

1. Bupivacaine
2. Buprenorphine
3. Carprofen
4. Fentanyl
5. Lidocaine

**Answer: b.** **Buprenorphine**

**References:**

1) Thiede et al. 2014. Pharmacokinetics of sustained-release and transdermal buprenorphine in Göttingen minipigs (Sus scrofa domestica). JAALAS 53(6):692–699.

2) Foley et al. 2011. Evaluation of sustained-release formulation of buprenorphine for analgesia in rats. JAALAS 50(2):198-204.

**Domain 2**

**159.** According to the AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, which of the following methods of euthanasia is considered to be acceptable for mice?

a. Carbon dioxide

b. Cervical dislocation

c. Decapitation

d. Focused beam microwave irradiation

e. Lethal dose of ketamine and xylazine

**Answer: e. Lethal dose of ketamine and xylazine**

**Reference:** American Veterinary Medical Association. 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, pp. 48-49

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

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

**160.** Which of the follow most accurately describes Class II Type B1 biosafety cabinets?

* 1. Have a 100 linear feet per minute face velocity and negative pressure plenums and are hard-ducted to the building’s exhaust system
  2. Air is recirculated and may be connected to the building’s exhaust through a thimble connection
  3. Should provide personnel protection and need not protect animals or samples.
  4. Should have air flow with 100% exhaust such that the cabinets do not recirculate air

**Answer: a. Should have a 100 linear feet per minute face velocity and negative pressure plenums and are hard-ducted to the building’s exhaust system**

**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 9 – Design and Management of Research Facilities for Mice, p. 301.
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 24 – Control of Biohazards Associated with the Use of Experimental Animals, p. 1050.

**Domain 4**

**161.** According to the 2013 AVMA Guidelines on Euthanasia: 2013 Edition, which of the following statements best describes the effects of carbon dioxide (CO2)?

One day old neonatal rats exposed to 100% CO2 require exposure time of 50 minutes for death

One day old neonatal mice exposed to 95% CO2 require exposure time of 35 minutes for death

If CO2 asphyxiation is used in young mammals, rabbits, reptiles, amphibians and birds, high carbon dioxide concentrations, with extended exposure times followed by a secondary method may be required to ensure death

For adult mink, 10 minutes of exposure to 100% CO2 was required to ensure death

Whenever gradual displacement methods are used, CO2 flow should be maintained for at least 3 minutes after respiratory arrest

**Answer: c. If CO2 asphyxiation is used in young mammals, rabbits, reptiles, amphibians and birds, high carbon dioxide concentrations, with extended exposure times followed by a secondary method may be required to ensure death**

**Reference:** American Veterinary Medical Association. 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, pp. 24-26

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

**Domain 5**

**162.** Which of the following best describes pinworms in rats?

1. *S. muris* is the most common species of pinworm found in the laboratory rat and either cecal examination or tape test alone can reliably predict infection
2. *S. obvelata* is the most common species of pinworm found in the laboratory rat and either cecal examination or tape test alone can reliably predict infection
3. *S. muris* is the most common species of pinworm found in the laboratory rat and neither cecal examination nor tape test alone can reliably predict infection
4. *S. obvelata* is the most common species of pinworm found in the laboratory rat and neither cecal examination nor tape test alone can reliably predict infection

**Answer: c. S. muris is the most common species of pinworm found in the laboratory rat and neither cecal examination nor tape test alone can reliably predict infection.**

**References:**

1. Meade and Watson. 2014. Characterization of rat pinworm (*Syphacia muris*) epidemiology as a means to increase detection and elimination. JAALAS 53(6):661-667
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 4 – Biology and Diseases of Rats, p. 149.
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. 339-340

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

**163.** When sampling for fur mites on mice, all of the following sites are commonly sampled **EXCEPT**?

1. Axillary regions
2. Base of tail
3. Head
4. Inguinal areas
5. Ventral abdomen

**Answer: a. Axillary regions**

**References:**

1. Karlsson et al. 2014. Combined evaluation of commonly used techniques, including PCR, for diagnosis of mouse fur mites. JAALAS 53(1):69–73.
2. Jensen et al. 2013. PCR testing of a ventilated caging system to detect murine fur mites. JAALAS 52(1):28–33.
3. Rice et al. 2013. Evaluation of diagnostic methods for Myocoptes musculinis according to age and treatment status of mice (Mus musculus). JAALAS 52(6):773–781
4. Baker DG, ed. 2007. Flynn’s Parasites of Laboratory Animals, 2nd edition. Blackwell Publishing, Iowa, USA. Chapter 11 – Parasites of Rats and Mice, pp. 361-362

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

**164.** What type of strain is indicated with the following designation: B6.D2N*Ahrd*/J?

1. Coisogenic strain carrying the *Ahrd* allele originating from the DBA2/N donor strain on a C57BL/6 inbred background.
2. Coisogenic strain carrying the *Ahrd* allele originating from the C57BL/6 donor strain on a DBA2/N inbred background.
3. Congenic strain carrying the *Ahrd* allele originating from the DBA2/N donor strain on a C57BL/6 inbred background.
4. Congenic strain carrying the *Ahrd* allele originating from the C57BL/6 donor strain on a DBA2/N inbred background.

