Coimisiún na Scrúduithe Stáit

State Examinations Commission

Leaving Certificate 2025

Marking Scheme

Agricultural Science

Higher 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.

Higher 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	Excellent	Very Good	Good	Fair	Weak
Introduction and background research *Suggested range between 300 and 500 words*	Directly address, contextualises and clarifies the brief theme. Identifies and interrogates convincingly, a broad range of relevant, authoritative and credible sources of evidence. Clear understanding and shows extensive knowledge of theme.	Directly address the brief theme. Identifies and questions a sufficient range of relevant, authoritative and credible sources of evidence. Logically based on a very good knowledge and understanding of the theme. Very few errors.	Brief theme is reasonably addressed in a limited context. Identifies and interrogates a limited range of evidence with an over reliance on unproven data. Basic knowledge and limited understanding of the theme. Minor errors.	Brief theme is vaguely addressed with no clear context. Evidence presented is simplistic or confused. Evidence is only vaguely relevant to the theme. Vague understanding of theme. Major errors.	Brief theme is vaguely or completely misunderstood Little or no evidence presented. Evidence is not relevant to the theme. Little or no knowledge of the theme. Significant major errors.
20 marks	**18-20**	**14-17**	**10-13**	**6-9**	**0-5**

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*	• Excellent - 9 – 10m • Very Good - 7 – 8m • Good - 5 – 6m • Fair - 3 – 4m • Weak - 0 – 2m	***Background Research*** *-Research, sources and knowledge – 10 marks*	• Excellent - 9 – 10m • Very Good - 7 – 8m • Good - 5 – 6m • Fair - 3 – 4m • Weak - 0 – 2m

Section	Excellent	Very Good	Good	Fair	Weak
The investigative process *Suggested range between 500 and 800 words*	Identifies and provides a comprehensive description of investigative process undertaken. Clear, specific and valid hypothesis generated and tested. Investigative design clearly showing examples of gathering data. Clear ideas, concepts and theories make focused links between complex aspects of the task and learning outcomes of the specification. An accurate detailed description of how data was gathered.	Identifies and provides a sufficient description of investigative process undertaken. Specific and valid hypothesis generated and tested. Investigative design clearly showing gathering data. Ideas, concepts and theories make some links between aspects of the task and to learning outcomes of specification. Description of how data was gathered to a high standard, with a few inaccuracies.	Identifies and provides a limited description of investigative process undertaken. Hypothesis generated and tested is valid but may lack some specificity. Investigative design showing some gathering data. Ideas, concepts and theories make basic between some aspects of the task and to learning outcomes of the specification. Description of how data was gathered to a good standard, with some minor omissions / errors.	Details of the investigative process presented are simplistic / confused and only vaguely relevant to the theme. Simplistic hypothesis generated and tested. Investigative design with limited gathering data. Ideas, concepts and theories make very vague links between aspects of the task and learning outcomes of the specification. Vague description of how data was gathered with major omissions / errors.	Little or no details of investigative process presented which is not relevant to the theme. Very simplistic hypothesis generated. Little / no evidence of ideas, concepts and theories presented. Investigative design with very little gathering data. No real link with learning outcomes of the specification. Very poor description of how data was gathered which is also incorrect and / or contradictory.
25 marks	**23-25**	**18-22**	**13-17**	**8-12**	**0-7**
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	• Excellent - 11 – 12m • Very Good - 9 – 10m • Good - 6 – 8m • Fair - 4 – 5m • Weak - 0 – 3m		*Data collection undertaken – 13 marks*	• Excellent - 12 – 13m • Very Good - 10 – 11m • Good - 7 – 9m • Fair - 4 – 6m • Weak - 0 – 3m	

