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Practical Section – 120 Questions & Answers without Photos

**56 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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Question 1: A ferret presents with lethargy, diarrhea and vomiting and then develops a head tilt and ataxia. The animal is euthanized within a few days of presentation due to non-response to supportive care. At necropsy, the following image is observed. What is your primary differential diagnosis?

1. Epizootic catarrhal enteritis
2. Ferret systemic coronaviral disease
3. Rotavirus
4. Canine distemper

**Answer: b. Ferret systemic coronaviral disease**

**References:**

1. Autieri CR, Miller CL, Scott KE, Kilgore A, Papscoe VA et al. 2015. Systemic Coronaviral Disease in 5 Ferrets. Comp Med 65(6):508-516.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd Ed. Elsevier Inc.: San Diego, CA. Chapter 14 - Biology and Diseases of Ferrets. P. 600

**Domain 1 – Secondary species; Ferret (*Mustela putorius furo*)**

Question 2: The equipment depicted in this image is used to measure what parameter?

1. Transepidermal water loss
2. Tumour size and density
3. Heart rate
4. Body temperature
5. Epidermal thickness

**Answer: a. Transepidermal water loss**

**References:**

1. Nicolaus ML, Bergdall VK, Davis IC, Hickman-Davis JM. 2016. Effect of Ventilated Caging on Water Intake and Loss in 4 Strains of Laboratory Mice. *J Am Assoc Lab Anim Sci*. 55(5):525-33.
2. http://www.cortex.dk/skin-analysis-products/tewl.aspx

**Domain 4, Primary species- Mouse (*Mus musculus*)**

Question 3: Which of the following statements best describes the intracage temperature and humidity compared to the macroenvironment when mice are housed in the depicted mouse caging system?

1. The intracage humidity and temperature remain the same as the macroenvironment of the room
2. The intracage humidity and temperature are higher compared to the macroenvironment of the room
3. The intracage humidity is higher and the temperature is lower compared to the macroenvironment of the room
4. The intracage humidity and temperature are lower compared to the macroenvironment of the room

**Answer: b.** The intracage humidity and temperature are higher compared to the macroenvironment of the room

**References:**

1. Nicolaus ML, Bergdall VK, Davis IC, Hickman-Davis JM. 2016. Effect of Ventilated Caging on Water Intake and Loss in 4 Strains of Laboratory Mice. *JAALAS* 55(5)525 – 533.
2. Rosenbaum MD, VandeWoude S, Volckens J, Johnson T. 2010. Disparities in ammonia, temperature, humidity, and airborne particulate matter between the micro-and macroenvironments of mice in individually ventilated caging. J Am Assoc Lab Anim Sci 49:177–183.

**Domain 4; primary species – Mouse (*Mus musculus*)**

Question 4: The above species is used as a model for what human condition?

1. Male-pattern baldness; males only
2. Male-pattern baldness; both sexes
3. Red-green color blindness; males only
4. Red-green color blindness; both sexes
5. Red-green color blindness; females only

**Answer: b. Male-pattern baldness; both sexes**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3nd edition. Elsevier: London. Chapter 17, Nonhuman Primates, p. 807.
2. Abee CR, Mansfield K, Tardiff S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition. Volume 2 - Diseases. Elsevier: London. Chapter 11 – Integumentary System Diseases of Nonhuman Primates, p 579.

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

Question 5: Which of the following is considered the most appropriate model for studying biofilm infections using the imaging modality pictured here?

1. Neutropenic mouse thigh
2. Subcutaneous catheter
3. Dermal wound punch
4. Intramedullary pin
5. Surgical mesh

**Answer: e. Surgical mesh**

**References:**

1) Walton KD, Lord A, Kendall LV and Dow SW. 2014. Comparison of 3 Real-Time, Quantitative Murine Models of Staphylococcal Biofilm Infection by Using In Vivo Bioluminescent Imaging. *Comparative Medicine* 64 (1) 25-33.

2) Funao H, Ishii K, Nagai S, Sasaki A, Hoshikawa T, Aizawa M, Okda Y, Chiba K, Koyasu S, Toyama Y and Matsumoto M. 2012. Establishment of a real-time, quantitative, and reproducible model of staphylococcal osteomyelitis using bioluminescent imaging. *Infection and Immunity* 80 (2) 733-741.

3) [Rocchetta](https://www.ncbi.nlm.nih.gov/pubmed/?term=Rocchetta%20HL%5BAuthor%5D&cauthor=true&cauthor_uid=11120955) HL, [Boylan](https://www.ncbi.nlm.nih.gov/pubmed/?term=Boylan%20CJ%5BAuthor%5D&cauthor=true&cauthor_uid=11120955) CJ, [Foley](https://www.ncbi.nlm.nih.gov/pubmed/?term=Foley%20JW%5BAuthor%5D&cauthor=true&cauthor_uid=11120955) JW, [Iversen](https://www.ncbi.nlm.nih.gov/pubmed/?term=Iversen%20PW%5BAuthor%5D&cauthor=true&cauthor_uid=11120955) PW, [LeTourneau](https://www.ncbi.nlm.nih.gov/pubmed/?term=LeTourneau%20DL%5BAuthor%5D&cauthor=true&cauthor_uid=11120955) DL,  [McMillian](https://www.ncbi.nlm.nih.gov/pubmed/?term=McMillian%20CL%5BAuthor%5D&cauthor=true&cauthor_uid=11120955) CL, Contag PR, [Jenkins](https://www.ncbi.nlm.nih.gov/pubmed/?term=Jenkins%20DE%5BAuthor%5D&cauthor=true&cauthor_uid=11120955) DE, and Parr TR, Jr. 2001. Validation of a Noninvasive, Real-Time Imaging Technology Using Bioluminescent *Escherichia coli* in the Neutropenic Mouse Thigh Model of Infection. [*Antimicrobial Agents and Chemother*](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC90250/)*apy* 45 (1) 129-137.

4) Nishitani K, Sutipornpalangkul W, de Mesy Bentley KL, Varrone JJ, Bello-Irizarry SN, Ito H, Matsuda S, Kates SL, Daiss JL and Schwarz EM. 2015. Quantifying the natural history of biofilm formation in vivo during the establishment of chronic implant-associated *Staphylococcus aureus* osteomyelitis in mice to identify critical pathogen and host factors. *Journal of Orthopedic Research* 33 (9) 1311-1319.

5) Seth AK1, Geringer MR, Hong SJ, Leung KP, Galiano RD and Mustoe TA. 2012. Comparative analysis of single-species and polybacterial wound biofilms using a quantitative, in vivo, rabbit ear model. *PLoS One* 7 (8): e42897. doi: 10.1371/journal.pone.0042897.

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

Question 6: The international biohazard warning symbol and sign imaged above must be displayed on the doors of rooms where microorganisms of what risk groups are handled?

a. Risk Group 5 or higher

b. Risk Group 4 or higher

c. Risk Group 3 or higher

d. Risk Group 2 or higher

e. Risk Group 1 or higher

**Answer: d. Risk Group 2 or higher**

**References:**

1. Laboratory Biosafety Manual, 3rd edition. Geneva: World Health Organization, 2004. Chapter 3 – Basic Laboratories – Biosafety Levels 1 and 2, p. 10.
2. Chosewood LC, Wilson DE, eds. Biosafety in Microbiological and Biomedical Laboratories, 5th edition. U.S. Department of Health and Human Services, HHS publication (CDC) 2009. Section IV – Laboratory Biosafety Level Criteria, p. 34.

**Domain 5**

Question 7: The following can be used to perform what technique on mice?

* 1. Tattooing
  2. Tail clipping
  3. Microchip implantation
  4. Ear notching

**Answer: a. Tattooing**

**References:**

1. Chen M, Kan L, Ledford BT, He, J-Q. 2016. Tattooing various combinations of ears, tail, and toes to identify mice reliably and permanently. JAALAS 55(2): 189-198.
2. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd Ed. Elsevier Inc.: San Diego, CA. Chapter 25 - Techniques of Experimentation. P. 1203

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

Question 8: If you examined a ferret with the following clinical signs and associated histological section from the bladder, what would be your most likely diagnosis?

1. Aleutian disease
2. Coccidioides
3. Canine distemper
4. Influenza
5. Mast Cell Tumor

**Answer: c. Canine distemper**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 14 – The Biology and Diseases of Ferrets, p. 595-596.
2. Quesenberry KE and Carpenter JW. 2004. Ferrets, Rabbits, and Rodents: Clinical Medicine and Surgery, 2nd edition. Saunders: St. Louis, Missouri. Chapter 7 – Respiratory Diseases, p. 72-74.

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

Question 9: The picture represents what type of IVC?

1. intracage supply/perimeter capture
2. intracage supply/intracage exhaust (direct)
3. intracage supply/intracage exhaust (indirect)
4. intracage supply/intracage exhaust (combination)

**Answer: a. intracage supply/perimeter capture**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 36 – Design and Management of Research Facilities, p. 1573.
2. Lipman NS. 1999. Isolator rodent caging systems (state of the art): a critical review. *Cont Top Lab Anim* 38:9-17.

**Domain 4; Primary Species – Mouse (Mus musculus) & Rat (Rattus norvegicus)**

Question 10: Identify the following species and the research model for which they are frequently used:

* 1. *Mus musculus;* diet-induced type-2 diabetes
  2. *Rattus norvegicus;* diet-induced type-2 diabetes
  3. *Acomys cahirinus*; diet-induced type-2 diabetes
  4. *Peromyscus leucopus;* diet-induced type-2 diabetes
  5. *Phodopus sungorus*; female aggression

**Answer: c. *Acomys cahirinus*; diet-induced type-2 diabetes**

**References:**

1. Haughton CL, Gawriluk TR[,](http://www.ingentaconnect.com/contentone/aalas/jaalas/2016/00000055/00000001/art00003#aff_2) Seifert AW[.](http://www.ingentaconnect.com/contentone/aalas/jaalas/2016/00000055/00000001/art00003#aff_3) 2016. The Biology and Husbandry of the African Spiny Mouse (*Acomys cahirinus*) and the Research Uses of a Laboratory Colony. *JAALAS*;55(1)9-17
2. Shafrir E, Ziv E, Kalman R. 2006. Nutritionally induced diabetes in desert rodents as models of type 2 diabetes: Acomys cahirinus (*spiny mice*) and *Psammomys obesus* (desert gerbil). ILAR J 47:212–224.

**Domain 3; Tertiary species – other rodents**

Question 11: Several rats of different ages in your colony are reported to be depressed, anorexic, have hunched posture, respiratory rales can be heard, and a few have died. Gross lesions include numerous pale foci 1-5 mm scattered throughout the lung parenchyma as shown in the image. Lesions are centrally liquefied. Histologically, necrotizing lobar pneumonia with fibrinous adhesions is present. What is the most likely causative agent?

1. Ciliary Associated Respiratory bacillus
2. *Streptobacillus moniliformis*
3. *Corynebacterium kutscheri*
4. *Bordetella bronchiseptica*
5. *Streptococus peumoniae*

**Answer: c. *Cornynebacterium kutscheri***

**Reference:**

1) Suckow MA, Weisbroth SH and Franklin CL. 2006. The Laboratory Rat, 2nd edition. Elseier Academic Press: Burlington, MA. Chapter 11 – Bacterial, Mycoplasmal and Mycotic Infections, p. 365-366.

2) Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd edition. Blackwell Publishing: Oxfrod, UK. Chapter 2 – Rat, p. 147.

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

Question 12: The organisms pictured below was found on the dorsal fin of a goldfish in quarantine. Which of the following would be an appropriate course of action?

