INTRODUCTION

For details of membership definition, standards of membership, study recommendations and other points about the written and oral/practical examinations, prospective membership candidates should consult the Membership Candidate Handbook.

For further information on membership and fellowship of the Australian College of Veterinary Scientists, the College should be contacted directly.

The examinations will cover the following species and production systems;
- Dairy cattle (grazing only through grazing/intensive supplementation /cropping to feedlot)
- Beef cattle (grazing, cropping, supplementary feeding, feedlot and cow/calf)
- Sheep (milk, wool and fat lamb; extensive grazing situations through to feedlot)

LEARNING OUTCOMES

PAPER A.

Irrespective of their species or production system of interest the candidate will have a sound\(^1\) knowledge of;

1. The physiology of digestion. How organic material is harvested by ruminants and the subsequent processes until physiological “work” is performed. How organic material is harvested by ruminants and how nutrients are transferred to maintenance, liveweight, milk production, growth and/or foetal development. Maintenance of optimal rumen function through optimisation of homeostatic mechanisms. The function of the ruminant digestive system.

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\(^1\) Knowledge Levels:
- **Detailed knowledge** - candidates must be able to demonstrate an in-depth knowledge of the topic including differing points of view and published literature. The highest level of knowledge.
- **Sound knowledge** – candidate must know all of the principles of the topic including some of the finer detail, and be able to identify areas where opinions may diverge. A middle level of knowledge.
- **Basic knowledge** – candidate must know the main points of the topic and the core literature.
2. The nutrient requirements and functions within ruminants including:
   2.1. Water requirements and the importance of water quality.

2.2. Energy utilisation in the animal.
   2.2.1. How “energy” is transferred from feedstuffs to “physiological work” within the ruminant, including the potential losses at each transformational stage from Gross Energy to Net Energy.
   2.2.2. How ruminal microflora provide benefit to ruminant animals.
   2.2.3. Methods of quantifying energy at different stages.

2.3. Protein digestion and metabolism.
   2.3.1. Knowledge of amino acid and protein catabolism and anabolism for the production of body tissue, growth, foetal development and milk production.
   2.3.2. How ruminal microflora are involved in ruminal protein production, costs and benefits.

2.4. Mineral and vitamin nutrition of ruminants.
   2.4.1. Knowledge of requirements for macro minerals, trace minerals and vitamins for ruminant health, including requirements for different productive states.
   2.4.2. Quantitative requirements for minerals and vitamins, including knowledge of potential for conditioned deficiencies of minerals.
   2.4.3. Diagnosis of sub-clinical deficiency, deficiency, nutritional requirements and supplementation (requirements, methods of supplementation).

2.5. Knowledge of the basis for, and application of, the major International systems for describing nutrient requirements of ruminants.

3. Factors influencing feed intake by ruminants.

   4.1. Effect of the foetus on the metabolism and physiology of the dam.
   4.2. Nutrition of newborn from birth to when classed as ruminant in own right.

5. Principles of growth of animals.
   5.1. Growth of different body components throughout life of ruminant, with special reference to;
       5.1.1. Efficiencies of liveweight gain,
       5.1.2. Carcase composition and,
       5.1.3. The potential for nutrition to manipulate aspects of growth.

   6.1. Knowledge of biological adaptations associated with change from non-lactating to lactating state.
   6.2. Knowledge of milk synthesis and milk secretion mechanisms and factors that moderate and control milk secretion.
   6.3. Knowledge of potential risks of lactation and nutritional management of the lactating ruminant.
7. Intermediary metabolism, particularly as metabolism relates to the pathogenesis of disease.

   8.1. Methods of quantitative and qualitative evaluation of feeds, and different parameters which are of importance to ruminants.
   8.2. Knowledge of uses and limitations of quantitative assessments.
   8.3. Knowledge of other methods of assessing/differentiating feeds.
   8.4. Knowledge of collection and storage of feed and forage samples.

9. The mechanisms by which rumen modifiers change rumen and animal physiology and the potential to influence ruminant production systems.

PAPER B.
Applied Nutrition of Ruminants.

