2022.M40

2022L024A1EL

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination 2022

Agricultural Science

Higher Level

Monday 20 June Afternoon 2:00 - 4:30

220 marks

Examination Number

Day and Month of Birth

For example, 3rd February is entered as 0302

Centre Stamp

The 2022 examination papers were adjusted to compensate for disruptions to learning due to COVID-19. This examination paper does not necessarily reflect the same structure and format as the examination papers of past or subsequent years.

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 **seven** questions from this section. There is internal choice in **four** questions.

Each question carries 10 marks.

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

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 — 70 marks

Answer any **seven** questions.

Each question carries 10 marks.

Question 1 Answer **either** (a) **or** (b).

(a) An agricultural science student wanted to determine the amount of organic matter present in a soil sample.

(i) Explain the underlined term.

(ii) Briefly describe **one** advantage of the presence of organic matter in a soil.

(iii) Describe how the student determined the % organic matter in the soil sample.

Or

(b) **(i)** Outline **one** advantage of spreading cattle or pig slurry on the land.

(ii) List **two** factors which affect the composition of slurry.

1.
2.

(iii) Identify the ideal timing and weather conditions for spreading slurry for optimum nutrient usage **and** protection of the environment by placing a tick (✓) in the correct box.

In spring on an overcast and windy day	
In spring on an overcast and misty day	
In summer on a warm and windy day	

(iv) Justify your answer in part (iii).

Question 2

(a) Identify **any four** of the following breeds of animals.

A

B

C

D

E

F

A:
B:
C:
D:
E:
F:

(b) A farmer was looking to select a female replacement animal for breeding for his chosen animal enterprise. Describe characteristics he would be looking for when selecting the animal.

Named animal enterprise:

Question 3

(a) Eanna wanted to sow barley on his farm and decided to investigate the effect of soil temperature on the germination of the crop.
Describe how he would carry out this investigation.

(b) State with reason if the results obtained by Eanna will be qualitative or quantitative.

(c) Suggest what information Eanna learns about the effect of temperature on the germination of seeds from this investigation which will inform his decision making on growing crops on his farm.

Question 4

Read the article and answer the questions which follow.

Avian flu detected in turkey flock in Co. Monaghan

Avian influenza (H5N1) has been detected in a turkey flock in County Monaghan, the Department of Agriculture, Food and the Marine has confirmed. Restriction zones are being set up around the area.

This highly pathogenic bird flu has already been confirmed in wild birds across the country.

(Adapted from RTE.ie, 2021)

(a) Explain the underlined term.

(b) Avian influenza is a notifiable disease. List **two** other notifiable diseases on farms.

1.

2.

(c) Using your knowledge of biosecurity measures describe how poultry farms could protect their flocks from avian influenza.

Question 5

Food conversion ratio (rate) (FCR) is a measure of how well an animal converts feed into liveweight gain.

(a) List **two** factors that affect FCR in animals.

1.
2.

(b) The table shows the weaning FCR for pigs from 2000 to 2020.

	2000	**2010**	**2020**
Liveweight at sale (kg)	90.1	103.6	115.3
Deadweight at sale (kg)	68.1	78.9	88.2
Average Daily Gain (ADG) (g)	585	668	735
FCR	1.83	1.80	1.75

(Adapted from Teagasc ePM, 2021)

(i) State which year the pigs were more efficient at converting feed to liveweight.

(ii) Describe **two** reasons for the increased performance of the pigs from 2000 to 2020.

1.
2.

Question 6

(a) Since 1994, it has been compulsory for each European Union (EU) member state to have agri-environment schemes.

Outline **three** reasons why hedgerow conservation is promoted in agri-environmental schemes.

1.
2.
3.

