Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2024

Marking Scheme

Agricultural Science

Ordinary Level

Note to teachers and students on the use of published marking schemes

Marking schemes published by the State Examinations Commission are not intended to be standalone documents. They are an essential resource for examiners who receive training in the correct interpretation and application of the scheme. This training involves, among other things, marking samples of student work and discussing the marks awarded, so as to clarify the correct application of the scheme. The work of examiners is subsequently monitored by Advising Examiners to ensure consistent and accurate application of the marking scheme. This process is overseen by the Chief Examiner, usually assisted by a Chief Advising Examiner. The Chief Examiner is the final authority regarding whether or not the marking scheme has been correctly applied to any piece of candidate work.

Marking schemes are working documents. While a draft marking scheme is prepared in advance of the examination, the scheme is not finalised until examiners have applied it to candidates' work and the feedback from all examiners has been collated and considered in light of the full range of responses of candidates, the overall level of difficulty of the examination and the need to maintain consistency in standards from year to year. This published document contains the finalised scheme, as it was applied to all candidates' work.

In the case of marking schemes that include model solutions or answers, it should be noted that these are not intended to be exhaustive. Variations and alternatives may also be acceptable. Examiners must consider all answers on their merits, and will have consulted with their Advising Examiners when in doubt.

Future Marking Schemes

Assumptions about future marking schemes on the basis of past schemes should be avoided. While the underlying assessment principles remain the same, the details of the marking of a particular type of question may change in the context of the contribution of that question to the overall examination in a given year. The Chief Examiner in any given year has the responsibility to determine how best to ensure the fair and accurate assessment of candidates' work and to ensure consistency in the standard of the assessment from year to year. Accordingly, aspects of the structure, detail and application of the marking scheme for a particular examination are subject to change from one year to the next without notice.

How to use the marking scheme

- Examiners must conform to this scheme, however the descriptions, methods and definitions given in the marking scheme are not exhaustive and alternative valid answers are acceptable.
    - This does not preclude synonyms or terms or phrases which convey the same meaning as the answer in the marking scheme. Although synonyms are generally acceptable, there may be instances where the scheme demands an exact scientific term or unequivocal response and will not accept alternatives.
- The marking scheme is a concise and summarised guide to awarding marks and is constructed in order to minimise its word content.
    - In many cases only key phrases are given in the marking scheme. These points contain the information and ideas that must appear in a candidate's answer in order to merit the assigned marks.
- If an examiner determines that a candidate has presented a valid answer, and where there is no provision in the scheme for accepting that answer, then the examiner must first consult with his / her advising examiner before awarding marks.
- The detail required in any answer is determined by the context, the phrasing of the question, and by the number of marks assigned to the answer in the examination paper. This may vary from year to year.
- Where only one answer is required alternative answers are separated by '**or**'.
- Use of an **asterisk*****
    - This happens when the only acceptable answer is a specific word or term. Each such instance is indicated in the scheme by an asterisk*.
- Use of a **solidus** (**/**)
    - Words, expressions or statements separated by a solidus (**/**) are alternatives that are equally acceptable for a particular point.
    - Where multiple answers are required each word, term or phrase for which marks are allocated is separated by a solidus (**/**) from the next word, term or phrase.
- Use of **brackets ( )**
    - A word or term that appears in brackets **( )** in the scheme is not a requirement of the answer, but is used to contextualise the answer or may be an alternative valid answer.
- **Note** however, that words, expressions or phrases must be correctly used in context and not contradicted and where there is evidence of incorrect use or contradiction, the marks may not be awarded.
- The mark awarded for an answer appears in **bold** in the mark's column, e.g. **2**.
- Where there are several parts in the answer to a question, the mark awarded for each part appears as e.g. **3(2)**. This means there are 3 parts to the answer, each part is allocated 2 marks.
- Award unit marks separately e.g. if an answer merits three 2-mark units, write 3 separate '2's, under each other, in the space at the right-hand side of the question in the answer book (**2, 2, 2**).

- The answers to subsections of a question may not necessarily be tied to a specific mark e.g. there may be four parts to a question - (i), (ii), (iii), (iv) and a total of 10 marks allocated to the question. The marking scheme might be as follows: 4 + 2 + 2 +2. This means that the first correct answer encountered is awarded 4 marks and each subsequent correct answer is awarded 2 marks.
- Italics are used where the examiner's attention is being drawn to an instruction relating to the answer or to some qualification of the answer.
- In general, names and symbols / formulae of elements / compounds are equally acceptable. However, in some cases where a name is specifically asked for, the symbol / formula may be accepted as an alternative. This will be clarified within the scheme.
- All blank pages should be marked to indicate they have been inspected.

Cancelled answers

- The following is an extract from S.63O *Instructions to Examiners, 2023* (section 5.4, p.18), *"Where a candidate answers a question or part of a question once only and then cancels the answer, you should ignore the cancelling and treat the answer as if the candidate had not cancelled it."*
- If the only answer offered is cancelled ignore the cancelling and mark as usual.
- If an answer is cancelled and a second version of the answer is given, you should accept the cancellation and award marks, where merited, for the un-cancelled version only.
- If two un-cancelled versions of an answer are given to the same question or part of a question, mark both and accept the answer that yields the greater number of marks. You may not, however, combine points from both versions to arrive at a manufactured total.

