



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination Sample Paper Agricultural Science

Higher Level

2 hours 30 minutes

300 marks

Examination Number

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Day and Month of Birth

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For example, 3rd February
is entered as 0302

Centre Stamp

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Instructions

There are two sections to this examination.

It is recommended that you spend about 50 minutes on Section **A** and 100 minutes on Section **B**.

Section A Answer **ten** questions from this section. There is internal choice in two questions. Each question carries 10 marks.

Section B Answer any **four** questions from this section.
Each question carries 50 marks.

Write your Examination Number and your Day and Month of Birth in the boxes on the front cover.

Write your answers in blue or black pen. You may use pencil for sketches, graphs and diagrams only.

Write your answers in the spaces provided to all parts of the examination into this answerbook. This answerbook will be scanned and your work will be presented to an examiner on screen. Anything that you write outside of the answer areas may not be seen by the examiner. You are not required to use all the space provided.

There is extra space at the end of Section A and at the back of the booklet. Label any extra work clearly with the question number and part.

Section A

100 marks

Answer all **ten** questions.
Each question carries 10 marks.

Question 1

Soil can become compacted over time due to both animal and machinery traffic, resulting in poor drainage. A farmer collected and sent soil samples for testing. The laboratory carried out tests comparing the capillarity and infiltration rate of a compacted soil and an un-compacted soil.



(a) State a possible hypothesis and prediction for this investigation.

Hypothesis:
Prediction:

(b) Suggest **one** suitable variable for this investigation.

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(c) Describe briefly how the infiltration rate of both the compacted and un-compacted soil was determined by the laboratory.

Question 2

Aquatic habitats such as streams and ponds can suffer from a process of enrichment called eutrophication. Eutrophication can be caused by run-off from artificial fertilisers.

(a) List **two** other farm products that can cause eutrophication.

1.
2.

(b) Examine the following sentences and select which **one** correctly describes the effect of eutrophication by putting a tick (✓) in the correct box.

High levels of nutrients cause aquatic creatures such as fish to die, fish are decomposed by bacteria, bacteria respire and release carbon dioxide, algae use carbon dioxide and grow excessively creating an algal bloom.	
High levels of nutrients promote growth of algae which create an algal bloom, algae die and are decomposed by bacteria, oxygen depleted, aquatic creatures such as fish die.	
High levels of oxygen allow algae to respire and grow excessively, bacteria cannot survive as algae has used up oxygen, algae are not decomposed, aquatic creatures such as fish die due to build-up of algae on surface of water.	
High levels of oxygen and nutrients allow bacteria to respire and release carbon dioxide, aquatic creatures such as fish die due to high levels of carbon dioxide, algae use carbon dioxide to grow excessively creating an algal bloom.	

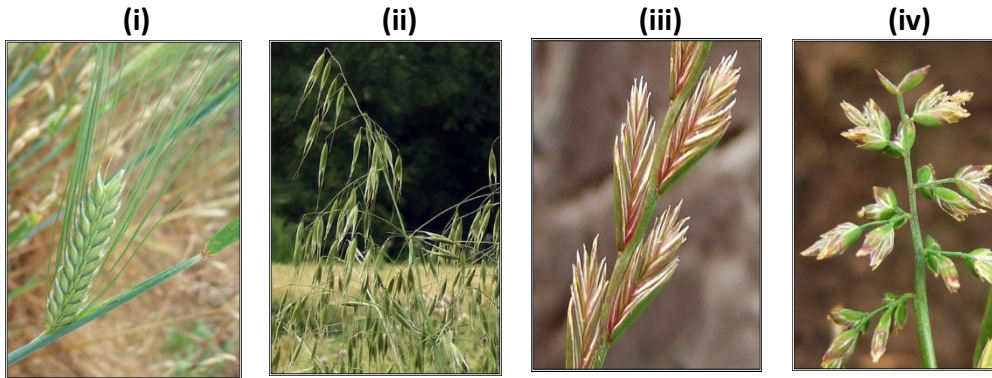
(c) Outline **two** management practices farmers can implement to prevent eutrophication.

1.
2.

Question 3.

Answer either (a) and (b) **or** (c) and (d).

- (a) Applying your knowledge of structure and function of plants, identify each of the following grass (*Poaceae*) species.



(i)
(ii)
(iii)
(iv)

- (b) Members of the grass family can be distinguished from one another based on their inflorescence. Explain the underlined term.