**Answer***.***c. Congenic strain carrying the Ahrd allele originating from the DBA2/N donor strain on a C57BL/6 inbred background**

**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. October 2013.

http://www.informatics.jax.org/mgihome/nomen/strains.shtml#congenic

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

**165.** Which of the following statements applies to disaster planning and emergency preparedness?

1. Should identify essential personnel that should be trained in advance of its implementation
2. Should establish how animals can be relocated in the face of disaster rather than euthanized
3. Should be approved by all the investigators at an institution
4. Should be independent of other disaster response efforts at the institution because of the unique animal component

**Answer: a. Identify essential personnel that should be trained in advance of its implementation**

**References:**

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, p. 35
2. Bayne K, Turner PV, eds. 2014. Laboratory Animal Welfare. Academic Press: San Diego, CA. Chapter 10 - Preservation of Animal Welfare during Unforeseen Events, pp. 146-150

**Domain 4**

**166.** According to the 2013 AVMA Guidelines on Euthanasia: 2013 Edition, which of the following statements best describes euthanasia of fetuses and neonates in rodents with altricial young?

a. Hypothermia is an acceptable method when fetuses are > 7 days of age and placed in direct contact with ice or pre-cooled surfaces

b. Hypothermia is acceptable with conditions when fetuses are < 7 days old and not in contact with ice or pre-cooled surfaces

c. Injectable barbiturates alone are an unacceptable method of euthanasia

d. When using injectable barbiturates, it is necessary to remove to fetuses for euthanasia after the dam is euthanized

**Answer: b. Hypothermia is acceptable with conditions when fetuses are < 7 days and not in contact with ice or pre-cooled surfaces**

**Reference:** 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 5**

**167.** Which of the following are frequent pathogens infecting the skin and gills of a wide range of wild-caught, marine and freshwater fish and identified by their large attachment organ with multiple anchors or hooks?

1. *Icthyophthirius multifiliis*
2. Monogean flatworms
3. *Pseudocapillaria tomentosa*
4. Trichodinosis
5. Turbellarian worms

**Answer: b. Monogean flatworms**

**References:**

1. Garcia et al. 2014. Gryodactylid ectoparasites in a population of rainbow trout (*Oncorhynchus mykiss*). JAALAS 53(1):92-97.
2. Noga EJ. 1996. Fish Disease: Diagnosis and Treatment. Mosby Publishing: St. Louis, MO. Chapter 14 – Problems 10 through 42, pp. 88-93.
3. Baker DG, ed. 2007. Flynn’s Parasites of Laboratory Animals, 2nd edition. Blackwell Publishing, Iowa, USA. Chapter 7 – Parasites of Fishes, pp. 76-79, 87-91.

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

**168.** Which of the following best describes euthanasia of an adult mouse by manual cervical dislocation?

1. Performed using a guillotine
2. Acceptable with the condition that the animal must first be unconscious or anaesthetized if the operator has not demonstrated technical competency
3. Acceptable with the condition that the animal is first pithed
4. Head is held in one hand and the hind limbs in the other, and the animal is stretched to separate the skull from the spine.
5. Causes the immediate cessation of heartbeat

**Answer: b. Acceptable with the condition that the animal must first be unconscious or anaesthetized if the operator has not demonstrated technical competency**

**References:**

1. American Veterinary Medical Association. 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, p. 38

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

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 22 – Preanesthesia, Anesthesia, Analgesia, and Euthanasia, p. 966

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

**169.** Syrian hamsters of the strain Bio TO-2 develop what type of cardiomyopathy which closely resembles the human disease and has been used to study treatment modalities?

* 1. Dilated cardiomyopathy
  2. Hypertrophic cardiomyopathy
  3. Restrictive cardiomyopathy
  4. Arrhythmogenic right ventricular cardiomyopathy
  5. Mitochondrial myopathy

**Answer: a. Dilated cardiomyopathy**

**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 IV – Hamsters. Chapter 34 – The Experimental Use of Syrian Hamsters, p. 885.
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 5 – Biology and Diseases of Hamsters, pp. 169-170.

**Domain 3; Secondary Species – Syrian Hamster (*Mesocricetus auratus*)**

**170.** Which of the following can result when chemical removal of chloramines from municipal water supplies for Xenopus via activated carbon is performed?

1. Acidification of water
2. Breakdown of deionization resins
3. Damage to biofilter
4. Damage to reverse osmosis membrane
5. Release of free ammonia

**Answer: e. Release of free ammonia**

Press: Boca Raton, FL. Chapter 2 – Husbandry, pp. 19-61.

**References:**

1. Green SL. 2010. The Laboratory *Xenopus* sp. CRC
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 17 – Biology and Diseases of Amphibians, p. 797.

**Domain 4; Secondary Species African Clawed Frog (*Xenopus* spp.)**

**171.** According to the Guide for the Care and Use of Laboratory Animals, responsibility for review and investigation of animal welfare concerns in the United States rests with the ?

a. Attending veterinarian

b. Institutional official and IACUC

c. IACUC Chair

d. CEO or Vice President of Research

**Answer: b. Institutional official and IACUC**

**Reference:** 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, p. 23.

**Domain 5**

**172.** Which type of antibiotics is most likely to result in dysbacteriosis and typhilitis when used in guinea pigs?

1. Broad spectrum antibiotics
2. Fluoroquinolones
3. Narrow spectrum antibiotics targeting Gram-negative bacteria
4. Narrow spectrum antibiotics targeting Gram-positive bacteria
5. Tetracyclines

**Answer: d. Narrow spectrum antibiotics targeting Gram-positive bacteria**

**References:**

1. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd edition. Blackwell Publishing: Ames, Iowa. Chapter 5 – Guinea Pig, p. 225.
2. 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 23 – Infectious Diseases, p. 646.

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

**173.** Which of the following describes sensitivity?

1. True Negative\_\_\_\_\_\_\_ x 100

True Negative + False Positive

1. True Positive\_\_\_\_\_\_\_ x 100

True Positive + False Positive

1. True Positive\_\_\_\_\_\_\_ x 100

True Positive + False Negative

1. True Negative\_\_\_\_\_\_\_ x 100

True Negative + False Negative

**Answer: c. True Positive\_\_\_\_\_\_\_\_ x 100**

**True Positive + False Negative**

**Reference:** Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 10 - Microbiological Quality Control for Laboratory Rodents and Lagomorphs, p. 385.

