Section One: Multiple-choice **20% (20 Marks)**

Question	Answer
1	b
2	b
3	d
4	d
5	b
6	b
7	a
8	c
9	a
10	a
11	c
12	d
13	a
14	b
15	c
16	d
17	a
18	c
19	b
20	d

Question 21 (continued)

(b) Propose **two** short- and **two** long-term strategies that would assist in the management of pesticide resistance. (8 marks)

Description	Marks
For each of the short-term strategies	
Proposes a relevant short-term strategy	2
States a relevant short-term strategy	1
Subtotal	**4**
For each of the long-term strategies	
Proposes a relevant long-term strategy	2
States a relevant long-term strategy	1
Subtotal	**4**
Total	**8**

Answers could include:
Short-term strategies:
- rotate products with different modes of action
- avoid under-dosing by weighing livestock before treatment
- calibrate treatment equipment to ensure correct dose rate is being delivered
- apply treatments according to the label directions
- quarantine and treat all livestock entering property on arrival
- monitor livestock regularly and treat early if pest population increases significantly.

Long-term strategies:
- develop, implement and review a biosecurity plan that incorporates long-term strategies to manage pesticide resistance
- select livestock for breeding programs that have greater natural resistance to infestations
- adopt Integrated Pest Management strategies such as biological control, to minimise reliance on chemicals.

Accept other relevant answers.

Question 22 **(14 marks)**

(a) (i) Outline how the feeding technique of flushing is used to manipulate the breeding cycle. (2 marks)

Description	Marks
Outlines how flushing can manipulate the breeding cycle	2
States a relevant fact about flushing	1
Total	**2**
Answers could include: • increases the rate of reproduction by giving females an extra boost of protein to elevate the plane of nutrition and stimulate the females to ovulate at a higher rate. • timing – seven days before males are introduced. Continue for seven days after introduction. • lupins are used because they have a high percentage of protein.	
Accept other relevant answers.	

(ii) State which reproductive hormone is **most** affected by the flushing technique. (1 mark)

Description	Marks
States a Follicle Stimulating Hormone (FSH)	1
Total	**1**

(iii) Describe how an artificial breeding technique would take full advantage of the flushing technique. (3 marks)

Description	Marks
Describes how flushing is advantageous to an artificial breeding technique	3
Outlines how flushing is advantageous to an artificial breeding technique	2
States a relevant fact about the link between artificial breeding and flushing	1
Total	**3**
Answers could include: • Artificial insemination – flushing increases the opportunity for multiple pregnancies. Better conception rate takes full advantage of high quality genetics. • Embryo transfer – flushing increases the number of eggs released and improves the collection rate for each female.	
Accept other relevant answers.	

Question 22 (continued)

(b) (i) Calculate A and B in the table. (2 marks)

Description	Marks
A = 13	1
B = 9	1
Total	**2**

(ii) Propose a relevant hypothesis for this experiment. (2 marks)

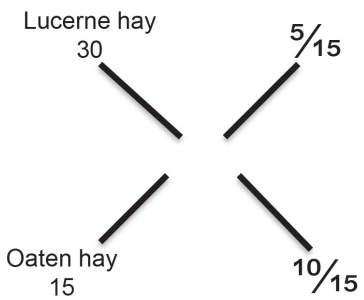
Description	Marks
Proposes that sheep fed lucerne hay will have extra income from lamb production (combines both independent and dependent variables)	2
States one variable – either fed lucerne hay or lupin grain (independent variable) or extra income from lamb production (dependent variable)	1
Total	**2**
Accept other relevant answers.	

(iii) State a possible management decision based on the results of the experiment. (1 mark)

Description	Marks
States that the results conclude that flushing with lucerne hay is the preferred feed to increase lamb income per hectare rather than lupins.	1
Total	**1**
Accept other relevant answers.	

(iv) The crude protein of lucerne hay is 30% and oaten hay is 15%. Using the Pearson square method, calculate the ratio of lucerne hay to oaten hay required to provide 20% crude protein. Show **all** workings. (3 marks)

Description	Marks
Lucerne hay – 1/3 or 5 parts	1
Oaten hay – 2/3 or 10 parts	1
Lucerne hay/Oaten hay ratio – 1:2	1
Total	**3**



Answers could include:
- States that twice as much oaten hay is required to achieve a 20% crude protein level in the ration.

