



The Australian and New Zealand
College of Veterinary Scientists

Fellowship Examination

June 2012

Veterinary Diagnostic Imaging

Paper 1

Perusal time: **Twenty (20)** minutes

Time allowed: **Three (3)** hours after perusal

In **Section A**: Answer **ALL FOUR (4)** essay style questions

All four questions in **Section A** are of equal value

Section A is worth 2/3 of the total marks for this exam

In **Section B**: Answer **ALL TEN (10)** short answer questions

All ten questions in **Section B** are of equal value

Section B is worth 1/3 of the total marks for this exam

The mark distribution within each section is as follows:

Section A: FOUR questions each worth 25 marks of a TOTAL 100 marks

Section B: TEN questions each worth 5 marks of a TOTAL 50 marks

Paper 1: Veterinary Diagnostic Imaging

SECTION A:

Answer all four (4) questions:

1. Reducing the signal from fat is an important technique in clinical magnetic resonance (MR) imaging, both in small and large animal patients. (25 marks)
 - a) List the **two (2)** common methods for reducing/eliminating the signal from fat.
 - b) Explain briefly the differences between the **two (2)** techniques.
 - c) List the hardware (if any) required to perform these techniques.
 - d) List the advantages and disadvantages of each technique.
 - e) Discuss some important clinical applications for these techniques

2. A local zoo specialising in avian species is dissatisfied with their radiographic images and wish to improve image quality, particularly for their smaller patients. The resources they have are:
 - an 80 KW 3 Phase falling load generator with 1.2 and 0.3mm tungsten focal spots
 - an indirect flat panel imaging plate with a pixel size of 160 microns
 - a standard small animal floating top radiographic table
 - standard commercial PACS and viewing stations
 - standard avian anaesthesia systems

List your recommendations for maximising image quality using their current resources. Explain in detail the rationale for each of your recommendations. (25 marks)

3. Define temporal resolution of an ultrasound system and discuss the factors that may influence temporal resolution. Explain why frame rates are lower in colour Doppler imaging than in gray-scale imaging. (25 marks)

4. Describe iodine metabolism in relation to the thyroid gland. Compare and contrast the processing by the thyroid of the two radiopharmaceuticals: technetium-pertechnetate and iodine 123 that may be used in thyroid scintigraphy. Explain how methimazole and iodinated contrast medium would impact the accuracy of thyroid scintigraphy performed using each of the above radiopharmaceuticals. (25 marks)

End of Section A

SECTION B

You must answer ALL questions.

1. You have just injected a nonionic contrast agent into a normal healthy dog and within minutes, the contrast medium is radiographically apparent in the left renal pelvis. Describe the route by which the contrast medium reaches the **left** renal pelvis and **commence your description at the descending aorta.** (5 marks)

2. Answer **all** subparts of this question
 - a) A chronic avulsion of the lateral palmer intercarpal ligament in a two-year-old filly is suspected. List the radiographic view in which a lesion of this structure might be best identified. Use abbreviated 'Nomina Anatomica Veterinaria' nomenclature. (1 mark)
 - b) Name the best radiographic view to assess the presence of osteochondrosis of the equine medial malleolus. Use abbreviated 'Nomina Anatomica Veterinaria' nomenclature. (1/2 mark)
 - c) Name the typical age at which the equine basioccipital/basisphenoid suture closes. (1/2 mark)
 - d) Name the typical age at which the proximal physis of the equine metastarsus closes. (1/2 mark)
 - e) List the components of the equine colon in order from orad to aborad including the flexures. (2 1/2 marks)

3. With respect to computer technology:
 - a) Write down the meaning of the acronym 'DICOM.' (1/2 mark)
 - b) List the **three (3)** basic elements of DICOM functionality. (1 1/2 marks)
 - c) List the **three (3)** address components of a standard 'DICOM' connection. (1 1/2 marks)
 - d) Caesium and gadolinium are commonly used scintillators in indirect digital flat panels. Briefly explain the basis of why one scintillator has theoretically better image quality. (1 mark)
 - e) Write down the approximate resolution of a digital flat panel in line pairs/mm. (1/2 mark)