Or

- (c) Outline **three** ways in which a leaf is adapted to maximise photosynthesis.

1.
2.
3.

- (d) In relation to the main plant structures, describe **two** external factors that affect the rate of transpiration.

1.
2.

Question 4

Cover crops are widely used on farms in Ireland. These crops include catch and energy crops.

Answer the following in relation to a named catch **or** energy crop.

Name of crop:

(a) Outline **two** benefits of sowing the named crop on a farm.

1.
2.

(b) Describe the harvesting technique of the named crop.

(c) Identify **one** disease that affects your chosen crop and select an appropriate method of treatment.

Name:

Treatment:

Question 5

- (a) Describe **one** management practice of new-born lambs at time of lambing under each of the following headings.

Housing:
Optimal health and welfare:

- (b) Read the passage below and answer the questions which follow.

Blowfly strike prevention in sheep

One of the principal roles of any living organism is to ensure the continuation of its own species. Blowflies are no different. After emerging, a female blowfly will mate almost immediately and look for a source of organic matter to lay her eggs. These eggs usually hatch within 12 hours to form the first stage larva (maggots), in suitable environmental conditions.

These first stage larva (maggots), then further develop into second stage maggots. These second stage maggots have mouthparts containing teeth.

It is these second stage maggots and the third stage which create the typical lesions we see as blowfly strike. The maggots create the lesions by eating the sheep alive. In Ireland, blowfly strike can be caused by the common green bottle (*Lucillia sericata*). (Adapted from Agriland, 2020)



- (i) Why do first stage larvae of the blowfly tend not to cause harm to sheep?

- (ii) Explain how the sheep are affected by blowfly strike.

- (iii) Outline how a farmer could prevent blowfly strike in their flock.

Question 6

Technology advances in agriculture have allowed farmers to practice sustainable agriculture while also becoming more productive and innovative with crop and animal production.

- (a)** The use of drones could aid farmers in crop production.



Describe how the use of drones could help with direct and indirect control of pests or diseases or weeds.

Direct control:
Indirect control:

- (b)** Apart from drones, identify **one** role biotechnology applications have in animal science.

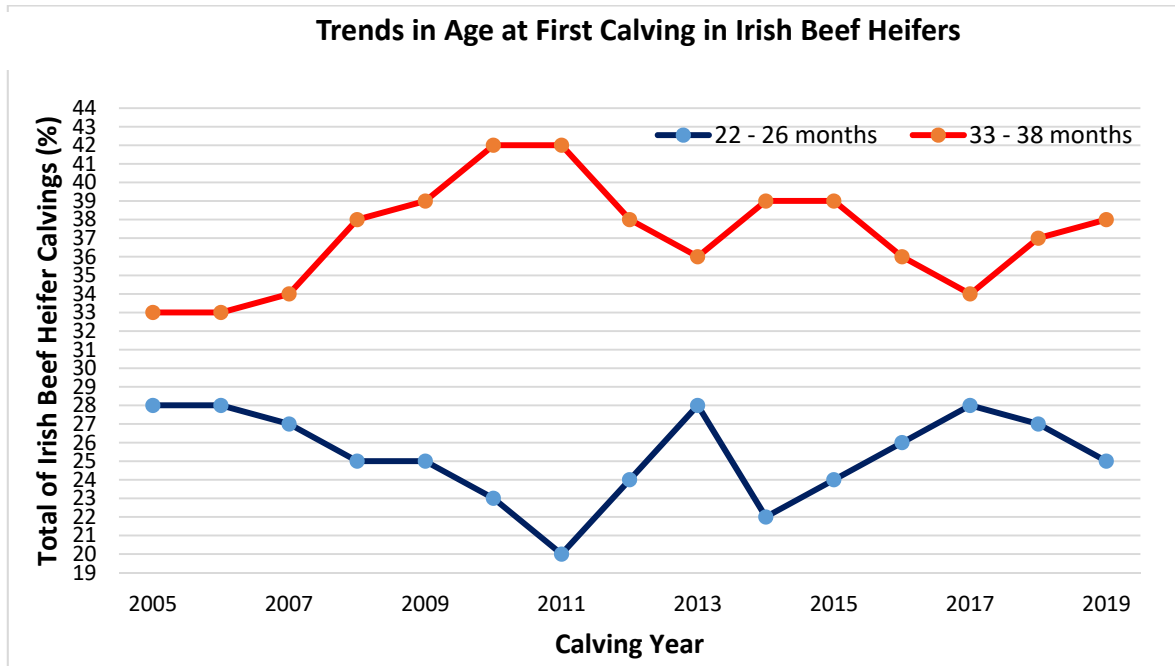
- (c)** Justify **two** benefits of the application stated in (b).

