Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2026

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 affect 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		

<table>
<tr><th>Section A</th><th></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="2">Q1</td><td>(a)</td><td>Briefly explain with reason one way the machine is environmentally friendly.
<table><tr><td>(wider) Tracks</td><td>Reduced Soil Compaction or weight spread over a larger surface area or reduced poaching</td></tr><tr><td>Lower fuel consumption / GPS</td><td>Less energy (fuel) to pull heavy equipment or reducing carbon emissions or fewer passes</td></tr><tr><td>Smoother, more even movement</td><td>Causes less disturbance to soil organisms or reduces erosion risk</td></tr></table></td><td>5+3</td></tr>
<tr><td>(b)</td><td>Identify one negative for using this large machine.
High maintenance or costs or emissions / safety issues or described / limited manoeuvrability / will not fit on all farms or roads</td><td>2</td></tr>
<tr><td rowspan="2">Q2</td><td>(a)(i)</td><td>Outline the role of two named plant structures in photosynthesis.
<table><tr><td>Leaf</td><td>Absorbing light / take in CO_2 / combine them with water to make glucose</td></tr><tr><td>Chloroplasts/ palisade layer</td><td>Contain chlorophyll which is used to trap light</td></tr><tr><td>(Spongy) Mesophyll</td><td>(Layer of leaf cells) allows diffusion</td></tr><tr><td>Stomata</td><td>(Pores) that absorb CO_2 or release O_2 or gas exchange</td></tr><tr><td>Root</td><td>Absorb water (from soil)</td></tr><tr><td>Vascular bundle or xylem or phloem</td><td>(Xylem) which transport water or (phloem) which transports food</td></tr></table></td><td>2(3)+ 2(1)</td></tr>
<tr><td>(ii)</td><td>Briefly describe one role photosynthesis contributes to the carbon cycle.
Plants absorb CO_2 from the atmosphere which they use to combine with water to make glucose, (using energy)
Or
Carbon Sequestration – capture atmospheric carbon into plant tissues and soils to help regulate climate change</td><td>2</td></tr>
</table>

<table>
<tr><td colspan="4">Or</td></tr>
<tr><td>Q2</td><td>(b)</td><td>Discuss how the knowledge of photosynthesis is used to enhance crop production on Irish farms. In your answer, refer to any three of the following:
<table>
<tr><td>Fertiliser</td><td>Provides nutrients (e.g. N, P, K) to enhance leaf growth/area or provides N for chlorophyll production or correct mineral function related to photosynthesis</td></tr>
<tr><td>Optimising light capture</td><td>Sow crops in rows / correct spacing to maximise sunlight / avoid shading /aspect described / time of sowing to maximise daylength (growth days) / relevant genetic selection for enhanced light capture</td></tr>
<tr><td>Genetic improvement of crops</td><td>(Breeding) genetically selecting crops for traits (like faster growth or larger surface area or higher chlorophyll content, or drought resistance) leads to increased photosynthesis or crop yields</td></tr>
<tr><td>Grassland management</td><td>Management of grazing system (stocking rate or reseeding or topping or rotation) to increase leaf growth / increase sugar content for silage or grazing.</td></tr>
</table></td><td>5+3+2</td></tr>
<tr><td rowspan="3">Q3</td><td>(a)(i)</td><td>Explain resistant.
The ability of an organism to remain unaffected by any factor (herbicide)</td><td>2</td></tr>
<tr><td>(ii)</td><td>Outline why Italian ryegrass would be a challenge on Irish tillage farms.
High seed production / herbicide resistance / similar growth habits to cereals / seeds stay in soil for long periods / long germination periods / competition for resources / crop contamination</td><td>2</td></tr>
<tr><td>(iii)</td><td>Describe two ways farmers could control weeds on tillage farms without the use of herbicides.
Mechanical or cultural control such as ploughing or harrowing or rogueing to disrupt growth cycle of weeds / crop rotation involving sowing a variety of crops breaks lifecycle of weeds / later sowing date allow weeds to germinate then cultivate lightly / competitive seed varieties are fast establishing varieties which shade out weeds / higher seed rates more competition for light or nutrients or space / min-till or direct drilling as to not disturb weed seed reservoir or machine hygiene to prevent transfer of weed seed / described biological control / certified seed with reference to high germination rate or high purity or free from wild oats</td><td>5 + 1</td></tr>
</table>

<table>
<tr><th colspan="4">Or</th></tr>
<tr><td>Q3</td><td>(b)(i)</td><td>Determine the weed score (1 – 3) in Sarah's field shown in the photograph below and justify your answer.