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4. Answer **all** subparts of this question
- a) List **three (3)** proposed pathophysiologic mechanisms of contrast agent associated acute renal failure. *(1½ marks)*
 - b) Performing an excretory urogram can affect the accuracy of subsequent urinary laboratory tests in the first 24 hours following the contrast study. List **three (3)** tests which may be affected and indicate what changes might occur. *(1½ marks)*
 - c) Myelography was a commonly used diagnostic tool in the assessment of spinal disease and can be associated with severe complications. List **four (4)** reported complications in the dog following the use of intrathecal, non-ionic, iodinated contrast agents. *(2 marks)*
5. Answer **all** subparts of this question
- a) With respect to computed tomography (CT) scanners that have multiple detectors, define 'pitch.' *(1 mark)*
 - b) Name a typical 'window width' and 'window level' used to assess the lung parenchyma. *(½ marks)*
 - c) Name the approximate range of Hounsfield units for acute intracranial haemorrhage. *(½ marks)*
 - d) With respect to CT, briefly define 'mA modulation.' List **two (2)** advantages of this technology. *(1½ marks)*
 - e) With respect to magnetic resonance imaging: write down the 'Lamor' equation. Briefly define each parameter of the equation. *(1½ marks)*

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6. Match **each** of the following descriptions (denoted by letters) with one or more CT artefacts (denoted by numbers). Each description may match more than one artefact; and each artefact may match no description, or one or more descriptions.

In your answer booklet, for each description letter, write the artefact number(s) that best suit(s).

Descriptions:

- a) A decrease in apparent bone opacity and loss of definition of bone edges in areas of skull that are thin or have curving surfaces. (*1/2 mark*)
- b) Increased noise and streaking through a region that is much thicker or attenuating than adjacent areas. (*1/2 mark*)
- c) Undersampling along the axis of rotation. (*1/2 mark*)
- d) Areas of increased attenuation within a portion of the liver that is at the edge of a scan circle in an abdominal scan. (*1/2 mark*)
- e) A single or concentric black ring seen on a scan of a whole body phantom with a third generation scanner. (*1/2 mark*)
- f) A star or sunburst pattern of white and black streaks emanating from some endotracheal tubes. (*1/2 mark*)
- g) A reason why contiguous transverse images should have 20 -30 % overlap. (*1/2 mark*)
- h) Generation of MPR images from a thick slice transverse dataset. (*1/2 mark*)
- i) An artefact commonly associated with thicker slices. (*1/2 mark*)
- j) 'Cupping' is a form of this artefact. (*1/2 mark*)

Artefacts:

- 1 = Beam hardening artefact
- 2 = Detector calibration artefact
- 3 = Stair step artefact
- 4 = Partial volume averaging
- 5 = Truncated image
- 6 = Windmill
- 7 = Photon starvation
- 8 = High density (~metal attenuation)
- 9 = Cone beam effect
- 10 = Zebra artefact

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7. Answer **all** subparts of this question
- a) With respect to radiation safety, write down the meaning of the acronym 'ALARA.' List the **three (3)** practical principles by which this concept is enacted. *(1 mark)*
 - b) With respect to diagnostic radiology, name the SI units for: *(1½ marks)*
 - i. exposure quantity
 - ii. absorbed dose
 - iii. dose equivalent.
 - c) With respect to diagnostic radiography, list the two most important means by which the x ray beam interacts with the patient on an atomic level. *(1 mark)*
 - d) With respect to c) above, briefly explain the practical implications of these interactions with respect to both image quality and patient dose. *(1½ marks)*