Section	Excellent	Very Good	Good	Fair	Weak
Results, analysis, and conclusions *Suggested range between 600 and 1000 words*	The data is relevant, comprehensively analysed, interpreted, evaluated and presented optimally. Draws insightful, independent informed conclusions based on a relevant, critical and perceptive analysis of the evidence to arrive at justification of own position (hypothesis).	Very good interrogation and presentation of the data. Analysis, interpretation and evaluation of data to a high standard. Draws very good independent conclusions based on a critical and perceptive analysis of the evidence and clearly justifies own position (hypothesis).	Good interrogation and presentation of the data, but may lack some structure. Draws some independent conclusions based on a basic analysis of the evidence to justify own position (hypothesis), but lacks depth and structure.	Limited interrogation and presentation of the data. Very basic conclusions stated to justify own position (hypothesis). Conclusions made are flawed with limited evidence in support and superficial analysis / with significant inaccuracies. Repetition of material is evident.	Poor / confused / illogical interrogation and presentation of the data. Little or no evidence presented / or not relevant. Analysis is poor. Little or no conclusions made with very little evidence in support. Irrelevant materials used with repetition of material evident.
35 marks	**32-35**	**25-31**	**18-24**	**11-17**	**0-10**
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 • Excellent - 9 – 10m • Very Good - 7 – 8m • Good - 5 – 6m • Fair - 3 – 4m • Weak - 0-2m		*Informed judgement and conclusions following analysis and interpretation of data, results and evidence – 15 marks* • Excellent -14 – 15m • Very Good - 11 – 13m • Good - 8 – 10m • Fair - 5 – 7m • Weak - 0 – 4m		*Limitations of study considered and clear linkage of conclusions to research question – 10 marks* • Excellent - 9 – 10m • Very Good - 7 – 8m • Good - 5 – 6m • Fair - 3 – 4m • Weak - 0 – 2m	

Section	Excellent	Very Good	Good	Fair	Weak
Reflection on the study *Suggested range between 150 and 200 words*	Clear capacity to an in-depth, comprehensive and clear self-reflection on the completed study. Considers in depth the learning gained by and through engagement with the study. Considers in depth reliability, possible error(s) / changes / modifications while comprehensively relating back to the theme and hypothesis / action question.	Clear evidence of self–reflection on the completed work. Considers the learning gained by and through engagement with the study. Considers reliability, possible error(s) / changes / modifications while relating it back to the theme and hypothesis / action question to a high standard.	Some reflection on the completed work. Considers some of the learning gained by and through engagement with the study. Considers reliability, possible error(s) / changes / modifications with some linkage to the theme and hypothesis / action question.	Limited reflection on the completed work. Poor reference to the learning gained by and through engagement with the study. Poor consideration of reliability, possible error(s) and any possible changes / modification with limited linkage to the theme and hypothesis / action question.	Weak or no reflection on the completed work. Little or no reference to the learning gained by and through engagement with the study. No consideration of reliability, possible error(s) and any possible changes / modification very limited or absent. Weak linkage to the theme and hypothesis / action question.
10 marks	**9-10**	**7-8**	**5-6**	**3-4**	**0-2**
Award a single mark out of 10 for this section. In arriving at this mark consider the indicative content requirement below.					
Knowledge and insights arrived at as a result of the study – 10 marks			• Excellent - 9 – 10m • Very Good - 7 – 8m • Good - 5 – 6m • Fair - 3 – 4m • Weak - 0 – 2m		
References	Full references for all sources used during the study and / or referred to in the report.	References for the majority 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 or referred to in the report.	Lack of proper or any referencing.in the study.
-	-	-	-	-	-
References should be checked within section(s) and linked to this section of study. *Any issues with the referencing should effect the mark awarded to the section in which the references are being cited in the study.*					

Section	Excellent	Very Good	Good	Fair	Weak
Communication and innovation *(This is not a distinct section of the report)*	Excellent coherence, clarity, construction and organisation throughout the study. Adheres to the IIS structure. Communication of data and information is thorough, very well structured, relevant and accurate. The study exhibits an overall detailed knowledge involving critical thinking, deep insight, sharp focus, accomplished argument and is supported by a range of evidence and sources. Significant evidence of individual approach and innovation.	Very good coherence, clarity, construction and organisation throughout most of the study. Adheres to the IIS structure. Communication of data and information is well structured, organised and presented Study exhibits an overall good knowledge and evidence of critical thinking. Good evidence of individual approach and innovation.	The organisation and coherence of the study is of a basic level. Some of the points made may not be integrated well into the content and to the IIS structure. Communication of data and information presented is relevant which may have some errors / omissions. The study has reasonable knowledge and some critical thinking. Reasonable structure with some evidence of individual approach and innovation.	Organisation and coherence is limited and confused throughout the study. Study shows a limited understanding with limited valid and appropriate evidence which is not developed and connected and deviates from the IIS structure. Communication of data and information lacks clear focus and organisation, which has substantial errors / omissions. Limited knowledge and critical thinking. Poor structure with little evidence of an individual approach and innovation.	The study lacks organisation, coherence, context and clarity. Study shows very poor or no understanding with no evidence provided in support. IIS structure very poorly used or not used. Communication of data and Information contains only a few valid points, is of a very poor quality, with fragments of information of little or no relevance and is, littered with errors / omissions No evidence of an individual approach and innovation.
10 marks	**9-10**	**7-8**	**5-6**	**3-4**	**0-2**
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			• Excellent - 9 – 10m • Very Good - 7 – 8m • Good - 5 – 6m • Fair - 3 – 4m • Weak - 0 – 2m		