1.
2.

Question 7

Answer either (a) or (b).

- (a) The two age intervals tracked in the data correspond to a first calving at two years or at three years of age in Irish beef heifers from 2005 to 2019.



(Adapted from ICBF)

- (i) Analyse the graph and identify at which of the two age intervals shown do the majority of beef heifers first calve?

- (ii) Using the graph, estimate by how many percentage points has the percentage of 22-26 month beef heifers calving in the 2019 calving year decreased compared with the 2005 calving year.

Place a tick (✓) in the correct box.

28%		6%		3%	
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- (iii) Based on the trends in the graph above, predict if the % of heifers calving at 33–38 months will have increase or decrease in 2020.

- (iv) Distinguish between **two** methods of fertilisation of a named farm animal.

Named animal:
1.
2.

Or

- (b) The table shows the calving and fertility performance for heifers calving at 22–26 months and 33–38 months of age.
Analyse the data in the table to answer the questions which follow.

Calving and fertility performance for age at first calving (2015)					
Age at first calving (months)	Number of cows	Calf mortality in 1 st gestation	Difficult calving in 1 st gestation	Calving interval all gestations	% of cows still alive
22–26	27,388	3%	8%	398 days	36%
33–38	36,435	2%	5%	410 days	36%

(Adapted from ICBF)

- (i) Explain why heifers calving at 22–26 months had a higher % of difficult calving.

- (ii) Identify which age of first calving would be more productive for beef farmers and justify your answer.

Calving Interval:
Justify:

- (iii) Explain what is meant by calving interval and reproductive efficiency.

Calving Interval:
Reproductive efficiency:

Question 8

(a) Explain what is meant by the term pH.

(b) Cathal and Sinéad collected four soil samples from the same location and tested the pH of each sample. The results are presented in the table below.

Soil Sample	pH of Cathal's samples	pH of Sinéad's samples
Sample 1	5.7	6.0
Sample 2	5.7	6.1
Sample 3	5.8	6.0
Sample 4	5.7	5.9

(i) The actual pH of the soil sample was 6.0. State with a reason who was most accurate in their analysis of the soil samples.

(ii) Place a tick (✓) in the correct box which illustrates the optimum pH level for crop growth.

pH levels	Optimum
5.0 – 5.9	
6.0 – 7.5	
7.6 – 8.5	

(iii) Identify **two** issues that may affect crop growth in soils when either a very low or a very high pH (i.e. below 5.5 or above 8.5) is present.

1.

2.

Question 9

(a) Define the term *body condition score*.

(b) Choose the ideal body condition score for a cow at mating by placing a tick (✓) in the correct box.

Body score at mating	
2.5	
3.0	
3.5	

(c) State **one** difficulty a farmer may encounter in their dairy herd if the body condition score of a cow is too high or too low.

(d) In addition to a suitable body condition score, identify **two** other factors a farmer should consider when selecting a replacement heifer for the dairy herd.

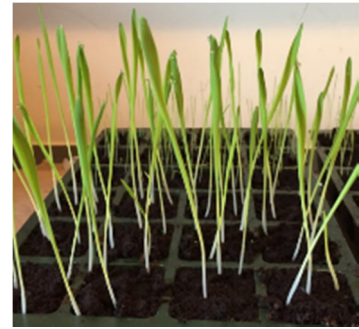
1.

2.

Question 10

A student investigates the effect of nutrients on the growth of plants as shown in the picture.

- (a) Suggest **one** type of qualitative data and **one** type of quantitative data the student could record when carrying out this investigation.



Quantitative data:
Qualitative data:

- (b) The student also wants to measure the biomass of the plant samples.

- (i) Explain what is meant by the term biomass.

- (ii) Outline how the student could measure the biomass of the plant samples.

Section B**200 marks**

Answer any **four** questions.
Each question carries 50 marks.

