Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2023

Marking Scheme

Agricultural Science

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

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

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

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

Future Marking Schemes

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

How to use the marking scheme

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

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

Cancelled answers

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

Surplus answers

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

Annotations used in the marking

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

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

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

✓9	This symbol can be used by an examiner to indicate **Nine** marks awarded
✓10	This symbol can be used by an examiner to indicate **Ten** marks awarded
✓11	This symbol can be used by an examiner to indicate **Eleven** marks awarded
✓12	This symbol can be used by an examiner to indicate **Twelve** marks awarded

Marking the Individual investigative Study (IIS)

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

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

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

Higher Level Agricultural Science Marking Criteria for Individual Investigative Study

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

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

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

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

Award a single mark out of 20 for this section. In arriving at this mark consider the indicative content requirements below.

Introduction *- Context for the IIS – 10 marks*	• Excellent - 9 - 10M • Very Good - 7 - 8M • Good - 5 - 6M • Fair - 3 - 4M • Weak - 0 - 2M	***Background Research*** *-Research, sources and knowledge – 10 marks*	• Excellent - 9 - 10M • Very Good - 7 - 8M • Good - 5 - 6M • Fair - 3 - 4M • Weak - 0 - 2M

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

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

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

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

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

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

<table>
<tr><th colspan="2">Section A</th><th>Answer any 10 questions
10 marks for each question
Total for section is 100 marks</th><th>Marks</th></tr>
<tr><td rowspan="3">Q1</td><td>(a)(i)</td><td>Identify each of the following breeds of animals.

A – Short horn
B – Belgian Blue
C – Simmental</td><td>3(2)</td></tr>
<tr><td>(ii)</td><td>Explain dual purpose breed

Dual-purpose breed is an animal breed that provides at least 2 kinds of resources (e.g. meat, eggs, milk)</td><td>2</td></tr>
<tr><td>(iii)</td><td>Explain the importance of using a purebred sire in a beef herd.

Better quality offspring / better traits passed onto offspring / higher heterosis or hybrid vigour / more uniform offspring or less variability in offspring</td><td>2</td></tr>
<tr><td colspan="4">OR</td></tr>
<tr><td rowspan="2"></td><td>(b)(i)</td><td>Identify each of the following breeds of animals.

D – Jersey
E – Suffolk
F – Texel</td><td>3(2)</td></tr>
<tr><td>(ii)</td><td>Suggest which Irish cattle industry this breed is most suited

Industry: Dairy

Evidence: Exceptional fertility / longevity / calving ease / a low somatic cell count / strong feet / overall good health traits / high milk yield (6,000kgs in their first lactation and over 7,000kgs in their later lactations) / good milk quality (estimated milk fat of 4.2% and protein of 3.7%)</td><td>2

2</td></tr>
<tr><td rowspan="2">Q2</td><td>(a)</td><td>Explain what happens at any two stages in a named plant.

<table><tr><td>Germination</td><td>Embryo's cells start to enlarge / seed coat breaks open / root or radicle emerges (first) / (followed by) the shoot or plumule emerges</td></tr><tr><td>Stem Elongation</td><td>Rapid growth of stems / stem lengthens (between the upper nodes)</td></tr><tr><td>Flowering</td><td>Seed head develops or heading out / stem is fibrous and strong enough to support seed head / plants stop growing / produce flowers (buds) for reproduction</td></tr></table></td><td>2(3)</td></tr>
<tr><td>(b)</td><td>Identify any two of the weeds that can be found in Irish fields.

<table><tr><td>Shepherd’s purse</td><td>Chickweed</td><td>Charlock</td></tr></table></td><td>2(2)</td></tr>
</table>

<table>
<tr><td>Q3</td><td>(a)</td><td>State one source of calcium for either plants or animals.

Grass / plant: lime / CAN / eggshells or seaweed or bone meal or other valid answer

Cattle / animal: grass / clover or legume crops / soybean / milk or milk substitute / mineral additive</td><td>2</td></tr>
<tr><td></td><td>(b)</td><td>Outline one process by which calcium becomes available to plants.

Weathering of limestone / absorbed as solution / cation exchange</td><td>2</td></tr>
<tr><td></td><td>(c)</td><td>Explain the symptoms of a named calcium deficiency in cattle.