Weed score – 2
Justification – there are few patches of wild oats present, but they are sparse</td><td>2
2</td></tr>
<tr><td></td><td>(ii)</td><td>Advise suitable weed control measures Sarah could implement on her farm.

Certified seed / hand rogueing / mechanical control / delayed sowing / competitive crops / good machine hygiene / crop rotation / min-till or direct drilling / stubble cleaning / creation of sterile seedbed</td><td>5+1</td></tr>
<tr><td>Q4</td><td>(a)</td><td>Explain milk fever.

Metabolic disorder caused by low blood calcium levels</td><td>2</td></tr>
<tr><td></td><td>(b)</td><td>Describe one clinical sign or symptom of milk fever in cows.

Staggering - cow has difficulty walking, may collapse / loss of appetite - reduced feed intake/ cold ears or low body temperature - poor circulation due to muscle failure / lying down and unable to rise - paralysis caused by nerve malfunction / reduced rumen activity - leads to poor digestion</td><td>2</td></tr>
<tr><td></td><td>(c)</td><td>Name one mineral added to the diet of dry cows and give a reason for its inclusion in the diet.

<table><tr><td>Magnesium</td><td>Essential for the cow's ability to absorb and metabolise calcium or prevent grass tetany or milk fever</td></tr><tr><td>Phosphorus</td><td>Supports bone development or energy or metabolism or appetite</td></tr><tr><td>Selenium</td><td>Boosts immunity or reduces retained placenta risk or improve fertility</td></tr></table></td><td>5+1</td></tr>
</table>

Q5	**(a)**	*Outline **two** causes of lameness in dairy cows.* Sole ulcers pressure on sole of foot or standing on concrete or poor cubicle comfort or foreign object or extensive walking to paddocks / laminitis – feeding high concentrate or high energy diets (weaken hoof structure) / sudden change in diet (rumen acidosis) / foot rot or bacterial infection (standing in wet or dirty conditions) / overgrown hooves or uneven weight bearing or digital dermatitis in hoof	**3+1**
	(b)	*Outline **one**-way lameness can be prevented.* Regular hoof trimming / foot baths / good hygiene / comfortable cow accommodation or roadways / balanced nutrition / minimise walking distance	**3**
	(c)	*Explain why the cost of lameness is high on dairy farms.* Decreased production (reduced milk yield or poor live weight gain) / reduced fertility (poor heat detection or increased calving intervals) / increased culling rates / high treatment or labour costs (higher AI or veterinary costs)	**3**
Q6	**(a)(i)**	*Explain faecal egg count.* Quantitative measure of how many worm eggs in sheep or cattle is passing in each gram of its manure	**2**
	(ii)	*Identify if the parasite is an endoparasite or ectoparasite.* Endoparasite ✓ Ectoparasite	**4**
	(iii)	*Apart from chemical control, outline **two** ways a farmer could control or prevent this worm spreading.* Rotational Grazing - prevents lambs grazing heavily contaminated paddocks where larvae build up / mixed grazing - graze sheep after cattle or horses as do not host barber pole worm / clean pasture - use silage ground or reseeded paddocks / quarantine of bought-in animals or maintain closed herd - prevents introducing resistant worm strains / breeding for resistance / select breeding stock that show natural resistance (good body condition, low FEC) / nutrition or health management - provide adequate protein and minerals / healthy sheep are better able to withstand infection / sow or graze multispecies sward	**3+1**

Or			
	(b)(i)	*Identify the trend in incidence of the worm on Irish farms.* The incidence of barber pole in increasing rapidly in recent years	**4**
	(ii)	*Outline **one** reason for the trend identified in part (i) above.* As Ireland's climate is getting milder, the incidence of barber pole worm in increasing	**2**
	(iii)	*Outline **two** practices a farmer could do to reduce the risk of anthelmintic resistance developing.* Weigh animals to ensure accurate weight for accurate dosage rates / only treat animals that require treatment (selective treatment) / use different groups of worm doses / isolate bought in animals / carryout out faecal egg count / good grassland management	**3+1**
Q7		*Outline how **any four** benefits can improve agricultural productivity and/or ecosystem health.* ***Carbon Storage*** It reduces the amount of carbon dioxide in the atmosphere, (helping to slow climate change) / (Carbon-rich) soils have better structure or water-holding capacity or higher fertility or allows stronger root growth or higher yields. ***Reduced Environmental Losses*** Healthy soil biome prevents nitrate leaching or phosphorus runoff (into rivers and lakes, improving water quality) / more nutrients stay in the field, meaning less fertiliser is wasted. ***Improved Plant Resilience*** Healthy soil biome (and diverse systems) help plants cope with stress / crops becomes more resistant to drought or disease or extreme weather / more reliable yields, even in difficult seasons. ***Improved Food Quality*** Improved access to soil nutrients improves crop quality / increases protein or vitamin or mineral content of food crops / produces healthier feed for livestock or higher quality produce for consumers. ***Nutrient Provision*** Soil organisms release nutrients naturally through decomposition / provides crops with a steady supply of nitrogen or phosphorus or trace elements / reduces reliance on chemical fertilisers, lowering costs. ***Protection from Pests and Diseases*** Diverse farming systems encourage beneficial organisms / natural predators control pests, (reducing the need for pesticides) / healthy soils suppress plant diseases or improving crop survival or improving yield.	**5+3+2(1)**

