



Coimisiún na Scrúduithe Stáit  
State Examinations Commission

Leaving Certificate Examination 2024  
Agricultural Science  
Higher Level

Monday 17 June Afternoon 2:00 - 4:30  
300 marks

**Examination Number**

<input type="text"/>					
----------------------	----------------------	----------------------	----------------------	----------------------	----------------------

**Date of Birth**

<input type="text"/>	<input type="text"/>	/	<input type="text"/>	/	<input type="text"/>
----------------------	----------------------	---	----------------------	---	----------------------

For example, 3rd February  
2005 is entered as 03 02 05

**Centre Stamp**

--

## **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 **four** questions.

Each question carries 10 marks.

**Section B**      Answer any **four** questions from this section. There is internal choice in **two** questions.

Each question carries 50 marks.

Write your Examination Number and your Day, Month and Year 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 any **ten** questions.

Each question carries 10 marks.

### Question 1

- (a) Identify the items of farm machinery or equipment shown in **A**, **B** and **C**.

**A**



**B**



**C**

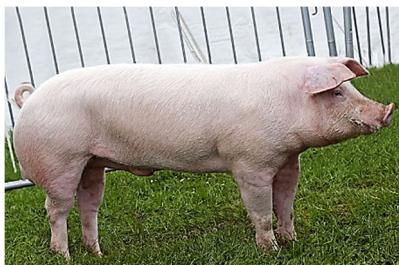


- (b) Briefly describe how the piece of equipment **B** in part (i) above is used on a sheep farm.


**Question 2**

Answer either (a) or (b).

- (a) (i) Identify **any two** of the following breeds.

**A****B****C**

--	--	--

- (ii) The sheep in **B** in part (i) above is known for its prolificacy.  
Explain the underlined term.


- (iii) Briefly explain characteristics of bull **C** in part (i) above that make it suitable as a terminal sire.


Or

- (b) Read the article and answer the questions that follow.



The Irish Moiled is one of the rarest Irish cattle breeds. It is a hornless medium sized breed with a mature cow weighing up to 650kg. Traditionally a dairy cow with yields of up to 5000 litres, it has earned the reputation as a truly dual purpose breed. In the suckler herd the cow will go into a negative energy balance to ensure the calf gets the best start in life.

They are generally easy to handle with a placid docile temperament. Surplus males sell well as steers finishing between 20-24 months on good quality forage diet to carcass weights from 220-260kg. The beef is of superb quality with a distinctive flavour.

The cow can be relied upon to produce a calf every 12 months if kept in good health and body condition. They will calve to a continental bull without difficulty and will continue to breed satisfactorily until at least ten years of age.

Tradition has it that they are 'big bellied' to consume and digest large quantities of poorer quality forage which was their traditional diet. They can be termed 'ready browsers' because they will graze willow, ash and ivy, which makes them ideal in extensive or conservation grazing situations.

They are sound in hoof and leg and at home on most types of terrain. They grow a thick winter coat and out-winter happily although being a heavy animal they will poach soft ground.



(Adapted from [thecattlesite.com](http://thecattlesite.com))

- (i) Explain the underlined term.


- (ii) Identify **one** characteristic of this breed which makes it suitable as an artisan product.