1. Isolate the fish and the infection will be self-limiting
2. Treat all water in the facility with chlorine
3. Physically examine each fish and remove organisms
4. Perform skin scrape and euthanize infected fish

**Answer: c. Physically examine each fish and remove organisms**

**References:**

1. Baker DG, ed. 2007. Flynn’s Parasites of Laboratory Animals, 2nd edition. Blackwell Publishing: Ames, IA. Chapter 7 – Parasites of Fishes, pp. 91-92
2. Wafer LN, Whitney JC, Jensen VB. 2015. Fish Lice (*Argulus japonicas*) in Goldfish (*Carassius auratus*). *Comp Med.* 65(2): 93-95

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

Question 13: This gross photograph shows tissues from a Long-Evans rat that died within days after arriving at an animal facility from a commercial breeder. What condition did the rat have and what is depicted in the picture?

1. Urolithiasis; kidney with calculi in the renal pelvis
2. Urolithiasis; urinary bladder with multiple variable sized calculi in the lumen
3. Spontaneous progressive glomerulonephropathy; kidney with granular surface
4. Pulmonary pneumocystosis; lung with focal cellular infiltrates
5. Spontaneous diplococcal (*Streptococcus pneumoniae*) infection; fibrinous pleuritis

**Answer: a. urolithiasis; kidney with calculi in the renal pelvis**

**References:**

1. Pang J, Borjeson TM, Parry NM, Fox JG. 2015. Struvite Urolithiasis in Long-Evans Rats. *Comp Med* 65(6): 486-91.
2. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 2 – Rat, p. 163.

**Domain 1, Primary species- Rats (*Rattus norvegicus*)**

Question 14: According to the *Guide*, what is the minimum cage height this animal should be provided?

1. 20 inches
2. 30 inches
3. 40 inches
4. 50 inches
5. 60 inches

**Answer: b. 30 inches; tamarins weigh under 1kg and the shortest cage height required by the Guide is 30 inches**

**References:**

1. National Research Council. 2011. Guide for the Care and Use of Laboratory Animals, 8th edition. The National Academies Press: Washington, DC. 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. (August 2002 Edition, p. 94)

**Domain 5; Secondary Species – Marmoset/tamarins (Callitrichidae)**

Question 15: The above species is currently used for which type of study?

1. DSS induced colitis
2. Multiple sclerosis
3. Human monkeypox
4. Parkinson disease
5. *Hepatitis B* pathogenesis

**Answer: c. Human monkeypox**

**References:**

1. Kastenmayer et al. 2013. Management and Care of African Dormice (*Graphiurus kellini*). *JAALAS* 49(2): 173-176.
2. Suckkow MA, Stevens KA, Wilson WP. 2012. The Laboratory Rabbit, Guinea pig, Hamster, and other rodents. Elsevier: London. Chapter 47 – Dormouse, p 1089-1094.

**Domain 3; Tertiary species – African Dormice (*Graphiurus Kelleni*)**

Question 16: What does this sign indicate?

1. biological hazard
2. chemical hazard
3. explosive hazard
4. radioactive hazard

**Answer: d. radioactive hazard**

**References:**

1. AALAS. 2012. Laboratory Animal Technologist Training Manual. Drumwright & Co.: USA. Ch 6 –Occupational Health & Safety, pg. 70.
2. <http://www.ehs.psu.edu/radprot/rad_signs.cfm>

**Domain 5**

Question 17: Which of the following pharmaceutical is ideal for analgesic therapy in this species?

1. Morphine
2. Acetaminophen
3. Butorphanol
4. Gabapentin

**Answer: c. Butorphanol**

**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 18 – Anesthesia and Analgesia in Birds, pp. 492-493.
2. Flecknell PA. 2009. Laboratory Animal Anaesthesia, 3rd edition. Academic Press: San Diego, CA. Chapter 2 – Anaesthesia, p. 235.

**Domain 2 – Tertiary species – Pigeon (*Columba livia*)**

Question 18: What is the device pictured used for, and what are its advantages?

* 1. Focused Beam Microwave Irradiation; fix brain metabo­lites in vivo while maintaining the anatomic integrity of the brain
  2. Class 1 BSC; provide personnel and environmental protection against low to moderate risk agents
  3. Decapitation Device; means of obtaining anatomically undamaged brain tissue for study
  4. Blue Box: uses ultraviolet irradiation to disinfect surgical instruments

**Answer: a. Focused Beam Microwave Irradiation; fix brain metabo­lites in vivo while maintaining the anatomic integrity of the brain**

**References:**

1. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition

**Domain 2**

Question 19: What is this piece of equipment used in the colony management of gnotobiotic mice?

a. Bulkhead fitting

b. Filter piping

c. Glove cuff

d. O-ring

**Answer: a. Bulkhead fitting**

**References:**

# 1) Foster, HL, Small D, Fox, JG. 2007. Volume III: The Mouse in Biomedical Research: Normative Biology, Immunology, and Husbandry, 2nd edition. Academic Press: San Diego, CA. Chapter 7 – Gnotobiotics, p. 218-223.

2) Vowles, CJ, Anderson, NE, Eaton, KA. 2016. Gnotobiotic Mouse Technology (An Illustrated Guide), CRC Press: Boca Raton, FL. Chapter 6 – Isolator Setup, p. 85.

**Domain 4; Primary Species – Mus musculus**

Question 20: What is the equipment depicted in the picture above?

1. Cabinet bottle washer
2. Reverse osmosis water purification system
3. Robotic tunnel washing system
4. Automated bottle filler equipment with proportioner

**Answer: d: Automated bottle filler equipment with proportioner**

**References:**

1. Fox. JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 36- Design and Management of Research Facilities, p. 1562.
2. 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, pp. 932, 935.

**Domain 4**

Question 21: A veterinary technician observes the bottom rat in both pictures. After reviewing, you discover it is a 2-year old Fischer 344 rat on a study evaluating effects of a novel treatment on aged myocardium. What is your top differential?

1. Chronic kidney failure
2. leukemia
3. pituitary adenoma
4. heart failure
5. normal rat

**Answer: b. leukemia (the strain of rat is what makes leukemia the top differential, even though the other answers can present in a similar manner).**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 4 – Biology & Diseases of Rats, p. 193.
2. Barthold SW, Griffey SM, Percy DH, eds. 2016. Pathology of Laboratory Rodents and Rabbits, 4th edition. Blackwell Publishing: Ames, Iowa. Chapter 2 – Rat, p. 166.

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

Question 22: A pathologist presents the following representative lesion from experimentally naïve, multiple adult C57BL/6 female mice found in your colonies. What test do you perform to rule out your primary differential?

1. Fecal float with iodine stains
2. PCR of the cage microfilter
3. Check ventilated blower flow rate
4. Resection tissues and stain with methenamine silver or PAS

**Answer: c. Check ventilated blower flow rate**

*Comment: Nasal cavity with epithelia necrosis is associated with excessive cage ammonia levels.*

**References:**

1. Ferrecchai, Jesen, Andel. 2014. Intracage ammonia levels in static and individually ventilated cage housing C57BL/6 mice on 4 bedding substrates. JAALAS 53(2): 146-151.
2. Fox *et al*. 2015. Laboratory Animal Medicine. Chapter 33. Factors that can influence animal research, pg. 1447.

**Domain 4, submdomain T1 Animal Husbandry; Species – Primary Species – Mouse (*Mus musculus*)**

Question 23: Which one of the following correctly describes the life cycle of this parasite?

a. The life cycle is direct and is completed in approximately 23-25 days.

b. The life cycle is indirect and is completed in approximately 23-25 days.

c. The life cycle is indirect and is completed in approximately 12-15 days.

d. The life cycle is direct and is completed in approximately 12-15 days.

**Answer: d. The life cycle is direct and is completed in approximately 12-15 days.**

**References:**

1) Fox, JG, Anderson, LC, Otto, G, Pritchett-Corning, KR, Whary, MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 – Biology and Diseases of Mice, p. 124.

2) Barthold, SW, Griffey, SM, Percy, DH, eds. 2016. Pathology of Laboratory Rodents and Rabbits, 4th edition. John Wiley & Sons, Inc.: Ames, Iowa. Chapter 1 – Mouse, p. 84-85.

**Domain 1; Primary Species – Mus musculus**

Question 24: What is the genus of the animal pictured below and what is it a model for?

* 1. *Aotus*; Rh Factor
  2. *Chlorocebus;* Vero cells
  3. *Saimiri*; Pelvic organ prolapse
  4. *Aotus*; Vision research

**Answer: c. *Saimiri*; Pelvic organ prolapse**

**References:**

1. Chapter 17, Nonhuman Primates. Laboratory Animal Medicine 3rd edition page 798
2. Nonhuman Primates in Biomedical Research Volume 1: Biology and Management 2nd edition. Page 383

**Domain 3, secondary species – Squirrel Monkey (Saimiri spp.)**

Question 25: What is this device?

1. Rodent restraint device
2. Test tube holder
3. Filter holder
4. Feed follower
5. Centrifuge

**Answer: d. Feed follower**

**Reference:** [**http://dyets.com/feeding-jars-and-accessories/**](http://dyets.com/feeding-jars-and-accessories/)

**http://www.braintreesci.com/prodinfo.asp?number=DYETS**

**Domain 4**

Question 26: A recent article described several 2-step euthanasia methods for this species. Which method was found to meet welfare and scientific requirements?

a. Immersion in reverse osmosis purified water followed by 10% formalin

b. Immersion in flat beer followed by 10% formalin or 70-90% ethanol

c. Immersion in ice water followed by 10% formalin or 70-90% ethanol

d. Immersion in 70% ethanol followed by 10% formalin

**Answer: b. Immersion in flat beer followed by 10% formalin or 70-90% ethanol**

**References:**

1) Gilbertson CR. 2016. Evaluation of Euthanasia Techniques for an Invertebrate Species. *JAALAS*. 55: 577-581.

2) AVMA Guidelines on Euthanasia (2013) http://www.avma.org/issues/animal\_welfare/euthanasia.pdf

**Domain 2; Tertiary Species – Succinea putris**

Question 27: What organization utilizes this emblem?

a. AAALAC International

b. International Air Transport Association

c. Occupational Safety and Health Administration

d. People for the Ethical Treatment of Animals

**Answer: b. International Air Transport Association**

**References:**

# IATA. http://www.iata.org/Pages/default.aspx

**Domain 5**

Question 28: What is the purpose of the Lixit piece indicated as A?

1. prevent the rodent’s upper lip from being trapped in the lixit
2. spring mechanism for maintaining proper water pressure in valve
3. to prevent rodent from pulling the stem of the lixit out
4. to inhibit rodents from stuffing bedding into the lixit

**Answer: d. to inhibit rodents from stuffing bedding into the lixit**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 36 – Design and Management of Research Facilities, p. 1583.
2. Gonzalez DM et al. 2011. Failure and life cycle evaluation of watering valves. *J Am Assoc Lab Anim Sci* 50:713-718.

**Domain 4; Primary Species – Mouse (Mus musculus) & Rat (Rattus norvegicus)**

Question 29: It’s Friday afternoon and the vet tech calls you in to look at hair pluck sample from sentinel mice. She is concerned about what appears to be an adult arthropod in the sample. What is the organism?

a. *Radfordia ensifera*

b. *Myocoptes musculinus*

c. *Tyrophagus putrescentiae*

d. *Myobia musculi*

**Answer: c *Tyrophagus putrescentiae* (Mold mite - not a pathogen of mice)**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning K, Whary M, eds. 2015. Laboratory Animal Medicine, 3rd ed. Academic Press: San Diego, CA. Chapter 3 – Biology and Diseases of Mice, p. 125.

2) Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 1 – Mouse, pg 85-87

**Domain 1; Primary Species – Mus musculus**

Question 30: Which of the following is **TRUE** regarding the apparatus pictured?