<table>
<tr><td>Q8</td><td>(a)</td><td>Identify breed A and B.

A – Limousin
B – (Holstein) Friesian</td><td>4+1</td></tr>
<tr><td></td><td>(b)</td><td>Compare the production traits of breed A and B under the following headings:
<table><tr><th></th><th>Limousin</th><th>Holstein Friesian</th></tr><tr><td>Growth / milk yield</td><td>Higher liveweight gain / low milk yield</td><td>Lower liveweight gain / higher milk yield</td></tr><tr><td>Temperament</td><td>Lively / excitable</td><td>Quiet / easy to handle</td></tr></table></td><td>4+1</td></tr>
<tr><td>Q9</td><td>(a)</td><td>State why this investigation is a fair test.

Used equal amounts of samples / same set up used for all or described</td><td>3</td></tr>
<tr><td></td><td>(b)</td><td>Predict the result the student would observe from the investigation.

Water drains fastest in the sand / slowest in clay / loam between the two</td><td>3</td></tr>
<tr><td></td><td>(c)</td><td>Using your predicted result from part (b), identify with reason which soil type would be most suitable for a crop production enterprise.

Soil type = loam

Reason = good drainage / retains water / won’t wash out nutrients / air spaces for root development or easily worked/ warms easily</td><td>2(2)</td></tr>
<tr><td>Q10</td><td>(a)</td><td>Identify any two of the plants A, B, and C.

A – Ragwort
B – Nettle
C – Dandelion</td><td>3+2</td></tr>
<tr><td></td><td>(b)</td><td>Explain two risks this poses to productivity and sustainability on his farm.

(Increase in weed populations) competition – reduced yield or income / seeds can remain viable in soil for many years / long term weed control very difficult or expensive / use of chemical or cultivation needed to control weeds or pests (reducing biodiversity) / damaged soil structure / increased risk of disease / lower percentage germination or any negative effect of not using certified seed</td><td>3+2</td></tr>
</table>

Q11	**(a)(i)**	*Outline with reason **two** features of good animal housing that promote animal health and welfare.* **Feature** / **Reason** **Good Ventilation** — Removes moisture or dust or harmful gases such as ammonia / reduces (respiratory) disease or improves overall air quality **Clean, dry bedding** — **C**omfortable lying areas prevent pressure sores or mastitis / dry conditions reduce the growth of bacteria or parasites **Adequate space or stocking density or light** — Prevents overcrowding or reduces stress or aggression or disease / allows animals to express normal behaviour (such as lying, feeding and social interaction) **Non-slip flooring** — Prevents injuries or lameness **Proper drainage or hygiene** — Reduces build-up of slurry or pathogens / lowers the risk of diseases such as foot rot or digital dermatitis **Easy access to feed or water** — Prevents bullying or uneven feed intake / ensures animals maintain good body condition or healthy **Comfortable temperature or draft free or shelter** — Protects animals from cold stress or heat stress / maintains immunity or productivity **Isolation unit** — Prevent transmission of disease **Enrichment materials** — Correctly described	**2(3)**