The candidate will have a sound knowledge of:

1. Nutrient requirements for production and health.
   1.1. Feeding for production
       1.1.1. The optimisation of nutrient supply to promote optimal production. Some appreciation of economic constraints and objectives in different enterprises and markets.
   1.2. Nutrition and reproduction.
       1.2.1. Knowledge of the ways in which nutritional management may influence reproductive function and performance and methods by which reproductive performance may be improved through altered feeding techniques.
   1.3. Evaluating sub-optimal nutrition.
       1.3.1. Clinical examination of the individual animal, group of ruminants and the farm as a whole.
       1.3.2. Knowledge of factors that lead to inadequate nutrition of ruminants.
       1.3.3. Clinical signs and evaluation of energy and protein deficiency, macro and micro mineral status and sub-optimal rumen function.
       1.3.4. Clinical signs of trace mineral and macro mineral deficiencies (metabolic diseases) and cost effective means of correction of these deficiencies.
       1.3.5. Basic knowledge of the effects of diet on immune function.

2. Traditional and non-traditional feedstuffs.
   2.1. Pasture and forage crop growth and management.
       2.1.1. Knowledge of the common pastures, conserved feeds, concentrates and forages fed to ruminants, particularly in the Australian and New Zealand context.
   2.2. Knowledge of pasture and crop conservation methods.
       2.2.1. An understanding of the influence on pasture and crop growth, conservation and storage as it influences ruminants that subsequently eat the material.
   2.3. Knowledge of the use of commodity and by product feeds.
       2.3.1. Knowledge of evaluation of the constituents and performance of a variety of by-product feeds, and how they could be profitably utilised by ruminant animals.
Knowledge of the potential for dietary disturbances, toxicity, residues and other problems.

2.4. Use of cereal and pulse grains in ruminant diets.

3. Diet formulation and feed delivery.
   3.1. Knowledge of the use of feed additives including rumen (production) modifiers, buffers, alkalising agents, macro and micro minerals.
   3.2. Understanding of practical delivery of feeds to ruminants for optimal feed efficiency and animal health.
   3.3. Demonstration of a knowledge and ability to effectively and practically integrate different feeds within the range of ruminant production systems.

4. Basic knowledge of the feed milling industry.
   4.1. Knowledge of the principles of formulating bulk total mixed ration diets.

5. Feed testing methodologies.

CURRICULA.

PAPER A. “The Principles of Ruminant Nutrition”

1. The physiology of digestion.
   1.1. How organic material is harvested by ruminants and subsequent processes until physiological “work” is performed.
       Physical breakdown of feed material.
       Structure and function of individual compartments of ruminant digestive system
       Microbial catabolism of feed constituents
       Positive benefits of microbial digestion in the ruminant versus monogastric type of digestion
   1.2. Ruminal bacteria
       Broad grouping of bacteria, fluctuation with feeding type, possible disorders and effects on host animal.
       Ruminal protozoa and impacts / importance of protozoa on digestive efficiency.
       Digestion of carbohydrates by ruminal flora.
       Digestion of nitrogenous compounds by ruminal flora.
       Effects of fats/oils in the rumen.
       Absorption of compounds through rumen wall.
       Production and absorption of Volatile Fatty Acids.
       Requirements of ruminal flora for optimal and maximal function.
   1.3. Function of omasum and abomasum, absorption of nutrients.
       Water, VFA absorption (omasum); Proteolysis (abomasum).
       Function of small intestine in chemical digestion.
       Absorption of individual nutrients and precursors.
   1.4. Digestion in the neonatal ruminant and transitional development from neonate to functioning ruminant.

2. The nutrient requirements and functions within ruminants including;
   2.1. Water nutrition.
Water requirements in various physiological states.
Water quality for health and optimal productivity.

2.2. Energy utilisation in the ruminant animal.
How “energy” is transferred from plants to “work” within the ruminant, including
the potential losses at each transformational stage.
How ruminal microflora provide benefit to ruminant animals.
Metabolic/physiologic adaptations required by animal due to presence of rumen.
Storage of energy in chemical bonds within plants.
Metabolisable Energy system for quantifying energy in feeds.
Determination and importance of Gross Energy, Digestible Energy, Metabolisable
Energy of feeds.
Net Energy and fates within ruminant animal.