Section A		Answer any 10 questions 10 marks for each question Total for section is 100 marks	Marks
Q1	**(a)**	*Identify both cattle breeds in A and B.* *A*: Aberdeen Angus *B*: Hereford	**5+1**
	(b)	*State which breed **A** or **B** has a dominant <u>polled</u> trait as a characteristic of the breed.* A or Aberdeen Angus	**2**
	(c)	*Explain the underlined term in part (b) above.* Does not have horns	**2**
Q2	**(a)**	*Explain any **two** lifecycles and provide an example of each one.* *Annual*: Completes its life cycle in one year / example: wheat *Biennial:* Completes its life cycle in two years / example: carrot *Perennial*: Flower and reproduce for multiple years / example: perennial ryegrass (Any other valid example of a plant)	**(3+2) + (3+2)**
	OR		
	(b)(i)	*Identify the correct explanation for marbling by placing a tick in the correct box.* Intramuscular fat found in meat	**4**
	(ii)	*Describe any two characteristics in the list that make the breed suitable for crossing with dairy cows.* *Meat quality:* Factors relating to marbling or texture or taste or tenderness (that appeal to consumers) / many cows go into calf to beef system so improved beef traits *Good growth rates:* Will influence when an animal gets to slaughter and kill out weight (fast maturing) *Ease of calving:* Reduced risk of complications / better suited for crossing with dairy cows rather than bigger continental breeds *Docility:* Animals with good temperament are easier to handle / less risk of injury *Fertility:* greater number of calves over lifetime of bull	**1+1**
	(iii)	*Outline **one** reason why dairy farmers would favour a guaranteed market for their calves.* Guaranteed income / no unwanted calves	**4**

Q3	**(a)(i)**	*Outline reasons why farmers install cow brushes in cattle sheds.* Allow cows to groom or scratch / reduce skin irritations / reduce stress or improved animal welfare / encourage natural behaviour / cleaner cows or improved hygiene (for animal) / improved blood circulation	**3+3**
	(ii)	*Describe the advantages of one other named piece of farm technology in relation to environmental sustainability.* Two points on any named valid piece of technology relating to environmental sustainability	**3+1**
		OR	
	(b)(i)	*Briefly explain how this technology would be safer for (1) animals and (2) the environment.* *Animals:* Less risk to animals from noxious (harmful) gases *Environment:* Reduction of greenhouse gases (which contribute to air pollution) / reduced runoff due to increased nutrient absorption by plants	**4+1**
	(ii)	*Apart from safety, outline ways this technology could benefit farmers.* Increased nutrient levels in slurry / reduces need for fertiliser / labour is reduced (as there is no need to agitate or move animals) / (as slurry is liquid) less blockages occur to equipment	**4+1**
Q4	**(a)(i)**	*Explain the underlined terms.* *Notifiable disease:* (contagious disease) which must be reported to vet or DAFM (and causes huge economic loss) *Zoonosis:* disease that can be transmitted from animal to human	**4+1**
	(ii)	*Briefly describe how TB is spread within or between herds.* Sale or movement of infected cattle can spread disease to other herds / contact between herds from neighbouring farms / contact with infected wildlife / airborne transmission/ infected milk / contaminated feedstuffs or water / direct contact between animals	**3**
	(iii)	*Outline the advice you would give farmers to help prevent the disease entering their farms.* Stock proof fencing on farm boundaries / culling infected animals / named biosecurity measure or closed herd / regular testing / quarantine infected farms	**2**

<table>
<tr><td></td><td colspan="2">OR</td></tr>
<tr><td></td><td>(b)(i)</td><td>Identify the bacteria that causes blackleg disease.