1. It is a two-chamber paradigm test known as Crawley's sociability and preference for social novelty protocol
2. It is used to study social interaction and social memory in inbred and mutant mouse lines
3. It assays activity, locomotor, and anxiety-related effects of neurobiological manipulations
4. It is used to evaluate development and metabolic intake and output
5. It is used to test learning and memory in which mice learn to associate a context and a cue with an unconditioned stimulus

**Answer: b. It is used to study social interaction and social memory in inbred and mutant mouse lines**

**References:**

1. Kaidanovich-Beilin O, Lipina T, Vukobradovic I, Roder J, Woodgett JR. 2011. Assessment of Social Interaction Behaviors. *J Vis Exp.* (48): 2473.
2. http://btc.psych.ucla.edu/socinteract.htm

**Domain 3, Primary species - Mouse (*Mus musculus*)**

Question 31: According to ***AVMA Guidelines for the Euthanasia of Animals: 2013 Edition***, which method of euthanasia for species depicted in the picture is **Acceptable with Condition**?

1. Barbiturates (alternate routes)
2. Immersion in isoflurane
3. Rapid chilling
4. Clove oil
5. Maceration

**Answer: d. Clove Oil**

**References:**

1. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition. Appendix 1. Agents and methods of euthanasia by species. p. 99.
2. Strykowski JL Joseph M Schech JM.Effectiveness of Recommended Euthanasia Methods in Larval Zebrafish (*Danio rerio*). JAALAS. January 2015, Vol 54(1). P.76–79

**Domain 2; Secondary Species – Zebrafish (Danio rerio)**

Question 32: What is the pictured device and what is it used for?

1. Visual cliff, a test to assess vision and depth perception
2. Balance beam, a test to assess motor coordination and balance
3. Elevated plus-maze, a test to measure anxiety-like behavior
4. Rotarod, a test to assess motor coordination and balance

**Answer: d. Rotarod, a test to assess motor coordination and balance**

**References:**

1. Fox J, Anderson L, Otto G, Pritchett-Corning, M Whary eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press. Chapter 2. Biology and Diseases of Mice, p. 69.
2. [Lee-Ronn Paluch](https://www.ncbi.nlm.nih.gov/pubmed/?term=Paluch%20LR%5BAuthor%5D&cauthor=true&cauthor_uid=24602538), [Christine C Lieggi](https://www.ncbi.nlm.nih.gov/pubmed/?term=Lieggi%20CC%5BAuthor%5D&cauthor=true&cauthor_uid=24602538), [Magali Dumont](https://www.ncbi.nlm.nih.gov/pubmed/?term=Dumont%20M%5BAuthor%5D&cauthor=true&cauthor_uid=24602538), [Sebastien Monette](https://www.ncbi.nlm.nih.gov/pubmed/?term=Monette%20S%5BAuthor%5D&cauthor=true&cauthor_uid=24602538), [Elyn R Riedel](https://www.ncbi.nlm.nih.gov/pubmed/?term=Riedel%20ER%5BAuthor%5D&cauthor=true&cauthor_uid=24602538), and [Neil S Lipman](https://www.ncbi.nlm.nih.gov/pubmed/?term=Lipman%20NS%5BAuthor%5D&cauthor=true&cauthor_uid=24602538). Developmental and Behavioral Effects of Toe Clipping on Neonatal and Preweanling Mice with and without Vapocoolant Anesthesia. [J Am Assoc Lab Anim Sci](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3966268/). 2014 Mar; 53(2): 132–140.

**Domain 3**

Question 33: When administered as shown, this common analgesic has been associated with severe respiratory depression, hypothermia, bradycardia and unresponsiveness. These effects can be reversed using:

1. Atipamezole
2. Flumazenil
3. Naloxone
4. Yohimbine

**Answer: c. Naloxone.**

**References:**

1. Fish R, Danneman P, Brown M, and Karas A, eds.. Anesthesia and Analgesia in Laboratory Animals. American College of Laboratory Animal Medicine, second edition, Academic Press, 2008. P.264.
2. Carlson AM, Kelly R III, Fetterer DP, Rico PJ, Bailey EJ. Pharmacokinetics of 2 Formulations of Transdermal Fentanyl in Cynomolgus Macaques (Macaca fascicularis). *JAALAS*. 2016: 55(4)436-442.

**Domain 2**

Question 34: Name the anatomical zero point on the skull for the coordinate system marked with letter A in the atlas depicted in the picture.

1. Bregma
2. Lambda
3. Sagittal Sutures
4. Interaural line

**Answer: a. Bregma**

**References:**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter25 – Techniques of Experimentation, p. 1238.
2. Paxinos G, and Watson, C. 2007. The Rat Brain in Stereotaxic Coordinates, 6th Edition. Academic Press: Amsterdam, The Netherland. p. XII.

**Domain 3**

Question 35: What is this apparatus?

1. A unit used to collect urine and feces from study animals
2. An inhalation chamber
3. A unit for housing poultry
4. A mechanical washer for fragile equipment

**Answer: b. An inhalation chamber**

**Reference: http://labproductsinc.com/product/inhalation-exposure-chamber/**

**Domain 4**

Question 36: This species has what unique husbandry requirement?

a. Monthly dust baths

b. Weekly dust baths

c. Daily dust baths

d. Daily water bath

**Answer: c. Daily dust baths**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning K, Whary M, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 9 – Biology and Diseases of Chinchillas, p. 389.

2) Suckow, MA, KA Stevens, RP Wilson, 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. 968-9.

**Domain 4; Tertiary Species – Chinchilla laniger**

Question 37: An infant mouse presented with lethargy, a bloated abdomen and fecal soiling of the perineum. Histology of the intestines is presented below. What disease caused the clinical and histological signs?

1. Mouse Hepatitis Infection
2. Mouse Parvovirus Infectiom
3. Mouse Rotavirus Infection
4. Tyzzer’s disease

**Answer: c. Mouse Rotavirus Infection**

**Reference:**

1. Laboratory Animal Medicine, 3rd edition. American College of Laboratory Animal Medicine, eds. Fox, Anderson, Otto, Pritchett-Corning, Whary. Academic Press, 2015. (p. 91)
2. Baker, D. G. (1998). Pathogens of Rats and Mice. *CLINICAL MICROBIOLOGY REVIEWS,* *11*(2), 237-238. doi:10.1128/9781555817824.ch2

**Domain 1, Primary species**

Question 38: What is this equipment used to measure?

a. Fear-aggression

b. Anxiety

c. Learned helplessness

d. Motor function

**Answer: b Anxiety**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning K, Whary M, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 38 – Laboratory Animal Behavior

2) Institute for Laboratory Animal Research, Committee on Guidelines for the Use of Animals in Neuroscience and Behavioral Research, and National Academies Press. 2003. Guidelines for the Care and Use of Mammals in Neuroscience and Behavioral Research. National Academies Press: Washington, D.C. Chapter 9 – Behavioral Studies, p. 135

**Domain 3**

Question 39: This device is used to aid:

a. UV sterilization

b. Behavioral studies

c. Filtration of toxins

d. Embryo collection

**Answer: d. Embryo collection**

**References:**

1) Wang W, Liu X, Gelinas D, Ciruna B, and Sun Y. 2007. A Fully Automated Robotic System for Microinjection of Zebrafish Embryos. *PLoS One* 2 (9): e862.

2) Fox J, Anderson L, Loew F, Quimby F, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 19 – Biology and Management of the Zebrafish, p. 864.

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

Question 40: Which of the following statements about the device depicted in the following image is **CORRECT?**

1. It requires the use of jackets, restraint devices or tethering systems
2. It can be maintained for a maximum of 14 days, depending on the species
3. It provides continuous delivery to ensure constant compound levels in plasma or tissues for maximized therapeutic efficacy and reduced adverse effects
4. It provides a convenient, reliable, and cost-effective alternative to chronic injections
5. It can be placed intravascularly to monitor blood pressure, temperature, and activity from acceleration

**Answer: e. It can be placed intravascularly to monitor blood pressure, temperature, and activity from acceleration**

**References:**

1. Fox JG, Anderson LC, Otto GM, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 25. p. 1232.
2. http://www.emka.fr/product/implants-for-rodents/

**Domain 3; primary species – Rat (*Rattus rattus norvegicus*)**

Question 41: When utilizing the agent depicted below to anesthetize *Xenopus spp.*; which of the following **IS NOT** required?

1. Powder must be dissolved in water
2. Solution must be sterile filtered prior to use
3. Powder must be handled under a chemical fume hood
4. Solution must be buffered prior to use
5. Solutions must be stored in a cool place away from light

**Answer: b. Solution must be sterile filtered prior to use**

**References:**

1. Green SL. 2010. The Laboratory Xenopus. 1st edition. CRC Press: Boca Raton, FL. Chapter 4- Veterinary Care, pp. 110-111.
2. Brown MJ, Danneman PJ, Fish RE, Karas AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals. 2nd edition. American College of Laboratory Animal Medicine. Academic Press: Oxford, UK. Chapter 20- Anesthesia and Analgesia in Amphibians, pp. 514-515.
3. Drug insert for Tricaine-S: http://www.wchemical.com/downloads/dl/file/id/3/tricaine\_s\_directions\_for\_use.pdf

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

Question 42: The picture below illustrates the blood smear of a macaque recently acquired from an institution in the south of United States. The following statement is false about the parasite depicted below:

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

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

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

d. Clinical signs are usually secondary to cardiovascular involvement.

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

**References:**

1. **1**)Laboratory Animal Medicine , 3rd edition. American College of Laboratory Animal Medicine, eds. Fox, Anderson, Otto, Pritchett-Corning, Whary. Academic Press, 2015. Pg. 883-884.
2. Elana R Rybak,1,4,5,† Steve Shipley,2,3,† Ivan Tatarov,1,2,\* Tianshu Zhang,1 Wenji Sun,1 Gheorghe Braileanu,1 Lars Burdorf,1 Evelyn Sievert,1 Agnes M Azimzadeh,1 Louis J DeTolla,2 and Richard N Pierson III1. Clinical Trypanosoma cruzi Disease after CardiacTransplantation in a Cynomolgus Macaque (Macaca fascicularis*). Comp Med*. Vol 66, No 6 December 2016 Pages 1–5.
3. Derek L Fong,1,\* Annie E Torrence,1 Keith W Vogel,1 Diane E Stockinger,1 Veronica Nelson,3 Robert D Murnane,1,2 Audrey Baldessari,1,2 LaRene Kuller,1 Michael Agy,1 Hans-Peter Kiem,3 and Charlotte E Hotchkiss1. Transmission of Chagas Disease via Blood Transfusions in 2 Immunosuppressed Pigtailed Macaques (Macaca nemestrina). *Comp Med*. Vol 64, No 1 February 2014 Pages 63–67.

**Domain 1; primary species- Cynomolgus macaque-(Macaque fascicularis)**

Question 43: The following zebrafish parasite can be effectively treated with:

1. Salt baths
2. Fenbendazole
3. Chloroquine
4. Fumagillin

**Answer: b. Fenbendazole.**

**References:**

1. Collymore C, Crim MJ, Lieggi C. Recommendations for health monitoring and reporting for zebrafish research facilities. *Zebrafish*. 2016; 13(1) S138-S148.
2. Fox JG, Anderson LC, Otto Glen, Pritchett-Corning KR, Whary MT,eds. Laboratory Animal Medicine, 3rd edition. American College of Laboratory Animal Medicine. Academic Press, 2015. p.1120.

**Domain 1; Secondary spp. – Zebrafish**

Question 44: This OSHA chemical hazard pictogram indicates that a chemical has the following toxicities **EXCEPT**

* 1. Target organ toxicity
  2. Respiratory sensitizer
  3. Skin sensitizer
  4. aspiration toxicity
  5. carcinogen

**Answer: c. skin sensitizer**

**References:**

1. Hazard Communication. OSHA. Accessed Jan 2017. <https://www.osha.gov/dsg/hazcom/index.html>.
2. GHS Symbol Pictograms. Society for Chemical Hazard Communication. Accessed Jan 2017. <http://www.schc.org/ghs-symbol-pictograms>.