Question 23 **(17 marks)**

(a) (i) Apart from fats, state the other **two** major components of a diet. (2 marks)

Description	Marks
States protein	1
States carbohydrate (not energy)	1
Total	**2**

(ii) State the main role of fat in an animal's diet. (1 mark)

Description	Marks
States that fat is a source of energy	1
Total	**1**
Answers could include: • improve body condition • improve fertility • reduces heat stress.	
Accept other relevant answers.	

(iii) State the substance that is released from the liver to break down fat in the digestive system. (1 mark)

Description	Marks
States bile	1
Total	**1**

(iv) Identify the site of fat absorption in the digestive system. (1 mark)

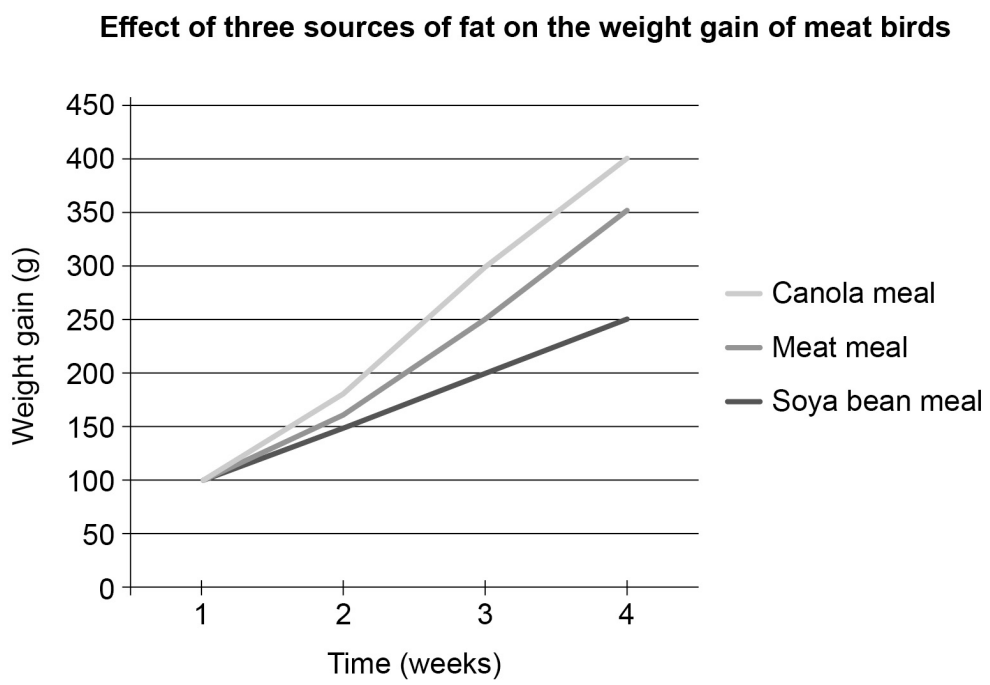
Description	Marks
Identifies small intestine	1
Total	**1**

Question 23 (continued)

(b) Using the table above, graph the results of the experiment in the grid below. (5 marks)

Description	Marks
Graph title relevant	1
X - axis title and units	1
Y - axis title and units	1
Weight gain for each fat type plotted accurately on a line graph	1
Plotted lines are correctly identified with their treatments in the key	1
Total	**5**

Answers could include:



(c) Outline **two** variables that would need to be considered in the experimental design to minimise experimental error. (4 marks)

Description	Marks
For each of the variables	
Outlines a variable in the design that would minimise experimental error	2
States a variable in the design that would minimise experimental error	1
Total	**4**

Answers could include:

- the meat birds should be weighed at the same time each to avoid variations caused by feed intake
- the meat birds need to be the same sex because male birds will grow at a faster rate
- the scales for weighing the birds needs to be calibrated before each weighing to ensure the weights are accurate.

Accept other relevant answers.

(d) From the table on page 14, identify the source of fat that should **not** be fed to cattle and outline the main reason for its restricted status. (3 marks)

Description	Marks
Identifies the source is meat meal	1
Subtotal	**1**
Outlines the main reason that it is a Restricted Animal Material (RAM) because bovine spongiform encephalopathy (BSE) is a disease caused by feeding animal matter to ruminants. It would endanger Australia's international livestock trade if there was an outbreak.	2
States it could cause mad cow disease or BSE.	1
Subtotal	**2**
Total	**3**

Question 24 (16 marks)

(a) (i) Explain, using an example, the process by which genetically-modified organisms can be produced. (4 marks)

Description	Marks
States an example of a genetically-modified (GM) organism	1
Subtotal	**1**
Explains the process, with an example, the process by which GM organisms can be produced	3
Outlines, with an example, the process by which GM organisms can be produced	2
Makes a general comment about the process by which GM organisms can be produced	1
Subtotal	**3**
Total	**4**
Answers could include: • DNA/gene for desired trait is identified, isolated • the gene is inserted into a fertilised ova which is then implanted into a surrogate animal • some of the offspring born will have the new (or changed) gene/DNA • can also refer to the removal or changing of existing DNA of organism (gene editing) • examples could include: pigs that excrete less phosphorous (Enviro-pig), fast-growing salmon (AquAdvantage salmon), chickens with higher resistance to avian flu, dairy cows that produce milk with similar composition to human milk.	
Accept other relevant answers.	

