# Coimisiún na Scrúduithe Stáit
State Examinations Commission

# Leaving Certificate 2024

# Marking Scheme

# Agricultural Science

# Higher Level

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

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

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

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

**Future Marking Schemes**

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

## How to use the marking scheme

- Examiners must conform to this scheme, however the descriptions, methods and definitions given in the marking scheme are not exhaustive and alternative valid answers are acceptable.
  - This does not preclude synonyms or terms or phrases which convey the same meaning as the answer in the marking scheme. Although synonyms are generally acceptable, there may be instances where the scheme demands an exact scientific term or unequivocal response and will not accept alternatives.
- The marking scheme is a concise and summarised guide to awarding marks and is constructed in order to minimise its word content.
  - In many cases only key phrases are given in the marking scheme. These points contain the information and ideas that must appear in a candidate's answer in order to merit the assigned marks.
- If an examiner determines that a candidate has presented a valid answer, and where there is no provision in the scheme for accepting that answer, then the examiner must first consult with his/ her advising examiner before awarding marks.
- The detail required in any answer is determined by the context, the phrasing of the question, and by the number of marks assigned to the answer in the examination paper. This may vary from year to year.
- Where only one answer is required alternative answers are separated by '**or**'.
- Use of an **asterisk***
  - This happens when the only acceptable answer is a specific word or term. Each such instance is indicated in the scheme by an asterisk**.
- Use of a **solidus** (**/**)
  - Words, expressions or statements separated by a solidus (**/**) are alternatives that are equally acceptable for a particular point.
  - Where multiple answers are required each word, term or phrase for which marks are allocated is separated by a solidus (**/**) from the next word, term or phrase.
- Use of **brackets ( )**
  - A word or term that appears in brackets **( )** in the scheme is not a requirement of the answer, but is used to contextualise the answer or may be an alternative valid answer.
- **Note** however, that words, expressions or phrases must be correctly used in context and not contradicted and where there is evidence of incorrect use or contradiction, the marks may not be awarded.
- The mark awarded for an answer appears in **bold** in the mark's column, e.g. **2**.
- Where there are several parts in the answer to a question, the mark awarded for each part appears as e.g. **3(2)**. This means there are 3 parts to the answer, each part is allocated 2 marks.
- Award unit marks separately e.g. if an answer merits three 2-mark units, write 3 separate '2's, under each other, in the space at the right-hand side of the question in the answer book (**2, 2, 2**).
- The answers to subsections of a question may not necessarily be tied to a specific mark e.g. there may be four parts to a question - (i), (ii), (iii), (iv) and a total of 10 marks allocated to the

question. The marking scheme might be as follows: 4 + 2 + 2 +2. This means that the first correct answer encountered is awarded 4 marks and each subsequent correct answer is awarded 2 marks.

- Italics are used where the examiner's attention is being drawn to an instruction relating to the answer or to some qualification of the answer.
- In general, names and symbols / formulae of elements / compounds are equally acceptable. However, in some cases where a name is specifically asked for, the symbol / formula may be accepted as an alternative. This will be clarified within the scheme.
- All blank pages should be marked to indicate they have been inspected.

## Cancelled answers

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

## Surplus answers

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

## Annotations used in the marking

The scripts were marked on-line by examiners. The following table illustrates the various **annotations** (symbols) applied by the examiners when marking the scripts. The meaning and use of each of the annotations applied are explained in the table below. These annotations will be seen on a script if viewed as part of the appeal process.

In some sections of the 'Individual Investigative Study' (IIS), where the mark award was greater than 12 marks for a single item(s), two annotations will be used to show the total marks awarded for the item(s). Annotations applied by an examiner will be viewed in red. Scripts that were also marked by an advising examiner will show annotations in a green colour.

| Annotation | Meaning |
|---|---|
| √ | This symbol indicates a correct response / answer. Use when all marks awarded to any additional correct answers. |
| ✗ | This symbol indicates an incorrect response / answer. |
| [ | This symbol indicates a surplus incorrect answer. A surplus incorrect answer has cancelled a correct answer. |
| ⧢ | This symbol is placed on all blank pages or part of page to indicate it has been seen by the examiner. |
| ⬚〰 | This symbol can be used by an examiner to indicate a part of a question answer of significance. |
| ◻ 0 | This symbol is used to indicate where a candidate answer was awarded zero marks. |
| ✔ 1 | This symbol can be used by an examiner to indicate **One** mark awarded |
| ✔ 2 | This symbol can be used by an examiner to indicate **Two** marks awarded |
| ✔ 3 | This symbol can be used by an examiner to indicate **Three** marks awarded |
| ✔ 4 | This symbol can be used by an examiner to indicate **Four** marks awarded |
| ✔ 5 | This symbol can be used by an examiner to indicate **Five** marks awarded |
| ✔ 6 | This symbol can be used by an examiner to indicate **Six** marks awarded |
| ✔ 7 | This symbol can be used by an examiner to indicate **Seven** marks awarded |

| | |
|---|---|
| ✔ **8** | This symbol can be used by an examiner to indicate **Eight** marks awarded |
| ✔ **9** | This symbol can be used by an examiner to indicate **Nine** marks awarded |
| ✔ **10** | This symbol can be used by an examiner to indicate **Ten** marks awarded |
| ✔ **11** | This symbol can be used by an examiner to indicate **Eleven** marks awarded |
| ✔ **12** | This symbol can be used by an examiner to indicate **Twelve** marks awarded |

