

THE ROYAL COLLEGE OF VETERINARY SURGEONS

DIPLOMA IN VETERINARY RADIOLOGY

22 August 2000

Paper 1

3 hours

Candidates should answer FOUR of the SIX questions which must include ONE from each section.

Please use a separate answer sheet for each question. Answers to the questions in Sections A and B should be put inside separate answer sheet covers.

Illegible handwriting or failure to answer the question in the form requested may result in examiners being unable to award marks for information which the candidates intended to convey.

SECTION A

1.
 - a. Outline the main interaction processes of x-rays with tissue leading to the formation of an X-ray image in diagnostic radiology. With the aid of a graph show what happens to the attenuation coefficient in tissue for each process as the photon energy is increased from 10 to 100 keV. (12 marks)
 - b. Explain the contribution of each of the interactions described above to the production of contrast between tissues in the image. (8 marks)
 - c. Briefly outline the actions which can be taken to improve contrast when taking a plain x-ray. (5 marks)
2.
 - a. Briefly describe a digital image intensifier and a film/screen system. Discuss, giving reasons, the advantages and disadvantages of a digital image intensifier system for spot images relative to x-ray film/screen imaging. (15 marks)
 - b. Describe the image processing which could typically be done to improve the digital images obtained from the system above. (5 marks)
 - c. Describe, with the aid of a diagram, the distribution and relative magnitude of scatter from an animal during fluoroscopy. (5 marks)

continued overleaf

3.
 - a. Describe, with the aid of a diagram, the major physical components of a gamma camera. (10 marks)
 - b. Discuss the factors which effect the choice of collimator. What effect does the energy of the radionuclide have on collimator design. (6 marks)
 - c. Outline typical procedures that should be in place to reduce dose to staff during nuclear medicine procedures. (9 marks)

SECTION B

4. Discuss the merits of the different imaging modalities in assessing disease of the canine calvarium and brain.
5. Scintigraphy may be used to diagnose portosystemic shunts in dogs. Compare the value of the information that may be obtained by this means with that from other imaging techniques.
6. Discuss the use of imaging in the investigation of problems associated with the navel in foals.

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THE ROYAL COLLEGE OF VETERINARY SURGEONS

DIPLOMA IN VETERINARY RADIOLOGY

Tuesday 22 August 2000

Paper 2

3 hours

Candidates should answer FOUR questions which must include ONE from each section.

Please use a separate answer sheet for each question. Answers to the questions in Sections A, B and C should be put inside separate answer sheet covers.

Illegible handwriting or failure to answer the question in the form requested may result in examiners being unable to award marks for information which the candidates intended to convey.

SECTION A (GENERAL)

1. Write short notes on radiologically visible lesions in the stifle of:
 - a) Cattle
 - b) Cats
 - c) Horses
2. Discuss the contribution of imaging to diagnosis of diseases of the eye and its adnexa.

SECTION B (LARGE ANIMAL)

3. Discuss the contribution of imaging techniques to the understanding of foot pain in the horse.
4. Comment on the usefulness of thoracic radiology in the investigation of respiratory disease in the horse.

SECTION C (SMALL ANIMAL)

5. Discuss the pitfalls in interpreting images of the diseased canine prostate.
6. Discuss the role of ultrasound guided biopsy in small animal medicine in the year 2000.

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THE ROYAL COLLEGE OF VETERINARY SURGEONS

DIPLOMA IN VETERINARY RADIOLOGY
TUESDAY 30 JULY 2002

PAPER I

Advanced Radiological Physics, Techniques and Interpretation
(3 hours)

This paper is in two Sections (A and B)
instructions relating to the number of questions to be answered
are given at the head of each Section.

SECTION A

Candidates are required to answer **FOUR** of the **SIX** questions which **MUST INCLUDE ONE FROM EACH SECTION**

Allow 45 minutes per question.

Illegible handwriting or failure to answer the question in the form requested may result in examiners being unable to award marks for information which candidates intended to convey.

If insufficient time is available to answer a question fully, it will be acceptable to complete in note form.

SECTION A

1.
 - a) **Briefly** describe the **TWO** processes by which X-rays are produced in the X-ray tube.
 - b) Draw a graph of the X-ray spectrum from a tungsten target X-ray tube operated at 80 kVp. **Briefly** explain each feature shown on the graph.
 - c) Explain how the contrast in a radiographic image will be changed by decreasing the tube voltage to 60kVp.
 - d) Give **TWO** other methods, with reasons, by which radiographic contrast can be maximised in film/screen radiography.

2.
 - (a) State the **THREE** principles of radiation protection described by the International Commission on Radiological Protection (ICRP) and **outline** how they apply in veterinary radiography.
 - (b) The Ionising Radiations Regulations 1999 define “controlled” and “supervised” areas. Explain the meaning of these terms.
 - (c) With reference to use of a mobile X-ray unit describe, giving reasons, the controlled area which would be defined and how entry is restricted.