Surplus answers

- A surplus wrong answer cancels the marks awarded for a correct answer.
    - e.g. Question: Identify the cattle and sheep breeds.
      Marking scheme: A = Suffolk / B = Shorthorn / C = Belgian blue / D =Texel - **4(1)**
      Candidates Answer = A = Texel, Suffolk / B = Shorthorn / C = Belgian blue / D =Texel
      The surplus answer (Texel) is incorrect,
      Therefore, the candidate scores 4 - 1 = 3 marks.

Annotations used in the marking

The scripts were marked on-line by examiners. The following table illustrates the various **annotations** (symbols) applied by the examiners when marking the scripts. The meaning and use of each of the annotations applied are explained in the table below. These annotations will be seen on a script if viewed as part of the appeal process. In some sections of the 'Individual Investigative Study' (IIS), where the mark award was greater than 12 marks for a single item(s), two annotations will be used to show the total marks awarded for the item(s). Annotations applied by an examiner will be viewed in red. Scripts that were also marked by an advising examiner will show annotations in a green colour.

Annotation	Meaning
✓	This symbol indicates a correct response / answer. Use when all marks awarded to any additional correct answers.
✗	This symbol indicates an incorrect response / answer.
[	This symbol indicates a surplus incorrect answer. A surplus incorrect answer has cancelled a correct answer.
	This symbol is placed on all blank pages or part of page to indicate it has been seen by the examiner.
	This symbol can be used by an examiner to indicate a part of a question answer of significance.
	This symbol is used to indicate where a candidate answer was awarded zero marks.
✓1	This symbol can be used by an examiner to indicate **One** mark awarded
✓2	This symbol can be used by an examiner to indicate **Two** marks awarded
✓3	This symbol can be used by an examiner to indicate **Three** marks awarded
✓4	This symbol can be used by an examiner to indicate **Four** marks awarded
✓5	This symbol can be used by an examiner to indicate **Five** marks awarded
✓6	This symbol can be used by an examiner to indicate **Six** marks awarded
✓7	This symbol can be used by an examiner to indicate **Seven** marks awarded
✓8	This symbol can be used by an examiner to indicate **Eight** marks awarded
✓9	This symbol can be used by an examiner to indicate **Nine** marks awarded
✓10	This symbol can be used by an examiner to indicate **Ten** marks awarded
✓11	This symbol can be used by an examiner to indicate **Eleven** marks awarded
✓12	This symbol can be used by an examiner to indicate **Twelve** marks awarded

Marking the Individual investigative Study (IIS)

Read the entire Individual Investigative Study (IIS) without allocating any marks. Mark the IIS using the marking criteria and total the marks. Each section of the IIS is awarded a single mark, which varies between sections (e.g. Introduction and back ground research is awarded 20 marks). To assist in the awarding of marks 'indicative content' has been stated for each section; e.g. in considering the allocation of marks for the introduction and background research section, this can be considered under;

- Introduction (context for the IIS) and
- Background Research (research, sources and knowledge).

To finalise the marks, review the criteria descriptors against the marked work.

Ordinary Level Agricultural Science Marking Criteria for Individual Investigative Study

Before commencing marking read the entire Individual Investigative Study to familiarise yourself with the content presented for marking.

Note: Be careful not to penalise skilful brevity, nor to reward unwarranted length.

These descriptors should be interpreted in the context of the challenges and demands of the investigation the candidate has chosen.

Section	Very Good	Good	Fair	Weak
Introduction and background research *Suggested range between 300 and 500 words*	Study reasonably addresses the brief theme in a context, even if the context is limited. Adequate level of knowledge with understanding; does not need to be fully coherent throughout. Identifies and interrogates a limited range of relevant and credible sources of evidence to support study. No significant omissions / errors.	Brief theme is addressed at a basic level with the context not well developed. Basic knowledge and limited understanding of the theme. Lacks depth and structure. Identifies and presents a narrow range of evidence simply with an overreliance on unsubstantiated data. Contains minor omissions / errors.	Brief theme is vaguely addressed and understood with no context developed. Knowledge and understanding of theme are poor. Very simplistic structure. Evidence presented is limited, simplistic or confused and only vaguely relevant to the theme. Contains major omissions / errors.	Brief theme is completely misunderstood. Little or no understanding and knowledge of the theme. Little or no evidence presented, with presented evidence not relevant to the theme. Information may be incorrect or contradictory. Contains significant omissions / errors.
20 marks	**16-20**	**12-15**	**8-11**	**0-7**
Award a single mark out of 20 for this section. In arriving at this mark consider the indicative content requirements below.				
Introduction *- Context for the IIS – 10 marks*	• Very Good - 8 – 10m • Good - 6 – 7m • Fair - 4 – 5m • Weak - 0 – 3m		***Background Research*** *-Research, sources and knowledge – 10 marks*	• Very Good - 8 – 10m • Good - 6 – 7m • Fair - 4 – 5m • Weak - 0 – 3m

Section	Very Good	Good	Fair	Weak
The investigative process *Suggested range between 500 and 800 words*	Identifies and provides a description of the investigative process undertaken, which may have some limitations. A valid hypothesis was generated and tested. Ideas, concepts and theories make tentative links between at least some aspects of the task. At least one experiment involving gathering and processing data. A logical description of how data was gathered, which may have some omissions / errors. An attempt at linking to learning outcomes of specification.	Identifies and provides a simplistic description of the investigative process undertaken. A simplistic hypothesis was generated and tested. At least one experiment involving gathering and processing data. Description of how data was gathered is vague, with some omissions / errors. Vague linking to learning outcomes of specification	Simplistic or confused details of the investigative process presented and only vaguely relevant to the theme. Very simplistic hypothesis generated and tested. At least one experiment involving gathering and processing data with only a very poor description of how data was gathered with major omissions / errors. Very poor linking to learning outcomes of specification	Little or no details of the investigative process presented and which has no relevance to the theme. A very poor hypothesis or no hypothesis generated. At least one experiment involving gathering and processing data with very poor description of how data was gathered which is also incorrect and /or contradictory. No link with learning outcomes of specification.
25 marks	**20-25**	**15-19**	**10-14**	**0-9**

Award a single mark out of 25 for this section. In arriving at this mark consider the indicative content requirements below.