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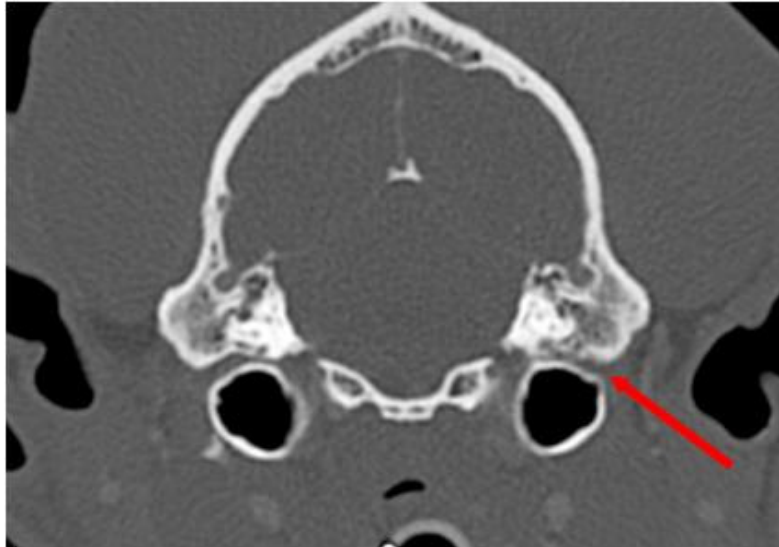
8. Answer **TRUE** or **FALSE** for each statement:

Each statement is worth half (1/2) a mark each.

- a) obstructive jaundice (post-hepatic icterus) results primarily in high levels of unconjugated bilirubin
- b) icterus due to haemolysis can be identified by haemological evidence of erythrocyte destruction and elevated plasma unconjugated bilirubin levels
- c) in horses with exercise induced pulmonary haemorrhage, radiographic lesions are most frequently located in the caudal dorsal part of the lung, however a diffuse pattern of parenchymal haemorrhage has been reported
- d) extrahepatic biliary obstruction can result in common bile duct enlargement within 24-48 hours and peripheral hepatic biliary duct enlargement in 5-7 days
- e) the embryonic origin of the main pulmonary artery is the truncus arteriosus
- f) bile acids that are produced by the liver are lower in dogs with portosystemic shunts due to the lack of resorption within the intestinal tract
- g) in immature canine long bones, blood vessels pass from the metaphysis into the hypertrophic zone of the physis
- h) during normal growth, the distal ulnar growth plate adds length to the bone at nearly twice the rate of the distal radial growth plate
- i) non-cardiogenic pulmonary oedema secondary to increased vascular permeability can be caused by a variety of pulmonary and systemic disorders and has a peri-hilar distribution pattern with abnormal pulmonary wedge pressures
- j) cardiac tamponade in pericardial effusion is due to elevation of intra cardiac systolic pressures.

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9. A transverse CT image of a canine skull.

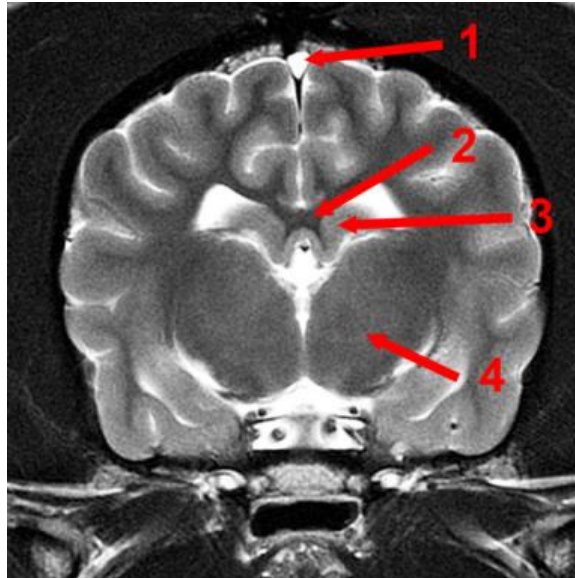


- Identify the name of the canal **and** foramen indicated by the arrow. *(1/2 mark)*
- Name the important structure that passes through this canal. *(1 mark)*
- List the clinical signs that may occur as a result of injury to this structure. *(1 mark)*
- Identify the name, describe the appearance and briefly explain the cause of the bone associated CT artefact commonly seen in the caudal fossa in dogs. *(1 mark)*
- List **three (3)** changes that can be made to scan parameters that may reduce the severity of the artefact described in d) above. *(1 1/2 marks)*

Continued over page

10 Answer **all** subparts of this question.

- a) A transverse T2 weighted image of a canine brain at the level of the thalamus.
Identify the regions labelled by the arrows. (*½ mark each*)



- b) A feline forelimb radiograph.