## Marking the Individual investigative Study (IIS)

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

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

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

# Higher Level Agricultural Science Marking Criteria for Individual Investigative Study

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

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

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

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

| *Introduction* - Context for the IIS – 10 marks | <ul><li>Excellent - 9 – 10m</li><li>Very Good - 7 – 8m</li><li>Good - 5 – 6m</li><li>Fair - 3 – 4m</li><li>Weak - 0 – 2m</li></ul> | *Background Research* -Research, sources and knowledge – 10 marks | <ul><li>Excellent - 9 – 10m</li><li>Very Good - 7 – 8m</li><li>Good - 5 – 6m</li><li>Fair - 3 – 4m</li><li>Weak - 0 – 2m</li></ul> |
|---|---|---|---|

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

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

| | | |
|---|---|---|
| *Details of the actions undertaken in response to stated hypothesis – 12 marks* | • Excellent - 11 – 12m<br>• Very Good - 9 – 10m<br>• Good - 6 – 8m<br>• Fair - 4 – 5m<br>• Weak - 0 – 3m | |
| | *Data collection undertaken – 13 marks* | • Excellent - 12 – 13m<br>• Very Good - 10 – 11m<br>• Good - 7 – 9m<br>• Fair - 4 – 6m<br>• Weak - 0 – 3m |

| Section | Excellent | Very Good | Good | Fair | Weak |
|---|---|---|---|---|---|
| **Results, analysis, and conclusions**<br><br>*Suggested range between 600 and 1000 words* | The data is relevant, comprehensively analysed, interpreted, evaluated and presented optimally.<br><br>Draws insightful, independent informed conclusions based on a relevant, critical and perceptive analysis of the evidence to arrive at justification of own position (hypothesis). | Very good interrogation and presentation of the data.<br><br>Analysis, interpretation and evaluation of data to a high standard.<br><br>Draws very good independent conclusions based on a critical and perceptive analysis of the evidence and clearly justifies own position (hypothesis). | Good interrogation and presentation of the data, but may lack some structure.<br><br>Draws some independent conclusions based on a basic analysis of the evidence to justify own position (hypothesis), but lacks depth and structure. | Limited interrogation and presentation of the data.<br><br>Very basic conclusions stated to justify own position (hypothesis).<br><br>Conclusions made are flawed with limited evidence in support and superficial analysis / with significant inaccuracies.<br><br>Repetition of material is evident. | Poor / confused / illogical interrogation and presentation of the data.<br><br>Little or no evidence presented / or not relevant.<br><br>Analysis is poor.<br><br>Little or no conclusions made with very little evidence in support. Irrelevant materials used with repetition of material evident. |
| **35 marks** | **32-35** | **25-31** | **18-24** | **11-17** | **0-10** |

**Award a single mark out of 35 for this section. In arriving at this mark consider the indicative content requirements below.**

| *Appropriate presentation of data – 10 marks* | *Informed judgement and conclusions following analysis and interpretation of data, results and evidence – 15 marks* | *Limitations of study considered and clear linkage of conclusions to research question – 10 marks* |
|---|---|---|
| <ul><li>Excellent - 9 – 10m</li><li>Very Good - 7 – 8m</li><li>Good - 5 – 6m</li><li>Fair - 3 – 4m</li><li>Weak - 0-2m</li></ul> | <ul><li>Excellent -14 – 15m</li><li>Very Good - 11 – 13m</li><li>Good - 8 – 10m</li><li>Fair - 5 – 7m</li><li>Weak - 0 – 4m</li></ul> | <ul><li>Excellent - 9 – 10m</li><li>Very Good - 7 – 8m</li><li>Good - 5 – 6m</li><li>Fair - 3 – 4m</li><li>Weak - 0 – 2m</li></ul> |