Details of the actions undertaken in response to stated hypothesis – 12 marks	• Very Good - 10 – 12m • Good - 8 – 9m • Fair - 5 – 7m • Weak - 0 – 4m	*Data collection undertaken – 13 marks*	• Very Good - 11 – 13m • Good - 8 – 10m • Fair - 6 – 7m • Weak - 0 – 5m

Section	Very Good	Good	Fair	Weak
Results, analysis, and conclusions *Suggested range between 600 and 1000 words*	Provides an adequate interpretation and evaluation of the data. Presentation is good but may lack some structure. Constructs informed independent conclusion to justify own position (hypothesis), which does not necessarily need to display great depth and structure. Conclusions are based on an analysis of evidence, even if basic in nature.	Limited and basic analysis of the data, with some inaccuracies. Presentation of the data is limited and may have some errors. Some very basic independent conclusion(s) made to justify own position (hypothesis). Conclusions are flawed or made with limited evidence in support. Repetition of material is evident.	Very little interrogation of the data, with many inaccuracies evident. Presentation of the data is very limited and contains many errors. Very limited independent conclusions made to justify own position (hypothesis). Conclusion is flawed with limited evidence of analysis / superficial analysis with significant inaccuracies. Significant repetition of material.	Poor / confused / illogical interrogation of the data. Presentation of data is very poor. Little or no evidence presented / or not relevant, with little or no justification of own position (hypothesis). Analysis is poor or not present. Conclusions are not present or significantly flawed. Significant amounts of and presentation and irrelevant material evident.
35 marks	**28-35**	**21-27**	**14-20**	**0-13**
Award a single mark out of 35 for this section. In arriving at this mark consider the indicative content requirements below.				
Appropriate presentation of data – 10 marks • Very Good - 8 – 10m • Good - 6 – 7m • Fair - 4 – 5m • Weak - 0 – 3m	*Informed judgement and conclusions following analysis and interpretation of data, results and evidence – 15 marks* • Very Good - 12 – 15m • Good - 9 – 11m • Fair - 6 – 8m • Weak - 0 – 5m	*Limitations of study considered and clear linkage of conclusions to research question- 10 marks* • Very Good - 8 – 10m • Good - 6 – 7m • Fair - 4 – 5m • Weak - 0 - 3m		

Section	Very Good	Good	Fair	Weak
Reflection on the study *Suggested range between 150 and 200 words*	A personal reflection on the completed work is evident. Considers some elements of the learning gained through engagement with the study. Considers some aspects of reliability, possible error(s), changes / modifications while relating it back in some way to the theme and hypothesis.	A personal reflection base on some insights gained through completion of the work is attempted. Considers at a basic level the learning gained through engagement with the study. Considers very simply reliability, possible error(s), changes / modifications with some attempt to link back to the theme and hypothesis.	A limited personal reflection on the completed work. Poor reference to the learning gained. Poor consideration of reliability and possible error(s) and any possible changes / modification, with very limited link back to the theme and hypothesis.	Weak / no personal reflection on the completed work. Little or no reference to the learning gained. Little or no consideration of reliability and possible error(s) and any possible changes / modification very limited or absent. Very weak linkage to the theme and hypothesis.
10 marks	**8-10**	**6-7**	**4-5**	**0-3**
Award a single mark out of 10 for this section. In arriving at this mark consider the indicative content requirements below.				
The candidate presents coherent reflections, lessons learned and significance of the study - 10 marks		• Very Good - 8 – 10m • Good - 6 – 7m • Fair - 4 – 5m • Weak - 0 – 3m		
References	References for the all or almost all of sources used during the study and / or referred to in the report.	References for most sources used during the study and / or referred to in the report.	References missing for a significant number of sources used during the study and / or referred to in the report.	Lack of referencing and references for sources used during the study and / or referred to in the report.
-	-	-	-	-
References should be checked within section(s) and linked to this section of study. *Any issues with the referencing should affect the mark awarded to the section in which the references are being cited in the study.*				

Section	Very Good	Good	Fair	Weak
Communication and innovation *(This is not a distinct section of the report)*	The study has a reasonable coherence in its structure and adheres to the IIS structure. Work is focused with material labelled appropriately and organised. Communication of data and information is clear but simplistic. Some evidence of innovative thinking and an individual approach.	In the main, the study adheres to the IIS structure. The work may lack focus in parts and there may be some omissions in both content and errors in labelling of material. Study organisation and coherence is of a basic level with limited evidence of originality and innovative thinking.	Poor construction and structure, with only some adherence to the IIS structure. Organisation and coherence is limited and confused throughout with many errors. Little evidence of originality and innovative thinking.	The work lacks structure, organisation, coherence, focus, context and clarity. IIS structure not well used. Irrelevant material and significant errors. No evidence of originality and innovative thinking.
10 marks	**8-10**	**6-7**	**4-5**	**0-3**
Award a single mark out of 10 for this section. In arriving at this mark consider the indicative content requirement below				
The report has an overall coherence, quality and clarity with the inclusion of individual innovative thinking by the candidate - 10 marks			• Very Good - 8 – 10m • Good - 6 – 7m • Fair - 4 – 5m • Weak - 0 – 3m	