**Domain 5**

Question 45: In anesthetized dogs, rabbits, and swine, the location shown above can be used to measure heart rate and which of the following important parameters, using which device:

1. PaO2 using a pulse oximeter
2. SaO2 using a pulse oximeter
3. PaCo2 using a pulse capnometer
4. SaCo2 using a pulse capnometer
5. SaO2 using a pulse capnometer

**Answer: b. SaO2 using a pulse oximeter**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 24 – Preanesthesia, Anesthesia, Analgesia, and Euthanasia, p. 1154, 1166.
2. Fish R, Danneman P, Brown M, & Karas A. eds. 2008. Anesthesia and Analgesia in Laboratory Animals. 2nd edition. American College of Laboratory Animal Medicine, Academic Press: San Diego, CA. Chapter 6 – Monitoring of Anesthesia, p. 178; Chapter 13 – Anesthesia and Analgesia in Dogs and Cats, p. 376.

**Domain 2; Primary species – Dog (*Canis familiaris*), Rabbit (*Oryctolagus cuniculus*), Pig (*Sus scrofa domestica*)**

Question 46: The device next to the paperclip is used for:

a. Measuring pain threshold in rodents

b. Nonpharmacologic pain control

c. Single cell recording in electrophysiology studies

d. Performing root canals

**Answer: b. Nonpharmacologic pain control (acupuncture needle)**

**Reference:**

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 29 – Nonpharmacologic pain control, pp. 626-627.

2) Fox, JG, LC Anderson, G Otto, KR Pritchett-Corning, MT Whary. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 17 – Nonhuman Primates, p. 844-845.

**Domain 2**

Question 47: What is the purpose of this piece of equipment?

a. Sanitizing equipment

b. Dispensing bedding

c. Scavenging anesthesia

d. Protecting employees from hazards

**Answer: d. Protecting employees from hazards (bedding dump station)**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning K, Whary M, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 30 Occupational Health of Laboratory Animal Workers, pg 1389

**Domain 4**

Question 48: These images are from a necropsy of a rat that was purchased from a pet store for comparison of pathogen profiles in pet versus laboratory reared rats. What is the suspected etiology?

a*. Trichosomoides crassicauda*

b*. Rodentolepis nana*

c*. Taenia taeniaformis*

d*. Laelaps echidnina*

**Answer: c. *Taenia taeniaformis* (larval stage in rat - Cysticercus fasciolaris)**

**References:**

1) Percy DH and Barthold SW. 2016. Pathology of Laboratory Rodents and Rabbits, 4rd ed. Blackwell Publishing: Ames, Iowa. Chapter 2 – Rat, pp. 153.

2) Baker HJ, Lindsey, JR, Wesibroth SH. 1979. The Laboratory Rat, Volume I Biology and Diseases, Academic Press, New York. Chapter 12 – Parasitic Diseases, pp. 314-315

**Domain 1; Primary Species – *Rattus norvegicus***

Question 49: These two images depict injection of what anatomic structure?

a. Epaxial muscle

b. Dorsal lymph sac

c. Coelom

d. Lateral line

e. Egg mass

**Answer: b. Dorsal lymph sac**

**Reference:** Fox JG, Anderson LC, Otto G, Pritchett-Corning K, Whary M, eds. 2015 Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 19 – Biology and Diseases of Amphibians, p. 948.

**Domain 3; Secondary Species – Xenopus laevis**

Question 50: Which of the following murine microbial agents is most likely to be detected by both dirty bedding sentinels and the method pictured?

a. Mouse hepatitis virus

b. *Pasteurella pneumotropica*

c. Fur mites

d. Sendai virus

**Answer: a. Mouse hepatitis virus**

**References:**

1. M Miller, B Ritter, J Zorn, M Brielmeier. 2016. Exhaust Air Dust Monitoring is Superior to Soiled Bedding Sentinels for the Detection of Pasteurella pneumotropica in Individually Ventilated Cage Systems. JAALAS. 55(6), pp. 775–781.
2. BA Bauer, C Besch-Williford, RS Livingston, MJ Crim, LK Riley, MH Myles. 2016. Influence of Rack Design and Disease Prevalence on Detection of Rodent Pathogens in Exhaust Debris Samples from Individually Ventilated Caging Systems. JAALAS. 55(6), pp. 782–788.

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

Question 51: Which of the following methods would be the safest, least destructive, and most practical and effective choice for environmental decontamination in the face of an outbreak involving this parasite?

a. Dry heat at 215°F for 30 minutes

b. Ethylene oxide gas at 1,200 mg/L for 12 hours

c. Formaldehyde fumigation for 7 hours

d. Chlorine dioxide gas at 1 mg/L for 4 hours

**Answer: d. Chlorine dioxide gas at 1 mg/L for 4 hours**

**References:**

1) Dix J, Astill J, and Whelan G. 2004. Assessment of methods of destruction of *Syphacia muris* eggs. *Laboratory Animals*. 38: 11-16.

2) Czarra JA, Adams JK, Carter CL, Hill WA, and Coan PN. 2014. Exposure to Chlorine Dioxide Gas for 4 Hours Renders *Syphacia* Ova Nonviable. *JAALAS*. 53: 364-367.

**Domain 4; Primary Species – Mus musculus**

Question 52: The following rodent depicted in the picture, commonly studied for periodontal disease is mainly carnivorous:

a. Geomys

b. Dipodomys

c. Neotoma

d. Oryzomys

**Answer: d. Oryzomys**

**References:**

1) Aguirre, JI. Et.al. 2015. Breeding, Husbandray, Veterinary Care, and Hematology of Marsh Rice Rats (Oryzomys palustris), a Small Animal Model for Periodontitis. JAALAS: 54 (1). Pp. 51-58

2) Fox, JG, et. Al. 2015. Laboratory Animal Medicine 3rd Edition. Elsvier. Pp. 308-309

**Domain 4 – Tertiary species – Marsh Rice Rats (*Oryzomys palustris*)**

Question 53: The apparatus shown below is used in studies evaluating which of the following?

1. Fecal and urinary output
2. Taste aversion
3. Sleep fragmentation
4. Fear response
5. Pulmonary function

**Answer: c. Sleep fragmentation**

**Reference:**

1. Trammell RA, Verhulst S, Toth LA (2014) Effects of sleep fragmentation on sleep and markers of inflammation in mice. *Comp Med* 64: 13-24.
2. Trammell RA, Toth LA (2015) Effects of Sleep Fragmentation and Chronic Latent Viral Infection on Behavior and Inflammation in Mice. *Comp Med* 65: 173-185.

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

Question 54: What does this test assess?

1. Anxiety
2. Learning
3. Depression
4. Motor function

**Answer: b. learning**

**References:**

1. Vorhees CV and Williams MT. 2006. Moris water maze: procedures for assessing spatial and related forms of learning and memory. *Nature Protocols.* 1, 848-858. 2

**Domain 3, Primary Species**

Question 55: The following item is primarily used to reduce and replace research animals for what training purpose?

1. Intravenous injection
2. Suturing or wound closure
3. Tattooing
4. Topical drug administration
5. Surgical site preparation

**Answer: b. Suturing or wound closure**

**References:**

1. <https://www.surgireal.com>
2. IRAC [Interagency Research Animal Committee]. 1985. U.S. Government Principles for Utilization and Care of Vertebrate Animals Used in Testing, Research, and Training. Federal Register, May 20, 1985.

**Domain 6: Multiple**

Question 56: Which of the following is the most likely scenario regarding the generation of these littermate mice?

a. These mice are the result of ENU mutagenesis.

b. The mouse on the far left has the highest contribution of B6 embryonic stem cells injected into a B6 albino blastocyst.

c. These mice are the result of pronuclear injection of B6 DNA into an FVB embryo.

d. These mice are the result of cytoplasmic injection of a CRISPR/Cas nuclease containing B6 DNA into an FVB embryo.

**Answer: b. The mouse on the far left has the highest contribution of B6 embryonic stem cells injected into a B6 albino blastocyst**

**References:**

1) Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 32 – Genetically Modified Animals, pp. 1417-1440.

2) Esmail MY, Peimin Q, Connor AB, Fox JG and Garcia A. 2016. Generating Chimeric Mice by Using Embryos from Nonsuperovulated BALB/c Mice Compared with Superovulated BALB/c and Albino C57BL/6 Mice. *JAALAS*. 55: 400-405.

**Domain 3; Primary Species – Mus musculus**

Question 57: The rodent pictured belongs to the family \_\_\_\_\_\_\_ and lives a predominantly \_\_\_\_\_ lifestyle.

* 1. Cricetidae; monogamous
  2. Bathyregidae; eusocial
  3. Neotoma; solitary
  4. Geomyidae; fossorial
  5. Castoridae; aquatic

**Answer: d. Geomyidae, fossorial.**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 7- p. 298.
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 50 – Pocket Gopher, p. 1116

**Domain 4; Tertiary Species- Pocket Gopher (*Thomomys talpoides*)**

Question 58: The image shown is a 40X image of necropsy tissue from a *Macaca nemestrina* in Texas. How was the infectious organism shown here transmitted to this animal?

* 1. *Aedes* spp.
  2. *Anopheles* spp.
  3. *Culex* spp.
  4. *Triatoma* spp.

**Answer: d. *Triatoma* spp.**

**References:**

1. Dickerson MF, Astorga NG, Astorga NR, Lewis AD. Chagas disease in 2 geriatric rhesus macaques (*Macaca mulatta*) housed in the Pacific Northwest. [*Comp Med*](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4170098/). 2014 Aug; 64(4): 323–328.
2. Straight K, Else JG, Eberhard ML. Chapter 4: Parasitic diseases of nonhuman primates. In Nonhuman Primates in Biomedical Research: Diseases, 2nd edition, Elsevier. 2012. Pp. 204-205.

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

Question 59: What is **TRUE** about this animal’s use in neurobehavioral research?

1. This animal is more sensitive to MTPT administration than the rhesus macaque
2. This animal is the preferred animal model of experimental allergic encephalitis (EAE) compared to the cynomologous and rhesus macaque
3. This animal is used to model the neuropathogenesis of lentiviruses such as HIV
4. The first transgenic Huntington’s disease model was developed in this species

**Answer: b. This animal is the preferred animal model of experimental allergic encephalitis (EAE) compared to the cynomologous and rhesus macaque**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 17, p. 785.
2. 't Hart BA, van Kooyk Y, Geurts JJ, Gran B. 2015. The primate autoimmune encephalomyelitis model; a bridge between mouse and man. *Ann Clin Transl Neurol*. 2(5):581-93.

**Domain 3, Secondary Species – Marmoset/Tamarins (Callitrichidae)**

Question 60: The multimodal imaging shown is being used to study the evolution and growth of \_\_\_\_\_\_\_.

a. xenografts

b. osteoarthritis

c. heart failure

d. reproduction

**Answer: a. xenografts**

**References:**

1) Peterson NC, Wilson GG, Huang Q, Dimasi N, and Sachsenmeier KF. 2016. Biodistribution Analyses of a Near-Infrared, Fluorescently Labeled, Bispecific Monoclonal Antibody Using Optical Imaging. *Comparative Medicine* 66 (6): 90-99.

2) Fox J, Anderson L, Loew F, Quimby F, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 21 – Techniques of Experimentation, p. 1033.

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

Question 61: According to the Animal Welfare Regulations, this animal, weighing 22 kg, requires which cage size?

1. Group 3
2. Group 4
3. Group 5
4. Group 6

**Answer: c. Group 5.**

**Reference:** Animal Welfare Regulations, CFR Title 9, Chapter 1, Subchapter A – Animal Welfare, Part 2 – Regulations, Subpart D – Specifications for the Humane Handling, Care, Treatment, and Transportation of Nonhuman Primates, §3.80 Primary enclosures, (b) Minimum space requirements. (https://www.gpo.gov/fdsys/pkg/CFR-2013-title9-vol1/xml/CFR-2013-title9-vol1-chapI-subchapA.xml)

**Domain 5, Secondary species – Baboon (*Papio sp*.)**

Question 62: The organisms seen here are associated with

1. Rectal prolapse and enteritis in Rag1-/- mice.
2. Zoonotic transmission from pet store rodents to humans
3. Hypersensitivity dermatitis in B6 background strains
4. Bronchiolitis and bronchitis from pulmonary pneumonyssiasis

**Answer: c. Hypersensitivity dermatitis in B6 background strains**

**References:**

1. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 1 – Mouse, p. 85
2. Moats, Cassandra R; Baxter, Victoria K; Pate, Nathan M; Watson, Julie. 2016. Ectoparasite Burden, Clinical Disease, and Immune Responses throughout Fur Mite (Myocoptes musculinus) Infestation in C57BL/6 and Rag1–/– Mice. *Comp Med.* 66 (3) p. 197-207.