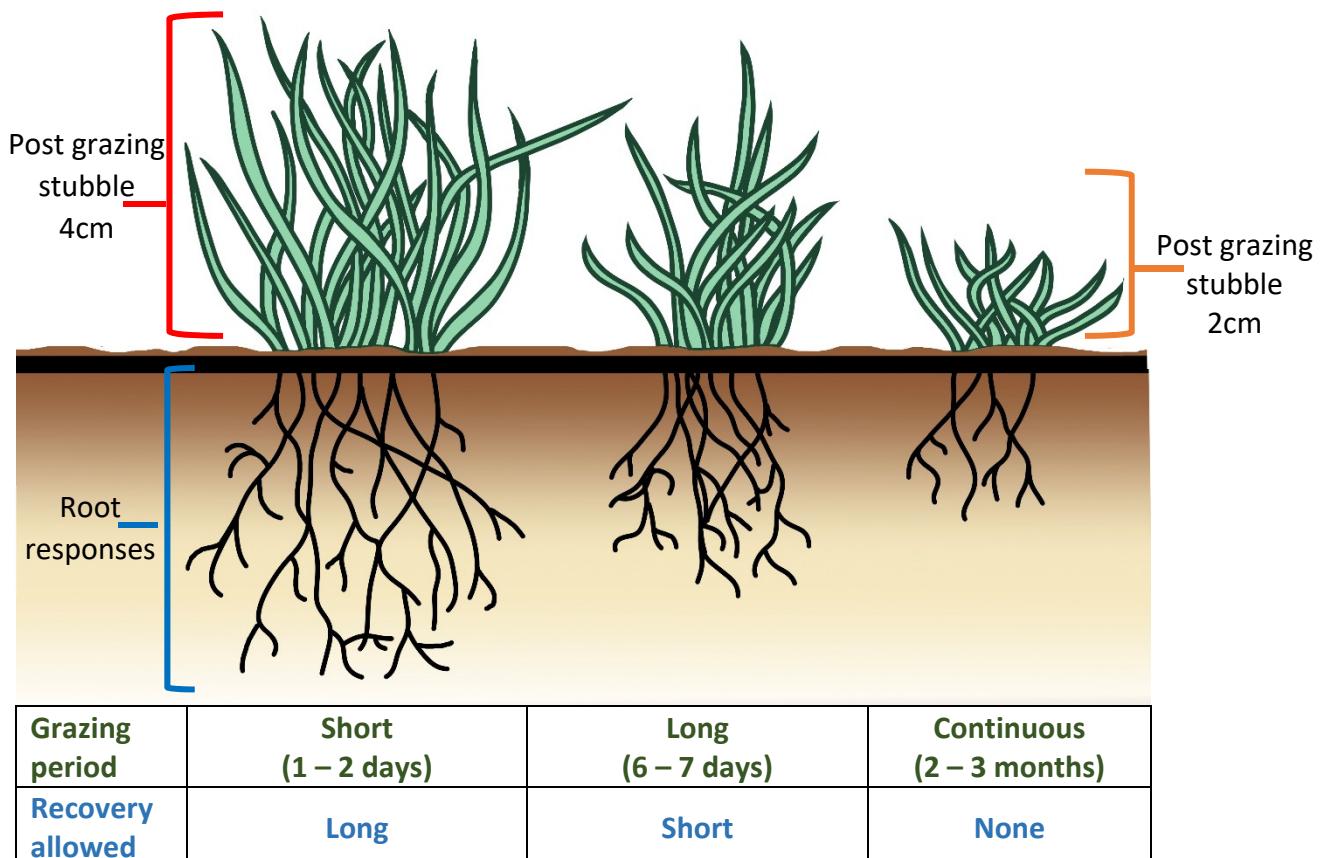

- (iii) Describe **one** characteristic of the Irish Moiled which makes them a sustainable breed choice on Irish farms.

Characteristic	Description
Example Medium size cow	<i>High producing cow without requiring large amounts of feed</i>

**Question 3**

Answer either (a) or (b).

- (a) Good grassland management is essential on farms. The diagram shows how grassland management can affect pasture recovery post grazing.  
Analyse the diagram and answer the questions that follow.



- (i) Identify the best grazing period for post grazing recovery.

- (ii) Outline **one** reason for the root development in fields that are continuously grazed.

- (iii) Using the list provided, state which grazing system is most likely to be associated with each of the following:

Rotational	Set stocking	Zero	Leader-follower
Short	<input type="text"/>		
Continuous	<input type="text"/>		

Or

- (b)** Rotational (paddock) grazing is described as a sustainable farming practice.

Briefly describe the climate and /or environmental benefits of rotational livestock grazing.



**Question 4**

Describe the impact of soil compaction and organic matter loss has on the productivity of farm land in the table below.



Impact of	Effect on productivity	Ways of reducing effect
Soil compaction		
Organic matter loss		

### Question 5

Cereal crops form the basis of many animal and human diets with an estimated 2.1 million tonnes being produced in 2023.

- (a) You have been asked to show a group of farmers barley, wheat and oats crops.

At the time of visiting the farm, each crop was at the stage shown in row 1.

Each crop at its ripening stage is shown for reference in row 2.

Assist farmers by identifying A, B and C as barley, wheat or oats.