<table>
<tr><th colspan="2">Section A</th><th>Answer any 10 questions
10 marks for each question
Total for section is 100 marks</th><th>Marks</th></tr>
<tr><td rowspan="4">Q1</td><td>(a)</td><td>Complete the table below, by placing a tick (✓)in the correct box to show the direction of grazing.
  </td><td>3</td></tr>
<tr><td>(b)</td><td>Label A in the diagram.
(Moveable)(Electric) Fence</td><td>3</td></tr>
<tr><td>(c)</td><td>Identify the type of grazing system shown in the diagram.
Strip grazing</td><td>2</td></tr>
<tr><td>(d)</td><td>Outline one advantage of this grazing system.
Leafy grass or more digestible grass or less weeds or increase animal production / gives grass a chance to recover / less soil compaction / less poaching or damage to grass / less grass wastage / less disease</td><td>2</td></tr>
<tr><td rowspan="5">Q2</td><td>(a)</td><td>Identify the machines that are involved in the farming.
<table><tr><th>Farming practice</th><th>Machine name</th></tr><tr><td>Spreading animal waste on land</td><td>Slurry tanker</td></tr><tr><td>Reducing the temperature of milk</td><td>Plate cooler</td></tr><tr><td>Turn and break up soil</td><td>Plough</td></tr><tr><td>Compacts material into shape for storage</td><td>Baler</td></tr></table></td><td>2(3) + 2(2)</td></tr>
<tr><td colspan="4">Or</td></tr>
<tr><td rowspan="3"></td><td>(b)(i)</td><td>State one use for the cattle handling facilities on the farm.
Restrain animals or allow treatment / prevent injury / reduce time or labour</td><td>3</td></tr>
<tr><td>(ii)</td><td>Briefly explain one reason why handling facility B is better for animal movement.
(As the animals go around the curve) they think they are going back to where they came from / the animals cannot see people and other moving objects (at the end of the chute) / it takes advantage of the natural circling behaviour of cattle / one-way system for ease of movement</td><td>3</td></tr>
<tr><td>(iii)</td><td>Outline one reason why the head gate labelled in picture A above is important when handling animals.
Easy to operate / safe working with animals / administer medicine easily or any named treatment</td><td>2</td></tr>
<tr><td></td><td>(iv)</td><td>Apart from using a crush, outline one other safety precaution taken when handling animals.
Be careful of swinging gates / have another person present or tell someone / don’t stand too close / or another one valid precaution</td><td>2</td></tr>
</table>

<table>
<tr><td>Q3</td><td></td><td>
<table>
<tr><th></th><th></th><th>True</th><th>False</th></tr>
<tr><td>(i)</td><td>Freeze thaw is a type of physical weathering in soil</td><td>✓</td><td></td></tr>
<tr><td>(ii)</td><td>Clay has the largest soil particles</td><td></td><td>✓</td></tr>
<tr><td>(iii)</td><td>Topography refers to the slope of the land</td><td>✓</td><td></td></tr>
<tr><td>(iv)</td><td>Iron pans are found in brown earth soil profiles</td><td></td><td>✓</td></tr>
<tr><td>(v)</td><td>Subsoil has a rich dark colour</td><td></td><td>✓</td></tr>
</table>
</td><td>5(2)</td></tr>
<tr><td>Q4</td><td></td><td>Complete the sentences below in relation to animal diseases using words from the list.

(a) Magnesium
(b) Foot rot
(c) Red water fever
(d) Pneumonia
(e) Orf</td><td>5(2)</td></tr>
<tr><td rowspan="2">Q5</td><td>(a)</td><td>Label any three parts of the diagram.

A: Omasum
B: Rumen
C: Abomasum
D: Reticulum</td><td>3(2)</td></tr>
<tr><td>(b)</td><td>Identify the first feed required by the calf by placing a tick (✓) in the correct box.
<table>
<tr><td>Hay</td><td></td></tr>
<tr><td>Colostrum</td><td>✓</td></tr>
<tr><td>Milk</td><td></td></tr>
<tr><td>Barley</td><td></td></tr>
</table>
</td><td>4</td></tr>
<tr><td rowspan="2">Q6</td><td>(a)(i)</td><td>Identify any three of the following breeds.

A: Charolais
B: Border Leicester
C: Texel
D: Suffolk</td><td>3(2)</td></tr>
<tr><td>(ii)</td><td>Outline one reason why any named breed in part (i) above is suitable for sheep meat production.