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

Question 63: Which etiologic agent, depicted below in a photomicrograph of a ventral nerve, may be associated with clinical signs of emaciation and spinal deformities in zebrafish (*Danio rerio)*?

1. *Pseudoloma neurophilia*
2. *Pseudocapillaria tomentosa*
3. *Pleistophora hyphessobryconis*
4. *Myxidium streisingeri*
5. *Lecythophora mutabilis*

**Answer: a. Pseudoloma neurophilia**

**References:**

1. Harper C and Lawrence C. 2010. The Laboratory Zebrafish, 1st edition. CRC Press: Boca Raton, FL. Chapter 5- Veterinary Care, pp. 159-160.
2. Murray KN, Dreska M, Nasiadka A, et al. Transmission, Diagnosis, and Recommendations for Control of Pseudoloma neurophilia Infections in Laboratory Zebrafish (Danio rerio) Facilities. Comparative Medicine. 2011;61(4):322-329.

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

Question 64: Which of the following chicken (Gallus domesticus) husbandry items shown in the first picture below would be a likely cause for the pulmonary hemorrhage and liver necrosis shown in the second set of histology slide pictures below?

1. New Polyethylene Terephthalate (PET) water bottles
2. Old Polyethylene Terephthalate (PET) water bottles
3. Noncoated, non-shatter-proof heat-lamp bulbs
4. Polytetrafluoroethylene (PTFE)- coated, shatter-proof heat-lamp bulbs

**Answer: d. Polytetrafluoroethylene (PTFE)- coated, shatter-proof heat-lamp bulbs**

**References:**

1. Shuster KA, Brock KL, Dysko RC, DiRita VJ, Bergin IL. 2012. Polytetrafluoroethylene Toxicosis in Recently Hatched Chickens (*Gallus domesticus*). Comparative Medicine 62 (1):49-52.
2. Richardson M. 1991. Teflon toxicity from heat lamps. J Assoc Avian Vet 5:192.

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

Question 65: The device pictured above is used for what application?

a. Operant-based pain assay

b. Memory testing

c. Metabolic chamber

d. Fear conditioning

e. Agility measurements

**Answer: a. Operant-based pain assay.**

**References:**

1) Taylor B, Ramirez H, Battles A, Andrutis K, Neubert J. 2016. Analgesic activity of tramadol and buprenorphine after voluntary ingestion by rats (*Rattus norvegicus*). *J Am Assoc Lab Anim Sci* 53 (1): 74-82.

2) Neubert J, Widmer C, Malphurs W, Rossi, H, Vierck C, Caudle R. 2005. Use of a novel thermal operant behavioral assay for characterization of orofacial pain sensitivity. *Pain* 116: 386-395.

3) Ramirez H, Queeny T, Dunbar M, Eichner M, Del Castillo D, Battles A, Neubert J. 2015. Assessment of an orofacial operant pain assay as a preclinical tool for evaluating analgesic efficacy in rodents. *J Am Assoc Lab Anim Sci* 54: 426-432.

**Domain 3**

Question 66: In the U.S. what controlled substance schedule is this anesthetic classified as?

1. Schedule 1
2. Schedule II
3. Schedule III
4. Schedule IV
5. Schedule V

**Answer d. Schedule IV**

**References:**

* + 1. CFR Title 21, Part 1305.03.
    2. USC Title 21, Chapter 13, Section 828.

**Domain 5; Multiple**

Question 67: What is the most likely diagnosis of the spontaneous eye lesion depicted below?

1. Unilateral cataract
2. Bilateral anophthalmia
3. Unilateral Enophthalmos
4. Horner’s syndrome

**Answer: a. Unilateral cataract**

**References:**

1. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. (2007). The Mouse in Biomedical Research: Diseases, 2nd edition. Academic Press: San Diego, CA. Chapter 25 - Spontaneous Disease On Commonly Used Mouse Strains, p672.
2. Fox JG, Anderson LC, Otto Glen, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 3 - Biology and Disease of Mice. p135.

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

Question 68: According to both the Animal Welfare Act and the Guide, what is the minimum floor space requirement for the primary enclosure of a three kilogram animal of the pictured species?

1. 1.6 ft2
2. 3 ft2
3. 4.3 ft2
4. 6 ft2
5. 8 ft2

**Answer: b. 3 ft2**

**References:**

1. Guide for the Care and Use of Laboratory Animals, 8th edition. The National Academies Press: Washington, D.C, 2011. Chapter 3-Environment, Housing and Management, Table 3.5, p. 61.
2. Animal Welfare Regulations, 9 CFR Chapter 1, Subchapter A, Part 3. USDA APHIS website, 2013. Subpart D—Specifications for the Humane Handling, Care, Treatment, and Transportation of Nonhuman Primates, section 3.80, Primary enclosures, p.100.

**Domain 5; Tertiary Species-White-headed capuchin (*Cebus capucinus*)**

Question 69: Which of the following is a characteristic of the device pictured?

1. It can deliver room air through an anesthetic circuit.
2. The risk of barotrauma is reduced by internal manifolds.
3. Inspiratory:expiratory ratio cannot be adjusted when it is running.
4. It will compensate for leaks in the anesthetic circuit, but an increase in the patient’s airway resistance will result in decreased tidal volume delivered.
5. It can operate in either intermittent positive-pressure or high-frequency mode.

**Answer: a. It can deliver room air through an anesthetic circuit.**

**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 5 – Anesthesia Delivery Systems, p. 154.

2) Flecknell, PA. 1996. Laboratory Animal Anaesthesia, 2nd ed. Academic Press, San Diego, CA. Chapter 5 – Special Techniques, p. 108.

3) Harvard Apparatus. [Internet]. 2016. Large animal ventilator (model 613) – single animal, volume controlled. [Cited 28 December 2016]. Available at: http://www.harvardapparatus.com/surgical/ventilators-and-accessories/ventilators/harvard-large-animal-model-613-single-animal-volume-controlled-ventilators.html.

**Domain 2**

Question 70: This is an example of enrichment commonly used for what species?

a. Dogs

b. Cats

c. Primates

d. Primates and Cats

e. Cats and Dogs

**Answer: c. Primates**

**References:**

1) National Research Council. 2011. Guide for the Care and Use of Laboratory Animals, 8th edition. National Academies Press, Washington, D.C. Chapter 3 – Environment, Housing, and Management, p. 52.

2) Fortman JD, Hewett TA, Halliday L. 2001. The Laboratory Nonhuman Primate. CRC Press: Boca Raton, FL. Husbandry, p. 50-53.

**Domain 4**

Question 71: Light exposure below what intensity at cage level might have prevented formation of the lesion in this rat?

a. 650 lux

b. 575 lux

c. 400 lux

d. 325 lux

**Answer: d. 325 lux**

**References:**

1) Fox JG, Anderson LC, Otto GM, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 4 – Biology and Diseases of Rats, p. 152.

2) National Research Council. 2011. Guide for the Care and Use of Laboratory Animals, 8th edition. The National Academy Press, Washington, D.C. Chapter 3 – Environment, Housing and Management, p. 49.

**Domain 4; Primary Species- Laboratory Rat (*Rattus norvegicus*)**

Question 72: How would you evaluate the following picture of a rat using the rat grimace scale?

1. Moderate orbital tightening and moderate nose/cheek flattening.
2. No orbital tightening and no nose/cheek flattening.
3. Obvious orbital tightening and moderate nose/cheek flattening
4. Moderate orbital tightening and no nose/cheek flattening

**Answer: c. Obvious orbital tightening and moderate nose/cheek flattening**

**References:**

1. [Matsumiya LC](http://www.ncbi.nlm.nih.gov/pubmed?term=Matsumiya%20LC%5BAuthor%5D&cauthor=true&cauthor_uid=22330867), [Sorge RE](http://www.ncbi.nlm.nih.gov/pubmed?term=Sorge%20RE%5BAuthor%5D&cauthor=true&cauthor_uid=22330867), [Sotocinal SG](http://www.ncbi.nlm.nih.gov/pubmed?term=Sotocinal%20SG%5BAuthor%5D&cauthor=true&cauthor_uid=22330867), [Tabaka JM](http://www.ncbi.nlm.nih.gov/pubmed?term=Tabaka%20JM%5BAuthor%5D&cauthor=true&cauthor_uid=22330867), [Wieskopf JS](http://www.ncbi.nlm.nih.gov/pubmed?term=Wieskopf%20JS%5BAuthor%5D&cauthor=true&cauthor_uid=22330867), [Zaloum A](http://www.ncbi.nlm.nih.gov/pubmed?term=Zaloum%20A%5BAuthor%5D&cauthor=true&cauthor_uid=22330867), [King OD](http://www.ncbi.nlm.nih.gov/pubmed?term=King%20OD%5BAuthor%5D&cauthor=true&cauthor_uid=22330867), [Mogil JS](http://www.ncbi.nlm.nih.gov/pubmed?term=Mogil%20JS%5BAuthor%5D&cauthor=true&cauthor_uid=22330867). 2012. Using the Mouse Grimace Scale to reevaluate the efficacy of postoperative analgesics in laboratory mice. *JAALAS,* 51(1):42-9.
2. Sotocinal SG, Sorge RE, et al. 2011. The Rat Grimace Scale: A partially automated method for quantifying pain in the laboratory rat via facial expressions. Molecular Pain 7, 55-65.

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

Question 73: You are verifying that environmental noise in your newly constructed facility meets the needs of an investigator using a mouse strain prone to audiogenic seizures. What is the following instrument’s use in this process?

1. An ultrasonic frequency detector to determine if ultrasound is present
2. A decibel detector to ensure that noise levels meet OSHA standards
3. A vibration detector to ensure that equipment doesn’t produce undue motion in cages
4. A frequency transducer that converts ambient noise to a standard score

**Answer: a. an ultrasonic frequency detector to determine if ultrasound is present**

**References:**

1) Fox, JG, et al, eds. 2015. Laboratory Animal Medicine*.* 3rd edition. Academic Press: San Diego, CA. Chapter 36 – Design and Management of Research Facilities, p. 1567-8.

2) The Guide for the Care and Use of Laboratory Animals*.* 2010. National Academy of Sciences. National Academic Press: Washington, DC. Chapter 3—Environment, Housing, and Management, p. 49.

**Domain 4, Primary species- *Mus musculus***

Question 74: Which is considered an unacceptable method of euthanasia for this species according to the AVMA Guidelines for the Euthanasia of Animals?

1. Cervical Dislocation
2. Decapitation
3. Thoracic Compression
4. Nitrogen and Argon
5. Inhaled Anesthetics

**Answer: c. Thoracic compression**

**Reference:** AVMA Guidelines on Euthanasia, 2013 ed. Schaumburg, American Veterinary Medical Association. S5.Avians, p.66-67.

**Domain 2; Tertiary Species- Chicken (Gallus Domestica)**

Question 75: Which of the depicted species has been use consistently as a robust rodent model of human respiratory syncytial virus (RSV)?

a.

b.

c.

d.