A



1

B



Well-developed hairy auricles

C



Large, hairless auricles

No auricles and leaf margins are hairless

2



--	--	--

- (b) Farmers asked if the seed produced by the cereal crops above would be a suitable seed source for sowing the next year.

Outline the advice you would give the farmers.


**Question 6**

Answer either (a) or (b).

- (a) Many Irish sheep farmers now take part in the Sheep Improvement Scheme.

Some of the target features / activities of this scheme are:

- lameness control
- mineral supplementation of ewe's post mating
- meal feeding of lamb's post weaning
- scanning of in-lamb ewes



For **any two** of the above listed target features / activities:

- (i) Describe how to action (carry out) these target features / activities.

- (ii) Describe the benefit of each target features / activities to overall production of the flock.

Named target feature / activity	Description
1.	Action:     Benefit:     
2.	Action:     Benefit:     

**Or**

- (b) The Sheep Improvement Scheme provides financial support to farmers for taking extra steps to improve the welfare of their flock. Farmers get €12 per breeding ewe for completing flock welfare measures.

Ryan and Fiona have the following sheep on their farm.

Stock type	Numbers on farm
Rams	4
Breeding ewes	132
Hoggets	42
Lambs	200



- (i) Calculate the financial value of the scheme to Ryan and Fiona.

Calculation:

- (ii) The Sheep Improvement Scheme has been introduced to enhance animal health and welfare in the sheep sector. Some of the target features of the scheme are:

- mineral supplementation of lambs pre-weaning
- flystrike control
- genotyping of ram

Briefly explain how the scheme enhances animal health and welfare using **any two** of the target features listed above.

Named target feature	Explanation
1.	
2.	

## Question 7

Read the article and answer the questions that follow.

Agroforestry is the integration of trees with either crops or livestock on the same land. It aims to achieve additional benefits in comparison to keeping agriculture and trees separate.

Across the world, agroforestry encompasses a wide variety of practices ranging from simple shelterbelts of trees around fields to a close integration of food crops and trees.



(Adapted from Teagasc, 2020)

- (a)** Explain agroforestry.

10. The following table summarizes the results of the study. The first column lists the variables, the second column lists the sample size, and the third column lists the estimated effect sizes.

- (b)** Outline possible benefits of agroforestry for Irish agriculture.

## Question 8

Read the article and answer the questions that follow.

### Irish Beetles Tackle Docks in New Trial

Irish-bred beetles are set to become an environmentally friendly, cost-effective weapon to kill docks.

Once released on a farm, the dock beetle breeds to colonise the whole field. Dock beetles are native and natural predators of docks. They skeletonise dock leaves and keep them at an acceptable level in grassland.

The population of dock beetle will initially rise to decimate the dock weed naturally. The population will reduce as its success diminishes its natural food supply in a sustainable way on an annual basis. They hibernate for the winter and reappear each spring.



(Adapted from Irish Farmers Journal, 2022)

- (a) Explain the underlined term.


- (b) Briefly describe how the dock beetle is an environmentally friendly way of controlling dock leaves on a farm.


- (c) Dock beetles are an example of a biological control. Based on your own knowledge of agriculture, provide another example of a biological control and state its target.

Biological control	Target

**Question 9**

Answer either (a) or (b).

- (a) Compare the different soil mineral particles and their properties under the headings that follow.  
*The first one has been done as an example.*

	Gravel and sand particles	Silt and clay particles
Particle size	Large particles	Small particles
Drainage		
Fertility		
Ion exchange		

**Or**

- (b) Soil structure describes the arrangement of soil particles within a soil. These particles form clusters known as aggregates or peds in the soil.

- (i) Based on your knowledge of soil structure, identify the soil quality of each of the different soils in **A**, **B** and **C** using the list below.