Question 11

- (a) Discuss the factors that determine the output **and** quality of produce from a chosen animal enterprise under the following headings.

Name of enterprise:
(i) Breed variety:

(ii) Nutrition:

(iii) Housing:

(iv) Management:

(b) Apart from grass, describe the production of another named crop under the following headings.

Named crop:

(i) Soil quality:

(ii) Soil factors that influence productivity of the crop:

(iii) Crop rotation:

(iv) Storage:

- (c) (i) Tuberculosis (TB) is a notifiable disease and all beef and dairy farmers must carry out a TB test on their farm once per year. Explain what is meant by the underlined term.

- (ii) Identify **one** other notifiable disease that occurs on Irish farms.

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- (iii) State **one** reason why it is important for Irish farmers to fully comply in relation to notifiable diseases.

- (iv) The picture shows a vet testing for TB in cattle. Identify **one** safety feature shown in the picture.



- (v) Sketch the best farmyard layout practice to ensure safety of the farmer when the animals exit the crush and return to the shed.

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Question 12

(a) The rhizosphere is an important biological characteristic of soil.

(i) Describe the rhizosphere.

(ii) Explain the importance of the rhizosphere to the root system of a plant.

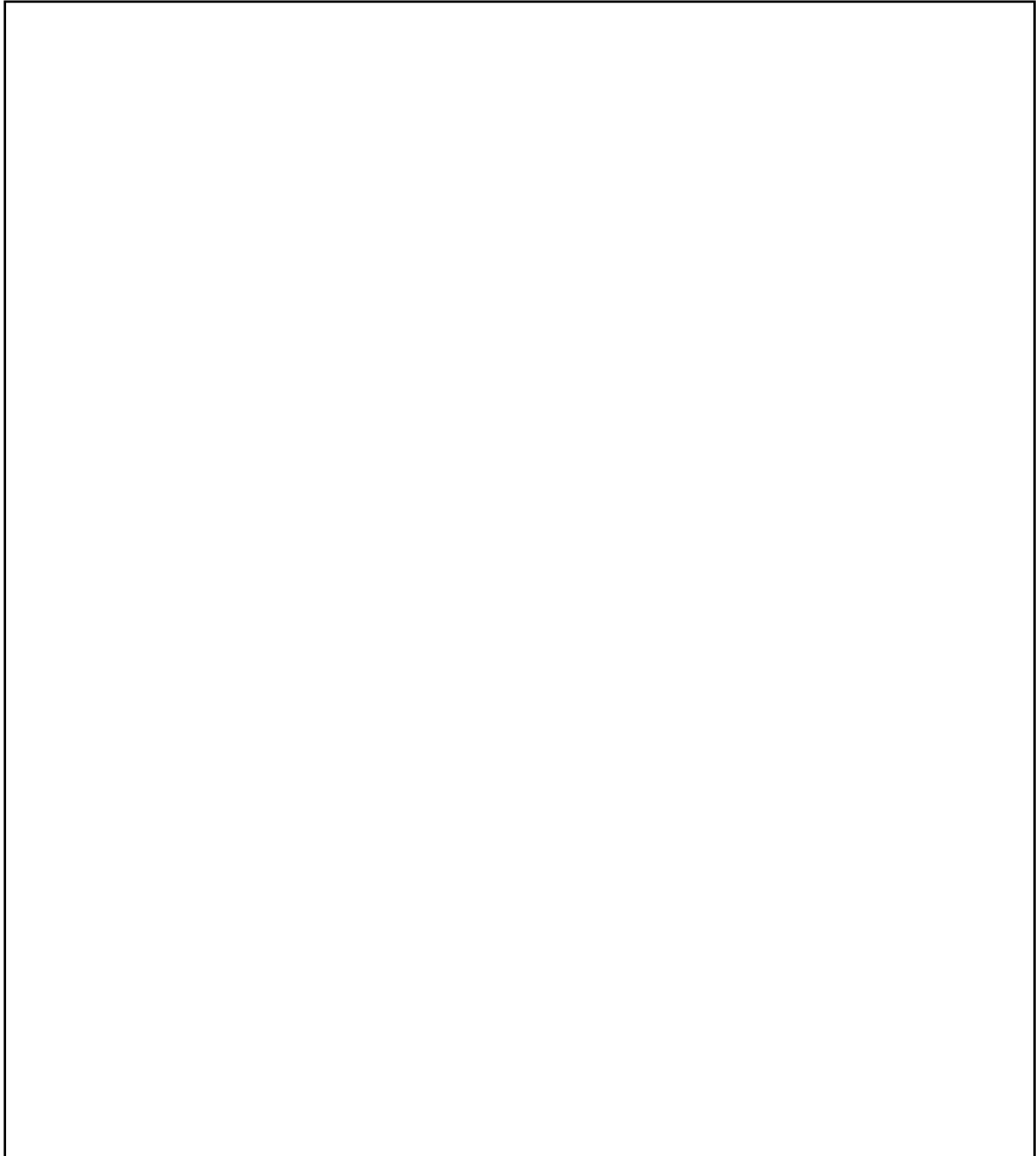
(iii) Briefly describe the impact regular soil cultivation and conventional farming practices may have on the rhizosphere.