**Domain 3**

**174.** All of the following apply to mouse inbreeding **EXCEPT**?

1. An inbred strain is produced after 20 sister-brother matings but should not be considered completely inbred until 40 matings
2. Mice from an inbred mouse strain are genetically homogeneous each other
3. Large sample sizes are required when using inbred strains
4. Generations of inbred strains are tracked by F numbers

**Answer: c. Large sample sizes are required when using inbred strains**

**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, pp. 36-37.
2. Pritchett-Corning et al. 2011. Guidebook on Mouse and Rat Colony Management. Charles River Laboratories. Part 5 – Laboratory rat and mouse nomenclature, p. 78.

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

**175.** Use of negative directional air flow in animal rooms is an example of which of the following?

1. Engineering controls
2. Personal protective equipment
3. Process controls
4. Standard operating procedures

**Answer: a. Engineering controls**

**References:**

1. 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, pp. 6-7 and Chapter 5 - Physical Plant, pp. 139-146.
2. 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 7 - Risk Management: The Principles Underlying the Design and Implementation of an Occupational Health and Safety Plan, pp. 98-99.

**Domain 5**

**176.** C57BL/6 mice are considered resistant to all of the following viral infections **EXCEPT**?

1. Ectromelia
2. Mouse adenovirus 1
3. Mouse cytomegalovirus
4. Murine polyoma virus

**Answer: b. Mouse adenovirus 1**

**References:**

1. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 1 – Mouse, pp. 17, 19, 22, 26.
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 2 – Mouse Adenoviruses, pp. 56, 61.

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

**177.** Which of the following opioids has the longest duration of action?

1. Buprenorphine
2. Fentanyl
3. Hydromorphone
4. Oxymorphone
5. Morphine

**Answer: a. Buprenorphine**

**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 4 – Pharmacology of Analgesics, pp. 112-115 115.
2. Thiede et al. 2014. Pharmacokinetics of sustained-release and transdermal buprenorphine in Gottingen minipigs (*Sus scrofa domestica*). JAALAS 53(6):692-699.

**Domain 2**

**178.** Which immunodeficient mouse is characterized by a defective DNA-dependent kinase that recombines gene segments coding for T and B cell receptors?

1. Beige
2. Nude
3. Rag-2
4. SCID
5. TcR KO

**Answer: d. SCID mouse**

**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. 55 [Table XII].
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)**

**179.** 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, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 11 – Biology and Diseases of Dogs, p. 398.
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**

**180.** According to the 8th Edition of the Guide for the Care and Use of Laboratory Animals, key components of identification cards should include which of the following?

1. Protocol number, room and facility, source of the animal, sex and pertinent dates (e.g. arrival date, birth date)
2. Protocol number, sex, strain, names and contact information for the responsible investigator(s), genotype, budget number.
3. Sex, strain, date of birth or other pertinent dates, identifying marks
4. Source of the animal, strain or stock, pertinent dates (e.g. arrival date, birth date), names and contact information for the responsible investigator(s) and protocol number

**Answer: d. Source of the animal, strain or stock, pertinent dates (e.g. arrival date, birth date), names and contact information for the responsible investigator(s) and the protocol number**

**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. 75.

**Domain 5**

**181.** Which of the following statements is **TRUE** regarding the immune system effects of mouse hepatitis virus infection in immune competent mice?

* + - * 1. Decreases interferon production
        2. Increases the proliferative response of lymphocytes to mitogens
        3. Induce thymic involution and apoptosis
        4. Suppresses polyclonal immunoglobulin production

**Answer: c. Induce thymic involution and apoptosis**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 29 – Factors That May Influence Animal Research, p. 1159.
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 6 – Mouse Hepatitis Virus, pp. 154-157
3. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 1 – Mouse, pp. 31-36

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

**182.** Which of the following genes is inherited as an autosomal recessive trait with incomplete penetrance in rabbits with malocclusion?

a. mp

b. rm

c. ot

d. mo

e. cm

**Answer: a. mp**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 9 – Biology and Diseases of Rabbits, p. 354.
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 17- Mycoses and Non-infectious Diseases, p.510.

**Domain 3; Primary Species – Rabbit (Oryctolagus cuniculus)**

**183.** Which of the following species requires sand bathing in order to keep their coats from becoming oily?

1. *Mastomys natalensis*
2. *Meriones unguiculatus*
3. *Mesocricetus auratus*
4. *Microtus californicus*

**Answer: b. *Meriones unguiculatus***

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 5 – Biology and Diseases of Hamsters, pp. 178-179; Chapter 7 – Biology and Diseases of Other Rodents, pp. 276-277, 281, 283
2. Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Elsevier: San Diego, CA. Section VI - Other Rodents, Chapter 52 – Gerbils, p. 1138.

**Domain 4; Secondary Species – Gerbils (Meriones spp.)**

**184.** According to the AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, manual cervical dislocation is acceptable with conditions for euthanasia of rats weighing how much when performed by individuals with a demonstrated degree of technical proficiency?

1. < 200 g
2. < 200 g
3. < 250 g
4. < 250 g
5. < 300 g

**Answer: a. < 200 g**

**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 I – General, Chapter 4 – Euthanasia and Necropsy, p. 123.
2. American Veterinary Medical Association. 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, p. 38
3. (https://www.avma.org/KB/Policies/Documents/euthanasia.pdf).

**Domain 5; Primary Species – Rat (Rattus norvegicus)**

**185.** Which of following statements applies to EDIM in mice?

1. Clinical signs of diarrhea and dehydration are common in pups born in endemically infected colonies
2. In infant mice, EDIM virus causes hydropic change and vacuolation of enterocytes located in intestinal crypts
3. Infection is often silent, but clinically affected mice can be runted and potbellied, with loose, mustard-colored feces staining the perineum
4. It is a DNA virus that produced intracytoplasmic inclusions in intestinal epithelial cells

**Answer: c. Infection is often silent, but clinically affected mice can be runted and potbellied, with loose, mustard-colored feces staining the perineum**

**References:**

1. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 1 – Mouse, p. 42.
2. 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. 73.