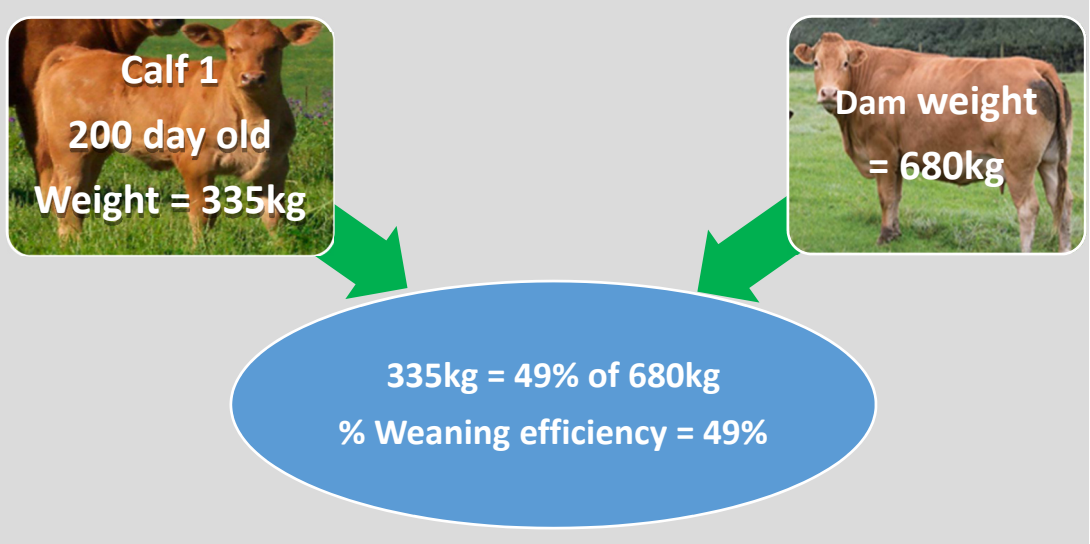
(b) Sustainable farming practices can benefit from conservation grazing.
Explain the purpose of conservation grazing.

(c) Outline **one** reason why it is important to preserve rare animal breeds on farms.

Question 7

Sadie, a suckler farmer is participating in the Beef Environmental Efficiency Programme (BEEP) and received her 'Weaning Performance Report'. This report calculates the % weaning efficiency of each dam (cow) and calf. The target weaning efficiency is 42%.

Analyse the diagram below which illustrates how the % weaning efficiency is calculated and answer the questions which follow.



(Adapted from ICBF, 2021)

(a) Calculate the % weaning efficiency for Sadie's suckler dam and calf 3 in the table below.

	200 Day Weight (kg)	Weaning Efficiency (%)
Calf 2	256	39%
Dam of calf 2	650	
Calf 3	333	Calculation:
Dam of calf 3	698	

(b) Calculate the average daily gain (ADG) of calf 3 if its birth weight was 50kg.

Calculation:

(c) Outline **one** implication for Sadie of calf 2 having a weaning efficiency of 39%.

Question 8

The European Commission has set targets for sustainable food production by 2030.

2030 Targets for Sustainable Food Production			
Pesticides	**Nutrient Losses**	**Antimicrobials**	**Organic Farming**
			
Reduce the overall use and risk of chemical and hazardous pesticides	Reduce nutrient losses by 50%	Reduce use of antibiotics for farm animals	Increase the percentage of organically farmed land in the EU

(Adapted from European Commission, 2020)

(a) Explain **one** way for each part (i) and (ii) below farmers can:

(i)	Reduce the use of pesticides on their farm	
(ii)	Reduce use of antibiotics for farm animals	

(b) In Ireland 2% of the farming area is devoted to organic production.
Briefly explain **two** benefits of converting to organic farming to a group of farmers.

1.
2.

Question 9 Answer **either** (a) **or** (b).

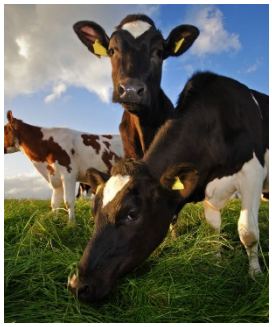
(a) **(i)** Draw a labelled diagram of a calf's stomach in its first week of life.

(ii) Describe how the calf's stomach in part (i) above differs from an adult ruminant stomach.

Or

(b) Read the article on the SEASOLUTIONS Project and answer the questions which follow.

SEASOLUTIONS PROJECT



Reducing methane emissions from ruminants is one of the biggest challenges to face the agricultural sector in the last decade. The SEASOLUTIONS Project is committed to making a positive impact on methane emissions in agriculture. By using seaweeds and seaweed derived ingredients to positively affect the rumen and rumen microbiota to reduce methane emissions and improve ruminant health. By adding seaweed components to the feed of sheep and cattle indoors on high grain based diets, Irish researchers have reduced methane production by 20%. A critical aspect of this project is to test such seaweed supplements within the context of a pasture-based production system.

(Adapted from SEASOLUTIONS.ie and Teagasc, 2021)

(i) Outline **two** roles of micro-organisms in the ruminant stomach.