P.T.O. for Question 3, and Section B

- 3.
- a) **Briefly** describe the main components of a superconducting MRI scanner.
 - b) Explain, with the aid of a diagram, how slice selection in the longitudinal axis is achieved.
 - c) State the significance of the 0.5mT (5 gauss) line around a MRI scanner and indicate the design features, which reduce the size of the controlled area.

SECTION B

4. Give an account of the contribution diagnostic imaging techniques can make in the qualitative and quantitative assessment of blood flow in limb vessels. For each imaging modality you describe, indicate the nature of the information available and the practicalities of its use.
5. Select **THREE** out of the following **FOUR** clinical situations and indicate how you would proceed or what advice you would give to a colleague:
- a) A single 1 cm diameter soft tissue mass has been identified on a lateral projection of the thorax. Your colleague believes this to be a pulmonary metastasis.
 - b) A colleague has obtained a dynamic study of $^{99}\text{Tc}^{\text{m}}\text{O}_4^-$ distribution in the liver and heart in an animal that has a single extra-hepatic congenital porto-caval vascular shunt. One hundred and eighty images, each of 1 second duration, have been acquired. The radioisotope was administered 10 seconds after the dynamic acquisition was started. Your colleague asks your assistance in quantifying as far as is possible the extent of vascular shunting present in this animal. Describe in detail how you would determine relevant areas of interest and indicate the effect on the results if regions of interest (ROIs) are not determined correctly.
 - c) A colleague is considering investing in an ultrasonic harmonic imaging facility as a tool for use in a project investigating cardiac function and morphology in guinea pigs. Explain the principle behind this technique, give the advantages attributed to it and give a view on its suitability for the above project.
 - d) A colleague is considering a switch from using a two sided emulsion film/two screen cassette combination, to a single sided emulsion / single screen system for use in the distal extremity of equine limbs. Comment on the consequence of making such a move on image quality and on any other consequences you consider relevant.
6. You are asked to provide informed advice on the possible purchase of a digital radiology system. Highlight the factors that need to be taken into account and **outline** the advice you might give.

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THE ROYAL COLLEGE OF VETERINARY SURGEONS

DIPLOMA IN VETERINARY RADIOLOGY

TUESDAY 30 JULY 2002

PAPER II

Radiological Interpretation
(3 hours)

This paper is in three Sections (A, B and C)
instructions relating to the number of questions to be answered
are given at the head of each Section.

SECTION A

Candidates are required to answer **FOUR** of the **SIX** questions which **MUST INCLUDE ONE FROM EACH SECTION.**

Allow 45 minutes per question.

Please use a separate answer sheet for each question. Answers to the questions in Sections A, B and C should be put inside separate answer sheet covers.

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If insufficient time is available to answer a question fully, it will be acceptable to complete in note form.

SECTION A (GENERAL)

1. Discuss the contribution ionizing radiation-based imaging modalities can make in the diagnosis of thyroid abnormalities.
2. Periosteal reaction is an indication of bone response. Discuss the interpretation that may be put on the different radiographic appearances produced by periosteal reaction using the cat and cattle as exemplars.

SECTION B (LARGE ANIMAL)

3. Describe with the aid of diagrams, the radiological measurements that have been applied to the phalanges of the horse. Indicate the contribution if any, these can make to the assessment of laminitis in the horse.
4. Discuss the contribution ultrasound imaging can make in the investigation of abdominal pain ("colic") in adult horses and foals. What criteria would you use to differentiate small bowel enteritis from bowel obstruction in a foal?

SECTION C (SMALL ANIMAL)

5. Compare and weight the information that may be gleaned from the use of plain radiographs, CT and MRI in the investigation of chronic nasal discharge in the dog
6. 'Ultrasonography has replaced conventional radiography in the investigation of prostatic disease in the dog.' Discuss.

THE ROYAL COLLEGE OF VETERINARY SURGEONS

DIPLOMA IN VETERINARY RADIOLOGY
THURSDAY 17 JULY 2003

PAPER I

Advanced Radiological Physics, Techniques and Interpretation
(3 hours)

This paper is in two Sections (A and B)
instructions relating to the number of questions to be answered
are given at the head of each Section.

Candidates are required to answer **FOUR** of the **SIX** questions which **MUST INCLUDE ONE FROM EACH SECTION**

Allow 45 minutes per question.

Illegible handwriting or failure to answer the question in the form requested may result in examiners being unable to award marks for information which candidates intended to convey.