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

**186.** Hounds, such as the whippet and greyhound, experience increased sleep times, rougher recoveries, and occasional fatalities when anesthetized with barbiturates due to which of the following reasons?

1. Decreased drug solubility
2. Increased drug solubility
3. Increased blood levels of unbound drug
4. Decreased blood levels of unbound drug
5. Inability to metabolize barbiturates

**Answer: c. Increased blood levels of unbound drug**

**Reference:** Tranquilli WJ, Thurmon JC, Grimm KA eds. 2007. Lumb and Jones’ Veterinary Anesthesia and Analgesia, 4th edition. Blackwell Publishing: Ames, IA. Chapter 1 - General Topics, p. 10.

**Domain 2; Primary Species – Dog (Canis familiaris)**

**187.** Which of the following drugs can induce diabetes in mice?

1. Dexemethasone
2. Glucagon
3. Insulin

d. Sildenaphil

e. Streptozotocin

**Answer: e. Streptozotocin**

**References:**

1. Graham et al. 2011. The streptozotocin-induced diabetic nude mouse model: differences between animals from different sources.Comparative Medicine 61(4):356-360.
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 30 – Animal Models in Biomedical Research, p. 1187.

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

**188.** Which of the following mammalian species exhibit eusociality or eusocial behavior?

1. *Acomys cahirinus*
2. *Cavia porcellus*
3. *Heterocephalus glaber*
4. *Synalpheus regalis*

**Answer: c. Heterocephalus glaber**

1. Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Elsevier Academic Press: San Diego, CA. Section VI – Other Rodents, Chapter 45 – Naked Mole Rat, p. 1067.
2. Artwohl et al. 2002. Naked mole rats: unique opportunities and husbandry challenges. Lab Animal (NY) 31(5):32-66.

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

**189.** According to the AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, all of the following statements apply to euthanasia of neonates **EXCEPT**?

1. Decapitation using scissors or sharp blades is acceptable with conditions for altricial neonates (< 7 days of age)
2. Gradual cooling of fetuses and altricial neonates as young as 7 days of age is an acceptable with conditions
3. Maceration is an acceptable means of euthanasia for newly hatched poultry up to 72 hours old
4. Manually applied blunt force trauma to the head is not acceptable for calves
5. Manually applied blunt force trauma to the head is not acceptable for suckling piglets

**Answer: e. Manually applied blunt force trauma to the head is not acceptable for suckling piglets**

**Reference:** American Veterinary Medical Association. 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, pp. 36, 50, 56-57, 63, 99

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

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

**190.** Mice differ from other mammals in that they secrete which of the following in urine?

1. Allantoin
2. Creatinine
3. Sodium
4. Taurine
5. Tryptophan

**Answer: b. Creatinine**

**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 2 – Mouse Physiology, pp. 72-73.
2. 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. 46.

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

**191.** A researcher is using salmonid fish for a research project and wants to euthanize the embryos using rapid chilling/hypothermic shock. According to the AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, this is considered to be which of the following?

1. Acceptable as a sole method
2. Acceptable only if followed with a secondary method like dilute hypochlorite solution
3. Unacceptable in any situation
4. Not discussed

**Answer: b. Acceptable only if followed with a secondary method like dilute hypochlorite solution**

**Reference:** American Veterinary Medical Association. 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, pp. 71, 73

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

**Domain 2; Tertiary Species – Other Fish**

**192.** Which of the following mouse pathogens is the least sensitive to chemical disinfection?

a. Lymphocytic choriomeningitis virus

b. Mouse parvovirus

c. Murine rotavirus (EDIM)

d. Reovirus 3

e. Sendai virus

**Answer: b. Mouse parvovirus**

**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, pp. 62-63, 66-73; and Chapter 10 – Microbiological Quality Control for Laboratory Rodents and Lagomorphs, p. 371.
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 4 – Parvoviruses, p. 101; Chapter 9 – Reoviridae, p. 258; Chapter 11 – Sendai Virus and Pneumonia Virus of Mice (PVM), p. 298.

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

**193.** According to the United States Department of Transportation (DOT) agency requirements for transport of infectious substances, which of the following is the assigned identification number for Category B infectious substances?

a. UN 2814

b. UN 2900

c. UN 3082

d. UN 3373

e. UN 4585

**Answer: d. UN 3373**

**References:**

1. http://www.phmsa.dot.gov/pv\_obj\_cache/pv\_obj\_id\_54AC1BCBF0DFBE298024C4C700569893C2582700/filename/Transporting\_Infectious\_Substances\_brochure.pdf
2. http://www.ncsu.edu/ehs/dot/Bio\_shipping.pdf
3. World Health Organization. 2011. Guidance on regulations for the Transport of Infectious Substances 2011-2012, p. 5.

(http://www.who.int/ihr/publications/who\_hse\_ihr\_20100801\_en.pdf)

**Domain 5**

**194.** Which of the following animals is the definite host for *Baylisascaris procyonis*?

1. Fox
2. Mouse
3. Raccoon
4. Rat

e. Wolf

**Answer: c. Raccoon**

**References:**

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 23 –Infectious Diseases, p. 674.

2) Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 5 – Guinea Pig, p. 237.

3) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 6 – Biology and Diseases of Guinea Pigs, p. 225

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

**195.** Indications that *Danio rerio* have reached a surgical plane (stage III, phase 2) of anesthesia suitable for taking biopsies include all of the following **EXCEPT**?