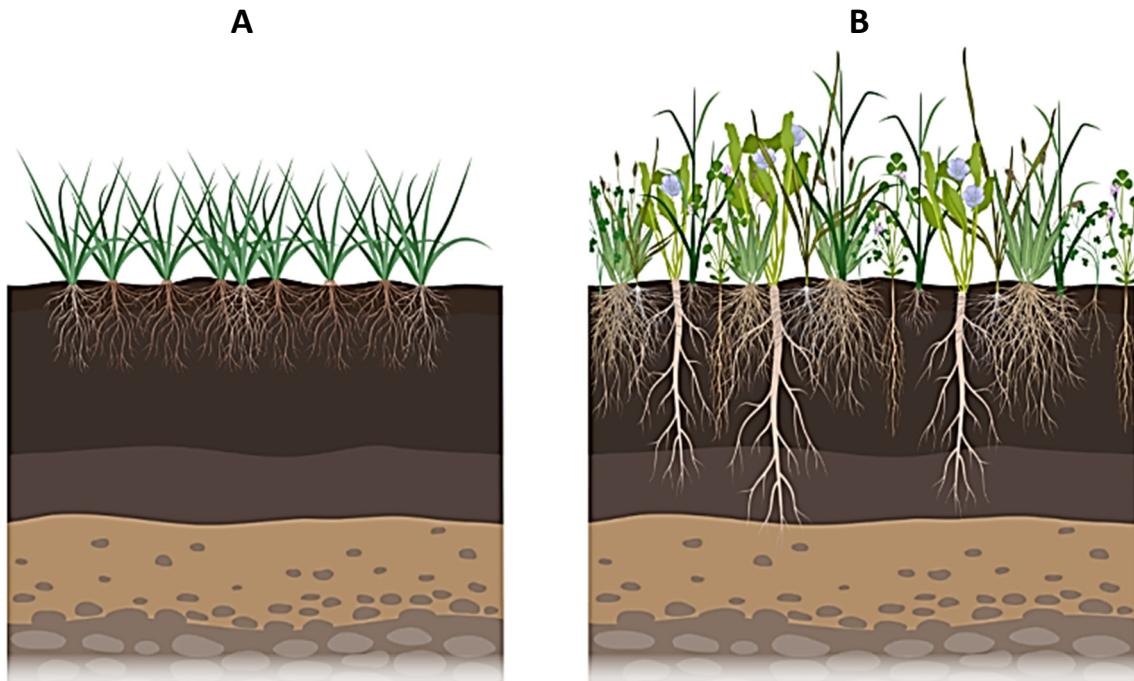
Moderate quality	Poor quality	Good quality
<b>A</b>	<b>B</b>	<b>C</b>
		

- (ii) Briefly describe **one** reason for your choice of good quality soil structure in part (i) above.


### Question 10

The pictures below show two swards with a varying level of diversity.

Analyse the pictures and answer the questions that follow.



- (a) Identify which picture **A** or **B** is more likely to be a multi-species (polyculture) sward.

- (b) List **two** plants that could be included in the multi-species sward.

1.
2.

- (c) Research has shown that plant diversity enhances soil biodiversity in grassland swards. Briefly describe how plant diversity can positively impact soil biology in swards.


### Question 11

The table below shows fertility summary data over five lactations for two cows on the Irish Cattle Breeding Federation's (ICBF) 'Cows Own Worth' database.

Analyse the data and answer the questions that follow.



Cow 1				Cow 2		
Calving date	Lactation number	Serves	Calving interval (days)	Lactation number	Serves	Calving interval (days)
30/01/2019	1	1		1	2	
27/01/2020	2	2	362	2	2	378
28/02/2021	3	2	397	3	3	406
08/02/2022	4	1	345	4	3	410
11/03/2023	5	1	397	5	4	426

- (a) Calculate the average calving interval for cow 1.

Calculation:

- (b) Briefly explain how the calving interval for cow 1 is reduced between lactation 3 and 4.

[Two empty lines for writing]

- (c) State with reason if cow 1 or 2 should be culled.