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

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

**Award a single mark out of 10 for this section. In arriving at this mark consider the indicative content requirement below.**

| | |
|---|---|
| *The report has an overall coherence, quality and clarity with the inclusion of individual innovative thinking by the candidate – 10 marks* | • Excellent - 9 – 10m<br>• Very Good - 7 – 8m<br>• Good - 5 – 6m<br>• Fair - 3 – 4m<br>• Weak - 0 – 2m |

| Section A | | | Answer any 10 questions<br>10 marks for each question<br>Total for section is 100 marks | Marks |
|---|---|---|---|---|
| **Q1** | **(a)** | | *Identify* **the** *items of farm machinery / equipment in* **A, B** *and* **C.**<br><br>**A**: Bale wrapper<br>**B**: Stomach tube<br>**C**: Head gate / fostering crate | 3(2) |
| | **(b)** | | *Briefly describe how the piece of equipment* **B** *in part (i) above is used on a sheep farm.*<br><br>Filled with colostrum / tube is put down oesophagus into stomach / feed weak lambs | 4 |
| **Q2** | **(a)(i)** | | *Identify* **any two** *of the following breeds.*<br><br>**A**: Landrace<br>**B**: Blue Leicester<br>**C**: Simmental | 2(2) |
| | **(ii)** | | *The sheep in* **B** *in part (i) above is known for its* <u>prolificacy</u>.<br>*Explain the underlined term.*<br><br>Produce many offspring | 2 |
| | **(iii)** | | *Briefly explain characteristics of bull* **C** *in part (i) that make it suitable as a terminal sire.*<br><br>Good conformation / high muscle / good KO% / good carcase weight | 2(2) |
| | | | **Or** | |
| | **(b)(i)** | | *Explain negative energy balance.*<br><br>Occurs when a cow cannot get sufficient energy from her diet to balance the amount of energy required for milk production. | 3 |
| | **(ii)** | | *Identify* **one** *characteristic of this breed that makes it suitable as for an artisan product.*<br><br>Superb quality beef / distinctive flavour | 3 |
| | **(iii)** | | *Describe* **one** *characteristic of the Irish Moil which makes it a sustainable choice on Irish farms.*<br><br>Early maturing – steers finish between 20-24 months / very fertile – produce a calf every 12 months / longevity – breed until they are 10 years old / easy calving – allows cross with continental bull or reduced veterinary costs / hardy or ready browsers (graze all pastures – extensive or conservation grazing / polled (hornless) – no need to dehorn / dual purpose – used for meat or milk production / docile – reduces labour (risk) | characteristic - 2<br>description - 2 |

| Q3 | (a)(i) | *Identify the best grazing period for post grazing recovery.* | 1 |
|---|---|---|---|
| | | Short (1-2 days) | |
| | (ii) | *Outline **one** reason for the root development in fields that are continuously grazed.* | 1 |
| | | Reduced root growth during grazing / as grass is continuously grazed, roots do not get a chance to grow or develop / does not allow for root reserves to develop | |
| | (iii) | *Using the list provided, state which grazing system is most likely to be associated with each of the following:* | 2(4) |
| | | <table><tr><td>**Short**</td><td>Rotational or zero</td></tr><tr><td>**Continuous**</td><td>Set stocking</td></tr></table> | |
| | | **Or** | |
| | (b) | *Briefly describe the climate and / or environmental benefits of rotational livestock grazing.* | 6 + 2(2) |
| | | Easily digestible or high-quality forage for lower emissions or finishing early / improves water quality for reduced sediment or nutrient run off / fence animals away from river / herd is healthier as reduced endoparasites or less animal disease / improves pasture productivity as better DMD (vegetative growth or tillering) / protects soil from erosion – (deeper plant roots) / increased biodiversity with multi species sward or addition of clover / reduced herbicides required for weed control / increased soil carbon as overgrazing causes the soil to release carbon / rotational grazing allow the soil or plants to recover between grazing / reduced housing which means less slurry storage needed | **Any 3 factors from climate and / or environment** |

| Q4 | | Describe the impact of compaction and organic matter loss has on the productivity of farm land. | | | 2(3) +2(2) |
|---|---|---|---|---|---|

| Impact of | Effect on Productivity | Ways of Reducing Effect |
|---|---|---|
| **Compaction** | Reduced crop yield or reduced productivity / increased risk of soil erosion / reduce water infiltration / reduced crop emergence / reduced root penetration / reduced nutrient or water uptake by the plant | Min till / crop rotation / extensive grazing / increase soil organic matter / subsoiling or deep ploughing / use lighter breeds/ described low compaction machinery or tramlines/ do not graze on wet ground / qualified drone use / addition of earthworms |
| **Organic matter loss** | Decreased nutrient store / reduced nutrient supply / reduced soil biodiversity (less food for soil organisms) / decreased earthworm population / more susceptible to drought / decreased aeration in heavy soils / decreased drainage in heavy soils | Spreading farmyard manure / spreading slurry / digestate from biodigester / green manures or cover crop / ploughing straw back into land / crop rotation / reduced or no tillage |

| Q5 | (a) | Assist farmers by identifying each of the following. | 5+2(1) |
|---|---|---|---|