Clostridium chauvoei</td><td>2</td></tr>
<tr><td></td><td>(ii)</td><td>State where the bacteria identified can be found.

Soil / animal faeces</td><td>3</td></tr>
<tr><td></td><td>(iii)</td><td>Outline one symptom of the disease.

Swollen joints or muscles / lameness / fever / rapid breathing / lethargy / blackened tissue / crepitation</td><td>3</td></tr>
<tr><td></td><td>(iv)</td><td>Describe how blackleg can be prevented.

Vaccination / remove from infected land</td><td>2</td></tr>
<tr><td>Q5</td><td>(a)</td><td>Outline one effect weaning can have on beef animals.

Reduced feed intake due to stress / behavioural changes in weanling or mother/ weight loss / more susceptible to disease due to reduced immune system</td><td>4</td></tr>
<tr><td></td><td>(b)</td><td>State one essential nutrient of a weanling concentrate ration and name a source of this nutrient.

<table><tr><th>Nutrient</th><th>Source</th></tr><tr><td>Protein</td><td>Soya beans, peas, beans, maize</td></tr><tr><td>Carbohydrate</td><td>Maize, barley, beet pulp, molasses</td></tr><tr><td>Fat</td><td>Rapeseed, vegetable oil</td></tr><tr><td>Vitamins A, D, E</td><td>Vegetable oil, rapeseed oil</td></tr><tr><td>Named mineral e.g. Calcium</td><td>Calcium salt/ valid source for a named mineral</td></tr></table></td><td>3+1</td></tr>
<tr><td></td><td>(c)</td><td>Calculate the amount of feed required for his beef calves during the six-week weaning period.

4 x 7 x 1 = 28 kg per animal pre-weaning
2 x 7 x 2 = 28 kg per animal post weaning
56 x 63 = 3528 kg

(1m for method, 1m for final answer, if answer is given and correct with no method award 2m)</td><td>2</td></tr>
</table>

<table>
<tr><td>Q6</td><td>(a)</td><td>Identify the three pieces of equipment needed for lambing.
A: Stomach tube / C: heat lamp / D: ropes</td><td>3x1 (names)
3x1 (identified)</td></tr>
<tr><td></td><td>(b)</td><td>Briefly describe how any one of your named pieces of equipment identified is used during the lambing period.
Stomach tube: Tube is placed into stomach through oesophagus to deliver milk to stomach
Heat lamp: The heat lamp is placed above the lamb
Ropes: Ropes are tied above the hooves of lambs to pull lamb during birth</td><td>4</td></tr>
<tr><td>Q7</td><td>(a)</td><td>List any two components of the soil microbiome.
Bacteria / fungi / actinomycetes</td><td>4+1</td></tr>
<tr><td></td><td>(b)</td><td>Outline how the soil microbiome contributes to one of the processes and state how this benefits productivity in a named catch or energy crop.
<table>
<tr><th></th><th>Water retention</th><th>Plant carbon sink</th><th>Carbon sequestration</th><th>Plant growth promotion</th></tr>
<tr><td>Contribution</td><td>(Mycorrhizal fungi) increase area for water absorption/ (bacteria and fungi) break down OM to humus which increase water retention / improves soil structure</td><td>Micro-organisms feed on OM and allow for nutrient recycling (store carbon) in soil (biomass or humus)</td><td>Decomposition of OM to humus for carbon storage in soil</td><td>Symbiotic relationship (between plants and mycorrhizal fungi/bacteria) fixes nitrogen or makes phosphate available/ mycorrhizal fungi produce growth hormones</td></tr>
<tr><td>Benefit</td><td>Increased water availability to the crop/ reduces effects of drought</td><td>Greater nutrient availability for crop growth</td><td>Improved soil structure for crop growth or greater nutrient availability for crop growth</td><td>Improved nutrient availability leading to improved yield / improved yield due to growth hormones</td></tr>
</table></td><td>4+1</td></tr>
</table>