1.
2.

(ii) Describe why is it critical for the researchers to test the seaweed supplements stated above within the context of a pasture-based production system.

(iii) Meat samples will also be collected as part of the trial to ensure the seaweed or seaweed extracts have no effect on meat quality.
Outline why this aspect of the trial is important.

Question 10

In relation to a named catch **or** energy crop you have studied answer the questions which follow.

Named crop:

(a) Identify the type of lifecycle which best describes your chosen crop by placing a tick (✓) in the correct box.

Annual	
Biennial	
Perennial	

(b) Describe the method of planting of your choosen crop.

(c) Outline advantages of sowing your chosen crop.

Question 11 Answer **either** (a) **or** (b).

(a) A plant has specialised structures which absorb nutrients through a specific process from the soil solution.

(i) Complete the table by stating the name of each of the following involved in nutrient absorption from the soil.

Plant structure	
Process involved	

(ii) Explain how the process stated in part (i) above occurs.

(iii) Mycorrhiza has a <u>symbiotic relationship</u> with plant roots. Explain the underlined term.

Or

(b) A farmer was checking her grass crop and noticed that the leaves and stems had turned purple, had stunted growth and reduced <u>tillering</u>.

(i) Explain the underlined term.

(ii) Advise the farmer regarding the cause of these symptoms.

(iii) Describe the role mycorrhizae fungi play in preventing the symptoms described above.

(iv) Outline how to increase the presence of mycorrhizae fungi in soil.

Question 12 Answer **either** (a) **or** (b).

(a) The results of silage analysis from a beef enterprise are presented in the table below.

Silage Quality				
% Dry Matter Digestibility (DMD %)	75	70	65	60
Harvest date	20 May	2 June	15 June	28 June
Silage tonne Dry Matter per ha	4.6	6.0	7.0	7.7
Intake (kg/day)	9.0	8.3	7.6	7.0
Liveweight gain (kg/day)	0.83	0.66	0.49	0.31

(Adapted from Teagasc, 2021)

(i) Explain Dry Matter Digestibility.

(ii) Using the data in the table above briefly explain the effect of harvest date on the DMD %.

(iii) Referring to the data in the table above outline **two** benefits of good quality silage on the beef animal productivity.

1.

2.

Or

(b) Bill wanted to test his grass for sugar and nitrate levels prior to ensiling the grass. He cut samples of grass, placed them in a freezer bag and then put them in a freezer prior to analysis.

	Bill's average results	Target
Sugar level	1.7%	>2.5%
Nitrate level	900 mg/ml	<600 mg/ml

(i) Suggest **one** reason why the nitrate level in the grass is high in Bill's samples.

(ii) Suggest why the sugar in Bill's grass samples are low.

(iii) Outline why high sugar levels are important in the ensiling process.

(iv) Briefly explain how Bill can increase the sugar content in his silage.

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

Section B — 150 marks

Answer any **three** questions.

Each question carries 50 marks.

Question 13

(a) Maintaining a constant supply of high quality leafy grass can be easily achieved by managing and measuring the amount of grass on the farm.

(i) Outline **two** advantages of grass measuring.

1.
2.

(ii) Grass is measured in kg DM/ha (kilograms dry matter per hectare). Every 1cm has approximately 250kg DM/ha for cattle farms. A residual post grazing height of 4cm is used when estimating grass cover.
Calculate the kg DM/ha with a sward height of 10cm.

Calculation: kg DM/ha =

(iii) A farmer identified different plants in the sward while measuring the grass.
Identify any **two** of the following plants **A**, **B** or **C** from the sward.

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

(iv) Identify the growth cycle stage of the plants in part (iii) and describe briefly what happens at this stage.

Stage:
Description:

(b) Gerry wants to reseed his grassland pastures.

(i) Outline **three** advantages of reseeding grassland pastures.

1.
2.
3.

(ii) In order to reseed his grassland, Gerry ordered two batches of seeds, certified and uncertified. On arrival both batch were unlabelled. He carried out a research trial to distinguish between the two batches of seeds. Describe using a labelled diagram, how he would carry out this trial in a small section of his field.

Labelled diagram:

(iii) Gerry was able to compare the plant uniformity of both batches of seed (certified and uncertified). Describe the characteristics Gerry would have observed to determine which batch was certified and which was uncertified.