(ii) Consider a potential benefit of using genetically-modified livestock in animal production systems. (3 marks)

Description	Marks
Considers a potential benefit of using GM livestock in animal production systems	3
Outlines a potential benefit of using GM livestock in animal production systems	2
States a potential benefit	1
Total	**3**
Answers could include: • animals use feed more efficiently, i.e. greater growth/production for same amount of feed as non-GM livestock • disease/parasite resistance – healthier, more productive animals • improved reproduction rates, e.g. increased number of offspring in a female's lifetime • reduced waste production, e.g. methane, faeces – lower environmental impact.	
Accept other relevant answers.	

(b) Define the term 'cloning' and outline a potential application of this technology to animal production systems. (3 marks)

Description	Marks
Defines the term cloning	1
Subtotal	**1**
Application of the technology	
Outlines a potential application	2
Makes a general comment about potential application	1
Subtotal	**2**
Total	**3**
Answers could include: Definition: • cloning is the process of generating a genetically identical copy of a cell or an organism. Application: • mass production of genetically-modified animals ensures that all offspring inherit the modification • cloning allows farmers to rapidly upgrade the overall quality of their herds by providing more copies of the best animals in the herd • producing more copies of superior breeding animals in a herd to upgrade overall herd quality and thus the quality of offspring.	
Accept other relevant answers.	

(c) (i) Outline **two** ways in which the introduction of genetically-modified or cloned livestock into commercial food production might have a negative effect on the sustainability of the production system. (4 marks)

Description	Marks
For each of the two ways	
Outlines a way in which GM/cloned livestock may impact sustainability	2
Makes a general comment about how GM/cloned livestock impacts sustainability	1
Subtotal	**2**
Total	**4**
Answers could include: • any reluctance of consumers or export markets to purchase these products could lead to reduced demand and thus income. Reduced economic sustainability • increased costs to use this technology must be outweighed by economic benefits otherwise economic sustainability may be threatened • consumer confidence in health and safety or ethics associated with these products – affecting social sustainability • potential environmental damage of modified organisms on natural ecosystems. This threat to natural resources can impact environmental sustainability.	
Accept other relevant answers.	

Question 24 (continued)

(ii) For **one** of the effects stated in part (c)(i), recommend what action could be taken to minimise this effect. (2 marks)

Description	Marks
Recommends an action that could minimise impact	2
Makes a relevant statement about minimising the impact	1
Total	**2**

Answers could include:
Recommendations:

- restore consumer confidence through education and marketing and/or rigorous safety testing
- carrying out cost-benefit analysis to determine use of technology is cost-effective long-term
- environmental impacts of escaping animals into natural ecosystems could be addressed by ensuring non-breeding individuals are sterile (e.g. AquAdvantage salmon), or ensuring GM animals cannot survive outside captivity.

Accept other relevant answers.

Question 25 **(17 marks)**

(a) Identify a natural ecosystem and compare its key characteristics with those of an agricultural ecosystem. (5 marks)

Description	Marks
Identifies a natural ecosystem	1
Subtotal	**1**
Comparing key characteristics	
Compares in detail key characteristics of a natural and agricultural ecosystem	4
Describes key characteristics of a natural and agricultural ecosystem	3
Outlines key characteristics of a natural and agricultural system	2
Makes a relevant statement about natural and/or agricultural ecosystem	1
Subtotal	**4**
Total	**5**
Answers could include: • natural ecosystems, e.g. grasslands, eucalypt and banksia woodlands, wetlands, eucalypt forests, acacia shrublands, rainforests • agricultural ecosystems, e.g. permanent pasture for grazing animals such as cattle, sheep etc. Comparison could include: • energy flow is similar for both types of ecosystems, originating from sunlight then flowing to producers, consumers and finally to detritivores and decomposers. Energy is also 'lost' from ecosystems via biological processes such as respiration (heat loss) • recycling of matter is efficient in natural ecosystems, but is more limited in agricultural systems. This involves the breakdown of waste products by detritivores and decomposers. In natural systems, little/no matter is removed or added. In agricultural systems, a large proportion of matter is removed as marketable products. In order to function effectively, it is often necessary to supply agricultural systems with additional inputs, e.g. fertilisers.	
Accept other relevant answers.	