Q8	**(a)**	*Outline the benefits of the nitrogen cycle to animal and /or crop production on Irish farms.* Symbiotic bacteria or Rhizobium / convert N compounds into nitrates (nitrification) / legumes (clover) carry out nitrogen fixation/ nitrates are available for plant use/ provides N to build proteins in plants or animals / healthy plant growth/ less fertiliser needed / more productive swards (so less need for concentrates) / more efficient fertiliser or slurry use / soil fertility maintenance	**5+4+1**
Q9	**(a)**	*Outline how Jack could test the pH of a soil sample.* Put a soil sample in clean beaker / add deionised water / filter mixture with funnel or shake and add flocculant / add universal indicator or pH test strip or probe to filtrate / read pH from digital meter or compare colour of pH strip or indicator to chart / a valid result described	**5+4+1**
	OR		
	(b)(i)	*Identify which fields are most suitable for growing barley with an optimum growing range of 6.0-7.0.* Field 2 and Field 3	**2+2**
	(ii)	*Outline how Jack could adjust the pH to ensure he could sow barley in the future.* Liming the soil to raise pH	**4**
	(iii)	*Explain the role of pH in the uptake of nutrients.* pH affects nutrient availability (or cation exchange) as some nutrients are not available (or cation exchange is reduced) or become immobilised at high or low pH	**2**
Q10	**(a)**	*Explain the underlined term.* *Terminal sire:* a male parent / who is used for producing lambs for slaughter or offspring not intended for breeding or raised for meat production	**3+1**
	(b)	*Describe the improvements to breeding and management a farmer could make to their sheep flock based on the information from the CT scan.* *Breeding:* assessing muscle and fat would allow the farmer to choose whether to breed an animal to pass on genes *Management:* allows farmer to make informed decision about feeding regime (to reach slaughter or target weights) / assessing muscle and fat would allow farmer to see ratio of each and decide if increased protein was needed in diet for muscle production	**5+1**

Q11	**(a)**	*Outline ways farmers can ensure quality produced on their farms to ensure they meet these standards for the export markets.* Be part of quality assurance scheme / maintain hygiene to reduce disease or contamination / implement biosecurity measures / use tagging or animal passports (for traceability of produce) / suitable health and welfare measures taken with housing or disease prevention / good quality feed for livestock	**5+1**
	(b)	*Briefly explain the importance of export markets to Irish agriculture.* Contribute to farm income / surplus produce can be exported / economic or employment benefit to country	**4**
Q12	**(a)**	*Outline **one** scientific reason for any four.* *Progeny testing* To assess the genetic merit (traits or characteristics) of a breeding animal through their offspring	**2(4)+ 2(1)**
	(b)	*Having a buffer zone close to a waterway.* Reduce run off or prevent eutrophication / reduce sediment in rivers / increased bank stability / increased biodiversity	
	(c)	*Presence of chloroplasts in the palisade layer of a leaf.* Close to surface to maximise photosynthesis	
	(d)	*Culling of breeding ewes on a sheep farm.* Ewe could be lame or infertile or diseased or prevent undesirable traits (so is not suitable for breeding)	
	(e)	*Movement of water from the soil through the plant to the atmosphere.* To transport minerals / to provide water for photosynthesis / to cool the plant	