2.3. Protein digestion and metabolism.
2.3.1. How ruminal microflora are involved in ruminal protein production.
“Costs” and benefits of this system.
Digestion of ruminal microflora in the small intestine.

2.3.2. Amino acid and protein formation, requirement and function.
Use of non-protein-nitrogen compounds by ruminant animals vs. preformed
protein sources.
Amino acids which may limit ruminant production.
Essential amino acids for ruminal microflora and ruminant animal.

2.4. Mineral and vitamin nutrition of ruminants.
2.4.1. Knowledge of macro mineral nutrition of ruminants including requirements and
potential interactions between minerals, including:
- calcium,
- phosphorus,
- nitrogen,
- magnesium,
- potassium,
- sodium,
- chloride,
- sulphur.

2.4.2. Knowledge of trace element (micro element) nutrition of ruminants including
function within the rumen and ruminant animal, including:
- cobalt,
- copper,
- selenium,
- zinc,
- iron,
- iodine,
- manganese,
- molybdenum

2.4.3. Knowledge of vitamin nutrition of ruminants, including;
- vitamin A (β-carotene),
- vitamin E,
- vitamin D,
- vitamin B complex.

2.4.4. Knowledge of conditioned deficiencies caused by nutritional factors.

2.4.5. Diagnosis of sub-clinical deficiency, deficiency, nutritional requirements and supplementation (requirements, methods of supplementation).

2.4.6. Knowledge of interactions and relationships between vitamins and minerals.

2.5. Knowledge of the basis for, and application of, the major International systems for describing nutrient requirements of ruminants.

3. Factors influencing feed intake of ruminants.

3.1. Feed factors.

“Palatability”.
Chemical and physical form of feeds.
Particle size, dry matter, feed delivery, storage conditions.
Contamination (moulds, pests, weeds).
Water intake.

3.2. Environmental factors.
Farm management factors that may influence feed intake.
Housing, weather, temperature, humidity.

3.3. Animal factors.
Disease, lactation, productive state.
Physiological control and drive of appetite (e.g. hormonal, rumen fill etc.)
Animal health factors and diseases influencing feed intake.

3.4. Diagnosis, control and management of these disorders.


4.1. From birth to when classed as ruminant in own right (i.e. as pre-ruminant).

4.2. Nutrient requirements of the foetus in-utero.
Metabolism within the foetus.

4.3. Colostrum feeding of newborn ruminants.
Diagnosis of failure of Passive transfer.
Describe the nutrient components of colostrum.
Describe production, storage and feeding of colostrum (colostrum management).

5. Principles of growth of animals.

5.1. Knowledge of growth of different body components throughout life of ruminant.
Muscle and meat quality and growth.
Feeding for improved meat production and quality.
Use of growth promotant hormones, antibiotics and other compounds to influence animal growth.


6.1. Knowledge of biological adaptations associated with change from non-lactating to lactating state.

6.2. Knowledge of driving mechanisms, including hormonal control pathways.

6.3. Potential risks of lactation and nutritional management of the lactating ruminant, including:
Disease risks
Effects of lactation on homeostatic control mechanisms.
7. Intermediary metabolism, particularly as metabolism relates to the pathogenesis of disease.
   7.1. Physiological benefits and risks imposed by “ruminant style of digestion” within a mammal, including;
       Ketoacidosis.
       Energy storage and transport within the ruminant.

   8.1. Methods of quantitatively evaluating feeds for ruminants.
       Measuring (in theory and in practice) different parameters of importance to ruminant nutrition;
       Digestibility, Dry matter %, Crude protein, “fibre fractions”.
       Laboratory testing of feeds (e.g. Near Infrared Spectroscopy, Van Soest digestion)
       Interpretation of laboratory feed test reports.
   8.2. Knowledge of uses and limitations of present (commonly used) quantitative assessments.
   8.3. Other methods of assessing/differentiating feeds.

9. The physiology of production modifiers.
   9.1. The use of compounds which influence the ruminal microflora in ruminant production.
       9.1.1 The modification and management of the balance of the organisms within the rumen.
       Advantages and disadvantages / limitations of modifiers.