1. Bradycardia
2. Loss of opercular movement
3. Loss of reactivity to manipulation
4. Low respiratory rate

**Answer: b. Loss of opercular movement**

**References:**

1) Collymore et al. 2014. Efficacy and safety of 5 anesthetics in adult zebrafish (Danio rerio). JAALAS 53(2): 198-203.

2) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine. 2nd edition. Academic Press: San Diego, CA. Chapter 20 – Biology and Health of Laboratory Fishes, p. 896.

**Domain 3; Secondary Species – Zebra fish (Danio rerio)**

**196.** According to a recent study, what effect does estrous cycle stage have on cardiac-reperfusion injury in female rats?

1. No significant effect on cardiac injury and severity of arrhythmias
2. Affects cardiac injury but has no effect on severity of arrhythmias
3. Affects severity of arrhythmias but has no effect on cardiac injury
4. Significant effect on cardiac injury and severity of arrhythmias

**Answer: a. No significant effect on cardiac injury and severity of arrhythmias**

**Reference:** Frasier et al. 2013. Stage of the estrous cycle does not influence myocardial ischemia-reperfusion injury in rats (*Rattus norvegicus*). Comparative Medicine 63(5):416-421

**Domain 3; Primary Species - Rat**

**197.** What information must be posted on the door of an animal room housing Syrian hamsters used for a research project on Bacillus anthracis?

a. Animal biosafety level, personal protective equipment requirements

b. Animal biosafety level, personal protective equipment requirements, responsible party’s name

c. Animal biosafety level, personal protective equipment requirements, responsible party’s name, telephone number

d. Animal biosafety level, personal protective equipment requirements, responsible party’s name, telephone number, general occupational health requirements

e. Animal biosafety level, personal protective equipment requirements, responsible party’s name, telephone number, general occupational health requirements, and required procedures for entering and exiting the animal areas

**Answer: e. Animal biosafety level, personal protective equipment requirements, responsible party’s name, telephone number, general occupational health requirements, and required procedures for entering and exiting the animal areas**

**References:**

1. U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, and National Institutes of Health. 2007. 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. 62

(http://www.cdc.gov/biosafety/publications/bmbl5/BMBL5\_sect\_V.pdf)

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 24 - Control of Biohazards Associated with the Use of Experimental Animals, p. 1053

**Domain 5; Secondary Species - Syrian Hamster (*Mesocricetus auratus*)**

**198.** All of the following statements apply to clinical disease due to lactate dehydrogenase elevating virus **EXCEPT**?

1. Altered serum enzyme levels
2. Caused differences in immunologic function
3. Changes tumor growth rate
4. Seen in immunocompetent and immunocompromised strains

**Answer: d. Seen in immunocompetent and immunocompromised strains**

**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. 65-66.
2. Adams and Myles. 2013. Multiplex fluorescent immunoassay for detection of mice infected with lactate dehydrogenase elevating virus. [JAALAS](http://aalas.publisher.ingentaconnect.com/content/aalas/jaalas) 52(3):253-258.
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 8 – Lactate Dehydrogenase-Elevating Virus, pp. 226-227.
4. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 1 – Mouse, pp. 30-31

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

**199.** Which of the following breeding systems results in the creation of congenic strains?

1. Brother x sister mating between two inbred strains
2. Brother x sister mating of F2 offspring of two inbred strains
3. Repeated backcrossing to host strain of mutation-bearing mice for 10 or more generations
4. Repeated backcrossing to donor strain of mutation-bearing mice for 10 or more generations
5. Repeated backcrossing to either of two parental inbred strains for 10 or more generations

**Answer: c. Repeated backcrossing to host strain of mutation-bearing mice for 10 or more generations**

**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 5 – Mouse Strain and Genetic Nomenclature: an Abbreviated Guide, p. 88.

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

**200.** All of the following describe standard rodent health monitoring using dirty bedding sentinel disease detection **EXCEPT**?

1. Infectious agent transfer via dirty bedding is most efficient for detection of diseases with low prevalence
2. Dirty bedding sentinels is a more reliable means of disease detection than PCR for some infectious agents
3. Detection of pathogenic agents tends to be optimal in agents that are more highly infectious
4. Soiled bedding sentinels are not always efficient and reliable in revealing the presence of infectious agents in rodent colonies

**Answer: a. Infectious agent transfer via dirty bedding is most efficient for detection of diseases with low prevalence**

**References:**

1. Leblanc et al. 2014. False-positive results after environmental pinworm PCR testing due to Rhabditid nematodes in corncob bedding. JAALAS 53(6): 717-724
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**

**201.** According to the 2013 AVMA Guidelines on Euthanasia, which of the following is considered an “acceptable” method to euthanize *Xenopus laevis*?

a. Carbon dioxide

b. Decapitation and double pithing

c. Isoflurane overdose

d. Topical benzocaine hydrochloride gel

**Answer: d. Topical benzocaine hydrochloride gel**

**References:**

1. American Veterinary Medical Association. 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, pp. 32-33, 99

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

1. Torreilles et al. 2009. Evaluation and refinement of euthanasia methods for *Xenopus laevis*. JAALAS 48:512-516

**Domain 5; Secondary Species – African clawed frog (Xenopus spp)**

**202.** What is the most common vertebral body injured in rabbits with traumatic vertebral fracture?

1. L3
2. L7
3. L5
4. S1
5. T13

**Answer: b. L7**

**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 17 – Mycoses and Non-infectious diseases, p. 511.

2) Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 6 – Rabbit, pp. 299-300.

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

**203.** According to the AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, which of the following methods is conditionally acceptable for euthanizing zebrafish?

a. Immersion in a buffered tricaine methane sulfonate

b. Rapid chilling in ice-water slurry

c. Immersion in buffered benzocaine

d. Immersion in CO2-saturated water

**Answer: d. Immersion in CO2-saturated water**

**References:**

1) Silverman J, Suckow MA, Murthy S. 2014. The IACUC Handbook, 3rd edition, p. 409

2) American Veterinary Medical Association. 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, p. 73

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

**Domain 2; Secondary Species - Zebrafish (*Danio rerio*)**

**204.** According to the Guide for the Care and Use of Laboratory Animals, which of the following statements best describes the use of contact bedding on solid-bottom rodent caging?