SECTION A

1.
 - a) **Briefly** describe the **TWO** main processes by which X-rays in the diagnostic energy range interact with tissue.
 - b) With the aid of a graph, show how the attenuation coefficient of each of these processes in tissue varies with photon energy.
 - c) Describe where the intensity of scattered radiation is greatest when imaging a large animal. Give a **brief** explanation.
 - d) Give **THREE** methods by which scatter reaching the film can be reduced.

2.
 - a) In veterinary radiology describe when Local Rules are required and what is their purpose.
 - b) Give a **list** of typical contents for a typical diagnostic X-ray room making it clear which items are mandatory and which cover local requirements.
 - c) How would you measure:
 - i) The dose rate from an animal having bone scintigraphy?
 - ii) The effective dose to a member of staff over a period of 3 months?

In **each** case give a **brief** explanation of how the detector works and give reasons for your choice.

P.T.O. for Question 3, and Section B

3. With reference to the situation of tendon scanning in the horse:
- a) **Briefly** describe the effects on the image of using a higher frequency probe. Explain the reason for **each** effect.
 - b) Explain, giving reasons, which of the **THREE** kinds of resolution (axial, lateral and contrast) is the most important for tendon imaging?
 - c) Under what circumstances would it be useful to use a standoff? Describe why a standoff is used and the effect it has on the detail which can be seen in the image?
 - d) **Briefly** describe artefacts likely to be encountered when scanning tendons. Include those introduced by a standoff.

SECTION B

4. Describe the theory and practice of the use of ultrasound contrast media. In your answer, you should mention the physical principles underlying their use, any special ultrasound machine requirements to gain the best results and their current applications in veterinary medicine.
5. Low osmolar non-ionic contrast media have largely replaced classical iodine contrast media in conventional radiography. Discuss the reasons for this, giving examples to justify the change.
6. You are asked to establish a teleradiology reporting service.
- a) Discuss the image acquisition options.
 - b) How images may reach the reporting service.
 - c) The impact that the various acquisition options and modes of transmission have on image quality.

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THE ROYAL COLLEGE OF VETERINARY SURGEONS

DIPLOMA IN VETERINARY RADIOLOGY

THURSDAY 17 JULY 2003

PAPER II

Radiological Interpretation
(3 hours)

This paper is in three Sections (A, B and C)
instructions relating to the number of questions to be answered
are given at the head of each Section.

Candidates are required to answer **FOUR** of the **SIX** questions which **MUST INCLUDE ONE FROM EACH SECTION.**

Allow 45 minutes per question.

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SECTION A (GENERAL)

1. Define the terms syringomyelia and hydromyelia. Discuss the diagnostic imaging options for these conditions. For each of the imaging modalities you describe, mention the sensitivity for the diagnosis of these conditions.
2. The interstitial pattern is often used to describe pulmonary change. What do you understand by the term 'interstitial pattern', and how do the features relate to underlying disease in the dog, cat, cow and horse?

SECTION B (LARGE ANIMAL)

3. **List** the structures seen on an ultrasonographic examination of the stifle joint in the horse, giving a brief account of their normal ultrasonographic appearance. Describe the changes you might expect to see in the patellar ligaments and their attachments, in a horse that had undergone desmotomy of the medial patellar ligament one month previously.

P.T.O. for Questions 4, and Section C, Questions 5 and 6

4. Osseous cyst-like lesions have been identified at multiple locations in the horse. Describe their location and imaging characteristics and suggested aetiopathogenesis in the metacarpophalangeal area. How would you evaluate their likely clinical significance? Comment on the roles of radiography and computed tomography in their diagnosis.

SECTION C (SMALL ANIMAL)

5. Changes in the canine cranial mediastinum can present a diagnostic challenge. **List** the diseases that might manifest in this region and describe how you would differentiate these conditions through imaging.
6. The peritoneum is a potential space. Discuss its role in disease and the features that might thus be anticipated using various imaging modalities.

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THE ROYAL COLLEGE OF VETERINARY SURGEONS

DIPLOMA IN VETERINARY DIAGNOSTIC IMAGING
WEDNESDAY 14 JULY 2004

PAPER I

Advanced Radiological Physics, Techniques and Interpretation
(3 hours)

This paper is in two Sections (A and B)

Candidates are required to answer **FOUR** of the **SIX** questions which **MUST INCLUDE ONE FROM EACH SECTION**

Allow 45 minutes per question.

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SECTION A

2.

- a) **Briefly** describe the process by which the continuous spectrum of X-rays is produced in the x-ray tube.
- b) Draw a graph of the typical x-ray spectrum from a tungsten target X-ray tube designed for CT and operated at 120kVp. Ensure all relevant features are clearly marked.
- c) Explain the physical origin of the contrast in a CT image.
- d) List **THREE** equipment-related variables which influence the contrast in a CT image. In **each** case **briefly** explain why.

