Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2023

Marking Scheme

Agricultural Science

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

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

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

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

Future Marking Schemes

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

How to use the marking scheme

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

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

Cancelled answers

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

Surplus answers

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

Annotations used in the marking

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

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

Marking the Individual investigative Study (IIS)

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

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

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

Ordinary Level Agricultural Science Marking Criteria for Individual Investigative Study

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

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

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

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

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

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

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

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

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

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

<table>
<tr><th colspan="3">Answer any 10 questions
10 marks for each question
Total for section is 100 marks</th></tr>
<tr><th colspan="2">Question</th><th>Section A</th><th>Marks</th></tr>
<tr><td rowspan="3">Q1</td><td>(a)</td><td>Identify any two pieces of equipment required for this investigation.

A: pH paper or (universal) indicator paper
B: Graduated cylinder
C: Electronic or mass balance</td><td>2(3)</td></tr>
<tr><td>(b)</td><td>State the pH of the soil filtrate.

6.5*</td><td>3</td></tr>
<tr><td>(c)</td><td>State a conclusion the student can make from this investigation.

Soil pH is suitable or important for growing (most) crops</td><td>1</td></tr>
<tr><td rowspan="2">Q2</td><td>(a)</td><td>Identify any three of the following continental beef cattle.

A: Charolais
B: Aubrac
C: Limousine
D: Simmental
E: Belgian Blue</td><td>3+2+1</td></tr>
<tr><td>(b)</td><td>Outline a reason why farmers put a ring in a bull’s nose.

Safety / control bull / easier to handle / legal requirement (after 10 months)</td><td>4</td></tr>
<tr><td rowspan="2">Q3</td><td>(a)</td><td>Outline three management practices carried out by the students from calves arriving on the farm to weaning.

Isolate calves from others for a few days / feed glucose or electrolyte solution / feed milk or milk replacer (once or twice a day) / good feed equipment hygiene (milk troughs or buckets or milk trolley) / feed at the same regular intervals each day / clean dry bed / adequate space / draft free or well ventilated / vaccination (IBR or pneumonia or scour) / disbudding / penned according to age / access to water / introduce hay / introduce concentrates</td><td>3+3+2</td></tr>
<tr><td>(b)</td><td>Identify the weaning weight of a dairy beef calf at weaning.

<table>
<tr><td>130kg</td><td></td></tr>
<tr><td>90kg</td><td>✓</td></tr>
<tr><td>75kg</td><td></td></tr>
</table>
</td><td>2</td></tr>
</table>

<table>
<tr><td>Q4</td><td></td><td>Outline one reason why each of the following farming practices is carried out.

Controlled grazing: increased yield of crop / effective harvesting of crop or increased forage intake / increased biodiversity / decrease fossil fuel usage or reduced labour and feed costs / increased digestibility of the sward / fewer weeds / environmentally responsible grazing areas

Crop rotation: helps return nutrients to the soil or better nutrient management / reduced need for artificial fertilisers / interrupt pest or disease cycles or weed cycles / improve soil health or improves soil structure or decreases compaction / increasing biomass from different crops root structures / increase biodiversity on the farm.

Using organic fertilisers: reduced need for artificial fertilisers or cheaper or more sustainable / improve water movement into the soil / add structure to the soil / feed beneficial microbes / increase soil fertility / meet organic certification or customer preference</td><td>6+2+2</td></tr>
<tr><td>Q5</td><td></td><td>Using your knowledge of biosecurity, explain how each of the following can threaten the biosecurity on a farm and outline what the farmer can do to reduce the risk in any two.

