



**Coimisiún na Scrúduithe Stáit**  
**State Examinations Commission**

**Leaving Certificate 2021**

**Marking Scheme**

**Agricultural Science**

**Ordinary Level**

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

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

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

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

## **Future Marking Schemes**

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

## How to use the marking scheme

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

- The mark awarded for an answer appears in **bold** in the marks 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.
- Examiners should write the total mark for each question at the beginning of the question, beside the question number, and circled.
- The cumulative total should be written in the bottom right-hand corner of each page on which a question total appears.
- All blank pages should be marked to indicate they have been inspected.

### Cancelled answers

- The following is an extract from *S.63 Instructions to Examiners, 2021* (section 7.3, p.25), "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 manually 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 also explained in the table. These annotations will be seen on a script if viewed as part of the appeal process. 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.
✗	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.

## 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 mark 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
<b>Introduction and background research</b>  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 is 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.
<b>20 marks</b>	<b>16-20</b>	<b>12-15</b>	<b>8-11</b>	<b>0-7</b>
<b>Award a single mark out of 20 for this section. In arriving at this mark consider the indicative content requirements below.</b>				
<i>Introduction - context for the IIS - 10 marks</i>	<ul style="list-style-type: none"> <li>• Very Good - 8 - 10 marks</li> <li>• Good - 6 - 7 marks</li> <li>• Fair - 4 - 5 marks</li> <li>• Weak - 0 - 3 marks</li> </ul>		<i>Background research - research, sources and knowledge - 10 marks</i>	<ul style="list-style-type: none"> <li>• Very Good - 8 - 10 marks</li> <li>• Good - 6 - 7 marks</li> <li>• Fair - 4 - 5 marks</li> <li>• Weak - 0 - 3 marks</li> </ul>

Section	Very Good	Good	Fair	Weak
<p><b>The investigative process</b></p> <p>Suggested range between 500 and 800 words</p>	<p>Identifies and provides a description of the investigative process undertaken, which may have some limitations.</p> <p>A valid hypothesis was generated and tested. Ideas, concepts and theories make tentative links between at least some aspects of the task.</p> <p>At least one experiment involving gathering and processing data.</p> <p>A logical description of how data was gathered, which may have some omissions / errors.</p> <p>An attempt at linking to learning outcomes of specification.</p>	<p>Identifies and provides a simplistic description of the investigative process undertaken.</p> <p>A simplistic hypothesis was generated and tested.</p> <p>At least one experiment involving gathering and processing data.</p> <p>Description of how data was gathered is vague, with some omissions / errors.</p> <p>Vague linking to learning outcomes of specification.</p>	<p>Simplistic or confused details of the investigative process presented and only vaguely relevant to the theme.</p> <p>Very simplistic hypothesis generated and tested.</p> <p>At least one experiment involving gathering and processing data with only a very poor description of how data was gathered with major omissions / errors.</p> <p>Very poor linking to learning outcomes of specification.</p>	<p>Little or no details of the investigative process presented and which has no relevance to the theme.</p> <p>A very poor hypothesis or no hypothesis generated.</p> <p>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.</p> <p>No link with learning outcomes of specification.</p>
<b>25 marks</b>	<b>20-25</b>	<b>15-19</b>	<b>10-14</b>	<b>0-9</b>
<b>Award a single mark out of 25 for this section. In arriving at this mark consider the indicative content requirements below.</b>				
<i>Details of the actions undertaken in response to stated hypothesis - 12 marks</i>	<ul style="list-style-type: none"> <li>• Very Good - 10 - 12 marks</li> <li>• Good - 8 - 9 marks</li> <li>• Fair - 5 - 7 marks</li> <li>• Weak - 0 - 4 marks</li> </ul>		<i>Data collection undertaken - 13 marks</i>	<ul style="list-style-type: none"> <li>• Very Good - 11 - 13 marks</li> <li>• Good - 8 - 10 marks</li> <li>• Fair - 6 - 7 marks</li> <li>• Weak - 0 - 5 marks</li> </ul>