**Answer: b. Sigmodon hispidus**

**References:**

1) Fox, Anderson, Otto, Pritchett-Corning, Whary. Laboratory Animal Medicine , 3rd edition. American College of Laboratory Animal Medicine, eds. Academic Press, 2015. Pg. 311

2) [Grieves JL](https://www.ncbi.nlm.nih.gov/pubmed/?term=Grieves%20JL%5BAuthor%5D&cauthor=true&cauthor_uid=26310461)1, [Yin Z](https://www.ncbi.nlm.nih.gov/pubmed/?term=Yin%20Z%5BAuthor%5D&cauthor=true&cauthor_uid=26310461)2, [Durbin RK](https://www.ncbi.nlm.nih.gov/pubmed/?term=Durbin%20RK%5BAuthor%5D&cauthor=true&cauthor_uid=26310461)2, [Durbin JE](https://www.ncbi.nlm.nih.gov/pubmed/?term=Durbin%20JE%5BAuthor%5D&cauthor=true&cauthor_uid=26310461)3..Acute and Chronic Airway Disease After Human Respiratory Syncytial Virus Infection in Cotton Rats (Sigmodon hispidus). [*Comp Med*.](https://www.ncbi.nlm.nih.gov/pubmed/?term=Acute+and+Chronic+Airway+Disease+After+Human+Respiratory+Syncytial+Virus+Infection+in+Cotton+Rats+%28Sigmodon+hispidus%29) 2015 Aug;65(4):315-26.

**Domain 3 Research; Tertiary species-Cotton rat (Sigmodon hispidus)**

Question 76: Which species is most likely to experience acute death when affected by the disease pictured above?

1. Oryctolagus cuniculus
2. Cavia porcellus
3. Meriones unguiculatus
4. Rattus rattus

**Answer: c. Meriones unguiculatus**

**References:**

1) Fox, Anderson, Otto, Pritchett-Corning, Whary. Laboratory Animal Medicine , 3rd edition. American College of Laboratory Animal Medicine, eds. Academic Press, 2015. Pg.318

 2) Mark A. Suckow, Karla A. Stevens, Ronald P. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press; 1 edition. Pg. 1145.

**Domain 1. Tertiary species. Gerbil- Meriones unguiculatus**

Question 77: The photomicrograph below shows an H&E stained section of the right ventricular myocardium and epicardium in a BALB/c mouse. On gross examination, the lesion appeared as white plaques on the surface of the heart. What condition is shown and what special stain should be used to confirm the diagnosis?

1. Cardiac amyloidosis, PAS stain
2. Cardiac mineralization, Von Kossa stain
3. Cardiac amyloidosis, Congo red stain
4. Cardiac mineralization, Alcian blue stain

**Answer: b. Cardiac mineralization, Von Kossa stain**

**References:**

1) Barthold SW, Griffey SM, Percy DH, eds. 2016. Pathology of Laboratory Rodents and Rabbits, 4th edition. Wiley Blackwell, Ames, IA. Chapter 1 – Mouse, p. 93

2) Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith AL, eds. 2006. The Mouse in Biomedical Research, Volume 2, 2nd edition. Academic Press: San Diego, CA. Chapter 25 – Spontaneous Diseases in Commonly Used Mouse Strains, p. 675.

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

Question 78: In the photograph below, the urinary bladder in this mouse is greatly distended with reddish urine. What is the light-beige cystic structure to the left of the tail at the bottom of the photograph?

1. A cystic bulbourethral gland
2. A cystic preputial gland
3. A cystic sebaceous gland
4. A cystic coagulating gland
5. A cystic urethral gland

**Answer: a. A cystic bulbourethral gland**

**References:**

1. Barthold SW, Griffey SM, and Percy DH. 2016. Pathology of Laboratory Rodents and Rabbits. 4th ed. John Wiley &Sons, Inc : Chapter 1 – Mouse, p. 104.
2. Hill, Lori R. Coghlan, Lezlee G. Baze, Wallace B. Perineal Swellings in Two Strains of Mice. [Journal of the American Association for Laboratory Animal Science](http://www.ingentaconnect.com/content/aalas/jaalas), Volume 41(1), January 2002, pp. 51-53**Bulbourethral Gland Cysts in Three MiceBulbourethral Gland Cysts in Three Mice.**

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

Question 79: Which of the following best describes the surgical model pictured below?

1. The ileal conduit model, commonly performed in *Sus scrofa*, is a model for the evaluation of radiochemotherapy or molecular-based therapies in bladder cancer following radical cystectomy.
2. The reversible intestinal tie-adult rabbit diarrhea (RITARD) model provides for the chronic evaluation of induced infectious gastrointestinal disease typically evaluating *Escherichia coli*.
3. The ileal loop model in *Oryctolagus cuniculi* provides for the evaluation of acute gastrointestinal disease and is typically used as a model for *Vibrio cholerae*.
4. Serial transverse enteroplasty (STEP) is a method of short bowel syndrome surgical correction typically refined in *Sus scrofa* models.

**Answer: c. The ileal loop model in *Oryctolagus cuniculi* provides for the evaluation of acute gastrointestinal disease and is typically used as a model for *Vibrio cholera.***

**References:**

1. Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press:San Diego, CA. Chapter 18 – The Rabbit as an Experimental Model, pp. 548-549.
2. Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, Fox JG. 2015. Laboratory Animal Medicine, Third Edition. Academic Press:San Diego, CA. Chapter 25 – Techniques of Experimentation, p. 1221.
3. Image taken from: Cheng, C., Zhou, Y., Kan, B., Wang, Q., Rui, Y."Construction and characterization of a Vibrio cholerae serogroup O139 vaccine candidate by genetic engineering". Molecular Medicine Reports 9.6 (2014): 2239-2244.

**Domain 3; Primary species – Rabbit (*Oryctolagus cuniculi)***

Question 80: The image shows an appropriate identification method for what species?

a. Dog

b. Cat

c. Primate

d. Dogs and cats

e. Dogs, cats, and primates

**Answer: e. Dogs, cats, and primates**

**References:**

1) National Research Council. 2011. Guide for the Care and Use of Laboratory Animals, 8th edition. National Academies Press, Washington, D.C. Chapter 4 – Veterinary Care, p. 106.

2) United States Department of Agriculture. 2013. AnimalWelfare Inspection Guide. Chapter 4 – Specific Types of Inspections – Records, 4-48.

**Domain 4**

Question 81: What does the equipment depicted below measure?

1. Depression
2. Memory
3. Avoidance
4. Mechanical allodynia
5. Rotational behavior

**Answer: e. Rotational behavior**

**References:**

1) <http://www.harvardapparatus.com/hapdfs/HAI_DOCCAT_3/BH1_18.pdf>

2) <http://www.panlab.com/panlabWeb/Hardware/ROTAMETER/ROTAMETER.pdf>

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

Question 82: According to the AWA and Regulations, which of the following cannot be used to sanitize primary enclosures for the following species?

1. Soap or detergent and hot water - 180 °F in a mechanical cage washer
2. Detergent solution followed by a safe disinfectant
3. Live steam
4. Flame
5. Wash and rinse water at 143 - 165 °F for 30 minutes

**Answer: e. Wash and rinse water at 143 - 165 °F for 30 minutes**

**References:**

1. Title 9, Chapter 1, Subchapter A, Part 2, Subpart C, Part 3.56 (b)(3)
2. US Code, Title 7: Chapter 54, Animal Welfare Act

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

Question 83: According to the *Guide for the Care and Use of Agricultural Animals in Research and Teaching, which of the* following illumination settings is recommended for this species in this type of housing?

1. 320 lux
2. 120 lux
3. 220 lux
4. 220 ft. candles
5. 25 ft. candles

**Answer: c. 220 lux**

**References:**

1. Federation of Animal Science Societies. *Guide for the Care and Use of Agricultural Animals in Research and Teaching*: Champaign (IL): Federation of Animal Science Societies; 2010, pg 131.
2. <https://www.aaalac.org/about/Ag_Guide_3rd_ed.pdf>

**Domain 5; Secondary – Sheep (Ovis aries)**

Question 84: Which of the following would be an inappropriate bedding substrate for this model?

1. Aspen
2. Beech
3. Maple
4. Birch
5. Pine

**Answer: e. pine**

**References:**

1. Fox JG, Barthold SW, Davisson MT, Newcomer CE, Quimby FW, Smith A, eds. 2007. The Mouse in Biomedical Research. 2nd edition. Volume III Normative Biology, Husbandry, and Models. Academic Press. San Diego, CA. Ch 9-Design and Management of Research Facilities for Mice. P. 306
2. Fox JG, Anderson, LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 36 –Design and Management of Research Facilities p. 1579

**Domain 4; primary species-Mouse (Mus musculus)**

Question 85: Fecal examination of a male *Mesocricetus auratus* revealed the organism below. Which of the following best describes the organism and an appropriate intervention strategy?

1. *Trichosomoides crassicauda* is commonly found in wild rats and enhanced vermin control is needed.
2. *Hymenolepis diminuta* has an indirect lifecycle and the animal must be treated with praziquantel.
3. *Dentostomella translucida* has a direct lifecycle in this species and the animal must be treated with piperazine citrate.
4. *Rodentolepis nana* has a direct lifecycle and all animals must be culled due to its zoonotic potential.
5. *Prosthenorchis elegans* can be identified with fecal sedimentation and the animal should be treated with carbon tetrachloride.

**Answer: b. *Hymenolepis diminuta* has an indirect lifecycle and the animal must be treated with praziquantel.**

**Reference:**

1. Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, Fox JG. 2015. Laboratory Animal Medicine, Third Edition. Academic Press:San Diego, CA. Chapter 5 – Biology and Diseases of Hamsters, pp. 226-227.
2. Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press:San Diego, CA. Chapter 32 – Parasitic Diseases, pp. 854-857.

**Domain 1 – Primary (mice, rat, macaque) and Secondary (hamster, gerbil) species**

Question 86: Rats housed in this style of cage have been reported to have an increase in which of the following parameters in comparison to individuals housed in clear cages?

* 1. Nocturnal melatonin
  2. Xenograft growth
  3. Diurnal total fatty acids
  4. Lactate

**Answer: a. Nocturnal melatonin**

**References**

1. Dauchy RT, Hoffman AE, Wren-Daail, MA, Hanifin JP, Warfield B, Brainard GC, Xiang S, Yuan L, Hill S, Belancio VP, Dauchy EM, Smith K, Blask DE. 2015. Daytime blue light enhances the nighttime circadian melatonin inhibition of human prostate cancer growth. JAALAS 65(6): 473-85.
2. Wren, Melissa A., et al. "Effect of different spectral transmittances through tinted animal cages on circadian metabolism and physiology in Sprague–Dawley rats." *Journal of the American Association for Laboratory Animal Science* 53.1 (2014): 44-51.

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

Question 87: Which U.S government agency enforces international agreements with the following agency?

1. Department of Interior
2. Department of Agriculture
3. Department of Commerce
4. Department of Health and Human Services
5. Department of Transportation

**Answer: a. Department of Interior**

**References:**

1. Endangered Species Act of 1973 - 16 U.S.C. § 1531 et seq.
2. <https://www.fws.gov>

**Domain 5**

Question 88: According to the standard pattern for ear notches punch numbering, what is the number of this mouse?

* 1. 12
  2. 21
  3. 32
  4. 23
  5. 51

**Answer: a. 12**

**References:**

1. Laboratory Animal Medicine, 3rd edition. American College of Laboratory Animal Medicine, eds. Fox, Anderson, Otto, Pritchett-Corning, Whary. Academic Press, 2015, p. 1203
2. The Laboratory Mice, 2rd edition. Hans J. Hendrich, Academic Press, 2012, p. 538

**Domain 4**

Question 89: According to USDA *Animal Welfare Regulation*, what is the minimum floor area for the male nonhuman primate species depicted in the slide weigh 20 kg?

1. 1.6 ft.2
2. 3.0 ft.2
3. 4.3 ft.2
4. 8.0 ft.2
5. 10.0 ft.2

**Answer: d. 8.0 ft.2**

**Reference:**

1. CFR, Title 9 – Chapter 1 – Subchapter A – Part 3 - Subpart D – Specification for the Humane Handling, Care, Treatment and Transportation of Nonhuman Primates, §3.80 Primary Enclosure. (08-1-02 Edition, p. 94)

**Domain 5; Secondary Species – Baboon (Papio spp.)**

Question 90: What is the ideal temperature for the system pictured here?