Name: Milk Fever or hypocalcaemia

Symptom: loss of appetite / excitability / nervousness / hypersensitivity / weakness / weight shifting or shuffling of the hind feet or staggers or valid answer</td><td>Name=3

Symptom =3</td></tr>
<tr><td>Q4</td><td>(a)</td><td>Suggest one reason for any three treatments.

<table><tr><td>Clipped</td><td>Improves heat dissipation (from the body when sweating) or prevention of pneumonia/ control of lice</td></tr><tr><td>Worm dosed</td><td>To kill any worms (endoparasites) present in animals</td></tr><tr><td>Treated for lice</td><td>To prevent lice being spread between cattle / prevent irritation</td></tr><tr><td>Sorted into pens based on breed and weight</td><td>Animals can be kept under the exact same conditions and comparisons can be made based on breed / reduced amount of competition between animals (as all similar weight)</td></tr></table></td><td>3(2)</td></tr>
<tr><td></td><td>(b)</td><td>Outline the importance of performance testing to the beef or dairy industry in Ireland.

Beef or Dairy

Establishing the genetic potential of particular bulls (namely genetically superior bulls) / allows a cost of production (to be placed on the output traits) / improve the productivity of their herd / information stored on the ICBF database which allow a genetic profile of all animals with records and related animals to be computed in the form of a €uro-star index / when bulls commence the performance test their new information can help to improve or dis-improve their indexes in an equal measure / reduced carbon footprint or increased sustainability</td><td>4</td></tr>
</table>

<table>
<tr><td rowspan="3">Q5</td><td>(a)</td><td>Briefly describe how to collect soil samples for soil testing.
Soil sampler or soil corer or soil auger / W shape / take sample every 2 - 4ha / taken at random / avoid gateways or troughs or dung or urine patches / taken at uniform depth / take separate samples from areas that are different in soil type, previous cropping history, slope, drainage or persistent poor yields / do not sample a field until 3 to 6 months after the last application of P and K and 2 years where lime was applied / take a minimum of 20 soil cores / sample fields at the same time of the year to aid comparisons of soil sample results or avoid sampling under extremes of soil conditions e.g. waterlogged or very dry soils / place the soil sample in a soil box to avoid contamination and write the field number on the soil box.
(marks maybe awarded for points on a diagram)</td><td>2(3)</td></tr>
<tr><td>(b)</td><td>Soil testing is recommended to be carried out every 3 – 5 years and between the months of October and February. Briefly describe a reason for these recommendations.
Samples should be taken between October and February as no fertiliser is applied and allows for at least 3 months after the last application of P or K to give an accurate reading / soil nutrient levels change slowly over time so for an accurate reading soil test min every 3 years</td><td>2</td></tr>
<tr><td>(c)</td><td>With record high fertiliser prices, outline how soil testing can improve the economic sustainability of the farm.
Soil tests allow you to identify the key nutrients your soil needs more of, so you can make an informed decision on the correct fertiliser in the right quantity for soil's needs.</td><td>2</td></tr>
<tr><td rowspan="2">Q6</td><td>(a)</td><td>State a cause of lameness in sheep.
Scald / foot rot / shelly hoof / CODD (Contagious Ovine Digital Dermatitis)</td><td>4</td></tr>
<tr><td>(b)</td><td>Briefly describe how the symptoms of the disease stated in part (a).
<table><tr><td>Scald</td><td>Inflammation (of the skin between the digits) / skin becomes red and swollen / covered with a thin layer of white discharge (no smell)</td></tr><tr><td>Footrot</td><td>Inflammation / red moist skin between digits / discharge between digits / lifting of skin-horn (between digits) / underrunning or separation of horn around the heel, sole, toe and finally to outside hoof wall / smell</td></tr><tr><td>Shelly hoof</td><td>Overgrown feet through lack of wear, the wall and toe horn can become long and loose.</td></tr><tr><td>CODD</td><td>Bacterial infection – first signs are ulcers at top of coronary band / progress under hoof horn capsule towards the toe / whole capsule may fall off</td></tr></table></td><td>2</td></tr>
</table>