Section	Very Good	Good	Fair	Weak
<b>Results, analysis, and conclusions</b> 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.
<b>35 marks</b>	<b>28-35</b>	<b>21-27</b>	<b>14-20</b>	<b>0-13</b>
Award a single mark out of 35 for this section. In arriving at this mark consider the indicative content requirements below.				
<i>Appropriate presentation of data - 10 marks</i> <ul style="list-style-type: none"> <li>Very Good - 8 - 10 marks</li> <li>Good - 6 - 7 marks</li> <li>Fair - 4 - 5 marks</li> <li>Weak - 0 - 3 marks</li> </ul>	<i>Informed judgement and conclusions following analysis - 15 marks</i> <ul style="list-style-type: none"> <li>Very Good - 12 - 15 marks</li> <li>Good - 9 - 11 marks</li> <li>Fair - 6 - 8 marks</li> <li>Weak - 0 - 5 marks</li> </ul>	<i>Knowledge and insights arrived at as a result of the study - 10 marks</i> <ul style="list-style-type: none"> <li>Very Good - 8 - 10 marks</li> <li>Good - 6 - 7 marks</li> <li>Fair - 4 - 5 marks</li> <li>Weak - 0 - 3 marks</li> </ul>		

Section	Very Good	Good	Fair	Weak
<b>Reflection on the study</b>  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.
<b>10 marks</b>	<b>8-10</b>	<b>6-7</b>	<b>4-5</b>	<b>0-3</b>
Award a single mark out of 10 for this section. In arriving at this mark consider the indicative content requirements below.				
<i>The candidate presents coherent reflections, lessons learned and significance of the study - 10 marks</i>		<ul style="list-style-type: none"> <li>• Very Good - 8 - 10 marks</li> <li>• Good - 6 - 7 marks</li> <li>• Fair - 4 - 5 marks</li> <li>• Weak - 0 - 3 marks</li> </ul>		
<b>References</b>	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.
-	-	-	-	-
<i>References should be checked within section(s) and linked to this section of study.</i> <i>Any issues with the referencing should effect the mark awarded to the section in which the references are being cited in the study.</i>				

Section	Very Good	Good	Fair	Weak
<b>Communication and innovation</b> (This is not a distinct section of the report)	<p>The study has a reasonable coherence in its structure and adheres to the IIS structure.</p> <p>Work is focused with material labelled appropriately and organised.</p> <p>Communication of data and information is clear but simplistic.</p> <p>Some evidence of innovative thinking and an individual approach.</p>	<p>In the main, the study adheres to the IIS structure.</p> <p>The work may lack focus in parts and there may be some omissions in both content and errors in labelling of material.</p> <p>Study organisation and coherence is of a basic level with limited evidence of originality and innovative thinking.</p>	<p>Poor construction and structure, with only some adherence to the IIS structure.</p> <p>Organisation and coherence is limited and confused throughout with many errors.</p> <p>Little evidence of originality and innovative thinking.</p>	<p>The work lacks structure, organisation, coherence, focus, context and clarity. IIS structure not well used.</p> <p>Irrelevant material and significant errors.</p> <p>No evidence of originality and innovative thinking.</p>
<b>10 marks</b>	<b>8-10</b>	<b>6-7</b>	<b>4-5</b>	<b>0-3</b>
Award a single mark out of 10 for this section. In arriving at this mark consider the indicative content requirement below				
<i>The report has an overall coherence, quality and clarity with the inclusion of individual innovative thinking by the candidate - 10 marks</i>			<ul style="list-style-type: none"> <li>• Very Good - 8 - 10 marks</li> <li>• Good - 6 - 7 marks</li> <li>• Fair - 4 - 5 marks</li> <li>• Weak - 0 - 3 marks</li> </ul>	

Section A		Answer any 7 questions 10 marks for each question Total for section is 70 marks	Marks
Q1	(a)	Identify the following plants	
	(i)	Oilseed rape*	2
	(ii)	Barley*	2
	(iii)	Clover*	2
	(iv)	Distinguish between Biennial – (complete lifecycle) grows in 2 years Perennial - plants that grow (complete their life cycle) every year (over many seasons) (producing flowers and seeds)	3 +1
OR			
Q1	(b)	Identify the following plants	
	(i)	A = Daisy	2
		B = Dock leaf	2
		C = Buttercup	2
		D = Thistle	2
	(ii)	Spray (with herbicide or weed killer) / digging up or ploughing (to remove weeds) / crop rotation to disturb (break) weed cycle	2
Q2	(a)	Identify the parts	
		A = Rumen	2
		B = Abomasum	2
	(b)	C = Omasum	2
		Two functions of microorganisms in digestive system Breakdown food or cellulose or roughage or fibre / make vitamins (B and K) / synthesis (make) amino acids (from non-protein sources) / produce (volatile) fatty acids (used as energy for maintenance and milk production)	3+1
Q3	(a)(i)	Explain crop rotation Growth of crops in a defined sequence / growing different crops in a field every year (in a particular order) / correct named example of sequence	2
	(ii)	State two advantages of crop rotation Manage soil fertility / reduce erosion / improve soil health / increase nutrient availability for crops / prevent build-up of pests and diseases / weed control / improve soil structure	3+1
	(iii)	Suggest two disadvantages of using chemical sprays in crop production Toxic (harmful to human health) / build-up of toxins in food chain / cause pollution / kill other plant or animal species (e.g. pollinators - bees) or harmful to the environment / pollution of air or soil / volatilisation of fertiliser (e.g. urea) can kill germinating seedlings / resistance to chemical / cost	3+1