3. Radiation Protection

- a) State the **THREE** general principles of radiation protection described by the International Commission on Radiological Protection (ICRP) and **outline** how they apply in veterinary radiography.
- b) Explain the difference between deterministic and stochastic biological effects of ionising radiation.
- c) State the dose limits for deterministic and stochastic effects for radiation workers (of 18 years or over) as defined in the Ionising Radiations Regulations 1999 and explain how these limits are derived.

P.T.O. for Question 3 and Section B

4. Nuclear medicine imaging

- a) **Outline** the physical processes in the gamma camera which lead to the production of an image.
- b) **Compare and contrast** the methods used to reduce the effects of scattered radiation on image quality in radionuclide imaging with that in plain radiography.
- c) Describe the factors that can be optimised to improve image quality (contrast and resolution) in a $^{99}\text{Tc}^{\text{m}}$ -HDP bone scintigraphy image.

P.T.O. for Section B

5. Describe the use of CT in the examination of canine lungs, indicating practical aspects of the examination and how the use of helical CT techniques can be considered an advance over sequential CT techniques in imaging this area.

6. Describe in detail the information contained in a pulsed wave Doppler display. Indicate with text and using diagrams the appearance on such a display of:

a) aliasing artefact

b) blood flow in a high resistance blood vessel

c) blood flow in a low resistance blood vessel.

Describe how the resistive and pulsatility indices are determined. How are data concerning flow rate across cardiac valves used to estimate a value for pressure differential across that valve?

7. Discuss the implications of field strength and magnet design with respect to MR imaging of:

(a) small animals

(b) horses.

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THE ROYAL COLLEGE OF VETERINARY SURGEONS
DIPLOMA IN VETERINARY DIAGNOSTIC IMAGING

WEDNESDAY 14 JULY 2004

PAPER II
Radiological Interpretation
(3 hours)

This paper is in three Sections (A, B and C)

Candidates are required to answer **FOUR** of the **SIX** questions which **MUST INCLUDE ONE FROM EACH SECTION.**

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SECTION A (GENERAL)

1. Discuss the radiographic changes seen in pleural cavity disease as it occurs in horses and dogs.
2. Define the terms "aggressive" and "non-aggressive" as applied to bone lesions. Describe the radiographic features of **each**, using examples and diagrams. Discuss the role of diagnostic imaging in the investigation of an aggressive bone disease.

SECTION B (LARGE ANIMAL)

3. Describe the reported ultrasonographic and radiographic findings that may be encountered in disease involving the palmar annular ligament of the metacarpophalangeal joint in the horse.
4. Discuss the role of radiography in the diagnosis of dental disease in horses. What extra information might be offered by other imaging techniques?

SECTION C – SMALL ANIMAL

5. Describe the ultrasonographic features of mitral valve endocardiosis in dogs. Mention how the disease progresses and indicate ultrasonographic parameters used to stage its course and to assist in determining the prognosis.

 6. Compare and contrast the use of different imaging techniques for the detection and characterisation of portosystemic shunts in small animals.
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THE ROYAL COLLEGE OF VETERINARY SURGEONS

DIPLOMA IN VETERINARY DIAGNOSTIC IMAGING
WEDNESDAY 13 JULY 2005

PAPER I

Advanced Radiological Physics, Techniques and Interpretation
(3 hours)

This paper is in two Sections (A and B)

Candidates are required to answer **FOUR** of the **SIX** questions which **MUST INCLUDE ONE FROM EACH SECTION**

Allow 45 minutes per question.

Illegible handwriting or failure to answer the question in the form requested may result in examiners being unable to award marks for information which candidates intended to convey.

SECTION A

1.
 - (a) **Briefly** describe the **TWO** main processes by which X-rays in the diagnostic energy range interact with tissue.
 - (b) **With the aid of a graph**, show how the attenuation coefficient of **each** of these processes varies with photon energy for bone and for soft tissue.
 - (c) Describe **briefly, with the aid of a diagram**, the distribution and relative intensity of scattered radiation produced when carrying out fluoroscopic procedures using a C-arm image intensifier.
 - (d) How could you measure the scattered dose during fluoroscopy procedures? Give reasons for your choice of detector and a brief explanation of how the detector works.

2.
 - (a) **List** the **TWO** main pieces of United Kingdom legislation which apply to a veterinary practice carrying out nuclear medicine. Give a **brief outline** of the purpose of **each** of these and state which government body polices them.
 - (b) Explain the meaning of the terms “controlled area” and “supervised area”.

State, giving reasons, which areas would be designated as such for a veterinary practice using Tc-99m-labelled methylene diphosphonate (MDP) to carry out equine bone scintigraphy.
 - (c) The radiation dose to staff must be “as low as reasonable achievable”. **Outline** the precautions taken to reduce dose to staff working in a veterinary practice using Tc-99m – labelled MDP to carry out equine bone scintigraphy. The hazards of radiation dose from both external and internal radiation should be covered.