<table><tr><th></th><th>Threaten Biosecurity</th><th>Reduce Risk</th></tr><tr><td>Sick animals</td><td>Can pass the disease (infect) onto other animals or humans / cause a disease outbreak on the farm</td><td>Isolate new animals when entering the farm / isolate sick animals / vaccination / cull sick animals</td></tr><tr><td>Contaminated vehicles and equipment</td><td>Can carry disease between farms (on tyres) / in slurry tankers</td><td>Wash or disinfect vehicles and equipment between farms</td></tr></table></td><td>4+4+1+1</td></tr>
<tr><td>Q6</td><td>(a)(i)</td><td>State your understanding of BCS.

Body condition score / technique used to assess how fat or thin an animal is / score 1 – 5 (1 = very thin and 5 = very fat)</td><td>6</td></tr>
<tr><td></td><td>(ii)</td><td>Identify the best quality silage and state which animals this silage is suitable.

Best quality silage = 76%+ DMD or A

Suitable animals = freshly calved dairy cows in winter milk</td><td>2

1</td></tr>
<tr><td></td><td>(iii)</td><td>State which silage DMD % is suitable for dry suckler cows that have a good BCS.

<67(%) or D</td><td>1</td></tr>
</table>

<table>
<tr><td colspan="4">Or</td></tr>
<tr><td></td><td>(b)</td><td>Outline the process a farmer would carry out to get good quality silage.
Spread fertiliser or slurry 6 weeks before cutting / test grass for nitrate and sugar level / cut in afternoon (using mower) / do not cut during or after rainfall / cut using a precision chop mower / cut around middle of May or when grass is in vegetative stage / leave in rows (swathes) / allow to wilt for 24 hours / bale or bring to pit / shake out with a pitchfork to remove large clumps / roll tightly to remove air / use an additive (acid or molasses) / cover with plastic / weigh down with tyres / allow time for fermentation to occur</td><td>6+2+2</td></tr>
<tr><td>Q7</td><td>(a)</td><td>Complete the table.
<table>
<tr><th>Ewe Number</th><th>Mothering Ability Score</th><th>Implications for Farmer</th></tr>
<tr><td>107</td><td>3</td><td>(Average mother), not protective and moderately attentive / or valid implication described</td></tr>
<tr><td>108</td><td>1</td><td>(Very poor mother) with no interest in lambs / or valid implication described</td></tr>
</table></td><td>2(3)</td></tr>
<tr><td></td><td>(b)</td><td>Briefly describe why it is important for ewes to be protective of her lambs.
So, a predator (e.g. fox / dog) won’t take them (kill them) or lambs will not get lost or die (from exposure)</td><td>4</td></tr>
<tr><td>Q8</td><td>(a)</td><td>Treating a cow with antibiotics involves a number of steps which are listed below. Place the steps in correct order.
<table>
<tr><td>D</td><td>B</td><td>A</td><td>E</td><td>C</td></tr>
</table></td><td>6+2+1+1</td></tr>
<tr><td></td><td colspan="3">Or</td></tr>
<tr><td></td><td>(b)(i)</td><td>Identify the bacteria that does not cause mastitis in dairy cows.
<table>
<tr><th>Bacteria</th><th></th></tr>
<tr><td>Rhizobium</td><td>✓</td></tr>
<tr><td>E. coli</td><td></td></tr>
<tr><td>Pseudomonas</td><td></td></tr>
</table></td><td>2</td></tr>
<tr><td></td><td>(ii)</td><td>Apart from teat dipping, outline ways farmers can reduce the incidence of mastitis on their farms.
Wiping the teat with antiseptic wipe / wash the parlour or milk lines thoroughly / lime on cubicles / change liners regularly / service milking machine regularly / clip tails / (selective) dry cow therapy / wear gloves / milk infected cows last / don’t over or under milk cows / control flies / choose suitable breed (for udder health) / cull infected animals / strip teats regularly or regular monitoring</td><td>2(4)</td></tr>
</table>