(b) (i) Explain the difference in the degree of biodiversity between natural and agricultural ecosystems. (4 marks)

Description	Marks
Explains the difference between the two types of ecosystems	4
Describes the difference between the two types of ecosystems	3
Outlines the difference between the two types of ecosystems	2
Makes a relevant statement about biodiversity	1
Total	**4**
Answers could include: • biodiversity tends to be much greater in natural ecosystems than in agricultural systems • in creating the agricultural ecosystem, land is cleared, significantly reducing biodiversity of the newly created agricultural ecosystem • in agricultural systems biodiversity is affected by the removal of pests/undesired species which compete with/injure agricultural production, e.g. kangaroos eat crops or pasture; farming practices that damage natural resources will limit biodiversity, e.g. overuse of fertilisers, drenches affecting soil flora and fauna; some recycling of materials provides a food source for soil microbes but much less than in natural systems.	
Accept other relevant answers.	

Question 25 (continued)

(ii) Compare the degree of biodiversity between an urban and a natural ecosystem. (4 marks)

Description	Marks
Compares the difference between the two types of ecosystems	4
Describes the difference between the two types of ecosystems	3
Outlines the difference between the two types of ecosystems	2
Makes a relevant statement about biodiversity	1
Total	**4**
Answers could include: • biodiversity tends to be much greater in natural ecosystems than in urban systems • in urban systems there is minimal recycling of matter; the system is often heavily managed to be aesthetically pleasing and functional; water flow is diverted and cover of soil by concrete affects movement of water and oxygen into soil; organisms deemed detrimental to these aims are controlled, especially those who negatively impact humans, e.g. rats and mice, mosquitos, kangaroos; food sources for various organisms are often limited (e.g. grass is mowed rather than being grazed, dead animals are removed from the area).	

(c) Explain, using examples, how the improvement of biodiversity in an agricultural system can enhance its productivity. (4 marks)

Description	Marks
Explains how improved biodiversity can enhance productivity, providing examples	4
Describes how improved biodiversity can enhance productivity, providing examples	3
Outlines how improved biodiversity can enhance productivity, providing an example	2
Makes a relevant statement about biodiversity and productivity	1
Total	**4**
Answers could include: Improvement of biodiversity: • natural predators of 'pest' species can reduce impact on production/animal health, e.g. dung beetles in parasitic worm control • increased shade and shelter provided by trees and shrubs can protect livestock against extreme weather – reducing stock deaths, increasing reproductive rates and improving utilisation of feed • improve soil biodiversity and thus quality will lead to improved pasture quality and quantity which aids animal growth and health • native grasses are more drought resistant than introduced varieties, so provide stock with more feed throughout the year; can also reduce methane emissions and thus energy loss from some livestock via microbial digestion.	
Accept other relevant answers.	

Question 26 **(17 marks)**

(a) (i) state the optimum specifications for selling beef. (1 mark)

Description	Marks
States the optimum specifications as 221-280 kg carcass weight and 4−15 mm fat depth	1
Total	**1**

(ii) evaluate the effect of product variation on financial return. (3 marks)

Description	Marks
Evaluates the effect of product variation. Where product varies in carcass weight and/or fat depth, the price paid can vary by up to $4/kg. In a 342 kg carcass with more than 25 mm fat depth, the financial loss is $1368.	3
Outlines the difference between the highest and lowest price paid without providing a calculated loss	2
Makes a relevant statement about the price paid for product variation	1
Total	**3**
Accept other relevant answers from the price grid that demonstrate a significant financial loss.	

(b) Describe a nutritional management strategy to help achieve market specifications for an animal production system with which you are familiar. (3 marks)

Description	Marks
Describes a relevant nutritional strategy linked to achieving market specification for a particular animal production system	3
Outlines a relevant nutritional strategy linked to achieving market specification for a particular animal production system	2
Makes a relevant statement about a nutritional strategy linked to achieving market specification	1
Total	**3**
Answers could include: Strategy: • balanced ration • supplementation on pasture • hormone growth promotants (HGP) • feed lotting. Achieving market specification: • ration should provide all necessary nutrients. Adjustments to the protein and carbohydrate components, as the animals are reaching their finishing weights, are made slowly so as not to induce acidosis • where supplements are fed with pasture, pasture quantity and quality (Food On Offer) is monitored regularly and the supplement is adjusted to compensate for an increase/decrease in pasture quality and/or quantity • HGPs can be used where the market accepts this treatment. They assist animals (usually females) to lay down more muscle than fat and make better use of their feed for high feed conversion efficiency (FCE).	
Accept other relevant answers.	