<table>
<tr><td></td><td>(ii)</td><td>Explain how poor housing design can negatively affect the following: animal performance and farmer safety.
<table>
<tr><td>Effects on Animal Performance</td><td>Poor ventilation leads to a build-up of ammonia or moisture, increasing the risk of (respiratory) diseases / (Sick animals eat less and convert feed poorly) resulting in reduced growth rates or lower milk yield
Overcrowding causes competition for feed or lying space. This leads to uneven feed intake or aggression or bullying, which can reduce fertility or milk production or weight gain or injury
Slippery or uneven floors increase the incidence of lameness or injury. (Lame animals spend less time feeding and more time lying down), reducing output or increasing veterinary costs
Damp, dirty conditions promote microbial growth or increasing cases of mastitis or foot rot or other infections, which further lower productivity</td></tr>
<tr><td>Effects on Farmer Safety</td><td>Inadequate handling facilities make it difficult to restrain or treat animals safely / frightened or stressed animals are unpredictable, increasing the risk of injury
Poor lighting or narrow passageways make it harder to move around buildings / increasing the chance of accidents
Slippery floors and poor drainage expose farmers to falls / while poorly positioned gates or barriers can lead to serious accidents (when working with large livestock)
Poor Ventilation inhalation of harmful gases or pathogens</td></tr>
</table></td><td>2(2)</td></tr>
<tr><td colspan="4">Or</td></tr>
<tr><td>Q11</td><td>(b)(i)</td><td>Calculate the straw bedded floor space and feed space required for 40 finishing bulls:
4 x 40 = 160 (m^2)
(2m for correct method, 2m for correct answer, if candidate gives 160 without showing calculation award 4m, no units required)</td><td>2+2</td></tr>
<tr><td></td><td>(ii)</td><td>Based on your answer in part (i), describe how the farmer would manage the housing of his finishing bulls to ensure they reach their target slaughter weight.
Bulls would have to be split between the two pens (according to weight or size)</td><td>3</td></tr>
</table>

	(iii)	*Evaluate **one** potential problem with repurposing housing designed for pigs to accommodate cattle.* **Floor and structural strength** - slats are not designed to support heavier animals **Space allowance and layout –** overcrowding or bullying or reduced feed intake or narrow pens or low headroom or low gates or narrow passageways or poor access **Ventilation systems** insufficient air flow **Handling and safety facilities** Cattle require strong or larger barriers or gates or handling facilities **Slurry storage** not designed for the much larger volumes produced by cattle	**3**
Q12	**(a)**	*Suggest **two** desirable traits the farmer might select when breeding pigs* Prolificacy (large litter size) / good mothering ability / fast growth rate / efficient food conversion ratio (low FCR) / good carcass quality / disease resistance / good feet / good genetics / good conformation	**2(3)**
	(b)	*Explain how hybrid vigour could improve the performance in a pig herd.* Increased litter size / fast growth rate / low FCR / good carcass quality / disease resistance / good feet / good genetics	**2**
	(c)	*Outline **one** genetic risk of relying heavily on pedigree breeding in animals.* Greater risk of Inbreeding / harmful recessive genes or described disease (BRD) are more likely to be expressed / possible reduction in overall performance (offspring show reduced fertility or slower growth) / poorer disease resistance / increase in inherited defects	**2**

<table>
<tr><th colspan="2">Section B</th><th>Answer any 4 questions
50 marks for each question
Total for section is 200 marks</th><th>Marks</th></tr>
<tr><td rowspan="4">Q13</td><td>(a)(i)</td><td>Identify the meaning of a nutrient management plan.
<table><tr><td>Plan to measure nutrient outputs on a farm</td><td></td></tr><tr><td>Blueprint for managing nutrient inputs and applications across the farm</td><td>✓</td></tr><tr><td>Plan to measure nutrient inputs on a farm</td><td></td></tr></table></td><td>6</td></tr>
<tr><td>(ii)</td><td>Explain how each of the following soil properties affects grass establishment:
<table><tr><td>P</td><td>Essential for root development / low P – weak root or slow seedling establishment / helps young grass plants develop (and compete with weeds) /energy production (ATP) or cell division</td></tr><tr><td>K</td><td>Essential for plant (stem) strength or stress tolerance / improves resistance to drought or stomata function or disease or poaching / low K levels are slow to establish or more easily damaged / maximise N uptake / translocation of nutrients/protein or enzyme synthesis</td></tr></table></td><td>1+1</td></tr>
<tr><td>(b)(i)</td><td>Explain flocculation and outline why it is important for soil structure.
Explanation:
Process by which fine soil particles (especially clay) bind together to form larger aggregates (peds)
Importance for Soil Structure
Improves soil porosity or aeration / better drainage or preventing waterlogging / increases root penetration or allows plants to access nutrients and moisture / reduces compaction or surface crusting or erosion, (making soils easier to cultivate) / promotes microbial activity</td><td>3+1</td></tr>
<tr><td>(ii)</td><td>Describe how soil pH and calcium influence flocculation in soils.
Maintaining a suitable soil pH (pH 6-8) ensures sufficient calcium is available / sufficient calcium cations attract negative clay particles allowing flocculation to occur / high soil pH (6-8) and calcium increases flocculation or low soil pH (<6) and calcium decreases flocculation</td><td>2</td></tr>
<tr><td>(iii)</td><td>Describe with the aid of a labelled diagram an investigation to show flocculation in a sample of soil.
Add 5g (or specified amount) of soil to each test tube / *add named reagent to each test tube (Lime or Calcium Chloride or Aluminium Chloride or Sodium Chloride or Hydrochloric Acid) / water as a control / add equal volume of deionised water to each test tube / stopper and shake / leave to stand or set period of time / record which suspensions settles faster/ (*Compulsory point)</td><td>3(5)+1</td></tr>
</table>

<table>
<tr>
<td></td>
<td>(c)(i)</td>
<td>
Compare the fertility status of Field A and Field B.