<table>
<tr><td rowspan="6">Q9</td><td>(a)(i)</td><td>Identify the stomach chamber A.
Abomasum*</td><td>3</td></tr>
<tr><td>(ii)</td><td>Explain the changes in the structure of the ruminant stomach as the animal gets older.
As the animal gets older the rumen develops (gets bigger) / abomasum or A gets smaller / oesophageal groove closes</td><td>4</td></tr>
<tr><td>(iii)</td><td>Identify the pH of the rumen by placing a tick (✓) in the correct box.
<table><tr><th>pH</th><th></th></tr><tr><td>7.0</td><td>✓</td></tr><tr><td>4.0</td><td></td></tr><tr><td>9.0</td><td></td></tr></table></td><td>3</td></tr>
<tr><td colspan="3">Or</td></tr>
<tr><td>(b)(i)</td><td>Explain the function of each of the following ruminant stomach chambers.
Rumen – microorganisms break down cellulose / breakdown starch (fermentation) / produces VFA / synthesise amino acids / synthesise B and K vitamins
Omasum – absorption of water</td><td>1

1</td></tr>
<tr><td>(ii)</td><td>List one example of an animal with a ruminant stomach.
Sheep / cow</td><td>4</td></tr>
<tr><td>(iii)</td><td>State one difference between a ruminant and monogastric stomach.
<table><tr><th>Ruminant</th><th>Monogastric</th></tr><tr><td>4 stomachs or chambers</td><td>one stomach</td></tr><tr><td>fermentation</td><td>no fermentation</td></tr><tr><td>pH rumen = 7 or
pH abomasum = 2</td><td>pH stomach = 2</td></tr><tr><td>regurgitation of food or chewing the cud</td><td>no regurgitation of food</td></tr></table></td><td>3+1</td></tr>
<tr><td rowspan="2">Q10</td><td>(a)(i)</td><td>Compact calving period.
Cows calve in a short or defined period of time (e.g. 6 weeks)

Increasing genetic merit.
Genetic merit is improved through selection / the overall improvement from selection for a trait or number of traits or correct interpretation (e.g. high growth rate or carcase yield or milk yield)</td><td>2

2</td></tr>
<tr><td>(ii)</td><td>Briefly describe ways to ensure the stock bull on the farm is fertile during the breeding season.
Fertility check or check for abnormalities in the scrotum or penis / correct BCS / good health or disease free / not lame / no sudden changes in diet / observe bull is serving the cows / record service / dose and vaccinate well before the breeding season / avoid stress</td><td>4+2</td></tr>
</table>

OR			
	(b)(i)	*Identify which bull has the most abnormal sperm cells.* Bull 4	**3**
	(ii)	*Identify which bull has the best motility.* Bull 1	**3**
	(iii)	*State which bull is the most fertile and best to use with the maiden heifers on the farm.* Bull 1	**2**
	(iv)	*Outline how the bulls could be restrained for the vet to carry out the procedure.* Crush / headgate	**2**
Q11		*Draw a labelled diagram showing earthworm activity.* Layer of organic matter (leaf litter) or grass on top / earthworms on top / layer of chalk or layer of compost / layer of sand or layer of gravel / layer of clay or layer of soil / earthworms create channels or channels shown / earthworms mixing layers or mixed layers shown / decompose organic matter *Diagram* – showing - suitable container, 2 layers, earthworms, mixing or tunnels Any 3 correct for 4 marks / any 2 correct for 2 marks *Labels* – any 3 correct labels	**D=0,2,4** **Labels=3(2)**
Q12	**(a)**	*Explain contagious.* Spread (disease) from one organism (plant) to another	**5**
	(b)	*List **two** examples of environmental factors that can affect crop production.* Soil Temperature / air temperature / soil compaction /soil drainage or drought or aeration / soil pH or soil type / light / nutrients / water / wind speed / lack of insects (pollinators) biodiversity or pest damage	**2+1**
	(c)	*Briefly explain how this new onsite technology can benefit crop production.* Fast results so can treat the disease or pest quickly / know if there is a problem quickly / cost effective	**2**