Question 26 (continued)

(c) (i) State a variation in product quality in a feedlot caused by mishandling. (1 mark)

Description	Marks
States a variation as dark cutting	1
Total	**1**
Answers also could include: • bruising • dog bite marks.	
Accept other relevant answers.	

(ii) Outline how the variation in part (c)(i) could be minimised. (2 marks)

Description	Marks
Outlines how low stress stock handling can minimise dark cutting	2
States that low stress stock handling should be used	1
Total	**2**
Answers could include: • low stress livestock handling training – understanding livestock behaviour and using their flight zone to advantage, minimising noise and use of electric prods • keep handling to a minimum and avoid handling in extreme weather conditions • maintain handling facilities in good working order.	
Accept other relevant answers.	

(iii) State a variation in product quality in a feedlot caused by road transport. (1 mark)

Description	Marks
States a variation as bruising	1
Total	**1**
Answers could include: • skin staining • downers • deaths • horn damage to eyes • dehydration.	
Accept other relevant answers.	

(iv) Propose how the variation in part (c)(iii) could be minimised. (2 marks)

Description	Marks
Proposes how the role of the truck driver is to ensure the correct pen density and loading procedure	2
States that animals should not be overcrowded in a truck	1
Total	**2**
Answers could include: • comply with pen densities on trucks to avoid overcrowding • only load livestock that are fit to travel • use an accredited transport company/driver with Truckcare credentials • yard livestock the night before to allow them to settle • horns no more than 12 cm and horn tipped (blunted).	
Accept other relevant answers.	

(d) Explain how quality assurance can ensure that on-farm practices can deliver the quality required by the market. (4 marks)

Description	Marks
Explains how quality assurance programs deliver the quality required by the market	4
Describes how a QA program underpins quality assurance	3
Outlines at least one aspect of quality assurance	2
Makes a relevant statement about quality assurance	1
Total	**4**
Answers could include: • Livestock Production Assurance (LPA) is an accredited on-farm assurance program which underpins market access through National Vendor Declarations (NVD) and maintains the integrity of on-farm practices through on-farm audits to check for compliance • each producer has a property identification code (PIC) and there are seven program requirements to gain accreditation • records are maintained of all relevant management activities in relation to the animal production system • each part of the program focuses on practices that are required to maintain the integrity of the red meat industry.	
Accept other relevant answers.	

Section Three: Extended answer **30% (40 Marks)**

Question 27 **(20 marks)**

(a) (i) Propose a breeding goal of the nominated animal enterprise that will enhance the marketable product. (1 mark)

Description	Marks
Proposed breeding goal stated	1
Total	**1**
Note: breeding goal must be measurable	

(ii) How can the breeding goal be measured? (2 marks)

Description	Marks
Objectively measured by	
Outlines a relevant measurement process	2
States a relevant measurement method	1
Subtotal	**2**
Total	**3**
Answers could include: Merino sheep – wool – breed sheep with an average micron of 16 – maidens are micron tested at their first shearing, ranked according to their micron. Those with a micron of 16 or less are selected. beef cattle – beef – breed vealers with an average weaning weight of 300 kg – weigh heifer weaners at weaning, rank according to liveweights. Select those heifers over 300 kg. • pigs – baconers – breed gilts with an average litter size of 16 – gilts selected from litters of 16 or more. Litter size assessed. • dairy – milk – breed heifers with an average lactation of 10 000 litres – heifers in their first lactation are measured for milk production or herd tested for potential milk production before being selected into the milking herd.	
Accept other relevant answers.	