<table>
<tr>
<td></td>
<td>(c)</td>
<td>Outline the treatment for disease in part (a).
<table>
<tr><td>Scald</td><td>Antibiotic sprays or footbaths are usually sufficient</td></tr>
<tr><td>Footrot</td><td>Antibiotics should be used / footbath or copper sulphate / there is a vaccine available to reduce the incidence of the disease</td></tr>
<tr><td>Shelly hoof</td><td>Treatment is only necessary if lame / careful paring may be required to release debris and soil.</td></tr>
<tr><td>CODD</td><td>Treatment with specific antibiotics / footbath solution</td></tr>
</table>
</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>(d)</td>
<td>Briefly describe one negative financial implication lameness has for a sheep farm.
It has a direct effect on production (20% reduction in body condition score) or reduced liveweight gain or reduced milk production / financial losses through increased prevention or treatment cost or culling</td>
<td>2</td>
</tr>
<tr>
<td>Q7</td>
<td>(a)</td>
<td>Complete the table to show how goat dairy farming compares to cow dairy farming.
<table>
<tr><th>Cow</th></tr>
<tr><td>305</td></tr>
<tr><td>280 - 283</td></tr>
<tr><td>18 - 24</td></tr>
<tr><td>(High yielding cows with high milk solids) bred every year (or 365 days)</td></tr>
</table>
</td>
<td>3+3+2+2</td>
</tr>
</table>

Or

(b) *Describe actions dairy farmers could do to improve their sustainability and receive the bonus.*

Action	Description
Milk recording at least four times a year	Identify high yielding cows with good milk solids for breeding or identifying and breeding more profitable and efficient cows which are better for the environment / identify and cull poorer producing cows or cows with high SCC
ASSAP (water) assessment	Undertake a water quality assessment to measure and improve the quality of water on the farm
Increasing EBI of the herd	EBI will help farmers breed a more profitable dairy cow and lower GHG emissions.
Improving soil health	Use of LESS / sow multispecies swards
Land management	Increase grazing season / sow multispecies swards / grassland management to reduce risk of parasites / incorporate clover for N fixation and reduced fertiliser user / soil testing for pH, N, P or K every five years
Farmer training	Experience in milk production / qualification from Ag College or Teagasc course
Record keeping or Traceability	Keep records of animal remedies / records of animal movements or births and deaths / use of AIM system / tagging / animal passports / compliance with disposal of animals
Animal welfare	Sufficient access to clean water and forage / livestock in individual pens to be in sight of other livestock / calving pens hygienic and safe / castration with burdizzo to be before 6 months / manage AI to minimise calving difficulty / appropriate animal handling facilities to minimise stress or injury / lactating cows to be milked daily / quarantine bought in stock to monitor disease

3+3+2+2

Q8	**(a)**	*State the dependent and independent variable in this investigation.* *Independent* – Fertiliser type *Dependent* – Amount of nitrate in leachate (water)	**2** **2**
	(b)	*Outline why is was important to carry out the test 3 times for each fertiliser.* Repeating an experiment more than once helps determine if the data was consistent or represents the normal case / It helps guard against jumping to conclusions without enough evidence / improves reliability / improving accuracy / to find an average	**3**
	(c)	*Briefly describe the conclusion the student made from his investigation.* There is a large amount of nitrate present in the water from the unprotected urea (250mg/l) compared to protected urea (50mg/l) / farmers should use protected urea as less nitrate is leached when compared to unprotected urea	**3**
Q9	**(a)(i)**	*Explain pre-emergence hoeing.* Controlling of weeds prior to the germination of the crop	**2**
	(ii)	*Explain how the Farmdroid can benefit the environment and farmer.* Less chemical herbicide required / fewer fossil fuels burned as solar powered / no need to recharge batteries / less soil compaction / increased yields as less weeds / precision sowing to maximise land usage / less labour	**2(3)**
	(iii)	*Apart from GPS, outline **one** piece of technology that you have studied that would benefit both the farmer and the environment.* Soil moisture sensors – send message to farmers when crop needs water and prevents crop failure / windmills or solar panels providing renewable energy / other valid example	**2**
Or			
	(b)(i)	*Briefly describe the benefits of pregnancy scanning in animals.* Know if the animal is barren or not (or pregnant) / know due date for accurate feeding / house animals at correct time / pen animals according to number of young they are carrying / a lot of barren animals will indicate a problem with fertility of sire / management practices at birth, especially for multiple births (identify due date)	**2(3)**