Section B Answer any 4 questions 50 marks for each question Total for section is 200 marks			
Q13	**(a)(i)**	*Outline reasons why reseeding is recommended.* Increased productivity or excess silage (can be sold) or increased liveweight gain or increased milk yield or increased palatability / increased stocking density or higher output / better nitrogen use efficiency or reduced nitrogen requirement / longer growing season or extended grazing / better silage or grass quality / increased protein or mineral content / less disease or weeds / reduce soil compaction	**4+2**
	(ii)	*Identify the plants that may be sown in a newly reseeded pasture.* *A*: Red clover *B:* Perennial ryegrass *C:* White clover *(clover accepted once only)*	**6+3+3**
	(iii)	*Outline reasons for sowing plants **A** and **C** shown in part (ii) in a newly sown sward.* Increased grass quality or production / increased dry matter (DM) (intake) or increased palatability / higher milk production / higher liveweight gain or higher output / increased protein / increased mineral content / nitrogen fixation or less artificial fertilizer / reduce weeds / increase biodiversity	**4+2**
	(b)(i)	*Identify which reseeding method(s) have the highest potential for grass production.* Disc	**6**
	(ii)	*Outline what conclusion the researchers can make in relation to the sustainable reseeding methods.* There is very little difference in the grass growth (between all the reseeding methods) or sustainable methods as good as plough or it would be better for the environment to use the sustainable methods / correct ranking in relation to sustainability (using data from graph)	**2**
	(iii)	*Briefly describe the advantages of reseeding using the one pass system.* Cheaper than the conventional ploughing method / less soil disturbance or no need to plough or less compaction / fewer stones / suitable for shallow soils / conserves soil moisture / conserves soil biodiversity / land fallow for shorter period	**4+2**

	(c)(i)	*Outline key points a farmer needs to consider when deciding what grass mixtures to sow.* Intended use of grass / varieties suitable to farm / animal production type / soil type / introduction of clover / multi species swards / palatability / productivity or yield / heading date	**4+2**
	(ii)	*Advise the farmer as to where to access information on grass varieties.* Department of Agriculture / recommended varieties list / Teagasc / (local) seed companies / other valid example	**6**
	OR		
	(d)	*Describe how a farmer would manage a newly reseeded sward in its first year after sowing.* Good weed control (selective herbicide) / ready for grazing (roots don't pull up when grazed) / fertilise / light stock to prevent poaching / increase tillering (fertiliser or grazing or topping) / pest control	**2(6)**
Q14	**(a)(i)**	*Explain disease resistance and time of harvest (in named food crop bar grass).* *Disease resistance:* Ability to prevent or reduce the presence of diseases in a crop / or correct example *Time of harvest:* The time of the year during which the crop is harvested / or correct example	**2** **2**
	(ii)	*State **one** essential element required by the crop and describe its role.* *Element:* N, P K, S etc. *Role:* N for protein formation or increases yield or chlorophyll formation or component of amino acids or DNA or ATP or ADP / P for growth or energy or ATP or ADP or root growth or seed (fruit) formation or tillering / K for growth or yield or development or resist drought or disease resistance or helps plants use water or translocation of carbohydrates / or any valid example with a matching valid role	**2** **2**
	(iii)	*Briefly outline **two** factors which affect the preservation of the crop.* *Factors:* Temperature or light / pH / oxygen / moisture *Outline of factor:* Temperature – if temperature is too warm crop can overheat or respire causing spoiling of the crop or if temperatures are too cold frost damage can occur or light will cause potatoes to sprout or turn green pH – if pH is not suitable grain may sprout in storage or grain may rot Oxygen – foods store best with no oxygen or the presence of oxygen may speed up spoilage Moisture – crops last longer when moisture is removed (e.g. reducing moisture in cereal crops)	**Factors-2(2)** **Outline-2(1)**