| A | B | C |
|---|---|---|
| Oats | Wheat | Barley |

| | (b) | Farmers asked if the seed produced by the crop could be kept and sown the next year. Outline the advice you would give the farmers.<br><br>Not certified seed / no guarantee of germination / could contain wild oats / not 98% pure / not treated with fungicide or pesticide | 3 |
|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| **Q6** | **(a)(i)** | *Explain how it is carried out.* | | |
| | **(ii)** | *Briefly describe the benefit of each target feature named in part (i) above to overall production of the flock.* | | |

| Action *(i)* | Benefit *(ii)* |
|---|---|
| *Lameness control*: regular checking or footbath or antibiotic spray or paring hooves or vaccination or closed flock or breed selection | *Lameness control*: increased LWG or increased conception rates or increased milk production |
| *Mineral supplementation of ewe's post mating*: (bucket) lick / bolus / injection / feed additive / drench | *Mineral supplementation of ewes' post mating*: improve (P) conception rate or maintain pregnancy / improved development of embryo (health) or foetus or lamb / (Mg) prevent grass tetany or reduced (nutritional) disease |
| *Meal feeding lambs post weaning*: creep feeder / trough | *Meal feeding lambs post weaning*: increase liveweight gain / reach slaughter weight quicker / reduces stress of weaning |
| *Scanning in-lamb ewes*: ultrasound scanner or scanner placed on abdomen | *Scanning in-lamb ewes*: determine the number of lambs the ewe is carrying / can feed ewes accordingly or housing management / cull barren ewes |

2(3) + 2(2)

**Or**

| | | | |
|---|---|---|---|
| | **(b)(i)** | *Calculate the financial value of the scheme to Ryan and Fiona.*<br><br>132 x 12 = €1584<br><br>(If candidate shows the correct formula award +3m) | **6** |
| | **(ii)** | *Briefly explain how the scheme enhances animal health and welfare.*<br><br>**Mineral supplementation lambs pre-weaning:** improved LWG or reduced nutritional disease<br><br>**Flystrike control:** prevent maggots feeding off them (which increases liveweight of animal) or less pain<br><br>**Genotyping of ram:** provides easier lambing or better disease resistance or less mutations or improved dag score or increased survival (rate) | **3+1** |

| Q7 | (a) | *Explain agroforestry.* <br><br> Integration of trees with either crops or livestock on the same land or farmers plant crops or allow livestock to graze around trees | 4 |
|---|---|---|---|
| | (b) | *Outline the possible benefits of agroforestry.* <br><br> Providing additional sources of (sustainable) on-farm revenue / timber or fruit production alongside livestock or crop production / provide shelter or allows animals to scratch/improved biodiversity/ improving water quality or reducing soil erosion / improved soil health or nutrient capture / enhancing the capacity for on-farm carbon sequestration / availing of grants or annual premiums | 2(3) |
| Q8 | (a) | *Explain natural predators.* <br><br> A living organism that kills and eats another organism / an organism that feeds on another living organism causing harm | 2 |
| | (b) | *Briefly describe how the dock beetle is an environmentally friendly way of controlling dock leaves on a farm.* <br><br> Controls the dock leaf without the use of (selective) herbicides | 2 |
| | (c) | *Dock beetles are an example of a biological control. Based on your own knowledge provide an example of a biological control and state its target to control.* <br><br> (see table below) | 2(3) |

| Biological Control | Target |
|---|---|
| Ducks / geese | Mud snail / slugs |
| Ladybird or parasitic wasp | Aphids (greenfly) |
| Cats / dogs | Rodents |

| Q9 | (a) | *Compare the soil mineral particles and their properties under the headings that follow.* <br><br> (see table below) | 4(2) + 2(1) |
|---|---|---|---|

| | Gravel and Sand | Silt and Clay |
|---|---|---|
| **Drainage** | Good drainage (due to large pore spaces) | Poor drainage (due to small pore spaces) |
| **Fertility** | Poor fertility | High fertility |
| **Ion exchange** | No ions present / no ion exchange | Good (source of cations K, P, Ca, Mg for) ion exchange / large surface area for ion exchange |

**Or**

| | (b)(i) | *Based on your knowledge of soil structure, identify the soil quality of each of the different soils in **A, B** and **C**.* <br><br> **A**: Good \| **B**: Moderate \| **C**: Poor | 3(2) |
|---|---|---|---|
| | (ii) | *Briefly describe **one** reason for your choice of good quality soil structure in part (i) above.* <br><br> Soil particles are predominantly small / soil particles are predominantly round / good crumb structure / presence of organic matter | 4 |