(b) Nitrogen gas (N₂) is the most abundant element in our planet's atmosphere. The nitrogen cycle has symbiotic relationships in its biochemical processes.

(i) Define the underlined term.

(ii) The presence of denitrifying bacteria can be an indication of poor quality soil. Suggest a technique farmers could carry out to improve the quality of the soil.

(iii) Sketch a labelled diagram to illustrate the nitrogen cycle.



(iv) Briefly describe **one** symbiotic relationship that is present in the nitrogen cycle.

(v) State **one** other symbiotic relationship that occurs on the farm.

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- (c) (i) The picture shows the root nodules of clover. Describe, with the aid of a labelled diagram, how you would isolate and grow bacteria from clover root nodules.



Labelled diagram:

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- (ii) State **two** safety precautions you would take when carrying out this investigation.

1.
2.

- (iii) Suggest **one** systematic error that could occur in this investigation.

Question 13

(a) Identify **two** characteristics of **one** named breed of pig or poultry or horse.

Named breed of animal:
1.
2.

(b) Examine the feed labels below from two sheep rations and answer the following questions.

Lamb Creep		Finishing Ration	
Crude Protein	18%	Crude Protein	14%
Crude fats and oils	3.1%	Crude fats and oils	3.4%
Crude Fibre	8.5%	Crude Fibre	9.1%
Crude Ash	6.4%	Crude Ash	6.4%
Sodium	0.65%	Sodium	0.64%

(i) Suggest a reason why the lamb creep is formulated to have a higher % of protein than the finishing ration.

(ii) State the function of fibre in the ration formulas.

(iii) Name **one** food ingredient that could be used as source of protein in a sheep ration.

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(iv) Copper is not included in sheep rations as there is sufficient copper in the forage and grains. Apply your knowledge of ration formulation to outline **one** role of copper in an animal's diet and outline any symptom of a copper deficiency.

Role:
Deficiency:

- (c) The following is an example of the weight gain for four grazing steer cattle over the course of one month.

Date	Animal 1	Animal 2	Animal 3	Animal 4	Average live weight of the four animals on each date
30/08/20	320 kg	315 kg	222 kg	244 kg	275 kg
06/09/20	324 kg	319 kg	226 kg	249 kg	280 kg
13/09/20	329kg	323 kg	230 kg	254 kg	284 kg
20/09/20	334 kg	327 kg	234 kg	259 kg	289 kg
27/09/20	339 kg	331 kg	238 kg	264 kg	293 kg
04/10/20					X.
DLG					Y.
FCR					Z.

- (i) Distinguish between daily live-weight gain (DLG) and feed conversion ratio (FCR).

- (ii) State two factors that affect the FCR of animals.