	(iv)	*Describe the safety considerations Lisa should consider when harvesting the crop.* Be careful of moving machinery or keep children away from yard / PTO covered / wear gloves or a mask / turn off machinery if clearing any blockages / extreme care on steep slopes / maintain a safe distance from waterways / experienced operators on machinery or machinery in proper working order / safety signs or cones on entrances or exits to roads	**2(4)**
	(b)(i)	*State which diagram has a higher biodiversity level and give a reason for your answer.* *Diagram*: C *Reason:* Different crops sown / lots of trees / animals are not allowed into river to drink / flowers or trees present or boundary created to allow for natural growth / no spraying	**4** **4**
	(ii)	*Outline the reason for the crop **X** being sown between the cows and the river in diagram **A**.* Wildlife corridor / prevent soil erosion into river / prevents the cattle from drinking in or entering the river / reduce nutrients leaching into the river / increase biodiversity	**4**
	(iii)	*Outline the advantage of spot spraying compared to spraying the whole field.* Less chemicals required or reduce pollution or more environmentally friendly / only treat the target plant / reduced resistance to herbicide / reduced cost of expensive chemicals	**4**
	(iv)	*State which diagram represents farming in the least environmentally friendly way and give **two** reasons for your answer.* *Diagram*: B *Two reasons*: cattle drinking in river / splash plate slurry spreading or slurry being spread near the river / no trees or plants / monoculture / no wildlife corridors / river banks are being eroded into the river / water quality (eutrophication) / spraying weed killer (near river)	**4** **2(4)**

Q15	**(a)(i)**	*Describe how he took soil samples for analysis.* Random / min 20 samples / 10 cm in depth / soil corer or sampler or auger / divide land into areas of 2-4 hectares / account for differences in soil type or slope or previous cropping history / W shape / avoid gateways or troughs or beside ditches or wet land / store samples from the same field together ***(marks can be awarded for points on diagram)***	**2(5)**
	(ii)	*Identify which soil is compacted and give a reason for your answer.* *Soil sample* – B *Reason* – less (air) spaces or soil particles closer together	**5** **5**
	(iii)	*Outline the effects of soil compaction on a farm.* Reduced crop yield or delayed germination or poor establishment or shorter growing season / reduced water availability or water intake / reduced root development (penetration) or mineral uptake / reduced animal production (reduced milk yield or lower LWG) / increased surface run-off or pollution / reduced water infiltration or poor drainage or flooding / reduced gaseous exchange which stunts plant growth / soil erosion / formation of plough pan / reduced optimal living conditions for soil organisms	**4+2**
	(iv)	*Suggest ways farmers can reduce soil compaction on their farm.* (Mole) plough or subsoil / reseed / multi species swards or reduce tillage / reduce stocking density / construct drainage or lime regularly / house animals in prolonged wet weather / increase organic matter / reduce traffic or axle loads (animal or machinery) / (add diversity to) crop rotations	**4+2**
	(v)	*Describe with the aid of a labelled diagram how he carried out this investigation to compare capillarity.* Two open ended tubes / put cotton wool in one end / dry soil / fill (same amount of soil tubes) with soil A and other with soil B / place tubes in beakers of water / leave for a period of time / measure the height of the water column in each / description of water movement or valid result ***(Points can be found on the diagram)***	**3(2)**
	(vi)	*State **two** errors that could have occurred in the investigation in part (v).* Different amounts of soil or time or water or soil type / failure to tap the glass to remove large soil spaces / soil not fully dry / failure to read height of water at eye level or error of parallax / another valid example	**2(1)**
	(b)	*Label diagram.* *A*: Top Soil *B:* Sub soil	**6+4**

<table>
<tr><td colspan="4">Or</td></tr>
<tr><td></td><td>(c)</td><td>Complete the graph to show the average organic matter and water composition of a brown earth soil.

Organic matter – 5%

Water – 25%</td><td>6+4</td></tr>
<tr><td>Q16</td><td>(a)(i)</td><td>Describe with the aid of a labelled diagram, how he would carry out the investigation to check the quality of milk.