1. It absorbs urine and feces and minimizes ammonia buildup to facilitate sanitation
2. It increases the air changes per hour in the cage
3. It reduces cross contamination from pathogens that travel on fomites
4. It must be autoclaved prior to use
5. Recycled paper bedding is preferred over corncob bedding

**Answer: a. It absorbs urine and feces and minimizes ammonia buildup to facilitate sanitation**

**References:**

1. Institute for Laboratory Animal Research. 2011. Guide for the Care and Use of Laboratory Animals. The National Academies Press: Washington, D.C. Chapter 3 – Environment, Housing, and Management, p. 52.
2. Ambery et al. 2014. Effect of corncob bedding on feed conversion efficiency in a high-fat diet-induced prediabetic model in C57Bl/6J mice. JAALAS 53(5):449-451.

**Domain 4**

**205.** According to the Public Health Service Policy on Humane Care and Use of Laboratory Animals, all of the following statements apply to the institutional animal care and use committee (IACUC) **EXCEPT**?

1. The IACUC shall consist of not less than five members
2. If an individual who meets the requirement of more than one of the committee categories, the individual may fulfill more than one requirement
3. The IACUC shall review at least once every six months the institution’s program for human care and use of animals
4. The IACUC shall inspect at least once every twelve months all of institution’s animal facilities (including satellite facilities) using the Guide as a basis for evaluation
5. The IACUC shall include one veterinarian, one practicing scientist experienced in research involving animals, one nonscientific member, and one member who is not affiliated with the institution

**Answer: d. The IACUC shall inspect at least once every twelve months all of institution’s animal facilities (including satellite facilities) using the Guide as a basis for evaluation**

**References:**

1. Office of Laboratory Animal Welfare. 2002. Public Health Service Policy on Humane Care and Use of Laboratory Animals. National Institutes of Health, Bethesda, MD, pp. 9-13.
2. 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.
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. 12-14, 17-18

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

**Domain 5**

**206.** What species of Bartonella was discovered in the Peruvian mountains and found to be transmitted by sandflies in the 1990s?

1. *B. henselae*
2. *B. alsatica*
3. *B. koehleraie*
4. *B. melogphagi*
5. *B. bacilliformis*

**Answer: e. *B. bacilliformis***

**Reference:** Breitschwerdt. 2014. Bartonellosis: one health perspectives for an emerging infectious disease. ILAR J 55(1):46-58

**Domain 1**

**207.** According to the AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, which of the following methods of euthanasia is considered acceptable with conditions for nonhuman primates?

1. Carbon dioxide
2. Injected barbiturates
3. Nonbarbiturate anesthetic overdose
4. Penetrating captive bolt or firearm

**Answer: a. Carbon dioxide**

**Reference:** American Veterinary Medical Association. 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, p. 79

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

**Domain 2**

**208.** Cardiac calcinosis is commonly found in what inbred strain of mouse?

a. C57BL/6

b. 129

c. FVB

d. DBA

e. AKR

**Answer: d. DBA**

**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, pp. 105-106.
2. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 1 – Mouse, p. 94.
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 25 – Spontaneous Diseases in Commonly Used Mouse Strains, p. 661.

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

**209.** Which of the following neuroanatomical locations serves to regulate the circadian rhythm?

1. Amygdala
2. Corpus callosum
3. Hippocampus
4. Hypothalamus
5. Superchiasmatic nucleus

**Answer: e. Superchiasmatic nucleus**

**References:**

1. Wren et al. 2014. Effect of different spectral transmittances through tinted animal cages on circadian metabolism and physiology in Sprague-Dawley rats. JAALAS 53(1):44-51.
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine. 2nd edition. Academic Press: San Diego, CA. Chapter 29 – Factors That May Influence Animal Research, p. 1147.

**Domain 4**

**210.** How many non-institutional members who represent the interest of the surrounding community with respect to health and protection of the environment must be present on an Institutional Biosafety Committee?

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

**Answer: b. 2**

**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)

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 24 – Control of Biohazards Associated with the Use of Experimental Animals, pp. 1053-1054

**Domain 5**

**211.** Irregular, circumscribed red ulcerative skin lesions were noted along the dorsal neck and interscapular region of a Sprague-Dawley rat. Bacterial cultures taken from the lesion will likely reveal which of the following organisms?

* 1. *Pseudomonas aeruginosis*
  2. *Staphylococcus aureus*
  3. *Staphylococcus epidermidis*
  4. *Streptobacillus moniliformis*

**Answer: b. *Staphylococcus aureus***

**References:**

1. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 2 – Rat, pp.149-153
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 4 – Biology and Diseases of Rats. pp. 139-140, 153
3. Suckow MA, Weisbroth SH, Franklin CL, eds. 2006. The Laboratory Rat, 2nd edition. Elsevier Academic Press: San Diego, CA. Chapter 11 – Bacterial, Mycoplasmal and Mycotic Infections, pp. 381-382

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

**212.** Which of the following documents, 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**

**Reference:** 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.

(http://grants.nih.gov/grants/policy/air/rate\_setting\_manual\_2000.pdf)

**Domain 4**

**213.** According to the AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, which of the following **IS NOT** an accepted method for the euthanasia of a suckling pig?

1. Carbon dioxide
2. Carbon monoxide
3. Decapitation after sedation
4. Isoflurane

**Answer: c. Decapitation after sedation**

**Reference:** American Veterinary Medical Association. 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition, p. 61

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

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

**214.** Substantial differences in what aspect of swine cardiovascular anatomy and physiology are noted compared to humans?