Charollais – fine boned / long loin / muscular hindquarters / fast growing / easy to flesh / high KO%

Border Leicester – fast growing / prolific

Texel – large amount of muscle / lean meat

Suffolk – fast growing or early maturing / high quality carcass or excellent conformation / prolific</td><td>4</td></tr>
</table>

Or			
	(b)(i)	*Explain selective grazers.* Cattle don't randomly consume forage / they display preferences for certain plant species or parts of plants or specific areas within the pasture	**3**
	(ii)	*Briefly outline the role of the herd of Luing cattle.* Allow plants to recover / reduce competition for plants or valid example / allows space for new habitats	**3**
	(iii)	*Outline **two** advantages of the virtual fencing.* Reduced overgrazing / promotes conservation or targeted grazing / better weed control / better nutrient management or enhanced soil health / protection of water sources / improved labour efficiencies or increased stocking rates / better animal welfare / reduced capital investment in fencing / locate livestock	**2(2)**
Q7	**(a)**	*Using the four headings in the diagram in relation to soil compaction, briefly describe how **any three** affect the growth of crops on the land.* *Machine size:* big heavy machines compact the soil reducing the growth of crops *Soil water content:* Increased water content allows soil particles to move together increases soil compaction which reduces crop growth *Tillage system:* Intensive or conventional tillage increases soil compaction reducing crop growth *Crop rotation:* planting different crops leads to less soil compaction and increased crop growth	**3(2)**
	(b)	*Identify the % air in the ideal soil composition.* *45%* ☐ *25%* ✓ *5%* ☐	**4**
Q8	**(a)**	*Briefly outline how **any three** advantages can improve the health and welfare of the animals.* Help animals regulate body temperature / protects from cold or wet or harsh conditions or illness / helps to prevent colds or pneumonia or illness or hypothermia or death / promotes LWG (liveweight gain) which increases profits / reduced energy or vet or housing costs	**3(2)**
	(b)	*Briefly explain how **one** piece of technology you have studied can improve animals' health and welfare on the farm.* Collars can read the temperature of the cow and alert farmer if they are sick or / any other valid answer	**4**

Q9	**(a)(i)**	*Identify the part of the plant that is involved in nutrient absorption.* Root(hairs)	**3**
	(ii)	*List **two** nutrients absorbed by plants.* N / P / K / Ca / Mg / S / other valid answer	**2(2)**
	(iii)	*Identify the bacteria found in clover roots which fix atmospheric nitrogen into nitrates to be used by the plant.* *Lactobacillus* ☐ *Rhizobium* ✓ *Clostridium* ☐	**3**
Or			
	(b)	*Complete the table below by stating **two** agricultural practices which contribute to water pollution and state **two** ways of protecting water quality from these practices.* Slurry (manure) (effluent) spreading – buffer or riparian zone / don't spread when heavy rain is forecast or don't spread on slopes or near water sources / LESS (slurry only) / do not store manure near water sources / correct application rate or timing or soil test Fertiliser spreading – buffer or riparian zone / correct application rate or timing or soil test / GPS for spreading Animals crossing or drinking water from rivers or streams – fence off all rivers or streams or provide water troughs or buffer or riparian zone Pesticides or herbicides – buffer or riparian zone / polyculture or crop rotation or valid example of indirect control / correct application rates / spread in correct weather conditions or timing	**2(3) + 2(2)**
Q10	**(a)**	*Explain artisan product.* A food or drink that is made in a traditional manner using high quality ingredients / products created with a greater focus on the uniqueness / products with novelty or a sense of being close to the producer	**2**
	(b)	*Macroom Buffalo Mozzarella is an example of a product being supplied to a niche market. Identify the meaning of niche market.* *Country or group of countries to which goods and services from another country are sold* ☐ *Specialised market with products aimed at satisfying the specific needs of consumers* ✓ *General direction in which a market is moving* ☐	**2**
	(c)(i)	*Using your knowledge of the composition of cow's milk, place a tick (✓) in the correct box to show if the % of water in cow's milk is higher or lower than in buffalo's milk.* *Higher* ✓ *Lower* ☐	**3**
	(ii)	*State which nutrient makes it most suitable for cheese production.* Protein or casein or whey	**3**

<table>
<tr><td>Q11</td><td>(a)(i)</td><td>Identify the desired characteristic being selectively bred.
Egg production</td><td>3</td></tr>
<tr><td></td><td>(ii)</td><td>In step 2, state which hen A, B or C is the best offspring to breed future generations.
A</td><td>3</td></tr>
<tr><td></td><td>(iii)</td><td>Using your knowledge of selective breeding, identify two characteristics of dairy cattle.
<table>
<tr><td>Marbling in meat</td><td></td></tr>
<tr><td>Milk volume</td><td>✓</td></tr>
<tr><td>Early maturing</td><td></td></tr>
<tr><td>Milk protein</td><td>✓</td></tr>
</table></td><td>2(2)</td></tr>
<tr><td colspan="4">Or</td></tr>
<tr><td></td><td>(b)(i)</td><td>Identify two physical characteristics of the Belgian Blue.
Double muscled / muscular or good conformation / strong legs / sloping rump / blue and white or white in colour / wide shoulders / short neck / straight back / fine skin</td><td>2(3)</td></tr>
<tr><td></td><td>(ii)</td><td>State with reason which cow A or B a farmer would choose to cross with the Belgian Blue bull.
Cow: B or Charolais
Reason: Big frame / continental breed / wide pelvis</td><td>2(2)</td></tr>
<tr><td>Q12</td><td>(a)</td><td>Identify each of the following variables in the investigation.
<table>
<tr><td>Control</td><td>plant type / pot size / ruler or metre stick / amount of light / amount of water</td></tr>
<tr><td>Independent</td><td>amount of fertiliser</td></tr>
<tr><td>Dependent</td><td>plant growth</td></tr>
</table></td><td>2(3) + 2</td></tr>
<tr><td></td><td>(b)</td><td>Briefly explain the relationship between the independent and dependent variables in this investigation.
As the different amounts of fertiliser are applied the plant growth (rate) will differ</td><td>2</td></tr>
</table>

<table>
<tr><th colspan="2">Section B</th><th>Answer any 4 questions
50 for each question
Total for section is 200 marks</th><th>Marks</th></tr>
<tr><td rowspan="6">Q13</td><td>(a)(i)</td><td>One of the areas Lisa decided to investigate was the botanical composition of the land. Describe with the aid of a labelled diagram how she would carry out this investigation.