OR			
Q3	(b)(i)	Define biological control  Control of a pest by introduction of natural enemy or predator / use of one living thing to control another / or valid example	2
	(ii)	Give two examples of biological control on farms  Ladybird (eat) greenfly / parasitic wasp (eat) greenfly / ducks or geese (eat) mud-snail / cats (prey on or eats) mice or rats / other valid examples	3+1
	(iii)	Outline two advantages of using biological control in crop production  No chemicals used / no entry of chemicals into food chain (soil) or water source / lower cost to farmer / no resistance build up / less labour required/ self-sustaining or long term solution / improves biodiversity	3+1
Q4	(a)	Identify two soli types A and B  A = Brown earth B = Podzol	2 2
	(b)	Outline one use of soil A  (Tillage) crops / horticulture / grazing pasture (grassland) / silage or hay	2
	(c)	Describe two disadvantages with use of soil B  Poor drainage (due to the impermeable iron pan) / poor aeration (as air spaces fill with water) / acidic or low pH (due to poor decomposition of organic matter) / poor fertility (low CEC) (due to acid leaching) / poor root penetration (due to iron pan) / reduced crop yield (due to acidic nature of soil or poor drainage or poor aeration or waterlogging of soil) / poor establishment or yield or growth	3+1
Q5	(a)	State the independent variable  Infiltration rate or drainage or soil (structure)	2
	(b)	Describe how the infiltration rate was measured in investigation  Use (same amount of) soil for each / (each) sample in a funnel / (lined) with filter paper / add (same volume of) water (using graduated cylinder or beaker) / record time for (all) water to pass through (both samples) (into graduated cylinder or container) or compare volume of water collected from each sample	3+1
	(c)	Which soil type has higher infiltration rate?  Uncompacted soil	2
	(d)	Suggest one way farmers could improve infiltration rate of soil  Ploughing / subsoiling / liming / manuring or composting / sanding / dig drains / reduce heavy machinery use	2

<b>Q6</b>		<i>Complete the following</i>	
	<b>(a)</b>	Flushing	<b>2</b>
	<b>(b)</b>	Steaming up	<b>2</b>
	<b>(c)</b>	Maintenance diet	<b>2</b>
	<b>(d)</b>	Twin lamb disease	<b>2</b>
	<b>(e)</b>	Milk fever	<b>2</b>
<b>Q7</b>		<i>Indicate whether True or False</i>	
	<b>(a)</b>	False	<b>2</b>
	<b>(b)</b>	False	<b>2</b>
	<b>(c)</b>	True	<b>2</b>
	<b>(d)</b>	True	<b>2</b>
	<b>(e)</b>	True	<b>2</b>
<b>Q8</b>	<b>(a)(i)</b>	<i>Outline why medicines are locked away</i> Prevent children or animal accessing them / poisonous / expensive	<b>2</b>
	<b>(ii)</b>	<i>What is meant by farm safety sign?</i> Danger overhead power lines / caution electric fence / electric shock risk	<b>2</b>
	<b>(iii)</b>	<i>Suggest two pieces of PPE</i> Gloves /respirator or mask / overalls (apron) / goggles / wellington (rubber) boots / or any two valid examples	<b>2(2)</b>
	<b>(iv)</b>	<i>Explain one precaution to prevent ringworm transmission</i> Wear gloves or wash hands afterwards / avoid touching the infected area on the cattle	<b>2</b>
	<b>OR</b>		
	<b>Q8</b>	<b>(b)(i)</b> <i>Explain farm safety sign</i> Caution farm machinery / beware of moving machinery	<b>2</b>
	<b>(ii)</b>	<i>Describe one safety precaution when handling the cow and calf immediately post calving</i> Have a clear exit plan / have stick or fork with you / keep all children and dogs away or do not make loud noises or sudden movements / never turn your back on the cow / other valid answer	<b>2</b>
	<b>(iii)</b>	<i>Outline three safety precautions when agitating and spreading slurry</i> Remove all animals from the shed / ventilate the shed /open tractor windows / use a gas monitor / do not enter shed while agitating / ensure another person is present /stay clear of all agitation points or open hatches/ spread on a windy day / don't spread near electric wires (when using the splash plate) / keep all persons and animals away during spreading / cover on PTO / ear safety equipment / other valid answer	<b>3+2+1</b>