<table>
<tr><td></td><td>(ii)</td><td>Describe the management implications for this heifer under the headings which follow.
<table><tr><td>Feeding (in late gestation)</td><td>Feed heifer well (in last trimester (3 months)) to ensure the heifer has enough milk for both calves or achieve correct BCS / to produce good quality milk (colostrum) / good quality silage (75+% DMD) or poorer quality silage and concentrates / mineral supplementation</td></tr><tr><td>Calving</td><td>Be there to assist with calving (as many twins may have malpresentation) / keep in small pen after calving to allow for bonding / feed both calves colostrum or colostrum replacer / clean, dry straw bed / move to pen on her own / clean calving jack / gloves and lubricant / iodine on naval</td></tr></table></td><td>2(2)</td></tr>
<tr><td>Q10</td><td>(a)(i)</td><td>Label the diagram of the monogastric digestive system.
A: Liver
B: Stomach
C: Small intestine</td><td>3(2)</td></tr>
<tr><td></td><td>(ii)</td><td>Outline the role of microorganisms in the monogastric digestive system.
Assist in the digestion of feedstuffs / help protect the animal from infections / (some microbes synthesize and) provide essential nutrients</td><td>4</td></tr>
<tr><td colspan="4">Or</td></tr>
<tr><td></td><td>(b)(i)</td><td>Explain the function of soya bean and rice bran in pig diets.
Soya bean: Source of energy or protein or for growth and repair or provides high quantity of amino acids or source of calcium for bone development
Rice bran: (rich) source of protein for growth and repair or carbohydrate or fat for energy or dietary fibres for gut development(or gut function) or vitamins or minerals for metabolism
• Accept source of nutrient or function of nutrient</td><td>3
3</td></tr>
<tr><td></td><td>(ii)</td><td>Outline the reason for the decreasing crude protein in the different pig rations.
As animals get older they don’t grow as fast as when they were younger so they don’t need the higher protein levels / excess protein can reduce energetic efficiency or cause greater organ weights or can lead to decreased carcass yield</td><td>2</td></tr>
<tr><td></td><td>(iii)</td><td>Briefly describe why there is no grass included in the diet of the monogastric animal.
Cannot breakdown the cellulose in the grass (as they are not ruminants or hind gut fermenters)</td><td>2</td></tr>
</table>

Q11	**(a)**	*Outline ways Tim can achieve the target of 0.95.* Good heat detection / good cow or sire fertility / grading up or cull poor performing cows / good hygiene at calving / enough good quality colostrum at birth / highly digestible feed (or concentrate supplementation) (to ensure good milk production or increased liveweight gain) / scanning of cows to accurately know calving date or proper supervision at calving or assist or vet if calving difficulties / iodine on navel at birth / vaccination programme	**2(3)**
	(b)	*Briefly explain ways Tim can achieve the 6-week calving rate target of 80%.* Monitor liveweight (of young heifers) to ensure they are on course to achieve target weights (aim for 60% of mature weight at mating) / correct BCS of 3.0 at mating / correct nutrition - good quality leafy grass / good heat detection (to increase submission rate) / use AI on cows in first 3 weeks of breeding for replacements or increase EBI of herd or keep early calves for replacements for high EBI / identify non-cycling cows (and get them checked by the vet) / ensure healthy cows (received vaccinations) / synchronised breeding	**2(2)**
Q12	**(a)**	*State the N content of this slurry sample.* 1.1(kg/m^3)*	**3**
	(b)	*Suggest **one** reason for a DM content of 2% in a slurry sample.* Slurry lagoon is not covered / rainwater or dairy washings entering slurry tank	**3**
	(c)	*Briefly explain why the nutrient content of slurry is higher in the 7% DM slurry.* As slurry is less dilute there are more nutrients available	**2**
	(d)	*Outline a safety precaution taken by the farmer when taking the sample of slurry for testing.* Use a weighted container into tank or never enter the pit due to the presence of lethal gases / in over ground tank, using the safe operator platform to add a weighted container / ventilation or mask to prevent inhaling lethal gases or take sample from agitation point	**2**

Section B
Answer any 4 questions
50 marks for each question
Total for section is 200 marks

Q13 **(a)(i)** *Describe **two** factors that are involved in the formation of soil.*