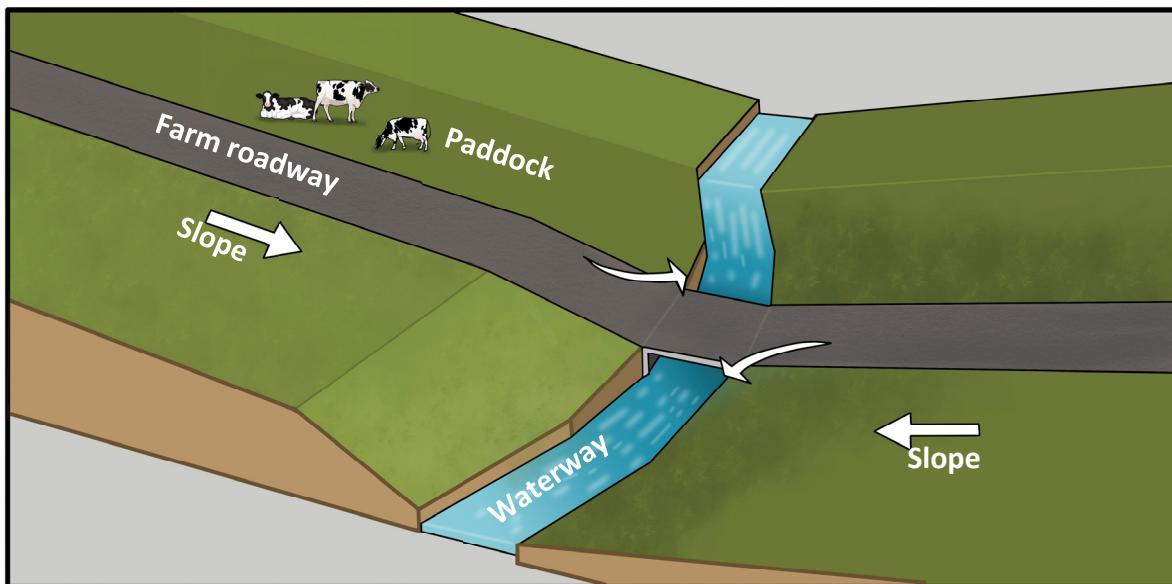
Cow:
Reason:
[Two empty lines for writing]
[Two empty lines for writing]

### Question 12

Farmers must prevent runoff from soiled farm roadways into waterways.

The diagram shows a picture of a dairy farm with cows grazing close to the waterway.

Analyse the picture and answer the questions that follow.



- (a) Outline actions farmers can take to reduce the runoff from the fields and farm roadway.


- (b) According to the Environmental Protection Agency (EPA), agriculture poses a risk to water quality. Apart from runoff, outline potential sources of water pollution from agriculture.


Additional writing space for **Section A**.  
Label all work clearly with the question number and part.





## Section B

**200 marks**

Answer any **four** questions.

Each question carries 50 marks.

## Question 13

Answer both (a) and (b) with either (c) or (d).

- (a) (i) Gill, an agricultural advisor, carried out an investigation to determine the botanical composition of a farmer's land.

Describe with the aid of a labelled diagram how she carried out this investigation.

Labelled diagram:

- (ii) Gill identified the following plants on the land when carrying out the investigation. Identify the plants A, B, C and D using the list below.

Ragwort	Meadow Thistle	Nettle	Primrose
A	B	C	D
			

Gill wanted to provide advice to the farmers on ways to enhance plant biodiversity. She used the Farmland Plant Identification Key for the Agri-Climate Rural Environmental Scheme (ACRES) to help identify positive plant indicator species which would enhance biodiversity. The range and cover of positive plant indicators is one of the best ways of quantifying the biodiversity value of the habitat (field).

Biodiversity indicators	Description
Positive grassland indicators	Grassland which is not managed intensively and contains plants such as Primrose and Meadow Thistle.
Negative grassland indicators	Grassland is managed intensively and is used to rapidly assess if land is in 'poor' condition. It contains plants such as Ragwort and Nettles.

- (iii) Gill identified significant numbers of negative grassland indicators in her investigation. Briefly explain what advice Gill would give the farmer in order to create a positive grassland for plant biodiversity.


- (b) (i)** Describe with the aid of a labelled diagram how a peat soil is formed.

## Labelled diagram:

- (ii) State **two** locations in Ireland where you would find a peat soil.

- 1.
- 2.

- (c) You have been asked to address a group of farmers.  
Outline the advice you would give them about the importance of preserving our peat bogs.

Or

- (d) Outline measures farmers can take to combat biodiversity loss on their farms.

## Question 14

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

Silage harvest 2023 has been difficult for farmers due to prolonged periods of adverse weather conditions.

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

<i>Lactobacillus</i>	
<i>Clostridia</i>	
<i>Staphylococcus aureus</i>	



- (ii) Describe the chemical / biological processes involved in the production of good quality silage from the harvested grass.