| Q10 | (a) | *Identify which picture **A** or **B** is more likely to be a multi-species sward.* <br><br> B | 4 |
|---|---|---|---|
| | (b) | *List **two** plants that could be included on the multi-species sward.* <br><br> PRG / red clover / white clover / plantain / chicory / timothy | 2(2) |
| | (c) | *Briefly describe how plant diversity can positively impact soil biology in swards.* <br><br> Increase in availability of food to all organisms / increase in diversity of food source / increased carbon sequestration at different levels / increased microbial communities / increased earthworm activity / increased air for (plant or animal) respiration (due to root activity at different levels) | 2 |
| Q11 | (a) | *Calculate the average calving interval for Cow 1 over her five lactations.* <br> $\frac{397+345+397+362}{4}$ = 375.25 or 375 days <br><br> (If a candidate gives 375.25 or 375 without showing calculation, award 4m <br> If the candidate gives the correct formula without correct answer, award 2m) | 4 |
| | (b) | *Briefly describe how the calving interval for Cow 1 is reduced between lactation 3 and 4.* <br><br> More accurate heat detection / served her on her first cycle after calving / mineral supplementation | 2 |
| | (c) | *State with reason if Cow 1 or 2 should be culled.* <br><br> *Cow*: 2 <br> *Reason*: Increased number of serves to get cow in calf or poor fertility / increasing calving interval | 2 <br><br> 2 |
| Q12 | (a) | *Outline actions farmers can take to reduce the runoff from the fields and farm roadway.* <br><br> Build bank (or wall or bridge) or plant hedgerow (beside watercourse) / include buffer zones / animals cannot access close to watercourse / slope roadway towards the field / runoff diverted (into field) prior to watercourse / barrier on bridge / do not graze during heavy rainfall or spread slurry or spread fertiliser | 4+2 |
| | (b) | *Apart from runoff, outline potential sources of water pollution from agriculture.* <br><br> Direct spreading of fertiliser or slurry or chemical sprays too close (nitrates or phosphate) / animals' access to water sources or pathogens or disease-causing organisms / sediment from erosion of banks / farm plastics / nitrogen leaching | 2(2) |

| Section B | | | Answer any 4 questions<br>50 for each question<br>Total for section is 200 marks | Marks |
|---|---|---|---|---|
| Q13 | (a)(i) | | *Gill, an agricultural advisor, carried out an investigation to determine the botanical composition of a farmer's land. Describe how she carried out this investigation.*<br><br>Throw pen at random / place quadrat / repeat at least 10 times / identify plants using key or acres guide book / record results<br><br>***Points can be found on the diagram*** | 3(4) |
| | (ii) | | *Gill was walking a farmer's land and identified the following plants on the land. Identify the plants using the list below.*<br><br>| A | B | C | D |<br>|---|---|---|---|<br>| Primrose | Nettle | Ragwort | Meadow Thistle | | 4(2) |
| | (iii) | | *Briefly explain what advice Gill would give the farmer in order to create a positive grassland for plant biodiversity.*<br><br>Reduce the amounts of fertiliser added / extensive grazing / topping or rotational grazing / reduced use of herbicides / sow multi species (clover) | 6+2 |
| | (b)(i) | | *Describe with the aid of a labelled diagram how a peat soil is formed.*<br><br>Water collection or retention or areas of high rainfall / area of depression / iron pan formation / waterlogged conditions / infill with plant material / incomplete decomposition / over a long time / acidic conditions / anaerobic conditions<br><br>***Points can be found on the diagram*** | 6+2 |
| | (ii) | | *State **two** locations in Ireland where you would find a peat soil.*<br><br>West of Ireland / midlands / any named correct location | 3+3 |
| | (c) | | *You have been asked to address a group of farmers about the importance of preserving our peat bogs. Outline the advice you would give them.*<br><br>Healthy peat bogs act as 'carbon sinks' or reduce carbon emissions (storing huge amounts of carbon) / mature bogs are not a net 'carbon sink' only ones in active growth / damaged or dry bogs release carbon dioxide into the atmosphere (accelerating climate change) / increased biodiversity / purify water / reduce flooding / habitats | 6+2 |
| | | | **Or** | |
| | (d) | | *Outline measures farmers can take to combat biodiversity loss on their farms.*<br><br>Plant or manage hedgerows or trees / only cut hedgerows at times of the year that is permitted / cut in A shape or only 1 in 3 years / agri-environmental schemes action (e.g. Acres) / install bird or bat or owl boxes / adhere to European directive e.g. nitrates directive / sow multi-species swards or cover or bird cover | 6+2 |

| Q14 | (a)(i) | Identify the bacteria that is required for good quality silage by placing a tick (✓) in the correct box. | | | 6 |
|---|---|---|---|---|---|

| | | | Lactobacillus | ✓ |
|---|---|---|---|---|
| | | | Clostridia | |
| | | | Staphylococcus aureus | |