Throw pen at random / place quadrat / repeat at least 10 times / identify plants using key or plant ID app or acres guide book / record plants present / calculate % frequency

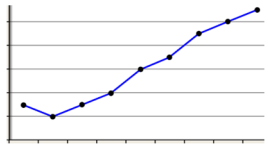
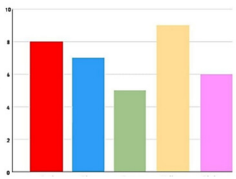
Marks can be awarded from diagram</td><td>4(4)</td></tr>
<tr><td>(ii)</td><td>Identify any three of the plants.

A: Nettle
B: Dock leaf
C: Clover
D: Perennial Ryegrass</td><td>3(4)</td></tr>
<tr><td>(b)(i)</td><td>Calculate the average % frequency A for the dock leaf.

4/10 x 100/1 = 40%

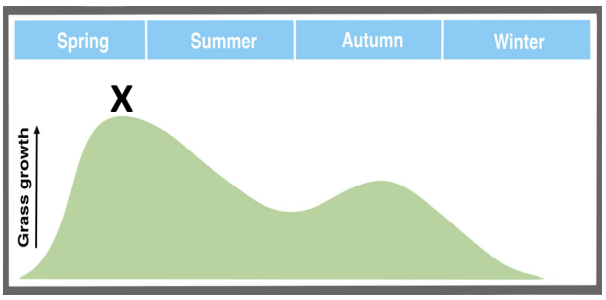
If answer alone is given allow 6m
If calculation is shown with incorrect answer award 3m</td><td>6</td></tr>
<tr><td>(ii)</td><td>State with reason if the results shown in part (i) are qualitative or quantitative.

State: Quantitative
Reason: Quantity or number of plants measured.</td><td>2(2)</td></tr>
<tr><td>(iii)</td><td>Identify the most suitable chart or graph to display the above results by placing a tick (✓) in the correct box.

<table>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>  </td><td>  </td><td>  </td></tr>
<tr><td></td><td>✓</td><td></td></tr>
</table>
</td><td>6</td></tr>
<tr><td>(iv)</td><td>State with reason if this investigation is accurate.

Accurate or Yes

Quadrat was thrown multiple times / land areas chosen randomly / average value used / used approved plant key or book or app to identify plants</td><td>2(3)</td></tr>
</table>

Q14	**(a)(i)**	*Briefly describe **two** ways a farmer could ensure a good grass yield at harvesting.* Fertiliser applied (6 weeks in advance) / slurry applied / grazed in spring prior to closing for silage / soil test (ensure adequate nutrients) / close for 6 weeks / sow productive species or control weeds	**2(3)**
	(ii)	*Identify the best time of the year to cut grass for silage by placing an **X** on the diagram.* 	**3**
	(iii)	*Briefly describe **one** disadvantage of the grass being cut at the wrong growth stage.* Less digestible / poor yield / poor quality silage / increased concentrate costs	**3**
	(b)(i)	*Identify the correct stage of cutting the grass for silage by placing a tick (✓) in the correct box.* **A** **B**   ☐ ✓	**2**
	(ii)	*Briefly outline **one** reason for your choice in part (i).* Leafy grass / no seed heads / more digestible (Allow opposite points for A).	**2**
	(iii)	*Identify the growth stage of plant **B** by placing a tick (✓) in the correct box.* *Inflorescence* ☐ *Vegetative* ✓ *Elongation* ☐	**2**
	(c)(i)	*One measure of silage quality is to measure the dry matter (DM)%.* *Describe how a student carried out this investigation in the school laboratory.* Cut a number of grass samples / use a tissue to dry off any excess water from the grass / use a scissors to cut the grass into short lengths of similar size / record mass of beaker / add grass to the beaker and record the mass / determine mass of grass sample / place the grass in an oven (at 100 C) or microwave at short intervals / repeat weighing / constant mass / mass of the dry grass is equal to the dry matter / calculate the DM% of the grass by putting mass of dry grass over mass of fresh grass multiply by 100/1 / calculate the average DM% for each treatment	**3(4)**

	(ii)	*Briefly describe **two** other ways to measure the quality of silage.* ***Allow 2 + 2 for name or description***	**2(2) + 2(2)**
	(d)	*Compare the preserving of grass as hay and silage under the headings which follow using the list of words in the box*.	**6(2)**

pH	squeeze liquid from silage / place pH probe into liquid and note the reading or dip pH paper in the liquid and compare to the colour chart / low pH indicates good quality
***colour*:**	Yellow - green indicates good quality / dark green indicates poor quality
smell	sharp acidic or vinegary indicates good quality / putrid or rancid indicates poor quality
DM content	squeeze with one hand / liquid removed indicates poor quality / wring with two hands / little or no liquid removed indicates good quality
texture	rub the silage sample between your fingers / soft but firm or fibres do not wear easily indicates good quality / wet and slimy indicates poor quality
leaf to stem	weigh sample of silage / separate leaves from the stems / weigh each separately / calculate the ratio of stem to leaves

	Hay	**Silage**
Length of drying	5 – 7 days	24 hours
Method of preservation	Dehydration	Fermentation
Storage	Shed	Under plastic

<table>
<tr><td>Q15</td><td>(a)(i)</td><td>Outline the management practices of the ewe at mating.