(iii) Explain how a producer could make progress toward the proposed breeding goal identified in part (a)(i). (3 marks)

Description	Marks
Explains it is a combination of recording selected traits, estimating breeding values, selecting potential parents and a mating program that incorporates breeding technologies to enhance the progress	3
Outlines a relevant statement about progress – using breeding technologies to take advantage of better quality sires	2
Makes a relevant statement about progress – selects better quality sires to make progress towards the breeding goal	1
Total	**3**
Answers could include: • classing and culling play an important role in improving the average genetic merit of a flock or herd. Replacement females are selected for the traits the breeder is trying to improve through measurement (objective) and then assessed subjectively for conformation and breed type. • use of estimated breeding values (EBV) to assist in a more precise selection of stock based on their genetic merit provided the breed has a database and the producer is able to provide accurate data on the	

selected traits. A value is estimated so that the breeder can assess the value gained by using a breeding animal with a particular EBV. • genomic testing is available for some breeds. It tests for genetic potential against important traits such as fertility and provides the breeder with an early assessment of the breeding potential on a female. It also provides the breeder with information about negative traits that will have a detrimental effect on a breeding program.
Accept other relevant answers.

(b) Discuss **two** new technologies that could optimise progress toward the proposed breeding goal identified in part (a)(i). (8 marks)

Description	Marks
For each of the new technologies	
Discusses a new technology that can optimise the progress towards the proposed breeding goal	4
Describes a new technology linking it to the breeding goal progress and how it supports the breeding goal	3
Outlines a new technology linking it to the breeding goal progress	2
States a relevant new technology	1
Subtotal	**4**
Total	**8**

Answers could include:

- Electronic Identification Devices (EID) on each animal to enable accurate data collection. Tags can be quickly scanned with a stick reader through a set of scales with a panel reader or remote walk over weighing (WOW) systems that weigh in the paddock in real-time. Scales can be set-up to draft on liveweight to identify specific weight groups. Animals have individual records that can be used as a selection base point.
- sheep - genomic testing assists in making the right breeding decisions to verify parentage and help screen for undesirable mutations. Increases accuracy of performance recording.
-
- remote systems in paddocks that monitor stock welfare and health, increasing timeliness of intervention and reducing stock losses that could be preventable with early intervention.
- pedigree matchermaker – collecting data on ewes and lambs between birth and weaning so that the performance of the individual ewe can be tracked to make sure she is performing to the enterprises breeding goal.

Note: A common misconception is that artificial insemination and embryo transfer are new technologies that will optimise progress however these procedures have been around for more than 20 years.

Accept other relevant answers.

Question 27 (continued)

(c) Identify and outline the effect of an aspect of climate change on the proposed breeding goal in part (a)(i), and describe a strategy to mitigate its impact. (6 marks)

Description	Marks
Identifies an aspect of climate change that can affect a proposed breeding goal	1
Subtotal	**1**
Outlines the effect of an aspect of climate change on the proposed breeding goal	2
States the effect of an aspect of climate change on the proposed breeding goal	1
Subtotal	**2**
Strategy to mitigate the impact of climate change	
Describes a relevant strategy to mitigate the impact of climate change	3
Outlines a relevant strategy linked to the aspect of climate change	2
Makes a relevant statement about the aspect of climate change	1
Subtotal	**3**
Total	**6**

Answers could include:

- Merino sheep – wool – breed sheep with an average micron of 16. Lower rainfall causing reduced pasture growth can be mitigated by providing supplementary feeding during low pasture periods, establish pasture species that provide grazing for longer under low rainfall conditions, reduce stocking rate to take the pressure off pastures.
- beef cattle – beef, breed vealers with an average weaning weight of 300 kg. Heat stress caused by higher temperatures, increase natural shade, breed cattle that are light coloured, wean earlier and supplementary feed.
- pigs – baconers, breed gilts with an average litter size of 16. Heat stress caused by higher temperatures, reduce stocking rates, install ventilation, farrow gilts during cooler months of the year.
- dairy – milk, breed heifers with an average lactation of 10 000 litres. Heat stress caused by higher temperatures, milk later in the afternoon, provide shade shelters, cool down concrete yards prior to milking, select heifers with predominately white coats.

Accept other relevant answers.

Question 28 **(20 marks)**

(a) Clarify how comparative advantage works in the context of an animal production system with which you are familiar. Describe the importance of the global economy for **two** Australian animal products, including their major market and main competitor.(11 marks)

Description	Marks
Clarifies what comparative advantage is and how it relates to an animal product	3
Outlines comparative advantage in context	2
States a relevant fact about comparative advantage in context	1
Subtotal	**3**
For each of the animal products	
Describes the importance of the nominated product in the global economy and nominates a major market and main competitor	4
Outlines the importance of the nominated product in the global economy and nominates a major market and main competitor	3
States both a major market and main competitor of the nominated animal product	2
States either a major market or main competitor of the nominated animal product	1
Subtotal	**8**
Total	**11**

Answers could include:

- Comparative advantage arises from a country's ability to produce a particular product at a lower opportunity cost than its trading partners. The advantage for Australia could be a range of factors such as natural resources, climate, human resources, market proximity and can be measured against Australia's major exports. The quality of Australian animal products is backed by high standards in biosecurity, welfare and animal health that makes its products very competitive.