Section B		Answer any 4 questions 50 marks for each question Total for section is 200 marks	Marks
Q13	**(a)(i)**	*Outline reasons why the farmers chose to cross some of the Friesian cows with an Aubrac stock bull.* Sell as beef animals / produce animals for calf to beef system / calves will not be used for breeding or milking / purebred Friesians will not have good conformation for beef production or improved conformation of offspring	**3+1**
	(ii)	*Identify which of the dairy cows in the herd were crossed with a Friesian bull, by placing a tick (✓) in the correct box* Early calving cows ✓ Late calving cows	**2**
	(iii)	*Outline a reason for your answer in part (ii) above.* These calves will be used as replacements and reach target weights in time for breeding	**1**
	(iv)	*Calculate the replacement rate for the herd.* $\frac{25}{120}\ x\ 100 = 20.8\%\ or\ 21\%\ replacement\ rate$ *(1m for method, 1m for final answer, if answer is given and correct with no method award 2m)*	**2**
	(v)	*Calculate the number of barren cows on the farm.* 25+ 28 + 25 + 35 = 113 120 – 113 = 7 barren cows *(3m for method, 3m for final answer, if answer is given and correct with no method award 6m)*	**6**
	(vi)	*State another dairy breed that would be suitable for the farm.* Jersey / Norwegian Red / Holstein / Ayrshire / other valid breed	**6**
	(vii)	*Outline advantages of breeding their own replacements.* Disease control / biosecurity / grading up or herd improvement / improved genetic merit / reduced cost of buying replacements / genetic provenance known	**5+1**
	(b)(i)	*Explain the term milk recording.* Keeping data (records) on the milk yield and quality (constituents or solids or bacterial count) in the milk produced by a cow	**3**
	(ii)	*Outline the advantages of pregnancy testing in dairy herds.* Identify barren cows / predicting calving dates / planning drying off dates / planning feed management / improve AI performance by monitoring success rates in herd	**4+1**

	(iii)	*Apart from pregnancy testing, outline the advantages of milk recording.* Identify best and worst producing animals / improved herd management / allows farmer to optimise feed management / identify cows for breeding for milk production / monitoring SCC	**4+1**
	(c)(i)	*Identify the optimal time for insemination using AI.* 12 – 18 hours	**5**
	(ii)	*Outline one reason why cows can be inseminated too early or too late.* Missed ovulation / inaccurate heat detection	**5**
		OR	
	(d)(i)	*Identify the hormone labelled **X** responsible for milk let down.* Oxytocin	**5**
	(ii)	I*dentify **one** trigger of milk let down in cows.* Sight of the calf / sound of the milking machine / hand stripping teat or suckling / milking routine	**5**
Q14	**(a)(i)**	*Identify which soil A or B is most compacted and outline a reason for your answer.* *Soil*: B *Reason*: (Compacted structure or) hard pan or little space for roots to grow	**6+4**
	(ii)	*Calculate the available water in a silt loam soil.* 30 – 10 = 20% *(3m for method, 3m for final answer, if answer is given and correct with no method award 6m)*	**6**
	(iii)	*Account for the difference in the permanent wilting point of sand soils and clay soils.* Sand has larger pore spaces and has better drainage or lower water retention / clay has smaller pore spaces and poorer drainage or retains more water	**3**
	(b)(i)	*Compare with the aid of a labelled diagram the capillarity of a compacted and uncompacted soil. State the results of the investigation.* Put cotton wool or muslin cloth in open end of one tube (and place in retort stand) / obtain dry soil sample and compact one half of the sample / place equal amounts of compacted soil in open end of the tubes and uncompacted soil in the other open-ended tube / place both tubes in equal amounts of water / leave for a suitable valid time / measure or observe the level of water in each tube / other valid method *Result: valid result for investigation described	**4x4** **1**

	(ii)	*Identify the variables in this investigation.* *Independent:* Compacted and uncompacted soil Dependent: Height water rose in tubes / time taken for water to rise to a specific level / volume of water absorbed in tubes *Control*: Same amount of soil / same size tubes / left for same length of time / same amount of water available / same soil type	**3x2**
	(iii)	*Outline **two** ways to make this investigation accurate.* Record the exact mass (of the compacted and un-compacted soil using) an electronic balance / measure the height of the water (in the tubes) using a ruler or use tube with graduations / calibrate the scales / record exact time using a stopwatch	**2(1)**
	(c)	*Outline ways farmers can reduce compaction on their farm.* Ploughing / subsoiling / add organic matter to soil / use min-till or conservation tillage / use machinery with wide tracks or tyres / install drainage / do not graze or use machinery on land when there is a high chance of poaching / rotational grazing to reduce time spent on land by livestock / do not overstock (reduce stocking rate) / sow a multi-species sward / use drones to avoid machinery compacting land	**4+2**
		OR	
	(d)	*Outline ways in which soil compaction occurs on a tillage farm.* Poaching/use of heavy machinery / continuous ploughing at the same depth (causing a plough pan) / lack of organic matter content	**4+2**
Q15	**(a)(i)**	*Explain the underlined terms.* *Physical traits:* The observable characteristics of an organism *Disease resistance:* The ability of a plant to withstand attack from a pathogen (or named)	**2x4**
	(ii)	*Outline characteristics a scientist would be looking for when selecting any two parent plants for breeding.* Disease resistance / yield / early ripening / pest resistance / drought tolerance / nutritional content / length of stem / strength of stem / resistance to lodging / frost resistance / market demand	**5+2**
	(iii)	*Place the steps in the correct order.* C D B A **Or** D C B A *[C and D are first two steps in either order]*	**2(3)+ 2(1)**