* 1. 27.4°C
  2. 28.5°C
  3. 30.1°C
  4. 26.2°C

**Answer: b. 28.5**

**References:**

1) Reed B, Jennings M. 2011. Guidance on the Housing and Care of Zebrafish (*Danio* *rerio*). Research Animals Department, Science Group, RSPCA. Chapter 4 – Housing and Care, p. 24. <https://www.aaalac.org/accreditation/refresources/zebrafishreference.pdf>

2) National Research Council. 2011. Guide for the Care and Use of Laboratory Animals, 8th edition. National Academies Press, Washington, D.C. Chapter 3 – Environment, Housing, and Management, p. 78.

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

Question 91: This is one benefit from this type of housing for *Danio rario*:

1. Decreased cortisol production for singly housed animals
2. Increased breeding
3. Increased growth rate
4. Increased shoaling behavior
5. Decreased aggression

**Answer: b. Increased breeding**

**References:**

1. Fox, J., et al. (2015). Laboratory Animal Medicine. San Diego, CA, Elsevier: 1023.
2. Wilkes, L., et al. (2012). "Does structural enrichment for toxicology studies improve zebrafish welfare?" *Applied Animal Behaviour Science* 139(1-2): 143-150.
3. Collymore, C., et al. (2015). "The Behavioral Effects of Single Housing and Environmental Enrichment on Adult Zebrafish (Danio rerio)." *J Am Assoc Lab Anim Sci* 54(3): 280-285.

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

Question 92: Two photos below are from an adult mouse. What is the likely cause of the pathological changes seen?

1. A lymphoid (B cell) neoplasm
2. A subcutaneous abscess in one of the hind limbs
3. A periorbital abscess
4. A mammary gland neoplasm
5. Infection with *Mycoplasma coccoides*

**Answer: a. A lymphoid (B cell) neoplasm**

**References:**

1. Barthold SW, Griffey SM, and Percy DH. 2016. Pathology of Laboratory Rodents and Rabbits. 4th ed. John Wiley &Sons, Inc: Chapter 1 – Mouse, p. 110.
2. Morse, HC 3rd, et.al. 2002. “Bethesda Proposals for Classification of Lymphoid Neoplasms in Mice”. Blood 100 (1), pp 246-258. Table 1, p. 248.

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

Question 93: Deficiency of which enzyme produces the gross findings shown above in a guinea pig (*Cavia porcellus*)?

1. L-lactose oxidase
2. L-gulonolactone oxidase
3. L-ascorbate oxidase
4. L-dehydroascorbic oxidase

**Answer: b. L-gulonolactone oxidase**

**References:**

1. Fox JG, Anderson LC, Otto GM, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 6 – Biology and Diseases of Guinea Pigs, p. 268.
2. Suckow MA, Stevens KA, Wilson RP, eds. 2012. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents, 1st edition. Academic Press: San Diego, CA. Chapter 21 – Management, Husbandry, and Colony Health, p. 613.

**Domain 4; Secondary Species – Guinea pigs (*Cavia procellus*)**

Question 94: Photo of abdominal contents of a healthy animal after necropsy. The gastrointestinal tract shown is from what species?

1. An herbivorous Old-World monkey because it has a large cecum and sacculus profundus
2. A large rodent because it has a sacculus rotundus and appendix
3. A ferret because it has a sacculus rotundus and fusus coli
4. A rabbit because it has a sacculus rotundus and fusus coli
5. A rabbit because it has a sacculus rotundus and ampulla caecalis coli

**Answer: e. A rabbit because it has a sacculus rotundus and ampulla caecalis coli**

**References:**

1. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits. 3rd ed. Blackwell Publishing: Ames, Iowa. Chapter 6 – Rabbit, p 253-254. (NOTE: The 4th ed. of this book does not describe the sacculus rotundus.)
2. Varga M. 2014. Textbook of Rabbit Medicine. 2nd ed. Butterworth-Heinemann. Edinburgh. Chapter 1, pp 14-19 (specifically p 16).

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

Question 95: The following health monitoring method is more efficient than soiled bedding change at detecting which of the following agents that can infect mouse colonies in the research facilities?

a. Mouse hepatitis virus

b. Pasteurella pneumotropica

c. Pinworms

d. Mouse parvovirus

**Answer: b. Pasteurella pneumotropica**

**References:**

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

2) Fox, et al, eds. 2015. Laboratory Animal Medicine, 3rd, edition, Academic Press: San Diego CA. Chapter 3: Biology and Diseases of Mice. P. 106

**Domain 1- Primary species – Mouse (*Mus musculus*)**

Question 96: The following picture allows visualization of what unique feature about the avian larynx?

a. the syrinx

b. incomplete tracheal rings

c. median tracheal septum

d. the lack of an epiglottis

**Answer: d. the lack of an epiglottis**

**References:**

1. Fish RE, Brown MJ, Danneman PJ, and Karas AZ, eds. 2008. Anesthesia and Analgesia in Laboratory Animals, 2nd ed. Academic Press: San Diego, CA. Chapter 18 – Anesthesia and Analgesia in Birds, p. 484
2. Ritchie, Harrison, Harrison, eds. 1997. Avian Medicine: Principles and Application, Abridged Edition. Wingers Publishing, Inc.: Lake Worth, FL. Chapter 22 – Pneumonology, p. 295.

**Domain 1; Tertiary Species – Birds**

Question 97: Which of the following statements is TRUE regarding the condition pictured above (tissue from a rabbit)?

* 1. Incidence does not seem to bear any relationship to parity
  2. Incidence is related to both increasing age and parity
  3. Metastases are uncommon, but when they do occur are found in the liver and lungs
  4. Metastases are uncommon, but when they do occur are found in the lungs and axial skeleton

**Answer: a. Incidence does not seem to bear any relationship to parity**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 10 – Biology and Diseases of Rabbits, p. 449
2. Suckow MA, Stevens KA, Wilson RP. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. 2012 Academic Press; San Diego CA. Section II: Rabbits, Chapter 16- Rabbit Neoplasia, pp 458-459
3. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd edition. Blackwell Publishing: Ames, Iowa. Chapter 6 – Rabbit , p. 304

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

Question 98: Which of the following organisms can transmit the rat tapeworm *Hymenolepis diminuta*?

a. 

b.

c.

d.

**Answer: b. Confused flour beetle (*Tribolium confusum*)**

**References:**

1) Clemmons, E. et. Al. 2016. Booklice (Liposcelis spp.), Grain Mites (Acarus siro), and Flour Beetles (Tribolium spp.): ‘Other pests’ Ocassionally Found in Laboratory Animal Facilities. JAALAS 55 (6): p. 737-743.

2) 2) Fox, et al, eds. 2015. Laboratory Animal Medicine, 3rd, edition, Academic Press: San Diego CA. Chapter 4: Biology and Diseases of Rats. P. 185

**Domain 4- Primary species – Rat (*Rattus norvegicus*)**

Question 99: Slowly filling euthanasia chambers with fixed rates of carbon dioxide as indicated in the newest guidelines, in mice has been shown to induce the following lesion in which of the following strains of mice?

a. C57BL6

b. SJL

c. BALB/c

d. C3H

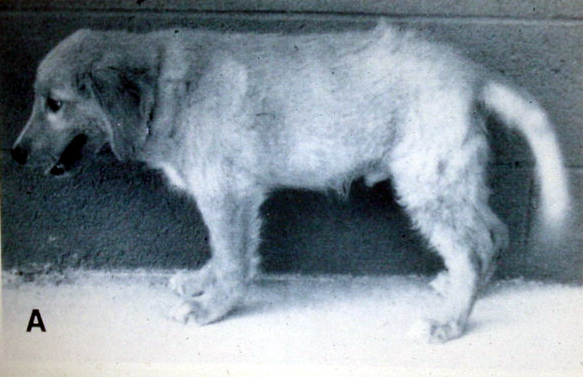
**Answer: c. BALB/c**

**References:**

1) Fisher, S. et. Al. 2016. Interstrain Differences in CO2-Induced Pulmonary Hemorrhage in Mice. JAALAS 55 (6): p. 811-815.

2) American Veterinary Medical Association. 2013. AVMA Guidelines for the Euthanasia of Animals.

**Domain 2- Primary species- Mouse (*Mus musculus*)**

Question 100: What is the most likely diagnosis for the 3 month disease progression noted between A and B?

1. Limb girdle muscular dystrophy (type II fiber deficiency)
2. Diffuse idiopathic skeletal hyperostosis
3. Duchenne muscular dystrophy (dystrophin deficiency)
4. Globoid cell leukodystrophy
5. Multiple sclerosis

**Answer: c. Duchenne muscular dystrophy**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 12-Biology and Diseases of Dogs, p.512.
2. Kornegay JN, Spurney CF, Nghiem PP, Brinkmeyer-Langford CL, Hoffman EP, Nagaraju K. 2014. Pharmacologic Management of Duchenne Muscular Dystrophy: Target Identification and Preclinical Trials. ILAR J: 55 (1):119-149.

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

Question 101: The technique depicted in this slide is a non-surgical refinement of what technique?

* 1. Administration of ENU
  2. Collection of sperm cells
  3. Urinary catheterization
  4. Collection of oocytes

**Answer: b. Collection of sperm cells**

**References:**

1. Boersma A, Olszanska O, Walter I, and Rulicke T. 2015. Microsurgical and percutaneous epididymal sperm aspiration for sperm collection from live mice. JAALAS 54(5): 471-477.
2. Del Val GM and Robledano PM. 2013. In vivo serical sampling of epididymal sperm in mice. Lab Anim 47:168-174.

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

Question 102: Which of the following is the appropriate way to ship a serum sample to be tested for B virus?

1. In package A with identification number UN 2814
2. In package B with identification number UN 2814
3. In package A with identification number UN 3373
4. In package B with identification number UN 3373
5. In package B with identification number UN 2900

**Answer: c. In package A with identification number UN 3373**

**References:**

1. Centers for Disease Control and Prevention and National Institute of Health. Biosafety in Microbiological and Biomedical Laboratories, 5th edition. 2009. Appendix C: Transportation of Infectious Substances pp.341-342
2. IATA Dangerous Goods Regulations, 56th Edition 2015. Division 6.2- Infectious Substances, Table 3.6D p 152.

Available at: https://www.iata.org/whatwedo/cargo/dgr/Documents/infectious-substance-classification-DGR56-en.pdf

**Domain 5; Primary species – Macaque (*Macaca* spp.)**

Question 103: This is a photo of a spleen from a rabbit. It is relatively small because:

1. Rabbits have a lot of lymphoid tissue in the GALT (Gut-Associated Lymphoid Tissue).
2. Rabbits have a lot of lymphoid tissue in the sacculus rotundus and Peyer’ Patches.
3. Rabbit bones are fragile but all contain abundant lymphoid tissue.
4. The red pulp is diminished because the bones contain abundant erythroid tissue.
5. The thymus gland of rabbits does not regress with age and thusly there is no need for T cells in the splenic white pulp.

**Answer: a. Rabbits have a lot of lymphoid tissue in the GALT (Gut-Associated Lymphoid Tissue).**

**References:**

1. Barthold SW, Griffey SM, and Percy DH. 2016. Pathology of Laboratory Rodents and Rabbits. 4th ed. John Wiley &Sons, Inc: Chapter 6 – Rabbit, p. 255.
2. Varga M. 2014. Textbook of Rabbit Medicine. 2nd ed. Butterworth-Heinemann. Edinburgh. Chapter 1, pp 17).