Context:

- Australia exports about 70% of its agricultural produce. Without reliable markets production would need to be scaled back and prices would be low, affecting farm incomes.
- wool – largest merino flock, extensive grazing area, suitable climate
- live sheep – large numbers of suitable sheep, close proximity to major markets
- beef – national herd is free of any major disease. Has a world class traceability process. Low cost of production.
- dairy – produce a wide range of manufactured products (cheese, yoghurts, UHT, powder). Competitively priced for export market due to unregulated local market. Highly efficient production systems.

Major market/main competitor:

- wool – China/New Zealand – there is very little processing of wool in Australia. The raw product is sold in a greasy state and purchased back as woollen garments/products. Without the Chinese market for wool, prices would drop as other countries do not have the manufacturing infrastructure to process the wool.
- live sheep – Kuwait/European Union – the demand for protein in countries that do not have the climate or infrastructure to raise large numbers of sheep provides Australia with an outlet for male/wethers that would otherwise need to be slaughtered and sold as an inferior product to lamb
- beef – Japan/Brazil – Australia runs second behind the USA in beef exports but leads the world in value of exports on the back of advantageous multilateral agreements and a high animal health status
- dairy – China/New Zealand – about one third of milk production is exported making Australia the fourth largest dairy exporter in the world. Australia's proximity to Asia reflects the concentration of trade and as incomes rise and Asian populations westernise their diet, dairy exports will strengthen.

Accept other relevant answers.

Question 28 (continued)

(b) Outline **four** on-farm strategies to maintain Australia's global competitiveness in animal production and evaluate the effectiveness of **one** of these strategies in promoting sustainable farming practices. (9 marks)

Description	Marks
Strategies	
Outlines four strategies	4
Outlines three strategies	3
Outlines two strategies	2
States a relevant strategy	1
Subtotal	**4**
Evaluation of the strategy	
Evaluates a strategy which promotes farming practices, with an emphasis on how they are sustainable	4–5
Outlines a strategy which promotes farming practices that are sustainable	2–3
Makes a relevant statement about a strategy which promotes farming practices that are sustainable	1
Subtotal	**5**
Total	**9**

Answers could include:

On-farm strategies:

- innovation – adoption of research and development outcomes that directly improve productivity and profitability
- biosecurity – adopt a robust biosecurity plan that can minimise outbreaks
- use of data – improved market specification compliance
- automation – progress towards net zero carbon emissions
- up-skilling producers – maintaining currency in production and marketing techniques
- food safety – minimise the use of pesticides to push production yields.

Innovation - less intensive grazing animal production systems:

- grazing practices that jeopardise the environment – grazing strategies that reduce the pasture biomass to the point where soil degradation and nutrient depletion requires the use of fertilisers which have a detrimental effect on the paddock environment and the surrounding ecosystems.
- sustainable practices:
  - pasture grazing systems that retain the biomass, using cell grazing techniques to encourage pasture regrowth while meeting nutritional requirements of livestock
  - multi-animal grazing to make better use of pasture, break pest cycles and increase biodiversity.

Accept other relevant answers.

Question 29 **(20 marks)**

(a) Identify **one** natural resource that is critical for sustainable animal production and discuss the issues farmers have in balancing the short-term needs of productivity with the long-term need to improve that resource. (11 marks)

Description	Marks
Identifies one natural resource – water, soil, natural vegetation	1
Subtotal	**1**
Discusses the issues	
Discusses the issues for short-term productivity against the needs for long-term improvement	9–10
Explains the needs for short-term productivity against the needs for long-term improvement	7–8
Describes the needs for short-term productivity against the needs for long-term improvement	5–6
Outlines the need for short-term productivity against the need for long-term improvement	3–4
States a need for short-term productivity and a long-term improvement	2
States a need for short-term or a long-term improvement	1
Subtotal	**10**
Total	**11**

Answers could include:

Water:

- the use of a waterway for livestock water access is an inexpensive way of providing water but the long-term effects on bank degradation, eutrophication of the water source and transference of water-borne diseases can build up and the source would become unsustainable. Fencing off waterways and pumping water to troughs means the banks stay intact and nutrients are less likely to find their way into the water. The long-term effect on water quality favours greater biodiversity and an ecosystem that is more balanced.
- water used for flood irrigation of pastures/fodder crops will provide livestock with feed in the short-term but the continual removal of nutrients from the soil through leaching and/or plant removal will require amendments, usually in the form of fertilisers, which lower soil pH and are expensive. Installation of centre pivots to distribute the water more evenly and incorporate liquid fertiliser (fertigation) to replace nutrients. In the long-term this reduces the annual removal of water from aquifers.
- the use of dams in paddocks to store drinking water for livestock is an inexpensive way of storing water however if there is not enough run-off rain, the dams don't fill and water needs to be carted from a reliable source. To improve run-off roaded catchments need to be installed and maintained, key dams built and water distributed by pipe to minimise evaporation. In the long-term producers will rely less on carting water, an expensive and time consuming exercise, and water proof their production system.

Soil:

- provides livestock producers with the cheapest source of feed – pasture. Over-grazing will cause degradation from wind and water erosion where the soil has no residual plant material and livestock with their cloven hooves disturb the top soil when it is dry. Grazing strategies such as cell/strip grazing allows producers to graze smaller areas less frequently, thus allowing pasture to regenerate and protect the soil. Cell grazing requires an investment in temporary or permanent fencing/gates/laneways and water points.
- grasses can produce large amounts of dry matter for livestock but require N fertilisers to realise their potential. N fertilisers are a major cause of a drop in soil pH towards acidic which has a knock-on effect on soil microfauna, which are

Question 29 (continued)

critical for nutrient recycling in the soil. In the long-term creating balanced soils with a grass/legume component reduces the reliance on N fertilisers however these pastures need to be managed differently to maintain the balance. Natural vegetation: • grazing natural vegetation areas on a farm has little nutritive value and cause damage to native annual populations and in severe cases ring-barking of trees that will die. Fencing these areas out of the grazing will preserve the biodiversity provided weeds and pests are controlled. Most weeds that grow in paddocks can be kept down by strategic grazing/spraying, but neither of these options are applicable in natural vegetation that has been fenced off. In the long-term the presence of well managed natural vegetation areas on farms will provide greater biodiversity and support a larger population of natural predators that will benefit the production system.
Accept other relevant answers.

(b) Analyse the concept of intergenerational equity as it relates to an animal production system and describe **two** economic strategies animal producers could adopt to improve sustainability. (9 marks)

Description	Marks
Analyses the relationship between the producer and the role they have as a custodian of the farming resource for the next generation	3
Outlines the main feature of the relationship between the producer and the role they have as a custodian of the farming resource for the next generation	2
Makes a relevant statement about the concept of intergenerational equity	1
Subtotal	**3**
For each strategy	
Describes how an economic strategy adopted by animal producers leads to sustainability	3
Outlines a relevant economic strategy that could be adopted by animal producers to be sustainable	2
States a relevant economic strategy that could be adopted by animal producers to be sustainable	1
Subtotal	**6**
Total	**9**

Answers could include:

- intergenerational equity is the ability of the current generation to be sustainable without compromising the ability of future generation's sustainability. No amount of economic progress can justify leaving future generations with a degraded environment.

Strategies:

- adopt diversification of livestock enterprises, allowing different species to work together to reduce costs, for example, sheep following cattle grazing to assist with control of intestinal worms for both species
- run an animal enterprise that can be flexible to changing markets, for example, breeding sheep for wool and lambs, breeding cattle that can be turned off at different ages to maximise market demand
- invest in genetics that will increase production and also provide resilience against changing climatic conditions, for example, introducing bos indicus genetics to improve production in a hotter environment
- adopting new technology to maximise productivity, such as walk over paddock scales to monitor livestock weight gain and virtual fencing that enables the producer to better utilise pasture and save money on fence and gate repairs.

Accept other relevant answers.

ACKNOWLEDGEMENTS

Question 24(b) Rugnetta, M. (2020). Cloning [Definition]. *Encyclopedia Britannica*. Retrieved August, 2021, from https://www.britannica.com/science/cloning

Question 27(b) Dot point 3 from: Schefers, J. M., & Weigel, K. A. (2012, January). Genomic selection in dairy cattle: Integration of DNA testing into breeding programs. *Animal Frontiers*, 2(1), pp. 4–9. Retrieved August, 2021, from https://academic.oup.com/af/article/2/1/4/4638584

Question 28(a) Dot point 1 (sentence 1) adapted from: Hayes, A. (2020). *Comparative advantage* [Definition]. Retrieved August, 2021, from https://www.investopedia.com/terms/c/comparativeadvantage.asp

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