Factor	Description
Parent material	Parent rock is weathered into smaller particles / granite contains quartz which is weathered into sand particles and acidic in nature / limestone rock is alkaline in nature and increases the pH of soil formed from it / determines physical or chemical characteristics of soil
Climate	Temperature – heating and cooling of rock Water – physical or chemical weathering (or any named form) – freeze-thaw or hydrolysis or solution or hydration or determines biological reactions
Topography	Slope of landscape / steep slopes the soil is eroded down to valley or thin layer of soil on slopes or deep fertile soil in valley
Organisms	Contribute humus when die / (microorganisms) help to decompose organic matter / organic matter increases soil fertility / soils that develop / increase soil fertility or improve soil structure (burrowing, binding, eroding)/ organisms break up rock
Time	Young soils (Ireland) have high levels of rock available for weathering / young soils not as deep

5+5+2+2

(ii) *Draw a labelled diagram of a Podzol soil profile.*

Elements of diagram: O or organic matter / A or topsoil / B or subsoil / C or bedrock or parent material / iron pan (or zone of accumulation) present in B = 6 marks

One element missing = 3 marks

Two or more elements missing = 0 marks

Any three labels = 3(2) marks

D = 0,3,6
L = 3 x 2

(b)(i) *Identify the soil water content level for each diagram.*

A: Saturation
B: Permanent wilting point
C: Field Capacity

3(3)

	(ii)	*Briefly describe the implications for a farmer of any **two** of the following.* *Field capacity*: Plants can remove water from the soil easily or water available to plant or land is usable or land is easily cultivated or conditions are suitable for growth *Saturation*: Excess water (lack of air spaces) can reduce crop growth or waterlogged or easily poached or roots cannot respire, or no earthworms or drainage required to reduce waterlogging *Permanent Wilting Point*: Lack of water so plants can no longer extract water from the soil or irrigation necessary or reduced yield or delayed growing season or wind erosion of soil	**2+1**
	(c)	*Describe with the aid of a labelled diagram how a farmer would carry out an investigation to compare the drainage (infiltration) rate of a podzol and brown earth soil sample.* Dried soil sample / same mass of both soils / add to filter paper in funnel / add set volume of water to soil / ***record time taken for water to flow into beakers or record volume for filtrate (for set time)** / water would pass through the brown earth sample quicker (as no iron pan) **OR FIELD METHOD** Two open ended tubes / set tubes into soil (one in each type)/pour equal volume of water into each tube / ***record time taken for water to drain down through tube** / result: soil where water drains fastest has best infiltration rate ***Compulsory point**	**3(4)**
		Or	
	(d)(i)	*Explain how the data gathered could help management decisions on the farm in relation to the drainage or wetting of land.* Assists farmers in deciding when to drain the land or when the water is reaching saturation point to ensure maximum crop growth / informs farmers on when land needs to be irrigated to prevent soil reaching permanent wilting point	**6**
	(ii)	*State the functions of soil moisture (water) in soil.* Provide water to plants (plant cells contain large amounts of water) / seed germination / photosynthesis / nutrients available / chemical reactions / keeps turgor / transpiration / microbial activity or soil organisms / to maintain soil structure or prevent erosion	**4+2**

Q14	**(a)**	*Explain the direct drilling and outline **one** advantage of this method of planting.* *Direct drilling* - the seed is placed without any prior soil cultivation (in the stubble of the previous crop) *Advantage* - Maintains or improves the soil structure / less soil loss from wind / less carbon lost from the soil / min soil disturbance / reduced soil compaction / increased organic matter / reduces weed germination / suitable on shallow soils	**2+1**
	(b)(i)	*Briefly describe why he chose to plant three different varieties of oilseed rape.* Harvest at different times or not all ready to harvest at the same time or spread workload / response of different varieties to weather conditions / response to different soil conditions or aspect / different yields / seed trials / different varieties for different markets / staggered or extended pollination	**5**
	(ii)	*Explain undersowing.* To sow two crops together where the second crop continues to grow after the first crop is harvested	**3**
	(iii)	*Outline the advantages of sowing clover with the oilseed rape.* Increase nitrogen supply to the crop / encourage mycorrhizal fungi / improve soil function / their own root systems can help drainage / improve soil structure / prevents weeds	**5+1**
	(iv)	*Explain annual plant.* Completes its lifecycle in one year.	**3**
	(v)	*Give another example of an annual plant.* Barley / wheat / oats / other valid example	**3**
	(c)(i)	*Describe how to carry out a plant count in a 2 hectare field.* Place quadrat ($0.25m^2$) on the ground / at random / count the number of plants (established) in quadrat / repeat (at least 10 times) / get average plant count / multiply by 80,000 to determine the number of plants in 2 hectares	**3(4)**
	(ii)	*Briefly explain advantages of carrying out a plant count in a newly sown or reseeded field.* Determine if sowing conditions were optimal or impact of weather conditions / if correct seeding rate was used / correct fertiliser amount used / determining germination or establishment rate / weed control	**5+1**
	(iii)	*Explain why it becomes difficult to count the plants are at the tillering stage.* (It is easiest to take plant counts before the crop starts to tiller) when the crop becomes thick, it is hard to see individual plants.	**4**
	(iv)	*Describe a scientific reason for the higher seeding rate.* To allow for seeds that do not germinate / certified seed has min 85% germination	**5**