	(iv)	*Identify the dominant trait in the plants grown by Alex and suggest how knowledge of genetic inheritance can improve crop production on a tillage farm.* *Dominant trait:* Purple *Suggest:* crops can be selected for traits (which beneficial to the farmer) e.g. yield, disease resistance, earliness of ripening	**6+2**
	(b)	*Identify **any three** common plants found on Irish farms in the photographs below.* *A*: Cleavers *B:* Chicory *C:* Silverweed *D*: Oilseed rape	**3x1**
	(c)	*Outline the advice you would give to the farmers about controlling weeds:* *Types of weed control* Crop rotation to reduce the build-up of weeds / correct seeding rate to increase competition / spray the field with pre-harvest or pre-emergence herbicides to reduce the weeds in the crop / ensure the machines are cleaned between fields to reduce weed seeds being carried / valid named biological control e.g. dock beetle to control dock leaves / stubble cleaning – depth of cultivation to target specific weeds / any valid qualified description of a point from diagram *Negative effects of weed control on farms.* Herbicides can kill non-target plants / reduced biodiversity / residues from herbicides in human or animal food chain / chemical run off into waterways / herbicide resistance in weeds *Safety considerations farmers need to take into account when controlling weeds.* Wear masks when spraying or wear gloves / take precaution when operating machinery / avoid drift / correct storage of chemicals *(One point under each heading and the fourth point from any heading)*	**4x4**

Q16	**(a)(i)**	*Identify the animal with the higher intake of feed.* Holstein Friesian	**4**
	(ii)	*Identify which animal had the better food conversion ratio (FCR).* Charolais	**4**
	(iii)	*Calculate the Daily Liveweight Gain (DLG) from birth to slaughter for the Charolais.* *Charolais: 725/654 = 1.1 kg* $\frac{725-50}{654} = 1.03$ *or* $\frac{725-40}{654} = 1.05$ *(2m for method, 2m for final answer, if answer is given and correct with no method award 4m)*	**4**
	(iv)	*Identify the animal with the inferior feed efficiency.* Holstein Friesian	**3**
	(v)	*Explain Food Conversion Ratio (FCR).* The amount of feed required to produced (1) kg of liveweight gain	**2**
	(vi)	*Outline factors affecting FCR in animals* Breed / sex / health or disease / feed or nutrition / management / age	**3(3)**
	(b)	*Calculate which animal would earn the most money.* *Charolais:* 446 x 5.25 = 2341.50 *Holstein Friesian:* 360 x 5.25 = 1890 *Animal:* Charolais	**3x2**
	(c)(i)	*Identify **two** inaccurate pieces of information from the paragraph.* Presence of oxygen allows anaerobic bacteria Butyric acid Acidification raises pH	**4+2**
	(ii)	*Outline the correct information for each inaccuracy stated in part (i) above.* *Presence of oxygen allows anaerobic bacteria* – absence of oxygen *Butyric acid* – lactic acid *Acidification raises pH* – reduces pH	**4+2**
	(iii)	*Suggest a better prompt Jack could have put into the app.* Be more specific on the location / be more specific on time of year / be more specific on sward mixture / be more specific on weather conditions / be specific on method (pit or bales) / any valid answer	**3**
	(iv)	*Suggest a suitable source of information Jack could use when researching agricultural information.* Teagasc / Department of Agriculture, (Food and Marine) / Farmers Journal / Farming Independent / other valid reliable source	**3**