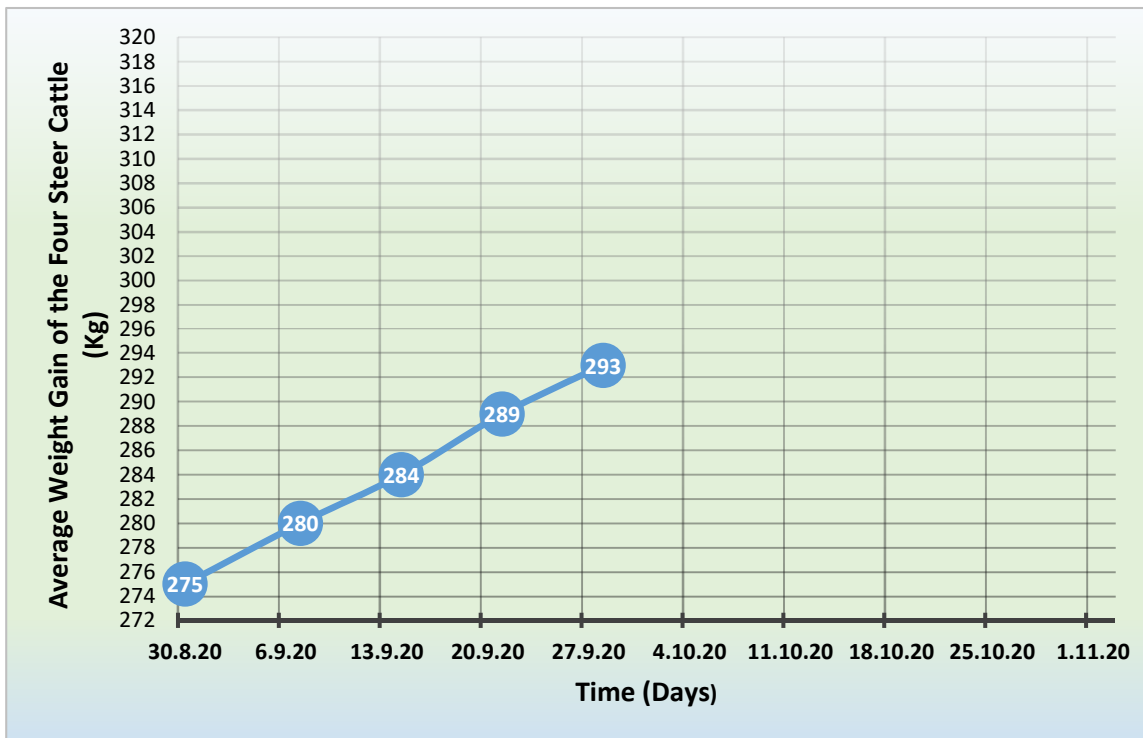
1.
2.

- (iii) Predict the average live weight of the animals on the 04/10/20 and enter the results into the average in the cell labelled X in the above table.

- (iv) Calculate the average DLG for the animals from 30/08/20 to 04/10/20 and enter the results into the average in the cell labelled Y in the above table.

Calculations:

- (v) The graph below is drawn using the average weight gain data from the previous table for the cattle. Complete the graph to show the predicted average weight of the cattle on the 01/11/2020.



- (vi) All four animals are being fed 7 kg of dry matter (DM) intake, made up of silage and concentrates per day. Calculate the average FCR for the animals and enter results into above table in the cell labelled Z.

Calculations:

- (vii) The DLG is lower than is typical for animals in a beef system. Suggest a reason why this is the case.

- (viii) Suggest a breed of cattle for animal 3. Justify your suggestion.

Breed:
Justify:

Question 14

(a) Farmers used preserved forms of grass as winter feed for their stock.

(i) Compare silage and hay as methods of grass preservation under the following headings.

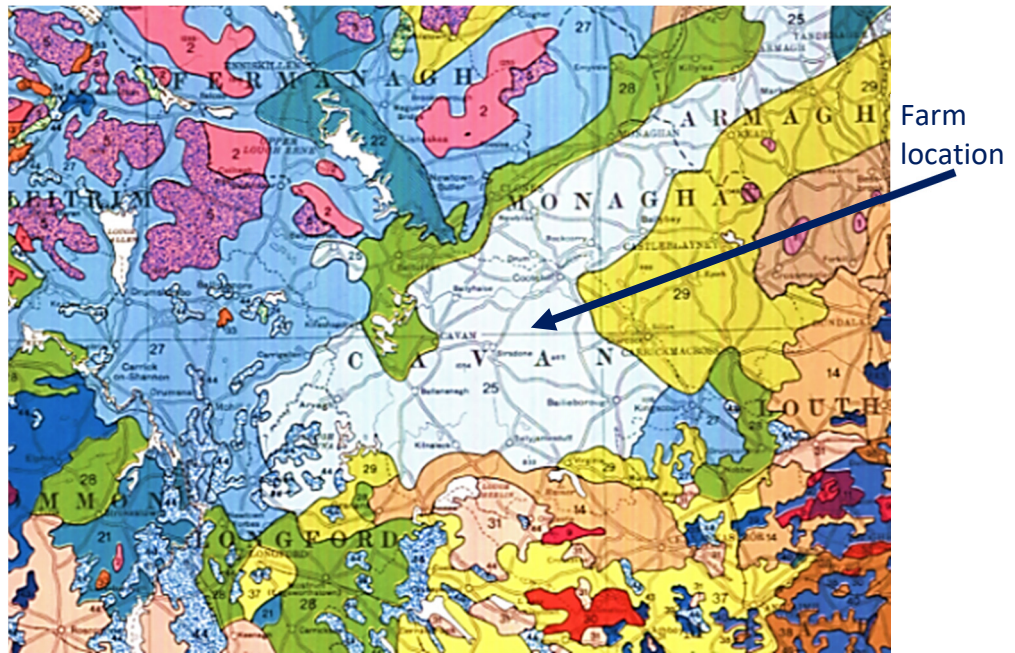
	Silage	Hay
Conservation technique		
Additives used		