Field B has good fertility due to Optimum pH, or adequate P or adequate K or higher Organic Matter

Field A has poor fertility due to Acidic soil or very low P or low K or lower Organic Matter.

*at least 2 factors compared correctly for full marks, 1 factor mentioned correctly for 6 marks
<table>
<tr><th>Field A</th><th>Field B</th></tr>
<tr><td>pH 5.2: acidic, below the optimum for grass (about 6.3–6.5). This will reduce nutrient availability and grass establishment</td><td>pH 6.6: close to optimum / slightly high for grass; good for nutrient availability and clover establishment</td></tr>
<tr><td>P Index 1: very low phosphorus status → (a definite response to P fertiliser is expected)</td><td>P Index 3: adequate/optimum phosphorus → (response to P fertiliser is unlikely (maintenance only))</td></tr>
<tr><td>K Index 2: low potassium status → (a likely response to K fertiliser)</td><td>K Index 3: adequate/optimum potassium → (response to K fertiliser is unlikely (maintenance only))</td></tr>
<tr><td>Organic matter 3.0%: relatively low, meaning poorer soil structure, lower nutrient supply, and lower water-holding capacity.</td><td>Organic matter 6.0%: higher OM improves soil structure, microbial activity, drainage / water retention, and nutrient supply.</td></tr>
</table>
</td>
<td>2(6)</td>
</tr>
<tr>
<td></td>
<td>(ii)</td>
<td>
Recommend appropriate management for each field to improve or maintain fertility.

Field A: (corrective action) Addition of Lime or P or K or organic matter necessary (qualified)

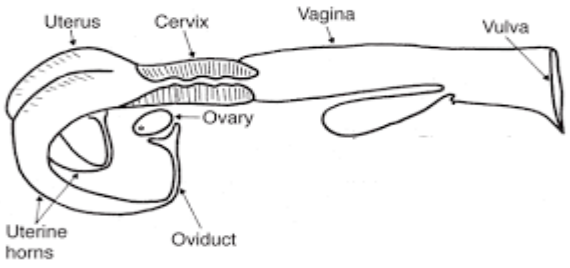
/

Field B: Lime or fertiliser or OM not necessary (qualified)

*at least 2 factors compared correctly for full marks
</td>
<td>6+2</td>
</tr>
</table>

Q14	**(a)(i)**	*Identify why clover is included in the sward for the finishing cattle, by placing a tick (✓) in the correct box.* Clover prevents nitrogen entering the soil: ☐ Clover absorbs large amounts of chemical nitrogen fertiliser: ☐ Clover fixes atmospheric nitrogen and makes it available to the soil: ✓	**5**
	(ii)	*Explain why maintaining soil pH is critical for clover establishment and grass growth.* If soil is too acidic (< 5.8), nutrients become unavailable (for plant growth) or pH 6-8 is required for clover establishment **or** grass growth / calcium or magnesium deficiency (reduces rhizobia survival) / in low pH soils manganese (Mn) and aluminium (Al) toxicity can have a major effect on white clover development. / formation of nodules for N fixation is reduced below soil pH 5.8 / (symbiotic) bacteria (Rhizobium or nitrogen fixing) are pH sensitive	**1**
	(iii)	*Outline **two** ways Dylan and Margaret can ensure safe practices on the farm.* Identify hazards and risks and remove them / lock away chemicals / proper signage / use of protective guards (PTO) / have an escape route when dealing with animals / barrier between cow during calving / beware of bull / keep gates closed / safe practices when using chemicals / any valid safety practice	**2(6)**
	(b)(i)	*Using your knowledge of ruminant digestion, explain how clover can increase live weight gain in the beef finishing cattle.* Improves the nutritional value of the diet or rumen efficiency / higher level of protein than grass / (palatable) increasing feed intake / (digestibility) improving feed conversion efficiency	**5**
	(ii)	*Outline with reason **one** risk of grazing high-clover swards for beef cattle.* ***Risk***: Bloat ***Reason:*** Clover is very rapidly digested in the rumen or very high in Nitrogen or protein and (produces a stable foam that traps gas) / prevents normal eructation (belching), causing the rumen to swell / if not treated quickly, bloat can restrict breathing and may lead to death	**4+1**
	(iii)	*Outline **two** management practices to maintain clover in a grass–clover sward under grazing conditions.* Maintain correct soil pH (around 6.3–6.5) / ensure adequate P and K levels / controlled nitrogen use (as this favours grass growth and suppresses clover) / rotational grazing – (use a tight grazing system) to prevent shading / avoid overgrazing in wet conditions or prevent poaching which damages clover / reseeding or oversown into existing swards (when plant numbers decline) / balanced stocking	**6+2**