<b>Q9</b>	<b>(a)</b>	<i>Rank greenhouse gas emissions from agriculture in 2018</i> 1 <sup>st</sup> (highest ranking) or most or top	<b>2</b>
	<b>(b)</b>	<i>List two sources of greenhouse gases from agriculture</i> Animal (respiration) / slurry / FYM / synthetic fertiliser / lime / soils or soil cultivation (ploughing) / machinery (fuel) / ruminant digestion (enteric fermentation)	<b>3+1</b>
	<b>(c)</b>	<i>Explain two ways to increase biodiversity on farm</i> Leave tree in hedges / plant more native hedgerows or trees / cut hedges at correct time of year / cut hedges 1 in 3 years / cut hedges in pyramid shape rather than box shape to allow for nesting birds / leave field margins and grassy areas / replace drinking points with an alternative water supply or move drinking troughs away from drains / install bird or bat boxes or insect boxes / (identify and control) invasive species / sow wild flowers (to increase pollinators) / sow multi-species swards (polycultures rather than monocultures) / clean water sources in an environmentally friendly manner / grow crops for wildlife / no ploughing / no chemical usage (herbicide or fertiliser) / other valid answer	<b>3+1</b>

<b>Q10</b>	<b>(a)</b>	<i>Name the part labelled A</i> Ovary*	<b>2</b>
	<b>(b)</b>	<i>Function of part labelled A</i> (Produces) eggs or ovulation or produces oestrogen or progesterone	<b>2</b>
	<b>(c)</b>	<i>State</i> Gestation length = 279 - 291 days Oestrous cycle length = 21 days	<b>2</b> <b>2</b>
	<b>(d)</b>	<i>Place an X on the diagram exactly where the top of the insemination gun positioned</i> X on the diagram (must reach cervix)	<b>2</b>

<b>Q11</b>	<b>(a)(i)</b>	<i>Identify structure B</i> Silage (pit)	<b>2</b>
	<b>(ii)</b>	<i>Describe one for each</i> <i>Environmental hazard</i> = (silage effluent) run off (into water sources) / plastic wrapping <i>Safety hazard</i> = fall off silage pit or walls (no safety rails) / machinery injury	<b>3+1</b>
	<b>(iii)</b>	<i>One way farmyard layout is economically sustainable</i> Buildings (structures) are close together (easy access) / labour saving / good access roads through the farm / other valid answer	<b>2</b>
	<b>(iv)</b>	<i>Explain how one piece of new technology could enhance economy of labour on this farm</i> Automatic calf feeder / robotic milking machine or rotary parlour / automatic scrapers / automatic drafting system / automatic feeding system / other valid named piece of technology	<b>2</b>
<b>OR</b>			
<b>Q11</b>	<b>(b)(i)</b>	<i>Explain why isolation area on plan</i> If animal (cow) is sick or injured (must have isolation area to put them in during treatment) / don't pass disease (infection) to other animals or humans	<b>2</b>
	<b>(ii)</b>	<i>Describe purpose of footbath</i> Disinfect or clean boots (to prevent entry of diseases on to or off the farm) / biosecurity	<b>2</b>
	<b>(iii)</b>	<i>One reason for robotic vs herringbone/rotary parlour</i> Better work-life balance / less labour needed / increased milk yield from cows	<b>2</b>
	<b>(iv)</b>	<i>Place an X on diagram where slatted tanks installed</i> X on the diagram - Where cows stand in the feeding passage / passage behind cubicles / entry or exit point to graze way /	<b>2</b>
		<i>Reason</i> - areas with high levels of slurry or cows are feeding or cows are there longer	<b>2</b>

<b>Q12</b>	<b>(a)</b>	<p><i>Identify each breed using the list</i></p> <p>A = Charolais*</p> <p>B = Limousin*</p> <p>C = Jacob*</p> <p>D = Border Leicester*</p>	<p><b>2</b></p> <p><b>2</b></p> <p><b>2</b></p> <p><b>2</b></p>
	<b>(b)</b>	<p><i>Describe one characteristic from a named breed of either pig or horse or poultry (0m for naming breed)</i></p> <p><i>Landrace</i> - floppy ears / long body / good conformation / light forequarters / excellent ham development / high carcase weight good milk production / prolificacy</p> <p><i>Large White</i> - upright ears / pale skin / high growth rate / high lean meat % / good terminal sires / good uniformity of pigs / prolific &amp; good at converting feed</p> <p><i>Rhode Island Red</i> - red-orange eyes / reddish-brown beaks / yellow feet and legs / hardy breed / produce well on marginal feed / lay 200 - 300 eggs per year (prolific) / produce large eggs / eggs pale brown colour (market demands) / produce medium weight eggs</p> <p><i>Irish Sport Horse</i> - athleticism / jumping ability / courage / intelligence / soundness</p> <p style="text-align: right;"><b>Or other valid answer</b></p>	<b>2</b>