P.T.O. for Question 3

3. (a) Both computed radiography and film screen systems are currently used for plain radiography. Briefly describe how each of these work. There is no need to include the detailed chemistry of film processing.
- (b) **Outline** the advantages and disadvantages of computed radiography relative to X-ray film/screen imaging.
- (c) **List**, giving reasons, **THREE** equipment or technique related variables which influence the spatial resolution of a film screen image.

SECTION B

4. Discuss the indications for scintigraphy in the investigation of axial skeletal disease in veterinary patients, describing its advantages and disadvantages. Indicate the potential technical difficulties and/or hazards in the various species that you mention.

5. Discuss the use of contrast media in:
 - a) radiography and CT.
 - b) MRI.

For **each**, use the following headings:

indications for contrast studies;
generic names of contrast media used;
the physical principles underlying their use;
examples in veterinary diagnostic imaging.

6. DESCRIBE THE PRODUCTION AND APPEARANCE OF ARTEFACTS THAT MAY BE SEEN WITH DIAGNOSTIC ULTRASOUND.

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THE ROYAL COLLEGE OF VETERINARY SURGEONS
DIPLOMA IN VETERINARY DIAGNOSTIC IMAGING

WEDNESDAY 13 JULY 2005

PAPER II
Radiological Interpretation
(3 hours)

This paper is in three Sections (A, B and C)

Candidates are required to answer **FOUR** of the **SIX** questions which **MUST INCLUDE ONE FROM EACH SECTION.**

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SECTION A (GENERAL)

1. Describe the radiographic investigation and radiological signs of sinonasal disease in:
 - a) small animals;
 - b) horses.

Briefly describe how other imaging techniques may be helpful.

2. Discuss the use of ultrasonography in the evaluation of non-cardiac thoracic disease in veterinary patients. What are its advantages and disadvantages compared with radiography?

SECTION B (LARGE ANIMAL)

3. Tangential (skyline) radiographic views are often used to profile various joints and bones in lame horses. Describe the techniques for these views in specific joints and the abnormalities that might be seen compared with conventional projections.
4. Ultrasonography of the umbilical region of neonates is often indicated in large animal practice. Describe, **with the aid of diagrams**, the normal ultrasonographic findings of the region and the ultrasonographic abnormalities which may be seen associated with umbilical remnants in foals and calves.

P.T.O. for Section C

SECTION C – (SMALL ANIMAL)

5. Discuss the use of diagnostic imaging in the investigation of disorders of the adrenal

gland in small animals and describe the changes that may be seen.

6. Write **short notes** on:

- a) radiographic technique for the investigation of elbow disease in dogs;
 - b) radiological features of the “elbow dysplasia” complex, illustrated with sketches of the lesions;
 - c) the workings of the BVA/KC Elbow Dysplasia Grading Scheme.
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THE ROYAL COLLEGE OF VETERINARY SURGEONS

DIPLOMA IN VETERINARY DIAGNOSTIC IMAGING
MONDAY 10 JULY 2006

PAPER I

Advanced Radiological Physics, Techniques and Interpretation
(3 hours)

This paper is in two Sections (A and B)

Candidates are required to answer **FOUR** of the **SIX** questions which **MUST INCLUDE ONE FROM EACH SECTION**

Allow 45 minutes per question.

Illegible handwriting or failure to answer the question in the form requested may result in examiners being unable to award marks for information which candidates intended to convey.

SECTION A

1.
 - a) **Briefly** describe the **TWO** processes by which X-rays are produced in the X-ray tube.
 - b) **Draw a clearly-labelled graph** of the X-ray spectrum from a tungsten target X-ray tube operated at 75 kVp. **Briefly** explain **each** feature shown on the graph.
 - c) **Explain** how the scatter reaching the film or CR plate in a radiographic image will be changed by increasing the tube voltage to 100kVp.
 - d) Give **THREE** methods by which scatter reaching the film or CR plate can be reduced, indicating the **advantages and disadvantages** of **each** method.

2.
 - d) **Briefly outline** the deterministic and stochastic biological effects of ionising radiation.
 - e) State the dose limits, for radiation workers over 18 years, for deterministic and stochastic effects defined in the Ionising Radiations Regulations 1999 and explain how these limits are derived.
 - f) State what instrument you would choose in order to measure:
 - i) The dose rate from a horse having bone scintigraphy.
 - ii) The effective dose to a member of staff over a period of 3 months.

In **each** case give a **brief** explanation of how the detector works and give reasons for your choice.