PAPER B.
Applied Nutrition of Ruminants.
“The Practise and Application of the Principles of Ruminant Nutrition”.

1. Nutrient requirements for production and health.
   1.1. Feeding for production.
       1.1.1. The optimisation of nutrient supply to promote optimal production
       Ruminant nutrient requirements for specific types of production (e.g. milk, wool, weaner growth)
       Economic constraints and objectives in different enterprises and markets.
       Assessing levels of production.
       Feeding management at different points in the “productive cycle”.

       1.1.2. Nutrition and reproduction.
       Knowledge of the ways in which nutritional management may influence reproductive function and performance.
       Animal health requirements. Nutritional requirements for health versus requirements for reproduction.
       Major nutrient requirements for optimal reproductive performance.
       “Energy” and crude protein requirements for optimal reproductive performance.
       Trace element and vitamin nutrition in reference to reproductive performance.

   1.2. Evaluating sub-optimal nutrition.
       Clinical examination of the individual animal to “at least general clinical practice standard”.

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Clinical examination of a group of ruminants.
Clinical examination of the farm as a whole.
Conditions which lead to inadequate nutrition of ruminants.
Detection of nutritional deficiencies
The effects of diet on immune function.
Cost-effective means of detection, confirmatory diagnosis, treatment and correction of nutritional deficiencies.

2. Traditional and non-traditional feedstuffs.
2.1. Pasture and crop growth and management.
The common pastures and forages fed to ruminants in Australian and New Zealand, including:
- Perennial, short-term and hybrid ryegrasses and fescues.
- Perennial and short term legumes (e.g. clovers, lucerne).
- Cereals (incl.) maize for fodder and grain.
- Grasses for fodder (e.g. *Phalaris*, *Paspalum*, millets, Sudan grasses, sorghum)
- Other forage and grazing plants grown for ruminants.
  - Soil fertility management.
  - Major nutrients (phosphorus, nitrogen, potassium and sulphur).
  - Potential toxicity to ruminants or creation of mineral deficiencies through nutrient applications to pasture or crops.
- Bloat, mineral deficiencies, cyanic acid, nitrate.
- Fungal-associated challenges associated with pastures including knowledge of ryegrass and tall fescue endophytes. Pasture-associated *Fusarium spp*.
- Nutritional limitations and imbalances that constrain the use of some pastures, forages and grains.
- Assessing and measuring pasture growth and production.
  - Different methods, strengths and limitations of measuring pastures (e.g. rising plate, electronic pasture probes, technologies such as Feedreader or C-DAX technology, dry matter cuts, visual appraisal of dry matter on offer, economic analysis and so on.)

2.1.1. Knowledge of pasture and crop conservation methods.
- Grazing management.
  - Effects of grazing management on whole farm performance.
    - Managing pastures and crops for optimal farm versus animal performance.
  - Costs and benefits of feed conservation
    - Hay production fundamentals and options.
    - Silage manufacture fundamentals and options including additives such as inoculants, molasses.
      - Pit, bale, bunker.
    - Potential hazards and risks associated with forage
conservation with respect to whole farm performance including implications of sub-optimal quality silage and hay to individual animals and whole farm systems

2.2. Knowledge of the use of commodity and by product feeds.
   Evaluation of the constituents and performance of a variety of by-product and “waste” feeds including drought afflicted, failed crops taken as ruminant feeds.
   How they could be profitably utilised by ruminant animals.
   The potential for dietary disturbance.
   The potential for toxicity and residue considerations.
   Limitations to use of these feeds.
   Storage and feed quality issues.
   Upper limits of inclusion of different feeds within the diets of ruminants
   Nutrient content.

2.3. Use of cereal and pulse grains in ruminant diets.
   Different processing methods as appropriate (e.g. rolling, hammer milling, steam flaking, pelletising). Effects on utilisation by ruminant, costs and problems. Managing these problems and deficiencies.
   Health-associated challenges arising from mismanagement of cereal and pulse grains.
   Nutrient profile of various cereal and pulse grains fed in Australasia.