Section B		Answer any 3 questions 50 marks for each question Total for section is 150 marks	Marks
Q13	(a)(i)	Estimate the cost of liver fluke annually  90 million*	4
	(ii)	Outline one environmental condition that allows liver fluke to thrive  Waterlogged or wet (poorly drained) areas or excess water	4
	(iii)	Suggest three ways to control / prevent liver fluke  Fence off wet areas (no mud snail which is secondary host of liver fluke) / add lime to soil to increase pH (remove mud snail) / drain land / ducks or geese (biological control) / molluscicide / dose animals (anthelmintic) / carryout faecal egg counts / closed flock (build up natural resistance) / breed with breeds with high resistance to liver fluke.	2+2+1
	(b)(i)	Which county with highest % fluke damage?  Louth* (at 17%)	4
	(ii)	State one reason why fluke damage less in Cork  Lower rainfall or higher rain in northern counties / drier land / lower incidence of mud snail	4
	(c)(i)	Explain notifiable disease  Disease that must be reported (immediately to authorities) (DAFM or DVO) (as it is contagious or infectious)	3
	(ii)	List two notifiable diseases in Irish Farms  TB / Swine Flu / Foot and Mouth / BSE / Brucellosis / BVD / Scrapie / sheep scab / other valid answer	2(4)
	(iii)	Outline importance of complying to notifiable disease regulations  Disease is infectious or contagious (could be passed onto animals very easily) / may pose threat to humans or zoonosis / risk to national herds	3
	(iv)	State three practices to ensure good biosecurity on farm  Operate closed herd (breed own replacements) / footbath or disposable footwear and clothing / limit visitors / fence boundaries / quarantine new animals or isolate sick animals / do not share equipment or machinery or colostrum / disinfect trailers (machinery) / use of AI (Artificial Insemination) / information signage / other valid answer	2+2+1
	(v)	Discuss three management practices when housing to ensure high standards of animal welfare  Adequate feeding / lying space (to ensure all animals can lie down or eat at the same time) / clean water (available for all animals to prevent disease) / house animals same age and size (together to prevent fighting or to allow animals to thrive) / good ventilation (to prevent pneumonia (chill)) / draft free (to decrease the animal's chance of getting pneumonia (chill)) / clean dry bedding or mats (to prevent any infection or disease) / lime on floor (to prevent infection) / other valid answer	4+4+2