		rate - grazed evenly and not out-competed by grass / clover friendly weed management plan	
	(iv)	*Identify the average recommended clover inclusion rate in swards* **Clover inclusion rate** 10% 20% ✓ 50%	**2**
	(c)(i)	*Identify method A or B and explain to a group of farmers how clover seeds can be sown using this method.* *Method:* ***A*** = Direct drilling / stitching in / slit sowing *Method* ***B*** = Broadcast **Direct Drilling/stitching in/slit sowing** ✓ Land grazed or cut tightly / ✓ The machine opens a small groove in the grass sward / ✓ Clover seed is dropped into the slot at the correct depth (5-10mm) / ✓ The slot then closes, leaving the seed in direct contact with the soil or rolled **Broadcasting** ✓ Land grazed or cut tightly / ✓ Seed is spread using a fertiliser spreader or by hand / ✓ The field is then lightly grazed or rolled so that animals' hooves or machinery help press the seed into the soil ** If the name and method match they get full marks, if the name and method don't match they get awarded the marks for the name*	**Name 3** **Method 2(3)**
	(ii)	*Identify the ideal post-grazing height of the sward at time of over-sowing by placing a tick (✓) in the correct box.* **Post grazing height at sowing** ≤ 4cm ✓ ≥ 8cm ≥ 5cm	**3**
Or			
(d)	**(i)**	*Describe with the aid of a labelled diagram, how a student could carry out an investigation to isolate and grow bacteria from the root nodules of a clover plant.* Sterilise equipment or wash roots in (Milton) solution or stay close to Bunsen burner (sterile environment) / rinse roots with water / remove nodules with scalpel or crush root nodules / swab some of the root nodules onto agar plate / in a zig zag / incubate upside down / 25^{o}C / > 48 hours (2-7days) / record no. of colonies present or correctly identify colonies or no growth on control / incubate unopened plate as a control *only one point accepted related to sterile	**4(3)**

Q15	**(a)(i)**	*Identify how long the cow ID number 453 is in calf.* 36 days	**5**
	(ii)	*Identify the lactation number of the cow.* 3 or 3.2	**5**
	(iii)	*Comment on the accuracy of the AI age of the foetus.* Very accurate AI accuracy is 36.2 days which is in line with the actual days served / AI provides precise reading using bank of comparison values	**4+1**
	(iv)	*Outline the importance of identifying twin pregnancies in cows.* require extra nutrition to maintain correct BCS or support the increased foetal demand / to provide extra supervision at calving (higher risk of calving difficulties) / cows can be put on a special pre-calving diet and monitored closely (greater risk of metabolic disorders) / adjust feeding levels or reduce stress to lower the risk of losing calves (higher incidence of abortion and premature calving) / more likely to produce freemartin heifers (sterile female calves when born with a bull twin)	**5**
	(v)	*Explain how an accurate reproductive status can improve dry cow management for next calving and breeding season.* Knowing the expected calving date ensures cows are dried off at the correct time (60 days) / give udder enough time to regenerate, leading to higher milk yield in the following lactation / feed cows at appropriate stage of pregnancy - prevent metabolic disorders or ensure available colostrum (such as milk fever or ketosis or retained placenta or maintain BCS) / identifies barren cows – culled (to shorten calving interval) / easier management at calving - moved to calving pens and monitored closely or reducing calving difficulties or improving calf survival	**2**
	(b)(i)	*Draw a labelled diagram of the cow's reproductive system.*  	**Diagram 0,3,6** **Labels 4(1)**
	(ii)	*Complete the following passage with key information relating to reproductive efficiency.* ***X*** = 365 days ***Y*** = 275 days ***Z*** = 45 or 90 days	**5+5+1**