P.T.O. for Question 3

3. a) **Briefly** describe the main components of a superconducting MRI scanner.

- b) **Explain, with the aid of a diagram**, how slice selection in the longitudinal axis is achieved.
- c) State the significance of the 0.5mT (5 gauss) line around a MRI scanner and indicate the design features which reduce the size of the controlled area.

P.T.O. for Section B

4. **Describe** the cause, appearance and reduction of the following artefacts that may be seen with MRI:

- (i) partial volume averaging artefact
- (ii) chemical shift artefact
- (iii) phase wrap (wraparound or aliasing)
- (iv) "magic angle" artefact.

5. You are presented with a ten year-old, entire male Labrador Retriever with dysuria.

Describe in detail the investigation of this case using:

(a) radiography

and

(b) ultrasonography

indicating the **advantages and disadvantages** of **each** technique and the normal appearance of the area under investigation.

6. **Discuss** the various methods which could be used to image the cervical spine of:

(a) a cat

and

(b) a horse.

Describe the indications, technical challenges, advantages and limitations of **each** technique in these **TWO** species.

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THE ROYAL COLLEGE OF VETERINARY SURGEONS

DIPLOMA IN VETERINARY DIAGNOSTIC IMAGING

MONDAY 10 JULY 2006

PAPER II

Radiological Interpretation

(3 hours)

This paper is in three Sections (A, B and C)

Candidates are required to answer **FOUR** of the **SIX** questions which **MUST INCLUDE ONE FROM EACH SECTION.**

Allow 45 minutes per question.

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SECTION A (GENERAL)

1. **Describe** in general terms, the radiological appearance of osteomyelitis in veterinary patients and illustrate this with **THREE** specific examples of bone infection, including at least **ONE** in a large animal and **ONE** in a small animal. **Discuss** the reasons for uncertainty in making a diagnosis of osteomyelitis, and indicate how these may be reduced or overcome.

You may write in **either essay or note form. Diagrams should be used where appropriate.**

2. *“Diagnostic imaging techniques are no longer relevant in the diagnosis of gastric disease in animals, which are better diagnosed with endoscopy”.*

Discuss this statement with reference to **both** small and large animals, indicating the **advantages and disadvantages** of **each** technique.

P.T.O. for Sections B and C

SECTION B (LARGE ANIMAL)

3. **Describe** the use of diagnostic imaging in each of the following clinical scenarios, with particular reference to the specific technical requirements for **each** case and the possible abnormal findings:

- a) Damage to the suspensory ligament (accessory ligament of the deep digital flexor tendon) of the right forelimb of a three year-old thoroughbred horse.
 - b) Suspected infected umbilical hernia in a three month-old lamb.
 - c) Dyspnoea in a two month-old calf.
4. **Discuss** the various imaging options for examining the pelvic region of the adult horse. Indicate the **advantages and disadvantages** of **each** modality (**in table form if desired**) and indicate the relative value of **each** in identifying pathological abnormalities.

SECTION C – (SMALL ANIMAL)

5. Describe the typical radiographic and ultrasonographic findings that may be seen in dogs with the following congenital heart diseases:
- a) Patent ductus arteriosus (PDA) shunting left to right.
 - b) Aortic stenosis.

Use diagrams where appropriate.

6. **Discuss** the use of diagnostic imaging in the investigation of diseases of the orbit in dogs and cats, indicating the advantages **and** disadvantages of the different modalities.

Describe briefly the typical appearance of orbital neoplasia, cellulitis, abscesses and foreign bodies.

THE ROYAL COLLEGE OF VETERINARY SURGEONS
DIPLOMA IN VETERINARY DIAGNOSTIC IMAGING

MONDAY 9 JULY 2007

PAPER I
Advanced Radiological Physics, Techniques and Interpretation
(3 hours)

This paper is in two Sections (A and B)

Candidates are required to answer **FOUR** of the **SIX** questions which **MUST INCLUDE ONE FROM EACH SECTION**

Allow 45 minutes per question.

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SECTION A
Physics Questions

8. With reference to nuclear medicine imaging:
- Briefly** describe the **TWO** main physical processes by which gamma rays interact with tissue and with the gamma camera crystal.
 - For imaging with $^{99}\text{Tc}^m$, draw a graph demonstrating the energies of the gamma photons detected by the gamma camera (the Z signal).

Using this graph, describe the function of the pulse height analyser in the gamma camera.
 - Describe the factors that can be optimised to improve image quality (contrast and resolution) in a $^{99}\text{Tc}^m$ –HDP or MDP bone scintigraphy image.
- 2.a) Name the two principal instruments of United Kingdom legislation which apply to a veterinary practice carrying out nuclear medicine examinations. Give a brief outline of the purpose of **both** of these and state which government body polices this legislation.
- Describe how you would decide whether Local Rules are required and **outline** their purpose.
 - Give a list of typical contents of Local Rules for a routine diagnostic X-ray room making it clear which items are mandatory and which cover local requirements.