<b>Q14</b>	<b>(a)(i)</b>	<i>Name two dairy breeds for good quality milk production</i> Holstein Friesian / British Friesian / Jersey / Brown Swiss / Shorthorn / Ayrshire / other valid answer	<b>5+3</b>
	<b>(ii)</b>	<i>Outline three ways farmer can maintain high levels of hygiene</i> Wash udders (prior to milking or stripping) / teat dipping (pre and post milking) / clean (collecting) yard or parlour / milk filters / service milking machine regularly / change cluster liners (twice a year) / store milk <4°C / plate cooler / lime on cubicles / clean, dry bedding / operator wear gloves or wash hands / milk or keep infected cows (high cell count) cows separately	<b>5+4+1</b>
	<b>(iii)</b>	<i>List two tests on milk used to calculate milk price paid to farmer</i> % fat / % protein / (excess) water / sediment / antibiotic / TBC / SCC / TCM (trichloromethane) / thermoduric bacteria	<b>4+3</b>
	<b>(iv)</b>	<i>Apart from hygiene practices, explain two ways dairy farmers could improve milk quality</i> Feed cows good quality feed (highly digestible leafy grass or good quality silage (72 - 75%) / use genomic bulls / clover (protein) in sward / 14 - 15% protein ration / breed from high quality (only high EBI) cows (in the herd) / use breeds with high % fat and % protein or named valid breed / cull infected cows (mastitis / high SCC)	<b>4+3</b>
	<b>(b)(i)</b>	<i>Identify one variable from investigation</i> Milk quality / time / same amount of milk / same amount of Resazurin / temperature / same equipment (condition of equipment (sterile)) (variable can be independent or dependent or control)	<b>3</b>
	<b>(ii)</b>	<i>Diagram showing the investigation to test hygienic quality of milk</i> <i>Diagram or text showing the following:</i> Place (equal amounts of) milk into the test tubes or suitable container / add (few drops 1 cm <sup>3</sup> ) of Resazurin / place (in water bath) at 37°C / 15 to 30 minutes / repeat (test on the same milk sample of various ages over time (immediately / at 5 hours / 24 hours / 48 hours / 72 hours) / (record) colour change or stated colour change (fresh - blue = good quality (low TBC) / blue - deep mauve = good / deep pink = fair / light pink = poor / white = poor)	<b>3(3)</b>
	<b>OR</b>	<i>Diagram showing an investigation relating to milk quality</i> Total Bacterial Count (TBC) using a serial dilution + growing on agar plate / SCC - California Mastitis Test (CMT) / antibiotics (Delvo) / % Solids - excess water / thermoduric - serial dilution & agar plate / % protein + % butterfat / Methylene Blue	
	<b>(iii)</b>	<i>State one error and one way to reduce the error</i> Wrong temperature on water bath - use thermometer to check temperature / incorrect amount of Resazurin or milk - use pipette or dropper / non sterile or dirty test tubes or containers - use sterile test tubes or containers / correct observation of time - use a watch or timer	<b>2+1</b>
	<b>(iv)</b>	<i>Results are quantitate or qualitative / justify</i> Result - Qualitative (Resazurin test) / Quantitative - TBC Justify Result - colour change not measured numerically / no. of CFU's (accept matching answer to valid test)	<b>2+1</b>

<b>Q15</b>	<b>(a)(i)</b>	<i>List two grasses commonly used in silage production</i> PRG / IRG / hybrid rye grass / other valid answer	<b>4+2</b>
	<b>(ii)</b>	<i>One reason for using one of the grasses named in part (i)</i> Good yield or fast growing / persistent / high quality (DMD) grass / good establishment / palatable / uniform growth	<b>4</b>
	<b>(iii)</b>	<i>What stage cut for silage / justify</i> Stage - Vegetative stage or leafy stage Justification - most digestible / leafy stage / high sugar content / high protein content / stem remains compact at base of stem / plant tillers (constant number of leaves on plant)	<b>4+2</b>
	<b>(b)</b>	<i>Steps for first cut silage</i> Time of cutting - May / (early) June Fertiliser requirement – soil test for nutrient requirement / apply (compound) fertilizer (18-6-12 or urea (protected urea) or 10 -10 - 20) / spread manure or slurry / 6-8 weeks prior to cutting Harvest & storage - do not cut during or after rainfall / cut in the afternoon / conditioner or precision chop mower / wilt for 24 hours / ensile (bale) - harvester (baler) / pit - pack to remove air (anaerobic conditions) / use additives / cover pit (wrap bales) / stack bales	<b>4</b> <b>4</b> <b>4+4+2</b>
	<b>(c)(i)</b>	<i>Calculate the DM%</i> 29.83% <i>(If a calculation is shown (37/124 x 100/1) but answer calculated is incorrect award 3 marks)</i>	<b>4</b> <b>(3)</b>
	<b>(ii)</b>	<i>Outline two reasons to feed concentrates to finishing steers</i> DMD not high enough (67%), will need to feed concentrates / concentrates with high protein % (14 - 16%) as silage protein low / / poor preservation, not enough lactic acid produced as pH too high	<b>3+1</b>
	<b>(iii)</b>	<i>Outline two ways to achieve target pH</i> Cut at leafy stage to increase sugar for fermentation / do not cut during or after rainfall as water dilutes the sugar content / cut in the afternoon as photosynthesis produces more sugar / ensure pit (bales) packed tightly to remove air to promote growth of anaerobic bacteria (lactobacillus) / allow grass to wilt to increase sugar content / use additive (molasses or acid or inoculants) to achieve correct pH	<b>4+2</b>
	<b>(iv)</b>	<i>Name one bacterial species required to make good quality silage</i> Lactobacillus or valid named species	<b>2</b>