Feeding: Flushing or high plane of nutrition or good quality grass

Health: reduce stress / good feet or footbath / dipping / good body condition or BCS 3.0 - 3.5 / dagging</td><td>2(4)</td></tr>
<tr><td></td><td>(ii)</td><td>Label the diagram of the female reproductive system.
<table><tr><th>A</th><th>B</th><th>C</th><th>D</th></tr><tr><td>Uterus</td><td>Fallopian tube</td><td>Ovary</td><td>Cervix</td></tr></table></td><td>4(3)</td></tr>
<tr><td></td><td>(b)(i)</td><td>The ram is an important part of a flock and needs to be looked after and checked. Briefly describe two things farmers would check in advance of the breeding season.

Feet or legs / mouth / testicles / BCS / fertility / disease</td><td>2(4)</td></tr>
<tr><td></td><td>(ii)</td><td>Explain the purpose of the raddle.

To mark the ewes that have been served.</td><td>6</td></tr>
<tr><td></td><td>(iii)</td><td>State how often a raddle colour would be changed by placing a tick (✓) in the correct box below.
<table><tr><td>13 – 15 days</td><td>✓</td></tr><tr><td>22 – 24 days</td><td></td></tr><tr><td>28 – 30 days</td><td></td></tr></table></td><td>2</td></tr>
<tr><td></td><td>(iv)</td><td>Using the colours in the box below, list the colours in order of sequence used by the farmer during mating.
<table><tr><td>1st colour</td><td>Yellow / C</td></tr><tr><td>2nd colour</td><td>Green / A</td></tr><tr><td>3rd colour</td><td>Blue / B</td></tr></table></td><td>4 + 1 + 1</td></tr>
<tr><td></td><td>(c)(i)</td><td>Identify the average ratio of rams to ewes in a mid-season lambing flock by placing a tick (✓) in the correct box.
<table><tr><td>1:80</td><td></td></tr><tr><td>1:40</td><td>✓</td></tr><tr><td>1:100</td><td></td></tr></table></td><td>6</td></tr>
<tr><td></td><td>(ii)</td><td>Explain the importance of dagging the ewes prior to mating.

To allow for successful mating / prevent injury to the ram / prevent flystrike</td><td>2</td></tr>
<tr><td colspan="4">Or</td></tr>
<tr><td></td><td>(d)</td><td>Explain seasonal polyoestrous.

Ewes come into heat / a number of times or at a certain time of the year (when the days get shorter)</td><td>6 + 2</td></tr>
</table>

<table>
<tr><td rowspan="6">Q16</td><td>(a)(i)</td><td>Explain organic matter.

Soil organic matter is the part of the soil that consists of plant or animal remains in various stages of breakdown (decomposition).</td><td>3</td></tr>
<tr><td>(ii)</td><td>Briefly describe two ways of increasing the organic matter content of soils.

Add FYM / slurry / plough in crop or straw or green manures / improve drainage / reduce cultivation / add earthworms or microbial inoculants</td><td>2(3)</td></tr>
<tr><td>(iii)</td><td>Describe the functions of soil organic matter under the headings that follow.

<table><tr><th>Function</th><th>Description</th></tr><tr><td>Effect on soil pH</td><td>reduce pH</td></tr><tr><td>Water retention (holding)</td><td>improves water retention</td></tr><tr><td>Soil compaction</td><td>reduces soil compaction</td></tr></table></td><td>3(2)</td></tr>
<tr><td>(iv)</td><td>Briefly explain two factors that influence the amount of organic matter in a soil.

Rainfall or soil moisture / temperature / aeration (oxygen levels) / type of plants / earthworm population or biological activity / another named valid agricultural practice</td><td>2(3)</td></tr>
<tr><td>(b)</td><td>Describe with the aid of a labelled diagram how a student could carry out an investigation to determine the percentage organic matter in a 100g sample of soil.

Dry soil sample / weigh out 100g of the soil (using an electronic balance) / place in a crucible/ heat over a Bunsen burner / burn off OM / weigh when stopped glowing or smoking / reweigh soil / loss in mass is equal to the amount of organic matter / mass of organic matter ÷ dry weight x 100/1

Marks may be awarded from the diagram</td><td>3(4)</td></tr>
<tr><td>(c)(i)</td><td>The results of the investigation are shown in the box below.

<table><tr><td>Mass of organic matter</td><td>25g</td></tr></table>
Calculate the % organic matter of the soil sample tested in part (b).

25/100 x 100/1 = 25(% OM)

If answer alone is given, award 6m
If calculation is shown with incorrect answer allow 3m</td><td>6</td></tr>
<tr><td>(ii)</td><td>Based on the results in part (i), state if the soil type is more likely to be a peat soil or brown earth soil.

Peat soil</td><td>5</td></tr>
<tr><td>(iii)</td><td>Calculate the % soil organic carbon in the soil sample using the equation shown in the box below.