- (iii) The dry matter (DM)% content of silage is a good indicator of quality.  
Identify the ideal DM% of good quality silage by placing a tick (✓) in the correct box.

45%	
25%	
15%	

- (b) (i)** Describe how an agricultural science student could carry out an investigation to measure the dry matter (DM) content of a sample of silage in the school laboratory.



Labelled diagram:

- (ii)** Apart from dry matter, outline factors affecting silage quality.


- (c)** Draw a labelled diagram of a grass plant at the ideal named growth stage for harvesting.

Stage:
Labelled diagram:

**Or**

- (d)** Outline the characteristics of grass that make it most desirable for grazing.


### Question 15

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

#### Nutrient Requirements of Beef Cattle

Beef cattle productivity is highly dependent on nutrition and the ability of the animal's diet to meet nutrient requirements. To survive and be productive, beef cattle require water, energy, protein, minerals, and vitamins. The animal's phenotype is the result of an interaction between its genetics and the environment. Nutrition often makes up a large portion of the environmental component and therefore can potentially affect the animal's phenotype.



(Adapted from mcdvetmanual.com)

- (i) Explain the underlined term.


- (ii) Briefly explain the function for growth and development of beef animals of each of the following nutrients.

Nutrient	Function in beef animals
Protein	
Vitamins	
Water	

- (iii) The amounts of nutrients that cattle require is influenced by various animal-related factors and environmental conditions.  
State **two** animal-related factors or **two** environmental conditions.

	Animal-related factor	Environmental conditions
1.		
2.		

- (iv)** Describe the energy requirement of a breeding cow at each stage of the production cycle.

Breeding	
Dry period	
Early lactation	

- (v)** Briefly describe the symptoms and prevention of a named mineral deficiency in cows.

Named mineral deficiency:	
Symptoms	
Prevention	

- (b)** Paul started weighing his beef calves to increase efficiency and comply with the Dairy Beef Weighing Scheme.

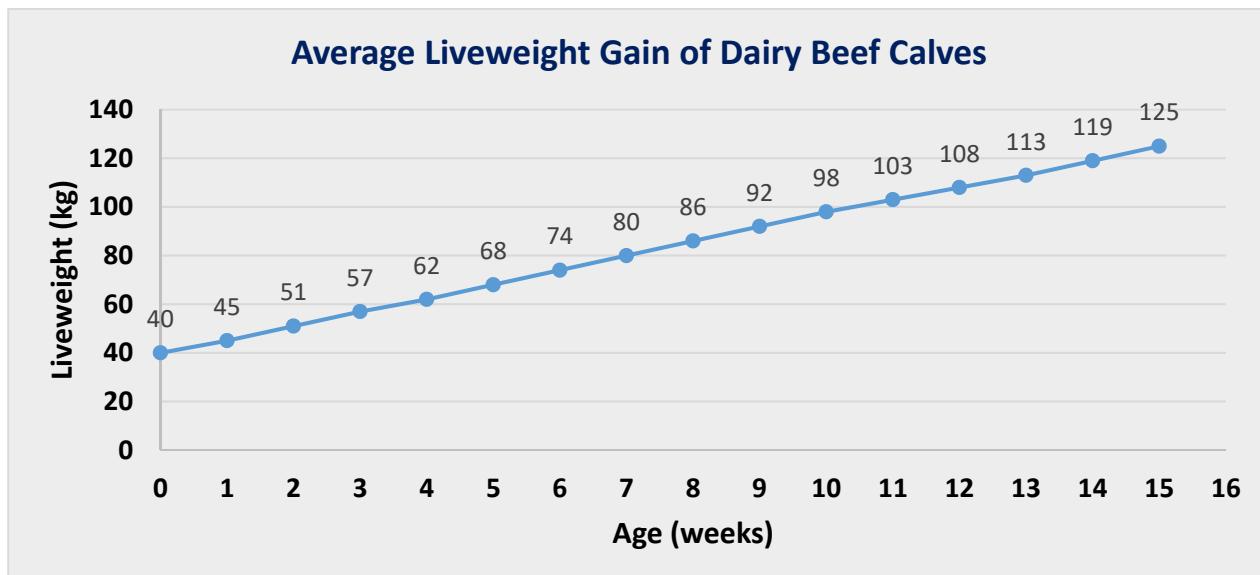
- (i)** Outline benefits of weighing cattle on beef farms.