	(iii)	*Based on a calving date of the 1st February, state what date a dairy cow should be dried off.* 1st to 3rd Dec	**2**
	(iv)	*Briefly explain the importance of heat detection in the reproductive cycle of dairy cows.* Limited opportunity to put in calf / if missed has to wait 21 days to serve / optimising calving intervals – (target 365-day calving interval or maximising lifetime milk or calf production) / maintain compact calving / identifying "silent" heats (high-producing cows often show less intense heat signs)	**5**
Q16	**(a)(i)**	*Describe **three** stages of grass growth and identify the ideal growth stage for cutting.* **Germination Stage** The radicle and plumule emerge / emergence of cotyledons **Leafy / Vegetative Stage** Grass is young with mainly leaf material (and little or no stem) / grass tillers / high in digestibility or energy or protein/ production of 3 leaves **Stem Elongation Stage** The stem begins to grow upwards (and the grass becomes less leafy) / fibre content increases /digestibility starts to fall **Reproductive / Heading / Flowering /inflorescence Stage** The seed head emerges / wind pollination occurs/ high fibre / low digestibility **Ideal Stage for Cutting** The best time to cut silage is during the leafy (vegetative) stage	**2(4)+ 2(1)**
	(ii)	*Identify plants A, B and C that farmers could sow in a multi-species sward.* ***A*** – Plantain ***B*** – Chicory ***C*** – Timothy	**5+3+1**
	(iii)	*Outline **one** purpose of including plant B from part (ii) in a multi-species sward.* (Deep or tap root leads to) drought tolerance or increased nutrient absorption / improve soil structure / very digestible or palatable (increased production or liveweight gain) / is a (natural) anthelmintic or reduce internal parasites or reduce usage of anthelmintic	**2**
	(iv)	*Identify if a multi-species sward is a monoculture or polyculture sward by placing a tick (✓) in the correct box* Monoculture: ☐ Polyculture: ✓	**3**

<table>
<tr><td></td><td>(v)</td><td>State with reason if farmers should graze grass in spring to 4cm prior to closing grass for silage.

No
Yield reduction - grazing too tightly (e.g., to 4cm) removes a large portion of the active leaf area required for photosynthesis / slow recovery - the growth of the grass is severely hindered by hard grazing or plant needs adequate energy reserves to initiate strong regrowth/ increased contamination risk - hard grazing can expose the base of the plant and potentially disturb the soil surface

Or

Yes
To remove dead (winter damaged) vegetation / increase light penetration / increased tillering / promotes rapid leafy (uniform) growth</td><td>2(3)</td></tr>
<tr><td></td><td>(b)(i)</td><td>Outline how the fertility of the soil affects the yield and quality of silage.

The better the soil fertility, the higher the yield and quality of silage</td><td>3</td></tr>
<tr><td></td><td>(ii)</td><td>If the target yield is 5 tonnes Dry Matter (DM) per ha, identify at what date each soil type will reach this target.

<table><tr><th>Soil Type</th><th>Date</th></tr><tr><td>Good soil fertility</td><td>26th May</td></tr><tr><td>Poor soil fertility</td><td>16th June</td></tr></table></td><td>2(4)</td></tr>
<tr><td></td><td>(iii)</td><td>Outline the conclusion you make based on the results in part (ii).

Good quality soil can produce 5 ton DM per ha (3 weeks or 20 days) earlier than poor quality soil / good quality soil will produce higher DMD silage (72% vs 62%)</td><td>3</td></tr>
<tr><td></td><td>(c)</td><td>Outline one reason why silage might spoil and how it can be prevented.

<table><tr><th>Reason</th><th>Prevention</th></tr><tr><td>Grass too wet</td><td>Cut grass in dry weather / wilt</td></tr><tr><td>Aerobic conditions present</td><td>Roll continuously during filling to remove air / high density bale / cover pit immediately after filling or secure plastic or repair damage plastic / fill and seal the pit as quickly as possible</td></tr><tr><td>Contamination</td><td>Prevent soil or slurry or N entering / close field for adequate length of time (6 weeks)</td></tr><tr><td>Insufficient sugars in grass</td><td>Cut leafy grass at the correct growth stage or time of day / use a silage additive (e.g. molasses or sulphuric acid or inoculant) / precision chop or conditioner mower</td></tr></table></td><td>2(3)</td></tr>
</table>