Q15	**(a)**	*Describe how determine the soil texture.* **Hand** – dry soil sample / rub between fingers and thumb / note grittiness and smoothness / wet sample (and rub between fingers and thumb and note grittiness, smoothness) / note plasticity or if sample is sticky / check if it is possible to roll sample into threads or ring or cast / valid result **Or** **Sediment** – add soil sample to water in a beaker and stir / pour mixture into graduated cylinder and rinse / completely cover the soil with water / stopper or cover the cylinder and shake to mix the soil / leave to settle for a few hours or overnight / observe layers that have settled / using the graduations on the cylinder record the amount of sand, silt and clay in the soil sample / calculate percentage / use soil triangle to find soil texture **Or** **Sieve** – dry soil samples / crush sample (with pestle and mortar) / get mass of soil sample / place sample in sieves with largest sieve on top and smallest on bottom and shake / weigh contents of each sieve / calculate percentage of each particle type / using soil (texture) triangle classify soil sample	**3(4)**
	(b)(i)	*State the optimum pH of a soil for crop growth.* 5.5 – 7.5	**6**
	(ii)	*Suggest another way the students could determine the pH of the soil filtrate more accurately.* pH probe or meter	**3**
	(iii)	*Briefly describe other benefits of liming the soil.* Increase in earthworm activity / improvement in soil structure (drainage or aeration or flocculation) / grass is more palatable to livestock / increased cation exchange capacity / improve nutrient availability	**5+2**
	(c)(i)	*State the soil pH that produces the least amount of N_20 emissions.* *6.9	**6**
	(ii)	*Discuss the relationship between pH and N_20 emissions on the graph and its implications for ongoing farming practice.* The higher the soil pH the lower the N_20 emissions (Farmers should test their soil pH and) add lime to increase the pH levels to as close to neutral as possible to reduce the N_20 emissions which is better for the environment and more sustainable	**5** **3**

<table>
<tr><td></td><td>(d)</td><td>For a named food crop other than grass, describe its production under the headings which follow.
Points unless qualified apply to potatoes, barley or other cereal, kale.<table><tr><td>Seedbed preparation</td><td>Plough and harrow or mintill or rotovate / allow weeds to germination and harrow again or valid method of weed control / stone removal / ridges for potatoes or fine seedbed for barley / spring cereals rolled after sowing (for good soil: seed contact)</td></tr><tr><td>Disease prevention</td><td>Sowing certified seed / crop rotation or remove groundkeepers / biological or chemical control</td></tr></table></td><td>4+4</td></tr>
<tr><td rowspan="3">Q16</td><td>(a)(i)</td><td>Identify the main source of carbon emissions on the farm.
*Animal digestion</td><td>5</td></tr>
<tr><td>(ii)</td><td>State with reason if the main source of emissions are above or below the national average for the enterprise.
Below
As the average for the enterprise is over 40% / is less for the current and previous assessments</td><td>5+1</td></tr>
<tr><td>(iii)</td><td>Comment on the overall carbon emissions on the farm since Anna and Lucy joined the scheme and justify your answer.
Comment
Since Anna and Lucy joined the scheme, their carbon emissions have remained fairly constant
Justify
No increase in emissions from any source / farm remains below national average in animal digestion and manure usage / farm emissions is still slightly higher than national average in fertiliser usage and forage or feed / correct use of percentages from graph</td><td>2(3)</td></tr>
<tr><td>(b)(i)</td><td>Anna and Lucy wanted to reduce the emissions on the farm so they spoke to you as their advisor to identify an action for each source of carbon emissions shown on the graph in (a). Describe the advice you would give to them to suit their farm.<table><tr><td>Animal digestion</td><td>Improve animal productivity / improve genetic merit / improve grass quality / improve grass DM / improve herd health / reduce days to slaughter / use feed additives e.g. seaweed</td></tr><tr><td>Manure</td><td>Aim for (70%) manure application in spring / low emission slurry spreading (LESS) / reduce housing period or extended grazing / compliance with the Nitrates Directive / correct spreading conditions</td></tr><tr><td>Fertiliser use</td><td>Use protected urea / apply lime / soil test – P & K requirements / use clover in swards / buffer zone / compliance with the Nitrates Directive / correct spreading conditions</td></tr><tr><td>Forage / feed</td><td>Improve grass utilisation and grazing season / reduce concentrate feeding</td></tr></table></td><td>4+4+2+2</td></tr>
</table>