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

Question 104: Which of the following cleaning agents is not safe to use on cages housing the specie depicted in the picture below?

a. 1% Virkon

b. Iodine-based cleanser

c. 2% bleach

d. 70% ethanol

**Answer: b. Iodine-based cleanser**

**References:**

1) Fox, et al, eds. Laboratory Animal Medicine, 3rd, edition, Academic Press, 2015, Amphibian chapter 18. Page.937

**Domain 4 Animal Care, tertiary species, poison dart frog, *Dendrobates spp.***

Question 105: What basic behavior does the following enrichment item provide for *Sus scrofa?*

* 1. Rooting
  2. Suckling
  3. Socialization
  4. Sexual

**Answer: a. Rooting**

**References**

1. Fox JG, Anderson LC, Loew FM, Quimby FW, eds. 2002. Laboratory Animal Medicine, 2nd edition. Academic Press: San Diego, CA. Chapter 16 – Biology and disease of swine, p. 697.
2. Huntsberry, M. E., Charles, D., Adams, K. M., & Weed, J. L. (2008). The foraging ball as a quick and easy enrichment device for pigs (Sus scrofa). *Lab animal*, *37*(9), 411.

**Domain 4; Primary Species- Swine *(Sus scrofa)***

Question 106: This cell, found in guinea pigs, is most prominent during the pregnancy when:

a. As the estrogen level decreases

b. As the progesterone increases

c. As the estrogen level increases

d. As the progesterone level decreases

**Answer: c. As the estrogen level increases. (Foa-Kurloff cell)**

1)“Mark A. Suckow, Karla A. Stevens and Ronald P. Wilso.n The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents” Pg 584

2)Fox, Anderson, Otto, Pritchett-Corning, Whary. Laboratory Animal Medicine , 3rd edition. American College of Laboratory Animal Medicine, eds. Academic Press, 2015. Pg 251

**Domain 1. Secondary species. Guinea pig (Cavia porcellus).**

Question 107: The following lesion in a squirrel monkey (*Saimiri sciureus*) is most likely due to which nutritional imbalance?

1. Hypervitaminosis A
2. Hypovitaminosis D2
3. Hypovitaminosis C
4. Hypovitaminosis D3
5. Folic acid deficiency

**Answer: c. Hypovitaminosis C**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 17 – Nonhuman Primates, p. 891.
2. Abee, CR, Manfield K, Tardif S, Morris T, eds. 2012. Nonhuman Primates in Biomedical Research, 2nd edition. Academic Press: San Diego, CA. Chapter 12 - Digestive System Diseases of Nonhuman Primates, p. 593.

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

Question 108: According to the regulations, what is the appropriate housing square footage for the following animal species shown below if he weighs 11.0 kg?

1. 1.6 square feet
2. 3.0 square feet
3. 4.3 square feet
4. 6.0 square feet

**Answer: d.** 6.0 square feet

**References:**

1. Animal Welfare Act and Animal Welfare Regulations, Part 3 – Standards, Subpart D – Specifications for the Humane Handling, Care, Treatment, and Transportation of Nonhuman Primates, § 3.80 - Primary enclosures (November 2013 Edition, p. 99-100).
2. National Research Council (NRC). 2011. Guide for the Care and Use of Laboratory Animals, 8th edition. National Academy Press, Washington, DC. Chapter 3 – Environment, Housing, and Management, p. 61.

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

Question 109: One of the following is **NOT** true about efficacy and safety of anesthetics in the pictured species:

a. High dose of lidocaine has a wide safety margin.

b. Metomidate hydrochoride is useful for sedation and immobilization.

c. Gradual cooling is useful for sedation and immobilization.

d. Isoflurane is unsuitable as a sole anesthetic due is high mortality rate.

**Answer: a. High dose lidocaine has a wide safety margin.**

**References:**

1) Chereen Collymore,1,\* Angela Tolwani,2 Christine Lieggi,1,3 and Skye Rasmussen1,2. Efficacy and Safety of 5 Anesthetics in Adult Zebrafish (Danio rerio). *JAALAS* Vol 53, No 2 March 2014

Pages 198–203.

2)Laboratory Animal Medicine , 3rd edition. American College of Laboratory Animal Medicine, eds. Fox, Anderson, Otto, Pritchett-Corning, Whary. Academic Press, 2015. Pg. 182-183.

**Domain: 2; Secondary species-Zebrafish (Danio rerio).**

Question 110: Which of the following terms best describes the breeding scheme depicted above?

1. Consomic strains
2. Recombinant inbred lines
3. Recombinant congenic strains
4. Advanced intercross lines
5. Diversity outcross

**Answer: b. Recombinant inbred lines**

**References:**

1. Hedrich HJ. (2012) The Laboratory Mouse, 2nd ed. Academic Press: London. Chapter 1.3- Strains, Stocks, and Mutant Mice, p. 46.
2. Fox JG, et al. (2007) The Mouse in Biomedical Research, 2nd ed. Elsevier. Chapter 4- Breeding Systems: Considerations, Genetic fundamentals, Genetic background, and Strain types. p.71.

**Domain 3**

Question 111: This picture shows a wet mount from the posterior brain of a zebrafish, infected with a certain pathogen. Which of the clinical signs listed below is not associated with this infection?

1. Emaciation
2. Scoliosis
3. Lordosis
4. Brain tumors

**Answer: d. Brain tumors.**

**References:**

1. Murray KN, Dreska M, Rinne M, Matthews JL, Carmichael C, Bauer J, Varga ZN, Westerfield M. 2011. Transmission, Diagnosis, and Recommendations for Control of Pseudoloma neurophilia Infections in Zebrafish (Danio rerio) Facilities. *Comp Med*, 61(4): 322-329.
2. Sanders JL, Watral V, Kent ML. 2012. Microsporidiosis in Zebrafish Research Facilities. *ILAR*, 53(2): 106-113.

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

Question 112: As described in the recent literature, what is projecting from the eye of the mouse pictured?

a. Phenol red thread for tear test

b. Electrode implanted into upper eyelid to detect blinking activity

c. Cannula for serial blood collection from retroobrital sinus

d. Cannula for serial intraocular infusion

**Answer: a. Phenol red thread for tear test**

**References:**

1. K Servet, K Kadri. 2016. Efficacy of Several Therapeutic Agents in a Murine Model of Dry Eye Syndrome. Comparative Medicine. 66(2) pp. 112–118.
2. K Servet, K Kadri. 2016. Tear Production Rate in a Mouse Model of Dry Eye According to the Phenol Red Thread and Endodontic Absorbent Paper Point Tear Tests. Comparative Medicine. 66(5) pp. 367-372.

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

Question 113: Which of the following methods would be best to euthanize eggs from this species that are at 60% incubation?

1. <4 C for 4 hours
2. freezing
3. Addling
4. Carbon dioxide exposure > 20 minutes

**Answer: d. carbon dioxide exposure > 20 minutes**

**References:**

1. AVMA Guidelines for the Euthanasia of Animal: 2013 Edition S5. Avians p. 67

**Domain 2, Tertiary Species**

Question 114: Changing this species to a new environment is associated with a decrease in which of the following parameters?

1. C-reactive protein (CRP)
2. Pig major acute-phase protein (PMAP)
3. Haptoglobin
4. Porcine α-1 acid glycoprotein (PAGP)
5. Albumin

**Answer: e. Albumin**

**References:**

1. Christoffersen BØ, Jensen SJ, Ludvigsen TP, Nilsson SK, Grossi AB, Heegaard PM. Age- and Sex-Associated Effects on Acute-Phase Proteins in Göttingen Minipigs. Comp Med. 2015 Aug;65(4):333-41.
2. URL: <http://www.sdsdiets.com/products_and_data_sheets/mini_pig/>

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

Question 115: Who is this person, who played an integral role in the development of Laboratory Animal Veterinarians?

a. Dr. William Gay, First President of AALAS

b. Dr. James Fox, ACLAM President 1990-1991

c. Dr. Thomas Clarkson, first Training Program Director

d. Dr. Nathan Brewer, First President of AALAS and ACLAM

**Answer: d. Dr. Nathan Brewer, First President of AALAS and ACLAM**

**References:**

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

2) College History. American College of Laboratory Animal Medicine. <https://aclam.org/about-us/college-history>

**Domain 6**

Question 116: A hematoma (arrow) is present in the mandibular area and extends caudally. Which of the following techniques is commonly associated with this finding?

1. Retroorbital sinus blood withdrawal
2. Sublingual vein blood collection
3. Facial vein blood collection
4. Retroorbital sinus injection
5. Temporal vein blood collection

**Answer: c. Facial vein blood collection**

**References:**

1. Effects on Animal Wellbeing and Sample Quality of 2 Techniques for Collecting Blood from the Facial Vein of Mice. J Am Assoc Lab Anim Sci. 2015 January;54(1):80-84.
2. Golde WT, Gollobin P, Rodriguez LL. 2005. A rapid, simple, and humane method for submandibular bleeding of mice using a lancet. Lab Anim (NY) 34:39–43.

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

Question 117: In the image below, which element is not in consistent with current recommendations for housing laboratory swine?

1. Cage bars
2. Water source
3. Food bowl
4. Enrichment device
5. Flooring

**Answer: c. Food bowl (*not attached to cage or floor*)**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 16 – Biology and Diseases of Swine, pp. 696-697.
2. Swindle MM, Smith AC. 2016. Swine in the Laboratory: Surgery, Anesthesia, Imaging, and Experimental Techniques, 3rd edition. CRC Press: Boca Raton, FL. Chapter 1 – Biology, Handling, Husbandry, and Anatomy, pp. 12-17.

* Includes picture

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

Question 118: Findings from an aged, experimentally naïve rat. With which strain is this condition most commonly associated?

1. Sprague Dawley
2. LEW
3. F-344
4. Wistar
5. BUF

**Answer: c. F-344**

**References:**

1. Fox JG, Anderson LC, Otto G, Pritchett-Corning KR, Whary MT, eds. 2015. Laboratory Animal Medicine, 3rd edition. Academic Press: San Diego, CA. Chapter 4 – Biology and Diseases of Rats, p. 193.
2. Percy DH and Barthold SW. 2007. Pathology of Laboratory Rodents and Rabbits, 3rd edition. Blackwell Publishing: Ames, Iowa. Chapter 2 – Rat, pp. 169-170.

* Includes picture

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

Question 119: According to the *Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching*, the procedure depicted below should occur at what age?

a. less than 1 week of age

b. less than 2 weeks of age

c. less than 3 weeks of age

d. less than 4 weeks of age

e. less than 6 weeks of age

**Answer: d. less than 4 weeks of age**

**References:**

1. Federation of Animal Science Societies (FASS), 2010. Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching, 3rd edition. FASS, Savoy. Champaign, IL, p. 136.

**Domain 5; Secondary Species – Goat (Capra hircus)**

Question 120: Approximately what volume of blood does this method require for analysis?

a. 1-2ul

b. 5-10ul

c. 20-25ul

d. 50-100ul

e. 100-200ul

**Answer: c. 20-25ul**

**References**

1. http://www.criver.com/files/pdfs/research-models/rm\_ld\_d\_ez\_spot.aspx[http://www.criver.com/files/pdfs/research-models/rm\_ld\_d\_ez\_spot.aspx](https://owa.utoronto.ca/owa/redir.aspx?SURL=IxMPHZY8oMxQX14zWZ2gHoUE41-iapfTFAJLd7Il6eTPiFu2tjDUCGgAdAB0AHAAOgAvAC8AdwB3AHcALgBjAHIAaQB2AGUAcgAuAGMAbwBtAC8AZgBpAGwAZQBzAC8AcABkAGYAcwAvAHIAZQBzAGUAYQByAGMAaAAtAG0AbwBkAGUAbABzAC8AcgBtAF8AbABkAF8AZABfAGUAegBfAHMAcABvAHQALgBhAHMAcAB4AA..&URL=http%3a%2f%2fwww.criver.com%2ffiles%2fpdfs%2fresearch-models%2frm_ld_d_ez_spot.aspx)
2. ER Wickremsinhe, EJ Perkins. 2015. Using Dried Blood Spot Sampling to Improve Data Quality and Reduce Animal Use in Mouse Pharmacokinetic Studies. JAALAS. 54(2), pp. 139-144.

**Domain 3 – primary species; Mouse (*Mus musculus*)**

***END OF EXAM***