		Or	
	(d)	*State **two** advantages of bailed silage on a sheep farm.* Flexibility and scalability (easy transport or handling or saleability) / better quality and nutrition / reduced spoilage or waste / lower risk at harvesting / easier manage different fields at harvest / efficient storage and handling / cost-effective	**2(3)**
Q17	**(a)(i)**	*State the target live weight **X** in the table above.* 40 – 50kg	**5**
	(ii)	*Calculate the ADG for the animal during its 2nd Summer.* 580-380 = 200 570-365 = 205 200 / 205 = **0.975 (0.97-0.98)** *(2m for 200kg and 2m for 205 days and 6m for correct answer given without showing calculation)*	**6**
	(iii)	*Explain why there is a difference in ADG during the different stages.* Maintenance diet in 1st winter / compensatory growth in 2nd summer / production or finishing diet in 2nd Winter	**2(1)**
	(iv)	Using the data in the table, plot a graph showing the trend in target live weight over the lifecycle of animal. 3m – correct scale 3m – correct data plotted (5 plotted points) 3m – line correctly drawn	**4+4+3**
	(v)	*Outline the consequences for the profitability **and/or** environmental footprint of the beef production system, if performance targets are not achieved.* **Profitability:** Cattle that fail to reach target daily live-weight gain (DLWG) take longer to reach slaughter weight / increases the length of the finishing period - meaning more feed or bedding or labour or housing required / reduced animals that can be finished each year / inefficient use of inputs (feed, fertiliser and veterinary costs) **Environmentally:** Underperforming cattle produce emissions for longer periods because they are on the farm for more time / increased greenhouse gas emissions (per kilogram of beef produced) / extra feed production or fertiliser use also increase the risk of nutrient losses to water or higher energy use	**5+1**

	(b)(i)	*Explain how Ireland's climate and agricultural practices support grass-based farming.* Ireland has a mild, temperate climate with few extremes of heat or cold / regular rainfall ensures consistent grass growth throughout most of the year / long grazing season (up to 300 days in many areas) / farmers use rotational grazing to maintain high-quality leafy grass / soil testing or liming optimise pH and nutrient availability / use of high-yielding grass or clover varieties improves pasture output / grass-based systems reduce reliance on imported feeds or fertilisers	**5+1**
	(ii)	*In relation to grass-fed beef identify if the following statements are true or false.* False False True False	**2(3)+ 2(1)**
	(iii)	*Outline **two** reasons why food traceability and origin labelling are important to consumers of Irish meat and dairy.* Food safety - tracked from farm to fork / consumer confidence – ensures trust in product / allows consumers to choose food that is produced in Ireland / associated with high animal welfare or environmental standards / supports local farmers / ensures consumers know the true origin of their food.	**5+1**
Q18	**(a)**	*Compare progeny testing and performance testing.* **Progeny testing**: Comparison of the performance of an organism's offspring with another organism's offspring (kept under the same conditions) **Performance testing**: Comparison of an organism's traits or performance with another organism kept under the same conditions	**2+2**
	(b)(i)	*Explain how selective breeding and genetic improvement benefit the herd over several generations.* (Increased production) - average milk yield or milk solids of the herd increases / increased fertility or shorter calving intervals or more calves per cow lifetime / cows become more efficient / improved health or longevity	**5+2**
	(ii)	*Describe how a recording system (e.g. ICBF for animals, DAFM for variety lists for plants) helps a farmer make genetic decisions.* (Informed genetic decisions) - provides farmers with reliable information on the genetic performance of breeding stock or plant varieties / farmers can select animals or plants with proven genetic merit / higher productivity / better fertility / improved health or disease resistance / greater profitability	**5+2**

	(iii)	*State **one** genetic traits of importance in:* ***Animal breeding:*** milk yield / fertility / calving difficulty / carcass traits / health data / any valid genetic trait ***Plant breeding:*** Yield / disease resistance / straw strength / quality traits (digestibility, etc) / any valid genetic trait	**5+2**
	(c)(i)	*Which variety would you recommend for an early-harvest system with low chemical input?* Wheat A	**5**
	(ii)	*Justify your choice with **two** reasons.* Matures (9 days) earlier than Wheat B / it has higher disease resistance (so reduced chemical requirement)	**2(4)**
	(iii)	*Explain how genetic traits in plants or animals can help farmers respond to soil conditions.* ***In plants:*** Select for traits such as disease resistant / tolerance to acidic soils or waterlogging or drought or low fertility (e.g. certain grass or cereal varieties have deeper or stronger root systems that allow them to access nutrients and moisture from poor or dry soils) ***In livestock:*** select animals that are better adapted to specific soil and grazing conditions. (e.g. hardy) / Native cattle or sheep breeds cope better on wet, heavy soils and are less prone to lameness /animals with efficient feed conversion or strong immune systems perform better on land with lower grass quality	**3**
	(d)(i)	*Explain genotyped* Genetic make-up of an organism determined	**2**
	(ii)	*Explain how the better management of SCC throughout the lactation period can benefit farmers.* Ensuring low SCC reduces the incidence of mastitis / (healthy udders) produce better quality milk or higher milk yields / fewer discarded milk days due to antibiotic treatments / milk with a low SCC attracts bonus payments from processors or avoids penalties / less need to cull (reducing replacement costs and improving genetic progress in the herd) / enhances animal welfare / reduces veterinary or labour costs	**5+2**

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.