| | (ii) | Describe the chemical / biological processes involved in the production of good quality silage. (Cut early afternoon when) grass sugars are highest / low nitrogen levels to allow for preservation (6 weeks after fertiliser application) / wilt (for 24 hours) to remove excess water / (transport grass to yard and) tip on clean concrete to avoid contamination / (compact pit to remove air) anaerobic conditions or anaerobic respiration / lactobacillus bacteria feed off sugar / produce lactic acid / pH 4 / fermentation occurs | 3(4) |
|---|---|---|---|

| | (iii) | Identify the ideal DM % of good quality silage by placing a tick (✓) in the correct box. | 6 |
|---|---|---|---|

| | | 45% | |
|---|---|---|---|
| | | 25% | ✓ |
| | | 15% | |

| | (b)(i) | Describe how an agricultural science student would carry out an investigation to measure the DM content of a sample of silage in the school laboratory. Cut a number of silage samples from the different treatment areas / Record mass of beaker / add silage to the beaker and record the mass / determine mass of silage sample / place the silage in an oven at 100 C (for 15 mins or longer at lower temp e.g. 60ºC for 48 hours) or microwave at short intervals / repeat weighing until you get a constant mass / calculate the mass of the silage by subtracting the mass of the beaker from overall mass / calculate the DM% of the silage by putting mass of dry silage over mass of fresh silage multiply by 100/1 / calculate the average DM% for each treatment. **Points can be found on the diagram** | 3(4) |
|---|---|---|---|

| | (ii) | Apart from DM, outline factors affecting silage quality. Grass type and variety /grass sugar content / fertiliser - minimum 6 weeks after N application / stage of growth at cutting / chop length / contamination / additive / anaerobic conditions | 6+2 |
|---|---|---|---|

| | (c) | Draw a labelled diagram of a grass plant at the ideal named growth stage for harvesting. *Name*: Vegetative Elements of diagram: To show at least 3 leaves or tillers, and no seed head for 2m; Seed head present or less than 3 leaves for 1m; No elements listed present 0m *Labelled diagram:* Leaf / tiller / node / stem/ sheath / collar / root | 2  D = 2, 1, 0  L= 2 |
|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| | | **Or** | | |
| | **(d)** | *Outline the characteristics of grass that make it most desirable for grazing.*<br><br>Palatability / digestibility or leafy / productivity / persistence | | **5+1** |
| **Q15** | **(a)(i)** | *Explain the animal's phenotype.*<br><br>All observable or physical characteristics of the animal | | **3** |

| **(ii)** | *Briefly explain the function for growth and development of beef animals of each of the following nutrients.* | |
|---|---|---|
| | **Nutrient** | **Function in animals** |
| | **Protein** | Repair / build muscle / milk production |
| | **Vitamins** | Vit A for bone development or good vision or good fertility / Vit D for absorption of Ca or bone development / Vit C prevent infection or repair tissue / Vitamin B for metabolic reactions / control chemical reactions (metabolic processes) in the body |
| | **Water** | Essential for digestion or reproduction or excretion or transport of nutrients around the body / milk production (milk is 87.5% water) / temperature regulation / prevent dehydration or osmoregulation |

Marks: **6+2+1**

| **(iii)** | *State **two** animal-related factors **or** two environmental conditions.* | |
|---|---|---|
| | **Animal-related factor** | **Environmental conditions** |
| | Weight / age / sex / stage and extent of production / body composition / genetics / amount of physical activity / health | Temperature / humidity / wind chill or draught free/ ultraviolet radiation or UV light / precipitation / soil nutrient deficiencies |

Marks: **2(2)**

| **(iv)** | *Describe the energy requirement of a breeding cow at each stage of the production cycle.*<br><br>*Breeding*– (high plane of nutrition for) high energy requirement to increase conception rates or regular heat periods or implantation<br>*Dry period*– (low plane of nutrition or) low energy requirement as feed requirement at this stage is just to keep cow in good health and condition<br>*Early lactation* – high energy requirement or increased concentrates or high digestible silage (75%+ DMD) or good quality (spring) grass to reduce the negative energy balance or reach peak yield or improved BCS | **3(1)** |

| (v) | Briefly describe the symptoms and prevention of a named mineral deficiency in cows. | | | 3(2) |
|---|---|---|---|---|
| | **Named mineral deficiency** | **Symptoms** | **Prevention** | |
| | **Milk fever or calcium deficiency** | Lack of appetite / lower body temperature / difficulties producing manure and urine / won't be able to stand / cold to touch / muscle tremors / collapse | Test macro mineral content of forage / minimise K content of forage or ration / limit Ca and P intake for 2 -3 weeks prior to calving / avoid forages high in Ca / Ca increased after calving / feeding high Ca concentrates (post calving) / supplement with Mg prior to calving | |
| | **Grass Tetany or magnesium deficiency** | Some excitability with muscle twitching / an exaggerated awareness / animal may appear aggressive / staggering / collapse / coma | Feeding high Mg concentrates / adding Mg to water trough / feeding hay or straw / avoid grazing pastures with high amounts of slurry and/or N applied / dusting pasture with Mg / mineral licks / magnesium boluses | |