P.T.O. FOR QUESTIONS 3 - 6

3. With reference to scanning the peripheral vasculature in any species

- a. **Briefly outline** the Doppler effect for an ultrasound beam incident on a moving target.
- b. **Briefly** describe the differences between colour flow imaging, power Doppler imaging and pulsed wave Doppler.
- c. What is the practical trade-off between imaging a blood vessel and observing the blood flow within it? How is this trade-off solved in linear array scanners?
- d. **Briefly** describe common artefacts which may lead to the impression that there is no flow in a blood vessel and **briefly** indicate how to correct for these artefacts.

SECTION B

(Advanced Techniques and Interpretation)

4. Discuss how diagnostic ultrasonography of the abdomen in a horse with colic and a dog with abdominal distension can be used to differentiate surgical from non-surgical conditions.
5. Describe your technique for an ultrasound examination of the palmar metacarpal and palmar pastern soft tissue structures of an adult Thoroughbred racehorse. **Use diagrams** to illustrate the ultrasonographic anatomy you would expect to find in a normal horse.

Discuss how operator errors can lead to a poor quality study.

6. Discuss the use of contrast media in:
 - c) Radiography (including CT).
 - d) MRI.

For **each**, use the following headings:

indications for contrast studies;

generic names of contrast media used;

the physical principles underlying their use;

examples in veterinary diagnostic imaging.

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THE ROYAL COLLEGE OF VETERINARY SURGEONS

DIPLOMA IN VETERINARY DIAGNOSTIC IMAGING

MONDAY 9 JULY 2007

PAPER II

Radiological Interpretation

(3 hours)

This paper is in three Sections (A, B and C)

Candidates are required to answer **FOUR** of the **SIX** questions which **MUST INCLUDE ONE FROM EACH SECTION.**

Allow 45 minutes per question.

Please use a separate answer sheet for each question. Answers to the questions in Sections A, B and C should be put inside separate answer sheet covers.

Illegible handwriting or failure to answer the question in the form requested may result in examiners being unable to award marks for information which candidates intended to convey.

SECTION A (GENERAL)

1. Discuss the role of radiology in monitoring the healing of fractures.
2. Discuss the statement 'Selective and non selective cardiovascular angiography has been superseded by alternative imaging techniques'.

Illustrate the relevant points in your answer using the horse and dog as examples.

SECTION B (LARGE ANIMAL)

3. Discuss the use of diagnostic imaging in the diagnosis of periapical tooth root infection in the equine maxillary arcade. You should include in your answer what role modalities other than radiography have in this field.
4. Discuss the use of current diagnostic imaging techniques in diagnosing pathology of the navicular bone.

P.T.O. FOR SECTION C

SECTION C – (SMALL ANIMAL)

5. Describe the typical imaging findings that may be seen in dogs and/or cats with the following diseases:

Use diagrams where appropriate.

- a) Air trapping.
- b) Tetralogy of Fallot.
- c) Renal dysplasia.
- d) Meningioma.

6. **Briefly outline** the types of portosystemic shunts seen in small animals.

Discuss the advantages and disadvantages of the various imaging modalities available to diagnose portosystemic shunts.

THE ROYAL COLLEGE OF VETERINARY SURGEONS

DIPLOMA IN VETERINARY DIAGNOSTIC IMAGING

TUESDAY 7 JULY 2009

PAPER I

Advanced Radiological Physics, Techniques and Interpretation

(3 hours)

This paper is in two Sections (A and B)

Candidates are required to answer **FOUR** of the **SIX** questions which **MUST INCLUDE TWO**
FROM EACH SECTION

Allow 45 minutes per question.

Illegible handwriting or failure to answer the question in the form requested may result in examiners being unable to award marks for information which candidates intended to convey.

SECTION A
Physics Questions

Radiation Protection

1. a. **Explain** the difference between deterministic and stochastic biological effects of ionising radiation.
- b. **State** the dose limits for deterministic and stochastic effects for radiation workers (of 18 years or over) as defined in the Ionising Radiations Regulations 1999. **Explain** how these relate to possible biological effects.
- c. **Explain** the meaning of the terms “controlled area” and “supervised area”. **State**, giving reasons, which areas may be designated as such for a veterinary practice using Tc-99m – labelled HDP to carry out equine bone scintigraphy.
- d. **State** what detector you would choose in order to measure the effective dose to a member of staff. **Outline** how the detector works and give reasons for your choice.