Q16	(a)	<p><i>Compare sandy and clay soils under the following headings</i></p> <p><i>Fertility</i> Clay is more fertile (than sandy soil) or sandy soil is less fertile (than clay soil)</p> <p><i>Drainage</i> Sandy soil had better drainage (than clay soil) or clay soil has poorer drainage (than sandy soil)</p> <p><i>OM content</i> Clay soil has higher OM content (than sandy soil) or sandy soil has lower OM (than clay soil)</p> <p><i>Tillage suitability</i> Sandy soil has good drainage or warms up earlier in spring or easier to cultivate or lacks fertility Clay has poorer drainage or takes longer to warm up in spring or more difficult to cultivate or is more fertile soil</p>	<p>4</p> <p>4</p> <p>4</p> <p>4</p>
	(b)(i)	<p><i>Suggest three examples of soil management practices for sustainable land use</i></p> <p>Sowing cover crops (to prevent leaching or soil erosion) / min till or use less heavy machinery (decreased fossil fuels or decreased compaction) / ploughing back in straw (increased OM in soil) / aerating soil or drain land (restore soil air in compacted soil or restore soil health) / remove animals from land during wet weather (to prevent poaching) / addition of FYM (slurry) or slurry seeding (to increase number of earthworms) / soil test on annual basis (to ensure correct pH and nutrient) /crop rotation (for nutrient management or maintain organic matter)</p>	3+1+1
	(ii)	<p><i>Outline two steps in collecting samples of soil for analysis</i></p> <p>Divide the area (to be sampled into regions) (2 - 4 ha in size) / Sample at correct depth (where crop roots are growing) (5 - 10 cm) / take account of different soil types or slopes or previous cropping history / W shape / random / min 20 samples / stay away from water troughs or ditches or wet marshy ground / soil auger</p>	4+2

WITH EITHER			
Q16	(c)(i)	Briefly explain two steps to measure pH of soil sample  Mix soil sample with (distilled) water / (filter sample through) filter paper in funnel / test filtrate with pH probe or universal indicator (paper) to determine pH / take reading or observe colour change	4+3
	(ii)	Outline the effect pH has on number of earthworms in field and advice for good grass growth  Number: Low earthworm numbers Advice: Lime regularly or reduce slurry / raise pH >6 / poor grass growth as pH too low	3 2
	(iii)	Calculate % water in soil sample  58.33%  (if a calculation is shown (70/120 x 100/1) but answer calculated is incorrect award 2 marks)	3 (2)
	(iv)	Briefly explain condition of the soil  Soil is very wet or needs to be drained or compacted / nearly all the air spaces in the soil are filled with water	4
	(v)	State one implication and one reason  Compaction or poaching - soft ground / late or failed germination of crops or lower yields of crops or later harvesting dates - cold soil temperatures / higher incident of disease - liverfluke	2+2
OR			
Q16	(d)(i)	State two principles of organic food production  No GMO's / no chemicals used (herbicides or pesticides or antibiotics or fertilisers) / tillage practices which increase OM or increase soil stability or soil health / tillage practices to prevent compaction and erosion / use organic fertilisers (e.g. slurry, seaweed) / use organic certified seed	4+4
	(ii)	Suggest three advantages of farming organically  Animals reared on land free from chemicals / free-range / no GMO crops / soil structure protected with addition of green manures (slurry or FYM) / decreased pollution risk / increased biodiversity / maintenance of habitat / increased housing space for animals / higher price for product	4+2+1
	(iii)	Suggest three recommendations for improving pH and N in soil for organic farming  Add lime - increase pH / drain the land - improves pH and increase N / add clover (legumes) or mixed species to sward - increase N / spread slurry or farmyard manure or compost - increase N / use sheep on land to increase N content through dung	4+2+2

<b>Q17</b>	<b>(a)(i)</b>	<i>Explain the terms</i>  Germination - growth of (plant from) seed Certified grass seed - weed free / high guaranteed germination / high purity (true to type)	<b>4+3</b>
	<b>(ii)</b>	<i>State a suitable Hypothesis</i>  By increasing the temperature of the soil (to a certain point) then there will be a higher germination or growth rate (as seeds require heat for germination)	<b>4</b>
	<b>(iii)</b>	<i>List two factors kept constant during investigation</i>  Amount or type of seeds / same soil type / volume of soil / volume of water / time	<b>4+3</b>
	<b>(iv)</b>	<i>How would depth of sowing affect germination rate</i>  Depth of sowing - if sown too deep the seeds won't (have enough energy) to get above ground / if not sown deep enough they are more prone to attack from birds or drying out (desiccation)	<b>3</b>
	<b>(v)</b>	<i>Calculate the mean % germination at 20°C</i>  60  (if a calculation is shown $(62+59+61+58 = 240/4)$ but answer calculated is incorrect award 2 marks)	<b>3</b>  <b>(2)</b>
	<b>(vi)</b>	<i>Suggest why repeated 4 times</i>  To get more accurate results / more fair results	<b>3</b>
	<b>(vii)</b>	<i>Outline two safety precautions</i>  Wear gloves when handling compost or wash hands afterwards / overheat switch on incubator / keep water away from incubator (electric) / care when handling glassware / other valid answer	<b>4+2</b>
	<b>(b)(i)</b>	<i>Complete the graph</i>  Correct bar drawn at 20°C up to 60 (if incorrect calculation is correctly graphed award 2 marks)  Correct bar drawn at 30°C up to 65	<b>3</b>  <b>(2)</b>  <b>3</b>
	<b>(ii)</b>	<i>One piece of advice</i>  Sowing seeds at 25°C will give best germination rates / increase soil temp (25°C) get majority of seeds to germinate	<b>3</b>
	<b>(iii)</b>	<i>Name two other factors needed for germination and one practice to ensure seeds are exposed to each factor</i>  Moisture - water the seeds Oxygen - till the soil prior to sowing / aerate soil (plough, sub-soiler) or drain the soil	<b>2+2</b>  <b>+2+2</b>