| (b)(i) | Outline benefits of weighing cattle on beef farms. | 5+1 |
|---|---|---|
| | Animal health or sick animals identified / calculate correct dose per animal / monitor livestock performance or feed animals to increase LWG / forecast time of sale of animals / support decision making through better quality data | |

| (ii) | Briefly describe **two** safety considerations taken when weighing beef animals. | 5+4 |
|---|---|---|
| | Have an escape route / mind swinging gates / have another (experienced) person / don't put your hand or foot in crush (to move foot onto scales) / use crush (to control animals) /situational awareness/ experienced person present | |

| (c)(i) | Calculate the average daily liveweight gain of the calves from birth to 15 weeks. | 6 |
|---|---|---|
| | 125 – 40 = 85 | |
| | 15 X 7 = 105 | |
| | 85/105 = 0.81(kg/day) | |
| | (If a candidate gives 0.81 without showing calculation, award 6m. If the candidate completes two correct calculations, award 5m If the candidate gives the correct calculation, award 4m) | |

| | | | | |
|---|---|---|---|---|
| | **(ii)** | *As part of the scheme, farmers are eligible to €20 per calf weighed up to a max of 50 calves. Calculate the value of the scheme to Paul.*<br><br>€20 X 50 = €1000<br><br>If a candidate has the correct method 2m | **4** |
| **Q16** | **(a)(i)** | *Outline a hypothesis for this investigation.*<br><br>Feeding pooled good quality colostrum to calves has no negative affect on the health or performance of calves<br><br>*(Hypothesis must include effect on health or performance of calves)* | **2** |
| | **(ii)** | *Outline with reason if this investigation is a fair test.*<br><br>It is a fair test (Yes)<br><br>*Reason*: equal sample size / similar birth weight or weighed weekly / all colostrum samples reach minimum concentration (> 50mg IgG) / same refractometer | **4 + 3** |
| | **(iii)** | *State the independent, dependent and control variables in this investigation.*<br><br>*Independent:* Colostrum sample<br><br>*Dependent:* Weight gain<br><br>*Control:* Same number of calves / same refractometer / same weighing interval | **4+4+3** |
| | **(iv)** | *Outline **two** possible sources of error in this investigation.*<br><br>Scales not calibrated / refractometer not calibrated / calves not standing on scales properly / colostrum contamination / measurement of volume of colostrum | **3+1** |
| | **(b)(i)** | *Based on the results shown, state if there is any difference colostrum quality when pooled.*<br><br>Pooled colostrum is best or valid comparison with Sample 2 or Sample 3 | **4** |
| | **(ii)** | *Outline the advice Ella and Sadie would give to farmers based on the results of their investigation.*<br><br>Pooling colostrum or using colostrum from another dam has little effect on calf performance or own dam colostrum is best followed by pooled colostrum | **4** |
| | **(c)** | *Explain how changes of diet from birth to weaning affects the development of the ruminant stomach.*<br><br>*Introduce hay or concentrates / cause scratch factor or introduction of microflora / increases size of rumen / allows for rumination or chewing the cud | **5+1** |

| | | | | |
|---|---|---|---|---|
| | **(d)** | Discuss the importance of feeding colostrum to young animals under the headings which follow. *(i) Timing of feeding* Immediately after birth / within 6 hours / antibody absorption decreases with time *(ii) Amount of colostrum* 10% bodyweight / 4 litres *(iii) Hygiene* Contaminated colostrum can cause sickness or diarrhoea or reduced antibody intake. | | **6+2(3)** |
| **Q17** | **(a)** | *Briefly describe how any named abiotic factor will affect Irish agriculture.* | | **5 (factor) + 1 (description)** |

| Abiotic factor | Description |
|---|---|
| Temperature | Too hot or cold will cause crop failure or animal disease |
| Humidity | Cause crop failure or animal disease |
| Soil chemistry | If not correct for plant type will cause reduced crop yields |
| Salinity | If not correct for plant type will cause reduced crop yields |
| Oxygen levels | If not correct for plant type will cause reduced crop yields |
| Moisture levels or drought or flooding | May cause reduced yield |
| Any named correct effect on plant or animal production + matching description | |

| | | | |
|---|---|---|---|
| | **(b)(i)** | *Draw a labelled diagram of the rhizosphere.* *Diagram:* diagram must show root with rhizosphere zone drawn around it. *Labels:* rhizosphere soil / microorganism / bulk soil / rhizoplane / metal(loids) / ectorhizosphere / endorhizosphere | **D= 3,0 L = 2(1)** |
| | **(ii)** | *Describe the relationship between the plant roots and the microorganisms in the rhizosphere.* Symbiotic relationship / microorganism's get nutrients from root / root benefits from fungi drawing nutrients and water from soil (which then are made available to the root) | **3** |