- (ii)** Briefly describe **two** safety considerations taken when weighing beef animals.

1.
2.

- (c) Paul recorded the weight of his 52 beef calves. The average weight from birth to 15 weeks is shown in the graph below.

Analyse the graph and answer the questions that follow.



- (i) Calculate the average (mean) daily liveweight gain of the calves from birth to 15 weeks.

Calculation:

- (ii) As part of the scheme, farmers are eligible for €20 per calf weighed up to a maximum of 50 calves.

Calculate the value of the scheme to Paul.

Calculation:

### Question 16

- (a) Ella and Sadie are agricultural science students carrying out an investigation to determine the effect of feeding pooled (combining colostrum from a number of cows) high quality colostrum on the health and performance of dairy calves. Experimental design was set up as follows.



Treatment	Sample 1 Pooled colostrum	Sample 2 Own dam colostrum	Sample 3 Colostrum from another dam
Number of calves per treatment	20	20	20
Colostrum quality was determined by Brix Refractometer and only IgG (Immunoglobulin) concentration of >50mg/ml was used			
Calves were weighed weekly			

- (i) Outline a hypothesis for this investigation.


- (ii) State with reason if this investigation is a fair test.

State:
Reason:

- (iii) State the independent, dependent and control variables in this investigation.

Independent	
Dependent	
Control	

- (iv) Outline **two** possible sources of error in this investigation.

1.
2.

- (b) Results of the investigation are shown in the table below.

Analyse the table and answer the questions that follow.

Sample number Treatment group	Colostrum IgG (mg/ml)	Average birthweight (kg)	Average weaning weight (kg)
<b>Sample 1</b> <b>Pooled colostrum</b>	100.7	34.0	94.0
<b>Sample 2</b> <b>Own dam colostrum</b>	99.4	33.3	93.7
<b>Sample 3</b> <b>Colostrum from another dam</b>	95.2	34.3	91.7

(Adapted from Teagasc, 2019)

- (i) Based on the results shown, state if there is any difference in colostrum quality when pooled.


- (ii) Outline advice Ella and Sadie would give to farmers based on the results of their investigation.


- (c) Describe how changes of diet from birth to weaning affects the development of the ruminant stomach.


(d) Discuss the importance of feeding colostrum to young animals under the headings that follow:

(i) Timing of feeding.


(ii) Amount of colostrum.


(iii) Hygiene.


## Question 17

Plant biostimulants and biotic factors in soil help improve plant growth by increasing nutrient uptake, nutrient use efficiency (NUE) and tolerance to stress from abiotic factors.

- (a)** Briefly describe how any named abiotic factor will affect Irish agriculture.

Named abiotic factor:

- (b)** Biostimulants are very active in the rhizosphere surrounding plant roots.

- (i) Draw a labelled diagram of the rhizosphere.

Labelled diagram:

- (ii) Describe the relationship between the plant roots and the microorganisms in the rhizosphere.

- (iii) Identify the fungi that plays a key role in the rhizosphere by placing a tick (✓) in the correct box.

<i>Rhizobium</i>	
Mycorrhizal	
<i>Rhizopus</i>	

**(iv)** Describe advantages of the fungi identified in part (iii) on soil productivity.


**(v)** Apart from increasing organic matter, outline ways the fungi identified in part (iii) can be increased in soil.


- (c)** A student carried out an investigation to determine the percentage organic matter of two different 90g soil samples, one a loam soil and the other a peat soil.

**(i)** Predict with reason which soil, a loam or a peat would have the higher % organic matter.

Predication:	
Reason:	

Results from the investigation are shown in the table below.

Soil sample	Loss in mass (g)	% Soil organic matter	% Soil organic carbon
Peat	55.2	A	B
Loam	3.8	4.2	2.4

- (ii) Calculate A the % soil organic matter in the peat sample.

Calculation:

- (iii) Calculate **B** the % soil organic carbon in the peat sample.

Calculation:

**Question 18**

- (a) (i) Isobel was crossbreeding some of the cattle on her dairy farm.  
Explain the underlined term.