(ii) Preservation of grass involves the use of machinery. Describe **three** risks and matching safety precautions farmers should take during grass preservation.

Risk 1:
Precaution 1:
Risk 2:
Precaution 2:
Risk 3:
Precaution 3:

(iii) Summer weather in Ireland is highly changeable as was seen in both 2018 and 2020. Consider the impact different weather conditions will have on both methods of grass preservation stated in part (i).

- (b) Derek has an autumn and spring calving suckler beef and pig farm in Co. Cavan.
- (i) From the section of the soil map of Ireland, determine what type of soil Derek is most likely to have on his farm in Co. Cavan.



Broad Physiographic Divisions	Soil Association		
	Number	Principal Soil	Associated Soils
Drumlin (Wet Mineral and Organic Soils)	25	Gleys (50%)	Acid Brown Earths (40%) Interdrumlin Peat and Peaty Gley (10%)
	26	Gleys (60%)	Acid Brown Earths (40%)
	27	Gleys (85%)	Interdrumlin Peat and Peaty Gley (15%)

Soil type:

- (ii) Outline **two** characteristics of this soil type and state the implications of these characteristics on his production.

Characteristic	Implication
1.	1.
2.	2.

- (c) Due to the nature of Derek's autumn and spring calving suckler enterprise, silage quality is vitally important. This is to ensure that his concentrate feeding is kept to a minimum and to enhance the economic sustainability of his farm. His local feed merchant representative took a number of samples of silage for analysis. The table below contains the results.

Farm		
Derek, Millbrook, Co. Cavan		
Forage type: First cut pit silage (cut 3 rd June 2020)		
Date received	14 th August 2020	
Lab report number	12345	
Analysis (Dry Matter)	Results	
Dry Matter	%	26.5
Protein	%	13.1
DMD	%	68.7
Metabolisable Energy	MJ / kg	10.7
Sugars	%	3.2
Ash	%	7.3
Non Digestible Fibre	%	46.7
Lignin	g/kg	19.1
pH	-	4.8

- (i) Based on the results shown, discuss the quality of Derek's silage.

- (ii) Outline the implications for the level of concentrate feeding required for the winter for both his dry cows and freshly calved cows. Support your answer with evidence from the table.

Question 15

(a) Read the following article and answer the questions that follow.

Farmers advised not to feed waste milk to calves

It has been stated by a European specialist in bovine health management that dairy farmers are advised not to feed antibiotic milk, or 'waste milk', to calves during the spring or autumn period.

Waste milk is milk held back from sale from a treated cow. This milk is unfit for sale due to poor quality or the presence of antibiotic residues. On some farms, waste milk is fed to calves as an alternative to feeding milk replacer or milk from freshly-calved cows. This waste milk has the potential to affect the bacteria in a calf's digestive system, but it is also unpalatable which can result in high rejection rates by calves. This in turn can affect the growth performance of the calf. As an alternative option to feeding waste milk, milk replacer or whole milk can be fed.



(Adapted from Teagasc 2017; Agriland, 2020)

(i) State **one** reason why farmers should not feed antibiotic milk or 'waste milk' to calves.

(ii) Name **one** alternative feed farmers can give to calves instead of antibiotic milk.

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(iii) The above picture shows Aberdeen Angus cross calves at three weeks of age from the dairy herd. In addition to milk, what nutritional requirements would these calves need prior to weaning? Justify your answer.