Q17	**(a)(i)**	*Explain what is meant by hogget?* A sheep that is 1-2 years old or two permanent teeth	**2**
	(ii)	*State the gestation length (in days) of a sheep.* 145-150 days	**4**
	(iii)	*Describe the management practices at breeding to ensure a successful breeding season.* Ensure sheep are at the correct BCS / check for any health issues / synchronise breeding for a compact lambing season / use a raddle to establish which ewes have been mated / have an appropriate ram: ewe ratio / flushing / proven ram fertility	**4+2**
	(iv)	*Describe the characteristics a farmer would look for in a replacement ewe lamb.* Age / free from disease / body condition score / good conformation / udder with no defects / mouth and teeth with no deformities / good feet / genetic merit	**4+2**
	(v)	*State with reason if it is good practice to keep ram lambs on the farm if not intended for breeding.* *State:* No *Reason:* Could interfere with breeding program	**4+2**
	(b)(i)	*Briefly describe the features of good sheep housing.* Good ventilation / good hygiene / draught free / adequate floor space or 1.2-1.4 m^2 per ewe / adequate feeding space or trough space per ewe / comfortable area to lie down / fresh water supply / accessible layout or easy to monitor	**4+2**
	(ii)	*Outline safety considerations when working with sheep.* Sheep crate or race for examining livestock / appropriate use of PPE / move sheep in flocks when livestock movement is necessary rather than isolating animals / correct manual handling / correct use of equipment or chemicals (e.g. shears, sheep dip)	**4+2**
	(c)(i)	*Using the data in the table below, plot a graph showing the DM yield for the Caledonia variety over the six-week period.* Graph could be plotted as trend graph, histogram, bar chart X-axis labelled Y-axis labelled Correct scale both axes Appropriate graph chosen 6 points plotted for Caledonia	**5x2**
	(ii)	*Identify which variety of kale would provide the highest DM intake for livestock.* *Variety:* Caledonia	**4**

<table>
<tr><td>Q18</td><td>(a)(i)</td><td>List with reason three types of plants they could include in the mixture.
<table><tr><th>Plant</th><th>Reason</th></tr><tr><td>Perennial ryegrass or Italian ryegrass</td><td>Palatability /productivity / digestibility</td></tr><tr><td>Clover</td><td>High protein content / fixes N / reduces the need for artificial fertiliser / palatability</td></tr><tr><td>Chicory</td><td>High protein content / anthelminthic / palatable</td></tr><tr><td>Plantain</td><td>Anthelminthic properties / drought resistant / deep rooting</td></tr></table></td><td>3x (3+1)</td></tr>
<tr><td></td><td>(ii)</td><td>Describe the cultivation of the seedbed for the grassland mixture.
Direct sowing: land is ploughed / harrowing to create fine seedbed / seed sown with seed drill or broadcast onto soil surface / rolling for good soil-seed contact
Direct drilling: Land is grazed bare or herbicide is applied / seed is sown in slit in soil / with direct drilling machine / rolling for good soil-seed contact
Slit seeding: seed is sown in slit in soil / with direct drilling machine / old grassland is not killed off / rolling for good soil-seed contact</td><td>2 (name)
2+2 (describe)</td></tr>
<tr><td></td><td>(iii)</td><td>Outline the nutritional requirements of the reseeded land.
Do a soil test to establish nutrients present in soil / apply fertiliser to match needs of soil and crop / N for growth / P for root development / K for enzyme activity / add lime to raise pH (6.5)</td><td>4+2</td></tr>
<tr><td></td><td>(b)</td><td>Describe how to investigate the establishment of grass with that of another crop.
Throw a quadrat / do a plant count (within the quadrat) / repeat 10 times and get an average / repeat for second crop /calculate the percentage establishment of both crops/ compare rate of establishment of both crops</td><td>3x4</td></tr>
<tr><td></td><td>(c)(i)</td><td>Explain crop establishment.
The point at which a seedling is able to absorb nutrients and support its own growth independently (of the cotyledon)</td><td>2</td></tr>
<tr><td></td><td>(ii)</td><td>With a very wet spring in 2024, describe the difficulties in establishing crops.
Difficulties to cultivate land / cold temperatures delay germination / anaerobic conditions in soil prevent root respiration / increased risk of attack by diseases or pests (such as slugs and snails) / (compacted soils due to) waterlogging (make establishment of crop difficult) / difficult to control weeds which compete with germinating seeds / leaching of nutrients / heavy rain washes seeds away</td><td>6+6</td></tr>
</table>