<b>Q18</b>	<b>(a)(i)</b>	<p><i>Discuss the production of a named crop</i></p> <p><b>Named crop</b></p> <p><i>Seedbed preparation</i></p> <p>Plough / harrow to produce fine tilth / pick stones to prevent damage to crop (potatoes only) / produce fine firm seedbed or ridge (potatoes only) / min-till to minimise travelling or minimise compaction or minimise soil disturbance (tillage only)</p> <p><i>Weed control</i></p> <p>Herbicide or weed killer / shading or earthing up (potatoes only) / stubble cleaning (tillage only) / crop rotation / hand pulling or dig</p>	<p><b>2</b></p> <p><b>4+3</b></p>
	<b>(ii)</b>	<p><i>Describe one safety precaution</i></p> <p>Beware of machinery / clothes are tight fitting so they don't get caught in machines / be careful of machinery around power lines / other valid answer</p>	<b>4</b>
	<b>(iii)</b>	<p><i>Outline two advantages of using technology when spreading fertiliser</i></p> <p>Accurate or even spreading / economic benefit (saves on fertiliser) / less chance of pollution (run off) / more environmentally friendly (sustainable as less fertiliser required)</p>	<b>4+2</b>
	<b>(b)(i)</b>	<p><i>Explain natural selection</i></p> <p>Process through which populations of living organisms adapt and change or organisms better adapted to their environment tend to survive and produce more offspring</p>	<b>2</b>
	<b>(ii)</b>	<p><i>State two ways to improve animal production system</i></p> <p>Using AI / performance or progeny tested bull / breed top EBI bulls / use genomic bulls / breed from top EBI cows / use of gene editing / DNA markers / sexed semen</p>	<b>2+2</b>
	<b>(iii)</b>	<p><i>State one physical trait and give one reason why trait an advantage to beef farmers</i></p> <p>BB or AA - good conformation (double muscle gene) - high % lean meat or high price</p> <p>AA - polled (no horns) - less dangerous / smaller calves - lower mortality rates</p>	<p><b>2</b></p> <p><b>2</b></p>

WITH EITHER			
Q18	(c)(i)	Calculate average DLG over the 16 week period  0.42kg / day  <i>(if a calculation is shown (51 - 4 = 47/112) but answer calculated is incorrect award 2 marks)</i>	4    (2)
	(ii)	Number of weeks  14 ( can be indicated on the graph)	4
	(iii)	Briefly describe growth rate of lambs  Lambs are putting weight on in a consistent manner / putting on similar weight every week / growth rate and age are proportional	4
	(iv)	Suggest a suitable diet for lambs  Colostrum / hay / milk (milk replacer) / concentrates (creep feed) / grass (silage)	4+1
OR			
Q18	(d)(i)	One reason why mean shoot length  More accurate results or more fair result	1
	(ii)	Which treatment group greatest effect on growth?  All nutrients (NPK)	2
	(iii)	Outline one way to measure plant  Cut shoot at base of plant and measure length with a ruler or hold the shoot straight and measure the length with a ruler or use a thread (string) to measure plant and then measure with a ruler	2
	(iv)	Compare slurry and FYM under the following headings  Composition - liquid (urine & dung) / solid (urine, dung & straw)	3
		OM content - lower / higher	3
		Storage - tank (under slats) / dung stead or manure pit or slab or dung heap	3
		Application - slurry tanker or umbilical cord or trailing shoe or injector / muck or side or dung spreader	3