(b) Resistance to antibiotics (antimicrobial resistance – AMR) is becoming an ever increasing problem. It is estimated to be responsible for the deaths of 700,000 people globally per year. The use of antibiotics in the farming sector is coming under increasing scrutiny in light of the very real public health threat of antimicrobial resistance (AMR).

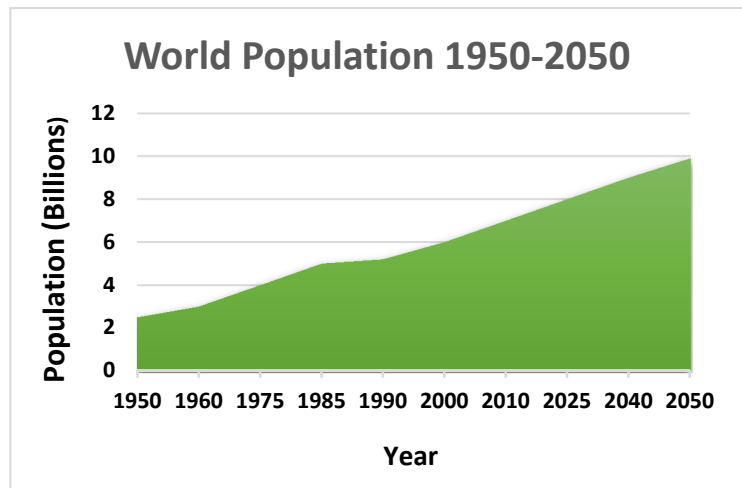
(i) Outline **three** ways farmers can reduce the amount of antibiotics used on their farms.

1.
2.
3.

(ii) Since the abolition of milk quotas in 2015 the dairy industry has intensified. There are now almost 1.4 million dairy cows in Ireland. You have been asked to advise dairy farmers on how to deliver milk in a sustainable and environmentally friendly way. Devise a general plan you could deliver to dairy farmers to help them produce milk in a more sustainable and environmentally friendly way. Your plan should include at least **three** specific suggestions.

- (c) By 2050 the world population is expected to reach almost 10 billion. The challenge for both scientists and farmers is how to meet this demand for food but also to produce the food in a sustainable way that simultaneously protects and enhances our natural environment.

Genetic engineering provides a possible solution to this challenge.



(Adapted from the World Resources Institute)

- (i) Explain what is genetic engineering.

- (ii) State **one** potential benefit of genetic engineering in the production of food.

- (iii) Describe how a plant genome can be altered to tackle a specific crop disease.

(iv) Identify **two** ethical issues surrounding the use of genetically modified organisms.

1.
2.

(v) List **two** biotechnological applications to improving crop development and management and explain **one** of the applications that you have named.

Applications to improving crops using biotechnology:
1.
2.
Explanation of one method:

(vi) In relation to genetic improvement and selection in plants, distinguish between performance and progeny testing.

Acknowledgements

Images

Image on page 1	nutrilawn.com
Images on page 5	Seawright, J. https://www.irishwildflowers.ie/pages-grasses/g-1.html Seawright, J. https://www.irishwildflowers.ie/pages-grasses/g-26.html Seawright, J. https://www.irishwildflowers.ie/pages-grasses/g-7.html Seawright, J. https://www.irishwildflowers.ie/pages-grasses/g-4.html
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Image on page 21	nationaltribune.com.au/how-well-do-you-know-your-nodules
Image on page 26	EPA.ie
Image on page 29	Teagasc.ie; Agriland.ie
Image on page 31	wri.org

Texts

Text on page 7	Agriland team. <i>Blowfly strike prevention in sheep</i> . < https://www.agriland.ie/farming-news/blowfly-strike-prevention-in-sheep > (5 June 2020).
Text on page 29	Gilsenan, Emma. <i>Farmers urged not to feed antibiotic milk to calves this spring</i> .< https://www.agriland.ie/farming-news/farmers-urged-not-to-feed-antibiotic-milk-to-calves-this-spring/ > (26 January, 2020). Teagasc. <i>The Teagasc calf rearing manual, milk feeding – the liquid diet</i> ; < https://www.teagasc.ie/media/website/publications/2017/section3-milk-feeding.pdf >. (20 February, 2017).

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Leaving Certificate Examination Sample Paper – Higher Level

Agricultural Science

2 hours 30 minutes