Place milk sample into test tubes / add few drops (1 cm^3) of Resazurin to three tubes (average) / place in water bath / at 37^oC / for 15 minutes / record colour change
Result: (allow one only)
Fresh – blue – good quality (low TBC)
Blue – deep mauve = good
(Deep) pink = fair
(Light) pink = poor
White = poor
Or

Total Bacterial Count on the Sample:
Get a sample of milk and carry out a serial dilution of the milk sample by adding 1ml of milk into 9ml of distilled water & shake to mix / take 1ml from this test tube and add to 9ml of distilled water & shake / repeat this for 4 more test tubes / take 1ml of milk from the last test tube & place on a prepared nutrient agar plate under aseptic conditions. Repeat 3 times for accurate results / spread the milk around the plate using a plate spreader / leave one agar plate unopened as a control / place in incubator for 72 hours at 25^oC / remove plate & record number of bacteria colonies on the plate & multiply by 10^6 to get the number of CFU’s / ml of milk /
Result: There will be CFU’s in the plate over - time as the number of bacteria in the sample multiply causing a decrease in quality of the milk.
Or
There are other valid tests a student could do - % protein / % butterfat (gerber method) / Presence of Thermoduric bacteria (serial dilution) / presence of antibiotics (Devlo test) / SCC – California Mastitis Test (CMT) / % Solids in a milk sample (excess water)
(Points can be found on the diagram)</td><td>3(4)</td></tr>
<tr><td></td><td>(ii)</td><td>Identify the following variables in the investigation in part (i).

<table><tr><td>Independent</td><td>Milk sample</td></tr><tr><td>Dependent</td><td>Quality – colour change of resazurin / cfu in bacterial count</td></tr><tr><td>Control</td><td>Fresh milk sample or milk sample of known quality or equal volumes of milk or equal volumes of Resazurin or all test tubes sterile or any other valid control variable</td></tr></table></td><td>3(2)</td></tr>
</table>

	(iii)	*State with reason if the data collected is qualitative or quantitative.* *Data type*: Resazurin test – qualitative; TBC - quantitative *Reason*: Resazurin – colour change as result / non-numerical data; TBC – count number of CFU's / numerical data	**2+2**
	(b)(i)	*Outline ways Pat could reduce the number of bacteria entering the milk.* Teat dipping pre and post milking / milk socks or filtering / (hot) wash machine regularly / change liners regularly (twice per year) / lime on cubicles / clean housing or clean lying area / clip hair on cow's tails / wash and dry udder / control flies or mastitis / operator hygiene	**6+6**
	(ii)	*Calculate the price Pat gets for 1000 litres of his milk in the table below if the milk fat is 3.8% and protein is 3.4%.* €174.72 + €317.45 – €40 = €452.17 **(If a candidate gives 452.17 without showing any calculation they may be awarded 6m)**	**3** **3**
	(c)(i)	*Explain climate-neutral dairy farm.* The amount of greenhouse gas emissions a farm produces is balanced by absorbing or removing equivalent emissions in the atmosphere or the carbon used = the carbon saved or a balanced carbon footprint / or valid explanation	**2**
	(ii)	*Outline why each of the following ingredients are added to the diet of a dairy cow.* *Beans:* source of protein / increase in milk fat *Barley:* source of carbohydrate or energy	**4** **4**