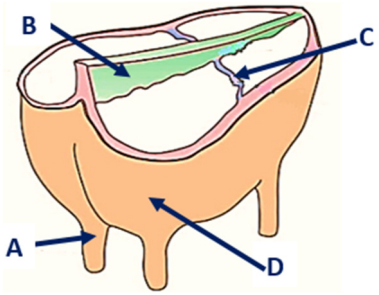
	(ii)	*List **two** other potential sources of carbon emissions on the farm.* Soil cultivation or land reclamation / fossil fuels / animal and plant respiration /biodigester	**5+1**
	(c)	*Draw a labelled diagram of the carbon cycle* • Point for correct cycle shown (3 marks) • Four other points for showing CO_2 in air / photosynthesis / respiration / combustion or decomposition (4x3) ***Max 12 marks awarded if not shown on diagram**	**5(3)**
Or			
	(d)(i)	*Describe three impacts of warmer than average temperatures will have on agriculture in Ireland.* Increased pests and diseases introduced with warmer temperatures / crop yields reduced due to lack of water / increased flooding causing damage to agricultural land / plant and animal stress factors / drought effects / the ability to provide sufficient resources for animals during extreme events / reduced animal performance / suitable climate for new crops / change in growing season / more wildfires	**3(3)**
	(ii)	*As part of the Climate Action Plan, 2021, there is a 22 – 30% reduction in agricultural emissions by 2023. Briefly describe ways farmers can play their part in achieving these targets.* Reduce chemical N usage by sowing clover or using protected urea / replace CAN with protected urea to reduce ammonia losses / spread slurry using LESS to reduce ammonia emissions / increase the level of milk recording on dairy farms / increase weighing of beef animals on farms to ensure target liveweights are met / reduce slaughter age to closer to 24 months / increase organic farming / increase in biomethane (biodigesters) / carbon farming / other valid answer	**2(3)**

<table>
<tr><td rowspan="4">Q17</td><td>(a)(i)</td><td>Describe the management of the reseeded land at the following stages:
<table><tr><td>1st 8 weeks</td><td>Graze at 2 – 3 leaf stage / spray weeds before grazing / add N, P and K / add slug pellets (if required) / don’t harvest for silage / don’t graze at high cover (>1400kg DM/ha) / roll (to encourage tillering) / graze with sheep or light animals</td></tr><tr><td>2nd grazing onwards</td><td>Graze at 6 – 8cm (1200 – 1600kg DM/ha) or don’t allow high covers to develop / respray weeds if necessary / don’t graze in really dry or wet conditions / named rotational grazing system / adequate N (18-6-12 or CAN or Urea)</td></tr><tr><td>Autumn</td><td>Keep grazing at 6 – 8cm (1200 – 1600kg DM/ha) / graze well before 1st winter (>4cm) / light slurry application or avoid excess slurry / don’t overgraze or poach / Test P and K levels (apply if necessary)</td></tr><tr><td>2nd year</td><td>Adequate N / monitor P & K levels / don’t overgraze or poach</td></tr></table></td><td>4(4)</td></tr>
<tr><td>(ii)</td><td>Explain ways plants can be encouraged to tiller.
Adding nitrogen / rolling / sheep or calf grazing or grazing to 4cm / topping</td><td>6+2</td></tr>
<tr><td>(b)(i)</td><td>Describe the reasons for including a hybrid seed mixture in his reseeding plan.
Get the best traits from each seed in his sward / develop at different stages / greater uniformity / can be used for silage and grazing / disease resistance / extend grazing season / better productivity (yield), palatability, or digestibility / better persistence / aggressive (or weed control)</td><td>2(6)</td></tr>
<tr><td>(ii)</td><td>Outline reasons for including a variety of heading out dates in the grass seed mixture when reseeding swards.
Ensures good digestible grass throughout the grazing season / allows for good quality silage early in year / won’t be all ready for cutting at the same time or greater opportunity for grazing digestible grass</td><td>2(2)</td></tr>
<tr><td>(iii)</td><td>Identify any two of the plant varieties found in Irish multi species seed mixtures.
A = Perennial ryegrass or PRG
B = (Ribwort) plantain
C = Chicory</td><td>2(2)</td></tr>
</table>