| | | | | | |
|---|---|---|---|---|---|
| | **(iii)** | *Identify the fungi that plays a key role in the rhizosphere by placing a tick (✔) in the correct box.* | Rhizobium | | **6** |
| | | | Mycorrhizal | ✔ | |
| | | | Rhizopus | | |

| | **(iv)** | *Describe advantages of the fungi identified in part (iii) above on soil productivity.* | **5+1** |
|---|---|---|---|
| | | Enhance water holding capacity or improved drought resistance / bind soil particles to improve soil structure or prevent soil erosion / selective uptake of minerals or preventing toxic metals being absorbed / improved disease resistance / protection from plant pests (soil borne nematodes) / increased plant establishment or survival at germination / increased (surface) area for absorption (of nutrients or water) | |

| | **(v)** | *Apart from increasing organic matter, outline ways the fungi identified in part (iii) above can be increased in soil.* | **5+1** |
|---|---|---|---|
| | | Reducing tillage operations / planting cover or companion crops / polycultures / sow mycorrhizal-friendly crops / avoiding overuse of fertilizers / avoiding (toxic) fungicides or herbicides or pesticides / add fungal culture | |

| | **(c)(i)** | *Predict with reason which soil, a loam or peat soil would have the higher % organic matter.* | **5+1** |
|---|---|---|---|
| | | Peat soil | |
| | | *Reason:* as it is formed from partially decomposed plant material | |

| | **(ii)** | *Calculate **A** the % soil organic matter in the peat sample.* | **6** |
|---|---|---|---|
| | | 55.2/90 X 100 = 61.3(%) | |
| | | (If a candidate gives 61.3 or 61 without showing calculation, award 6m.<br>If the candidate gives the correct formula without correct answer, award 3m) | |

| | **(iii)** | *Calculate **B** the % soil organic carbon in the peat sample.* | **6** |
|---|---|---|---|
| | | 61.3 x 0.58 = 35.55 or 36% | |
| | | (If a candidate gives 35.55 or 36 without showing calculation, award 6m.<br>If the candidate gives the correct formula without correct answer, award 3m) | |

| Q18 | (a)(i) | *Explain crossbreeding*<br><br>Offspring produced from purebred parents of different breeds or mating of animals from two different breeds | 4 |
|---|---|---|---|
| | (ii) | Identify the breeds shown in **A** and **B**.<br><br>**A**: Hereford<br><br>**B**: (Holstein) Friesian | 6+2 |
| | (iii) | *List **two** dominant features from parents in **A** and **B** in part (ii) above that are passed to the offspring.*<br><br>Black coat colour / coat pattern / white face / white legs and belly / pink nose / tail switch | 6+2 |
| | (b)(i) | *Explain genotype.*<br><br>Genetic make-up (code) of an organism | 4 |
| | (ii) | *Outline benefits of genotyping.*<br><br>Parent verification / higher reliability EBI or €uroStar figures / traceability - genotyping ensures that there is full traceability of every meat and milk sample from birth / predict genetic merit / identify carriers (of lethal gene or defects) / targeted selective breeding / to determine carbon footprint (of herd) | 6+2 |
| | (iii) | *Briefly describe **one** named method of genetic engineering you have studied and explain its importance in animal breeding.* | 3(2) |

| Method | Description | Explain importance |
|---|---|---|
| **Cloning** | Exact genotypic copies of living things are mad | To produce more meat or milk / research animal diseases / maintain superior animal characteristics |
| **Genetic modification (GM)** | Organism whose genetic make up has been modified in a lab | Increased disease resistance / polled animals / sterile male animals / reduced genetic disorders passed on / reduced genetic variation / increased productivity / research animal diseases / adjust rumen function |
| **Gene editing** | Scientist can change or alter the DNA of an organism | |

**Or other valid example and explained importance**

| | | (c) | *With the EU's Farm to Fork Strategy proposed to reduce by 50% the use of chemical pesticides, Integrated Pest Management (IPM) systems are becoming more important. Using the information shown in the diagram on IPM, advise farmers on ways they can reduce chemical inputs on their farm.*<br><br>*IPM – Preventative methods are the most important part of IPM and the use of chemicals should be a last resort*<br><br>*Biological* – ladybirds control aphids / ducks or geese control mud snail / dock beetle and dock leaf / cat or dog and rodent<br><br>*Physical / mechanical* – fans / pulling by hand or rogueing / scorching / grazing / fleece / netting / eggshells / sticky pads / named relevant physical barrier / topping<br><br>*Cultural / sanitation* – machine hygiene / biosecurity or closed herd / correct crop storage methods<br><br>*Prevention* – crop rotation / sterile seed bed /correct sowing date / certified seed / timely harvest / resistant varieties / any minimum cultivation method / companion crop (cover crop) | **6+6+4** |