25 x 0.58 = 14.5(%)

If a candidate gives 14, 14.5 or 15 without showing calculation, award 6m
If the candidate uses the correct formula without correct answer, award 3m</td><td>6</td></tr>
</table>

Q17	**(a)(i)**	*Sexed semen is when the X chromosome (female) and the Y chromosome (male) are separated in the sperm. Explain why this technology is an advantage on farms.* Farmer gets to choose the sex of the calf / choose heifers for replacements or allows for expansion or reduces male dairy calves or males for beef / reduces calving difficulty in maiden dairy heifers / maintains biosecurity	**3**
	(ii)	*Outline **one** advantage of using straws that were 40 years old.* Incorporate genetics from years ago to get a better breed today / better conformation in calves / access to a wider choice	**3**
	(iii)	*Briefly describe **two** advantages and **two** disadvantages of Artificial Insemination (AI) in cattle.* **Advantages:** pick bull (breed) or wide choice of bulls (breed) / upgrade genetics or target specific genetic traits / less danger of having bull on farm / different breeds available to suit different cows / easy calving bull for heifers / proven bull fertility / prevents sexually transmitted diseases / prevents injury / cost of AI straw is little in comparison to that of a bull / semen can be sexed to produce gender of choice **Disadvantages:** heat detection / lower conception rates compared to a fertile bull / increased labour / trained professional required / specialist equipment / semen must be properly stored / stock bull may still be required for mopping up	**2(5) + 2(1)**
	(b)(i)	*Based on a named food crop (forage other than grass or for human consumption) you have studied, describe its growth cycle under the headings which follow.* *Barley (or another valid crop):* *Germination:* radicle grows down to develop roots / plumule grows up to develop shoot / cotyledon store for food *Ripening:* grain hardens / moisture levels decrease / crop turns a golden colour *Potatoes:* *Germination:* sprouts develop on tubers and grow upwards / roots develop from the base of the sprouts and grow down *Ripening:* tubers fully grown / plant turns yellow / plant loses its leaves / potato skins harden *Kale:* *Germination:* radicle grows down to develop roots / plumule grows up to develop shoot / cotyledons emerge from the soil *Ripening:* leaves grow to grazing or harvesting stage / stem elongates / leaf quality declines ***Marks may be awarded from the diagram***	**2(4)**

<table>
<tr><td></td><td>(ii)</td><td>Describe how the food crop named in part (i) above is harvested and stored.

Barley:

Harvested: combine harvester / grain around 14 - 16% moisture / straw baled or ploughed in

Stored: bales stored in shed / grain stored in rodent proof bins / treated with fungicide / dried if moisture about 14%

Potatoes:

Harvested: burn off haulms using a contact herbicide / leave in the ground for 3 weeks for skins to harden / elevator or chain digger / pick by hand or fully automated to storage bin

Stored: leak-proof or frost- proof or well-ventilated shed / store in stacks with natural or forced ventilation / spray with sprout inhibitor / access for tractor and trailer

Kale:

Harvested: strip grazed / zero grazed / ensiled

Stored: wrapped in plastic / bales stored in yard or fields</td><td>2(4)</td></tr>
<tr><td></td><td>(iii)</td><td>Outline one safety precaution that should be taken during harvesting this crop.

Be careful of PTO or don’t wear loose clothes / turn off machine when working on it or any other valid example</td><td>4</td></tr>
<tr><td></td><td>(c)</td><td>Using the list of words below, state what category of pest management they belong to.

<table><tr><td>Biological</td><td>predators or crop rotation</td></tr><tr><td>Physical / Mechanical</td><td>fans or machine hygiene</td></tr><tr><td>Cultural / Sanitation</td><td>crop rotation or machine hygiene</td></tr><tr><td>Prevention</td><td>machine hygiene or crop rotation or fans</td></tr></table></td><td>4(3)</td></tr>
</table>

<table>
<tr><td rowspan="5">Q18</td><td>(a)(i)</td><td>Outline three ways dairy farmers can prepare for the calving season in order to ensure the survival of healthy calves.

Have all equipment (calving jack etc.) / clean bedding / vet number / supply of colostrum / experienced person present or adequate supervision / CCTV / calving pen to isolate the cow / scanning / accept one description of hygiene / cow in good condition or BCS 3 – 3.5</td><td>3(4)</td></tr>
<tr><td>(ii)</td><td>Briefly explain two practices carried out on the calf at birth.

Iodine on navel / ear tagging / colostrum fed to calf / clean bedding / clear airways or check breathing / salt the calf or allow mother to lick the calf / assist delivery of calf</td><td>6 + 5</td></tr>
<tr><td>(iii)</td><td>Identify the breed of dairy cow shown.

(Holstein) Friesian</td><td>6</td></tr>
<tr><td>(b)</td><td>Using the target weights given in the list below, match the weights to the growth stage of the dairy animals.

<table><tr><td>Birth</td><td>40kg</td></tr><tr><td>Weaning</td><td>90kg</td></tr><tr><td>1st housing</td><td>200kg</td></tr><tr><td>Mating</td><td>350kg</td></tr><tr><td>1st calving</td><td>600kg</td></tr></table></td><td>5(3)</td></tr>
<tr><td>(c)</td><td>Explain the feeding of a dairy cow in the first 10 weeks of lactation during the period of negative energy balance.

High plane of nutrition / concentrates / good quality silage (75%+ DMD) or good quality spring grass</td><td>2(3)</td></tr>
<tr><td colspan="3">Or</td></tr>
<tr><td>(d)</td><td>State the duration of each of the following in dairy cows.

<table><tr><th></th><th>Number of days</th></tr><tr><td>Lactation</td><td>300 - 305</td></tr><tr><td>Dry period</td><td>55 - 60</td></tr><tr><td>Gestation</td><td>280 -283</td></tr></table></td><td>4 + 1 + 1</td></tr>
</table>