Q17	**(a)(i)**	*Briefly describe the advantages of ultrasound scanning.* Determine number of lamb's ewe is carrying / identify barren ewes / estimate lambing date / group and feed ewes to ensure body condition and lamb birth weight or more economical or efficient use of feed / reduce problems at lambing or reduce twin lamb disease / ease of fostering	**4+2**
	(ii)	*Explain the importance of having a good marking system for the ewes at scanning.* Know how many lambs' ewes are carrying / identify barren ewes to cull / for management of ewes prior to lambing or at housing / ease of fostering	**4**
	(iii)	*Outline the advice you would give on the management of the ewes based on the results.* Cull the ewes that are not in lamb / adequate number of pens or pen the ewes according to the number of lambs / fosters from triplets / increase or improve the quality of concentrate feeding for multiple births (prevent twin lamb disease) or restrict feed intake for singles / plan for adequate supervision during lambing	**4+2**
	(b)(i)	*Advise the farmer as when to house the ewes prior to lambing.* 4 – 8 weeks prior to lambing / start of steaming up / correct time of year indicted (Jan/Feb)	**4**
	(ii)	*Suggest reasons for housing the ewes prior to lambing.* Allow for early grass / protect sheep (from cold conditions during lambing) / easier feeding or management / reduce mortality at lambing / less predators / reduce stress on pregnant ewes	**4+2**
	(iii)	*List features of winter housing for sheep.* Adequate feeding space (450 mm) or all sheep can feed from the one feeding passage / adequate lying space (1.2 m^2) or adequate pen depth (2.7m) / good ventilation / draft free / individual lambing pens / group pens / clean bedding or slats / water troughs	**4+2**
	(c)	*Describe the management practices carried out on lambs in the first week after birth.* *Feeding* – colostrum for antibodies or to warm up or laxative or energy / milk or milk replacer *Housing* – individual pen or fostering crate to bond with mother / group pen for hardening off / turned out with mother/ clean dry bedding *Health* – iodine on navel to prevent joint or navel ill / vaccination (e.g. Orf) / tag for identification / tail dock / castration male animals / place under infra-red to prevent chill or give glucose injection / any other valid disease prevention or treatment in first week	**6** **6** **6**

Q18	**(a)(i)**	*Identify the function of the underlined term by placing a tick (✓) in the correct box.* Genetic information ✓	**6**
	(ii)	*Explain how the police used the DNA evidence to prove that the heifer was stolen.* Blood samples were taken from cow / (DNA) matched other cows from original farm	**2(6)**
	(iii)	*Briefly describe another innovative method used on farms you have studied.* Sexed semen- semen is separated into X and Y chromosomes and farmer can choose if they want a heifer or bull / genomic selection – genetically estimating the breeding value of animals / or other valid innovation method of farming	**6**
	(b)(i)	*Explain how the gene editing process works.* Gene responsible for a specific trait is identified / CRISPR-Cas9 edits genes by precisely cutting DNA at the target gene / desired gene is inserted / natural DNA repair processes occurs	**3+1**
	(ii)	*Briefly describe the advantages of gene editing.* Breed high yielding plants or superior animals or increase growth in food production and quality / disease resistant plants or animals / pest resilient crops / results quicker than selective breeding / can target specific diseases / good precision with ability to target individual cell types / drought resilient crops / genetically polled breeds / or any two valid examples	**3+1**
	(iii)	*Explain any **two** of the following ethical or economic issues of producing GM crops in Ireland.* *Impact on environment*: GM crops can help reduce agricultural greenhouse gas (GHG) emissions / less fertiliser requirements / fewer chemical sprays required / negative – herbicide resistant weeds *Effect on food chain:* More nutritious food / tastier food / disease resistant or pest resistant plants or drought resistant / less use of chemicals / increased supply of food with reduced cost / longer shelf life of food / negative - allergies *Increase in production*: increased yield of plants / less weeds / less diseases / faster growing / negative – market place monopoly / lower the value of crops	**4+2**
	(c)(i)	*Explain selective breeding.* Selective breeding involves choosing parents with particular characteristics to breed together / produce offspring with more desirable characteristics.	**2+2**
	(ii)	*Briefly explain **two** characteristics farmers or scientists would select in their breeding programme.* (High) crop yields / resistance to disease / (high) growth rate / (good) conformation / good milk production (yield and milk solids) / prolificacy / or any two valid examples	**6+2**