<table>
<tr><td></td><td>(c)</td><td>Explain, with the aid of a labelled diagram, how grass plant reproduces either sexually or asexually.

Asexually
Only one parent / cloned / grass plant reproduces via vegetative propagation / rhizomes produce shoots below ground at nodes / produce new plant / stolons produce new shoots above ground / root at nodes

Sexually
Pollen grains are light or plentiful / wind pollination or long hanging anther or anther or stamen / caught in (feathery) stigma or carpel / male gamete (pollen) fuses with female gamete (egg) or fertilisation or zygote or seed formed</td><td>5+1</td></tr>
<tr><td>Q18</td><td>(a)(i)</td><td>Label any three parts of the structure of the udder

<table>
<tr><td>A</td><td>Teat</td></tr>
<tr><td>B</td><td>Median suspensory ligament</td></tr>
<tr><td>C</td><td>Connective tissue / fine membrane</td></tr>
<tr><td>D</td><td>Epidermis / hind quarter / outer wall</td></tr>
</table></td><td>3(1)</td></tr>
<tr><td></td><td>(ii)</td><td>Briefly describe the symptoms of mastitis in cows

Hard swollen (udder) quarter or inflammation / reduced milk yield / (white) clumps (of cells) in milk or clots in milk / cow agitated / high SCC</td><td>4+3</td></tr>
<tr><td></td><td>(iii)</td><td>Explain the treatment of mastitis in cows

Milk out the quarter (fully before infusing(injecting) the antibiotic) / disinfect the teat end / avoid contamination of the nozzle of the antibiotic tube / partially insert the antibiotic tube nozzle into the teat canal / infuse the contents of the antibiotic tube into the infected quarter and gently massage the antibiotic into the teat / teat spray treated quarters immediately after infusion / clearly mark the treated cow and treated quarter / record treatment details on a chart at the parlour so that other milkers may check treatment details</td><td>4</td></tr>
</table>

	(iv)	*Briefly describe ways farmers can reduce mastitis in cows.* Disinfect teats pre and post milking / wash and dry udders / lime on cubicles / clean bedding / clip hair on tail / milk infected cows at the end or disinfect clusters between milking / cull high SCC cows / service machine regularly (to avoid any stray electricity) / change liners (twice per year) / good milking routine / hot wash machine	**2(3)**
	(v)	*Assist Jenny in placing each step in the correct order by matching the correct letter to the number in the box.* *1* **A** *2* **D** *3* **B** ***4*** **C**	**4(2)**
	(b)(i)	*The table below shows the milk composition in the morning and evening. Analyse the table and outline the reasons for the difference.* There is a higher total solid content in the evening / as there is a shorter milking interval between morning and evening or less produced **OR** The milk in the morning is more dilute due to the higher volume produced between evening and morning	**3+1**
	(ii)	*Describe the factors affecting milk quality.* **Cow health**– susceptible to irritation or inflammation of the udder if hygiene conditions are poor / sick cows have reduced milk yield and poorer quality milk **Somatic cell counts**– high somatic cell counts in milk indicate an increased presence of white blood cells—a signal that the cow is fighting an illness / other types of somatic cells can degrade the fat and protein content in milk which adversely affect milk quality **Diet**– affects the composition of milk / require good digestible feed / ~14% crude protein diet / lack of sufficient nutrients reduces milk quality **Milk handling or storage**– machine hygiene is very important, or machine is hot washed after milking / install plate cooler to reduce milk temperature as quickly as possible / bulk tank kept below 4^{o}C / no milk washings entering the tank **Milk hygiene**: any relevant point on hygiene or TBC **Breed or genetics**: high EBI cow used or named breed with high milk solids ***Maximum two matching points (factor + describe) from any one category and third factor from another category***	**F:3(3) + D:3(3)**