1. Cardiac size
2. Conduction system
3. Coronary circulation
4. Hemodynamic values
5. Low-density lipoprotein (LPL) vs. high-density lipoprotein (HDL) ratio

**Answer: b. Conduction system**

**References:**

1. Lelovas et al. 2014. A comparative anatomical and physiological overview of the porcine heart. JAALAS 53(5): 432-438.
2. Swindle MM. 2007. Swine in the Laboratory: Surgery, Anesthesia, Imaging, and Experimental Techniques. CRC Press: Boca Raton, FL. Chapter 9 - Cardiothoracic and Vascular Surgery/Chronic Intravascular Catheterization, pp. 195-252.

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

**215.** Which of the following drugs is commercially known as “Inactin” and can produce prolonged anesthesia in rats?

1. Alphaxalone
2. Alpha-chloralose
3. Thiobutabarbital
4. Tiletamine
5. Tribromoethanol

**Answer: c. Thiobutabarbital**

**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. 32.

2) Flecknell PA. 2009. Laboratory Animal Anaesthesia, 3rd edition. Academic Press: San Diego, CA. Chapter 2 – Anaesthesia, p. 67.

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

**216.** Which common ingredient in rodent diets has been proven to interfere with research involving endocrine-disrupting compounds?

1. Alfalfa
2. Bonemeal
3. Casein
4. Cellulose
5. Fishmeal

**Answer: a. Alfalfa**

**References:**

1. Thigpen et al. 2013. The estrogenic content of rodent diets, bedding cages, and water bottles and its effect on Bisphenol A studies. JAALAS 52(2):130-141.
2. Suckow MA, Weisbroth SH, Franklin CL, eds. 2006. The Laboratory Rat, 2nd edition. Elsevier Academic Press: San Diego, CA. Chapter 9 – Nutrition, pp. 265-266
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 10 – Nutrition, pp. 348-350.

**Domain 4**

**217.** The mdx mouse model serves as a model for which of the following human diseases?

1. Amyotrophic lateral sclerosis
2. Becker muscular dystrophy
3. Duchenne muscular dystrophy
4. Infantile scoliosis
5. Neurofibromatosis

**Answer: c. Duchenne muscular dystrophy**

**Reference:** Kornegay et al. 2014. Pharmacologic management of duchenne muscular dystrophy: target identification and preclinical trials. ILAR J 55(1):119-149.

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

**218.** A budgerigar presenting with scaly, hyperkeratotic lesions on the cere and legs is most likely infested with which of the following ectoparasites?

* 1. *Argas persicus*
  2. *Dermanyssus gallinae*
  3. *Knemidocoptes pilae*
  4. *Menacanthus stramineus*
  5. *Ornithonyssus sylviarum*

**Answer: c. *Knemidocoptes pilae***

**Reference:**

1. Ballard B, Cheeks R, eds. 2010. Exotic Animal Medicine for the Veterinary Technician, 2nd edition. Wiley-Blackwell: Ames, IA. Chapter 2 - Psittacines and Passerine, p. 33.
2. http://en.wikivet.net/Knemidocoptes
3. http://en.wikivet.net/Argas\_spp
4. http://en.wikivet.net/Dermanyssus\_gallinae
5. http://en.wikipedia.org/wiki/Menacanthus
6. http://eol.org/pages/4318169/overview

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

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

a. 4°C (40°F)

b. 15°C (60°F)

c. 21°C (70°F)

d. 27°C (80°F)

**Answer: c. 21°C (70°F)**

**References:**

1) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002 Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 21 – Design and Management of Animal Facilities, p. 916.

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**

**220.** A new protocol was submitted to the IACUC for review. An IACUC member’s name appears in the personnel section (but not as the PI). According to the Guide for the Care and Use of Laboratory Animals, regarding decisions concerning the protocol, the IACUC member \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

1. Is not in conflict and may make decisions concerning the protocol
2. May recuse himself
3. Must recuse himself
4. Should recuse himself

**Answer: c. Must recuse himself**

**Reference** Institute for Laboratory Animal Research. 2011. Guide for the Care and Use of Laboratory Animals Academies Press: Washington, D.C. Chapter 2 – Animal Care and Use Program, p. 26.

**Domain 5**

**221.** Which of the following organ systems is the most sensitive to acute radiation exposure?

1. Gastrointestinal
2. Hematopoietic
3. Musculoskeletal
4. Neurovascular
5. Skin

**Answer: b. Hematopoietic**

**References:**

1. Nunamaker et al. 2013. Endpoint refinement for total body irradiation of C57BL/6 mice. Comparative Medicine 63(1):22-28.
2. Mocci et al. 2010. Evaluation of hydration and nutritional gels as supportive care after total-body irradiation in mice (*Mus musculus*). JAALAS 49(3):323-328.

**Domain 1**

**222.** According to the Guide for the Care and Use of Laboratory Animals, what is the recommended minimum floor space/animal (ft2) for a dog weighing 15-30 kg?

a. 8

b. 10

c. 12

d. 20

e. 24

**Answer: c. 12**

**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. 59.

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

**223.** Which of the following statements applies to ATP based monitoring systems?

a. Indirect measure of the amount of live organic matter present on a surface or material

b. Indirect measure of the amount of dead organic matter present on a surface or material

c. Indirect measure of the amount of live and dead organic matter present on a surface or material

d. Direct measure of the amount of live organic matter present on a surface or material

**Answer: c. Indirect measure of the amount of live and dead organic matter present on a surface or material**

**Reference:** Collymore et al. 2014. Evaluation of 5 cleaning and disinfection methods for nets used to collect zebrafish (*Danio rerio*). JAALAS 53(6):657-660