- (ii) Identify the breeds shown in **A** and **B**.

**A**



**B**



--	--

- (iii) Isobel crossed breeds **A** and **B** in part (ii) above. The resulting offspring is shown in **C** below.

**C**



List **two** dominant features from parents in **A** and **B** in part (ii) above that are passed to the offspring **C**.

1.
2.

- (b)** In June 2023, The National Genotyping Programme was introduced to genotype the national herd.



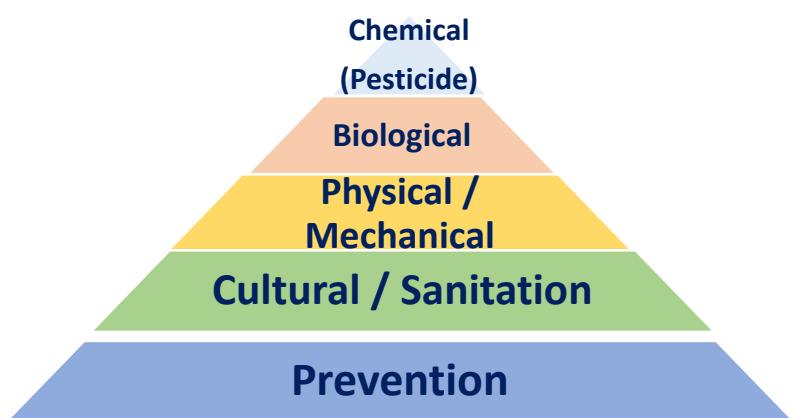
- (i)** Explain the underlined term.


- (ii)** Outline benefits of genotyping.


- (iii)** Briefly describe **one** named method of genetic engineering you have studied and explain its importance in animal breeding.

Named method:
Description:
Explanation:

- (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 increasingly important.



Using the information shown in the diagram on IPM, advise farmers on ways they can reduce chemical inputs on their farm.

Additional writing space for **Section B**.  
Label all work clearly with the question number and part.





## Acknowledgements

### Image(s)

- Page 3 agriland.ie; premier1supplies.com; odonovaneng.ie  
Page 4 britishpigs.org.uk; raisingsheep.net; thatfarming.com  
Page 5 ystradorganics.co.uk  
Page 6 grant.k-state.edu  
Page 7 nwfagriculture.co.uk  
Page 8 farmersjournal.ie  
Page 9 teagasc.ie; kids.britanica.com; world-grain.com; britanica.com  
Page 10 teagasc.ie  
Page 11 independent.ie  
Page 12 teagasc.ie  
Page 13 farmersjournal.ie  
Page 14 teagasc.ie  
Page 15 teagasc.ie  
Page 16 teagasc.ie  
Page 17 teagasc.ie  
Page 22 gardenia.net; x.com; countryfile.com; assets.gov.ie  
Page 25 farmersjournal.ie  
Page 26 germinal.com  
Page 28 State Examinations Commission  
Page 31 ahdb.org.uk  
Page 37 icbf.com; agriland.ie  
Page 38 icbf.com  
Page 39 teagasc.ie

### Texts

- Page 5 *Irish Moil.* [\(4 September 2022\).](https://www.thecattlesite.com/breeds/dairy/107/irish-moiled)
- Page 12 Agroforestry. <https://www.teagasc.ie/media/website/rural-economy/rural-development/diversification/Forestry-2-Agroforestry.pdf>
- Page 13 Donovan, R. *Irish Beetles Tackle Docks in New Trial.* [\(27 June 2022\).](https://www.farmersjournal.ie/irish-beetles-tackle-docks-in-new-trial-706444)

**Do not write on this page**

**Copyright notice**

This examination paper may contain text or images for which the State Examinations Commission is not the copyright owner, and which may have been adapted, for the purpose of assessment, without the authors' prior consent. This examination paper has been prepared in accordance with Section 53(5) of the *Copyright and Related Rights Act, 2000*. Any subsequent use for a purpose other than the intended purpose is not authorised. The Commission does not accept liability for any infringement of third-party rights arising from unauthorised distribution or use of this examination paper.

Leaving Certificate – Higher Level

## Agricultural Science

Monday 17 June

Afternoon 2:00 - 4:30