3. Diet formulation and feed delivery.
3.1. Formulation of diet to meet desired nutrient specifications.
   Dietary energy.
   Dietary fibre requirement of different stock classes, methods of assessing “fibre” provision, different definitions of “fibre” requirements.
   Macro and microelements and vitamins.
   Knowledge of the use and requirements of feed additives.
   Production modifiers.
   Buffers and alkalising agents.
   Other additives.
   Toxicity and restraints regarding use of some feeds for ruminants.
3.2. Delivery of feeds to ruminants.
   Grazing management for optimal ruminant production.
   Integration of grazed and “handfed” feeds.
   “Feed Bunk” management. Optimising feed use efficiency, ruminant production and animal health.

4. Some knowledge of the feed milling industry.
   Broad overview of feed milling industry as it relates to ruminant production industry.
   Knowledge of the principles used when formulating bulk diets.
   Applications for cost-effective use of these diets by individual ruminant producers.

5. Feed testing methodology.
   Testing requirements for ruminant diets.
   Testing methodology for common feeds (e.g. barley) versus uncommon feeds (e.g. citrus molasses). Overview of methods required, not individual chemical procedures.
   Investigating where ruminant production is not as predicted from laboratory test results.
Special feed-testing methodology for specific circumstances.
Appropriate techniques for collection of feed samples for analysis. Sample numbers, collection methods, storage of samples before analysis.

EXAMINATION

For general information on the required standards for both the Written and Oral examinations, candidates are referred to Sections 3, 10 and 11 of the Membership Candidates Handbook. The Membership examination has **two separate, autonomous components:**

1. **Written Examination (Component 1)**
   - **Written Paper 1** (two hours): Principles of Ruminant Nutrition
   - **Written Paper 2** (two hours): Nutritional Management of Ruminants

2. **Oral Examination (Component 2)**
   - **Oral** (one hour)

The written examination will comprise of two separate two-hour written papers taken on the same day. There will be an additional 15 minutes perusal time for each paper, during which no writing on the examination paper is permitted. In each paper you are provided with four (4) questions to answer, worth 30 marks each, giving a total of 120 marks per paper. There is no choice of questions. Questions may be long essay type or a series of shorter answer sub-questions. Marks allocated to each question and to each subsection of questions will be clearly indicated on the written paper.

**Written Paper 1:**
This paper is designed to test the candidate’s knowledge of the principles of Ruminant Nutrition as described in the Learning Outcomes.

**Written Paper 2:**
This paper is designed to (a) test the candidate’s ability to apply the principles of Ruminant Nutrition to particular cases/problems or tasks and (b) test the candidate’s familiarity with current issues in Ruminant Nutrition and recommended current diagnostic and management practices in Ruminant Nutrition.

**Oral Examination:**
This examination will consist of images, video of livestock and farms, feed samples and other clinically relevant material to assess the candidate’s skills in the practical nutrition of ruminants, problem solving skills and ability to solve farm health and production problems which have a nutritional basis. An understanding of pathogen or toxin related diseases that may influence the differential diagnosis of nutritional problems appropriate to a veterinary education and orientation is expected. The duration of this examination is approximately one (1) hour. Five cases are presented with supporting questions asked verbally in a face-to-face setting. The oral examination has a total of 100 marks with each case allocated 20 marks.

**RECOMMENDED READING MATERIAL**

The candidate is expected to read widely within the discipline, paying particular attention to areas not part of their normal work experiences. This list of books and journals is intended to guide the candidate to some core references and other source material. Candidates also should be guided by their mentors. *The list is not comprehensive and is not intended as an indicator of the content of the examination.*
Texts

A series of articles relevant to the examination will be produced through the Cattle Chapter and will be available for all candidates with modifications for species of interest.

Nutrient Requirements of Beef, Dairy Cattle, Sheep and Goats - NRC Publications, Nation Academy, Washington.
Lot Feeding and Beef Production - Proceedings of the Postgraduate Committee in Veterinary Science 137.

Scientific and Technical


Journals

Australian Vet. Journal
Aust J Exp Agriculture
Feed Science and Technology
J. Dairy Science
J. Dairy Research
J. Animal Science
J. Agric. Science (Camb)
Proceedings New Zealand Society Animal Prod.
FURTHER INFORMATION

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