Name the structure indicated by the arrow (*½ mark*) and list the structure(s) that pass through this. (*½ mark*)



- c) List the components that make up the **canine** common calcanean tendon. (*2 marks*)

End of paper



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Fellowship Examination

June 2012

Veterinary Diagnostic Imaging Paper 2

Perusal time: **Twenty (20)** minutes

Time allowed: **Three (3)** hours after perusal

In **Section A**: Answer **ALL FOUR (4)** essay style questions

All four questions in **Section A** are of equal value

Section A is worth 2/3 of the total marks for this exam

In **Section B**: Answer **ALL TEN (10)** short answer questions

All ten questions in **Section B** are of equal value

Section B is worth 1/3 of the total marks for this exam

The mark distribution within each section is as follows:

Section A Essay style: FOUR questions each worth 25 marks of a **TOTAL 100** marks

Section B Short answers: TEN questions each worth 5 marks of a **TOTAL 50** marks

Paper 2: Veterinary Diagnostic Imaging

SECTION A:

Answer all four (4) questions:

1. Pulmonary oedema is an important radiographic diagnosis. List **three (3)** broad pathophysiologic mechanisms by which pulmonary oedema develops, and state **one (1)** disease or disorder that results in pulmonary oedema by each mechanism. Discuss the radiographic findings associated with pulmonary oedema in dogs and how these findings can assist in defining the probable cause for the oedema. (25 marks)
2. Magnetic resonance (MR) imaging is increasingly used to assess for the presence of discospondylitis in the dog. Describe the MR features of discospondylitis. List **two (2)** differential diagnoses for discospondylitis and discuss the MR imaging features used to distinguish these differential diagnoses from discospondylitis. (25 marks)
3. Septic arthritis in a foal may lead to a reduced athletic performance as an adult racehorse. Discuss both the pathogenesis of septic arthritis in the foal and the imaging recommendations that you would make for the investigation of septic arthritis in the foal. (25 marks)
4. A surgeon suspects an insulinoma in a labrador and requires pre-surgical imaging assessment. You have access to digital radiography, diagnostic ultrasound, a 16 Slice CT scanner and a 0.3T magnet. Discuss your recommendations for imaging this patient. In your answer, include any important image acquisition parameters that would be necessary to ensure a study of the highest diagnostic potential. (25 marks)

End of section A

SECTION B

You must answer ALL questions.

Answer each question on a new page.

1. List the MR imaging features of a mid cervical discal cyst. (5 marks)
2. Epulis is a common condition in dogs. List the **three (3)** forms of epulis and the radiographic features of each. (5 marks)
3. List the CT features of a cholesteatoma. (5 marks)
4. Both ventilation and perfusion imaging of the lung (pulmonary physiology) are possible with scintigraphy. Name a radiopharmaceutical that can be used for **each**, and briefly describe the method of localisation. (5 marks)
5. The signal intensity of hemorrhage on various MRI sequences changes over time. With respect to T1, T2 and T2* weighting, using terms such as *hypointense*, *isointense* and *hyperintense*, describe the MR findings of intracranial hemorrhage and how it may change over time. (5 marks)
6. List the MRI characteristics of cryptococcal abscessation located in the brain of a dog. (5 marks)
7. Describe how 'Simpsons rule' is calculated and how this may be used to calculate ejection fraction. (5 marks)
8. Abdominal sonography is an important screening tool when staging small animal patients with mast cell disease. With respect to the dog, briefly discuss the sonographic features of splenic mast cell infiltration that would prompt you to recommend fine needle aspiration. (5 marks)

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9. Portal vein to aorta and portal vein to caudal vena cava ratios have been reported to be useful in discriminating between animals with extrahepatic portosystemic shunting and normal animals. Name the commonly accepted ratios and list the potential sources of error in calculating these ratios. (5 marks)

10. You are presented with images of an eight-month-old filly that has recently fallen on her head. She is unable to stand unassisted and has epistaxis and blood in her horizontal ear canals. Name the most likely diagnosis and briefly discuss the radiographic findings you would predict in these circumstances. (5 marks)

End of paper