Plain Radiography

2. a. **Describe** the basic components and principles of a computed radiography (cr) system.
- b. **Outline** the **advantages and disadvantages** of computed radiography relative to X-ray film/screen imaging.
- c. **List**, giving reasons, **THREE** equipment- or technique-related variables which influence the contrast in a plain X-ray using computed radiography.

P.T.O. for Question 3 AND Section B

MRI

3.
 - a. **Briefly describe** the role (in acquiring the image) of the following fields associated with MR imaging: static (B_0) field, gradient fields, RF fields.
 - b. **Outline** the possible bioeffects that may be generated by **each** type of field listed in part (a).
 - c. **Explain** the cause of the Chemical Shift artefact and **describe** its appearance. **Describe** how it is affected by the static field strength and the bandwidth.

SECTION B

(Advanced Techniques and Interpretation)

4. A complete echocardiographic examination requires the use of Doppler. **Briefly outline** the principles of Pulsed Wave, Continuous Wave, Colour Flow Doppler and Power Doppler. **List** the various artefacts that might arise during a Doppler study and **discuss**

how you would minimise these problems during the examination.

5. **Discuss** the role of scintigraphy in diagnosing the cause of lameness in dogs and horses.

6. The terms “sensitivity” and “specificity” are often used when describing the usefulness of a diagnostic test. **Define** these **TWO** terms.

Describe how you would test the sensitivity and specificity of any **TWO** diagnostic imaging techniques that are being applied to the same clinical condition. **Use examples** from recent veterinary peer-reviewed literature to illustrate your answer.

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THE ROYAL COLLEGE OF VETERINARY SURGEONS

DIPLOMA IN VETERINARY DIAGNOSTIC IMAGING

TUESDAY 7 JULY 2009

PAPER II

Radiological Interpretation

(3 hours)

This paper is in three Sections (A, B and C)

Candidates are required to answer **FOUR** of the **SIX** questions which **MUST INCLUDE ONE FROM EACH SECTION.**

Allow 45 minutes per question.

PLEASE USE A SEPARATE ANSWER SHEET FOR EACH QUESTION.

ANSWERS TO THE QUESTIONS IN SECTIONS A, B AND C SHOULD BE PUT INSIDE SEPARATE ANSWER SHEET COVERS.

Illegible handwriting or failure to answer the question in the form requested may result in examiners being unable to award marks for information which candidates intended to convey.

SECTION A (GENERAL)

1.
 - a. **Briefly** review the use of diagnostic imaging techniques in the investigation of diseases of the eye in animals.
 - b. **Indicate the advantages and disadvantages** of the different imaging modalities in aiding in the diagnosis of orbital disease.
 - c. **Describe** the typical ultrasonographic appearances of retinal detachment, cataracts, intra-ocular foreign bodies and intra-ocular neoplasia.

2. The appearance of periosteal new bone is often used to aid in the diagnosis of bone pathology. **Describe** the difference manifestations of periosteal new bone and how you would interpret them. Using the horse, cow and dog as examples, **describe** how periosteal new bone can vary between species.

SECTION B (LARGE ANIMAL)

3. You are asked to examine an 18 month-old Thoroughbred colt with a history of recent onset hindlimb ataxia. A neurological examination has localised the region of pathology to the cervical vertebral column.
- a. **Describe** how you would use diagnostic imaging to further localise the site(s) of pathology and come to a diagnosis. **Use diagrams** where appropriate to **illustrate** your answer.
- b. **Describe** the radiological appearance of **ONE** condition that commonly presents with the described clinical signs.
4. You are presented with a 12 year-old Cob mare with a two-month history of right fore lameness. The horse is insured for veterinary fees. The lameness did not respond to diagnostic nerve blocks up to a low four-point block, but was markedly improved following a high four-point block.
- a. What diagnostic imaging modalities are currently available to further investigate this lameness?

- b. **Explain** the **advantages and disadvantages** of **each** technique.

- c. **State** which modalities you would use in this case, including your reasoning.

SECTION C – (SMALL ANIMAL)

- 5. A 35kg 5 year-old Labrador retriever is referred to, a fully equipped 'state of the art' imaging referral centre for a complete investigation of suspected pancreatic disease.
 - a. **Discuss** the **advantages and disadvantages** of the imaging modalities that might be used which you would recommend as useful in this case.

 - b. **Indicate** the imaging features that would help to differentiate pancreatitis from pancreatic nodular hyperplasia and neoplastic disease for **ONE** of the modalities you recommend.

- 6. You are presented with a ten year-old, entire male cat with dysuria and haematuria.
 - a. **Describe in detail** the investigation of this case using (i) radiography, and (ii) ultrasonography, indicating the **advantages and disadvantages** of **EACH** technique.

- b. **Discuss** the normal appearance (radiographic and ultrasonographic) of the area under investigation and the abnormalities seen in **TWO** conditions that may cause this clinical history.