**Domain 4**

**224.** All of the following describe “stereotypic behavior” in laboratory mice **EXCEPT**?

a. May indicate compromised welfare

b. May manifest as back flipping

c. Is positively correlated to age and weight at weaning

d. Is predicted by litter size if pups are female

**Answer: c. Positively correlated to age and weight at weaning**

**References:**

1. Bechard et al. 2012. Litter size predicts adult stereotypic behavior in female laboratory mice. JAALAS 51(4):407-411.
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 15 – Behavioral Testing, pp. 514-516
3. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 32 – Laboratory Animal Behavior, pp. 1240-1243

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

**225.** All of the following statements apply to SIV and SRV infection in macaques **EXCEPT**?

1. Natural host range of SIV includes several species of African monkeys
2. Natural host range of SRV includes several species of Asian monkeys
3. SRV is considered the most significant viral agent of acquired immunodeficiency in captive macaques
4. SRV viral tropism includes B and T lymphocytes, macrophages, and epithelial cells
5. Unique SIV-associated diseases include retroperitoneal and subcutaneous fibromatosis and noma

**Answer: e. Unique SIV-associated diseases include retroperitoneal and subcutaneous fibromatosis and noma**

**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. 58-60.
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 16 – Nonhuman Primates, pp. 753-756.

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

**226.** Communal nesting in mice has shown to produce all of the following effects **EXCEPT**?

1. Decreased body weight at weaning
2. Females will nurse pups of other females
3. Increased body weight in adults
4. Increased pup survival

**Answer: a. Decreased body weight at weaning**

**References:**

1) Heidestadt et al. 2014. Communal nesting increases pup growth but has limited effects on adult behavior and neurophysiology in inbred mice. JAALAS 53(2):152-160.

2) Heidestadt et al. 2011. Increased juvenile and adult body weights in BALB/cByJ mice reared in a communal nest. JAALAS 50(4):484-487.

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

**227.** All of the following are required of those facilities importing nonhuman primates **EXCEPT**?

1. Importers must contact the CDC immediately to report any suspected zoonotic illness in an employee
2. Importers must quarantine all NHPs for at least 31 days after arrival at a U.S. Quarantine facility
3. Three tuberculin skin tests are required for all imported NHPs to decrease the risk for human exposure to tuberculosis
4. Importers must notify CDC at least 10 days before importing a shipment of NHPs.

**Answer: d. Importers must notify CDC at least 10 days before importing a shipment of NHPs**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 16 - Nonhuman primates, p. 724.
2. Roberts and Andrews. 2008. Nonhuman primate quarantine: its evolution and practice. ILAR J 49(2):145-156.
3. http://www.cdc.gov/animalimportation/lawsregulations/nonhuman-primates/nprm/questions-answers-importers.html
4. http://www.gpo.gov/fdsys/pkg/FR-2013-02-15/pdf/2013-03064.pdf (p. 11524)
5. 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.

**Domain 4**

**228.** An African green monkey presents with mucohemorrhagic diarrhea and severe depression. At necropsy, multifocal hepatic and splenic necrosis, mesenteric lymphadenopathy and ulcerative enterocolitis were found. An impression smear from foci showed Gram-negative rods with bipolar staining. What is the most likely etiologic agent?

a. Bordetella bronchiseptica

b. Helicobacter spp.

c. Lawsonia intracellularis

d. Yersinia enterocolitica

**Answer: d. Yersinia enterocolitica**

**References:**

1)Soto et al. 2013. An outbreak of Yersinia enterocolitica in a captive colony of African green monkeys (Chlorocebus aethiops sabaeus*)* in the Caribbean.Comparative Medicine 63(5):439-444

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, pp.138-141.

3) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 16 – Nonhuman Primates, pp. 733-734

**Domain 1, Tertiary Species – Other Nonhuman Primates**

**229.** *Mustela putorius furo* are ideal research models for human pulmonology studies for all of the following reasons **EXCEPT**?

1. Proportionally long trachea
2. Pulmonary structure and airways are similar to humans
3. Total lung capacity is 3 times greater than what is predicted based on body size
4. Higher degree of bronchiolar branching as compared to the dog
5. Less extensive bronchial submucosal glands as compared to the dog

**Answer: e. Less extensive bronchial submucosal glands as compared to the dog**

**References:**

1) Bossart et al. 2009. A neutralizing human monoclonal antibody protects against lethal disease in a new ferret model of acute nipah virus infection. *PLoS Pathology* 5(10):e1000642.

2) Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine. 2nd edition. Academic Press: San Diego, CA. Chapter 13 – Biology and Diseases of Ferrets, p. 485.

**Domain 3; Primary Species – Dog (Canis familiaris) and Secondary Species – Ferret (Mustela putorius furo)**

**230.** Which of the following statements applies to the A/J mouse strain?

1. Resistant to experimental hepatitis induced by a highly virulent MHV3; related genotype: a/a Tyrp1b/Tyrp1b Tyrc/Tyrc; increased tumor incidence
2. Susceptible to experimental hepatitis induced by a highly virulent MHV3; related genotype: a/a; increased tumor incidence
3. Susceptible to experimental hepatitis induced by a highly virulent MHV3; related genotype: a/a Tyrp1b/Tyrp1b Tyrc/Tyrc; increased incidence of spontaneous lung adenoma formation
4. Resistant to experimental hepatitis induced by a highly virulent MHV3; related genotype: a/a Tyrp1b/Tyrp1b Myo5ad/Myo5ad; increased tumor incidence

**Answer: a. Resistant to experimental hepatitis induced by a highly virulent MHV3; related genotype: a/a Tyrp1b/Tyrp1b Tyrc/Tyrc; increased tumor incidence**

**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 6 - Mouse Hepatitis Virus, p. 151.
2. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 27- Genetic Monitoring, p. 1123

**Domain1; Primary Species – Mouse (Mus musculus)**

**END OF EXAM**