(iv) Gerry decided to use certified seed when reseeding his pasture.
Outline the effects his decision would have on the environmental sustainability of his farm.

Question 14 Answer both (a) **and** (b) with **either** (c) **or** (d).

(a) **(i)** Outline using scientific reasons why colostrum is fed to calves at birth.

(ii) Explain why colostrum should be given as the first feed to calves within 4 hours of birth.

(iii) Outline **one** reason why dried colostrum is not as effective as colostrum from the calf's mother as the calf's first feed.

(iv) Briefly explain why good hygiene is essential when harvesting colostrum.

(v) Colostrum quality varies enormously between cows, so quality should be tested every time with a colostrometer or BRIX refractometer.

Rating	Measure of Quality (milligrams of IgG in each ml of colostrum)
Very good	60 mg/ml
Good	50 mg/ml
Poor	30 mg/ml

(Adapted from Teagasc, 2017)

Alice tested the colostrum from one of her freshly calved cows using the refractometer and recorded a reading of 25 mg/ml. Describe briefly what advice you would give Alice in relation to feeding the cow's new born calf.

(b) The table shows the difference in nutrient composition between colostrum, transition milk and whole milk.

	Milking Number Post Calving			
	First	Second	Third	Fourth
	Colostrum	Transition Milk		Whole Milk
Total solid (%)	23.9	17.9	14.1	**A**
Fat (%)	**B**	5.4	3.9	3.8
Protein (%)	**C**	8.4	5.1	3.3

(Adapted from Teagasc, 2021)

(i) Complete the table for the composition of colostrum and whole milk.

A:
B:
C:

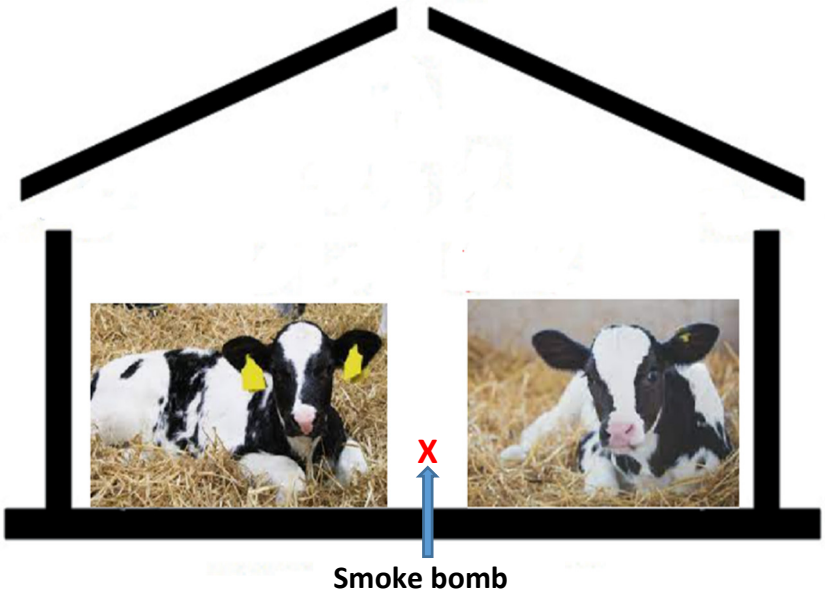
(ii) Briefly explain the advantages of feeding transition milk to replacement heifers.

(c) Analyse the picture of calf housing below and answer the questions which follow.

(i) Identify **three** aspects of the shed which make it a suitable environment for calves and provide a reason for each aspect identified.

1.
2.
3.

(ii) A farmer let off a smoke bomb in his calf shed to check the ventilation. Complete the diagram using arrows to show the natural airflow he should expect through the shed.

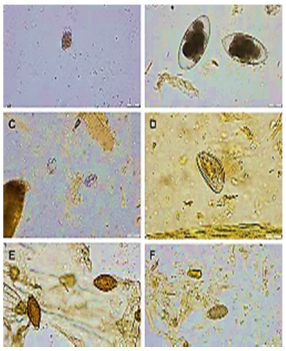


Or

(d) A faecal egg count (FEC) is used to monitor parasite numbers in sheep. It is carried out regularly throughout the grass growing season. Jim took dung samples from each of his 3 flocks and sent it for analysis. The following are the results.

		Flock 1	Flock 2	Flock 3
Jim's Samples	FEC (eggs per gram)	430	220	790

		Low	Medium	High
Reference Data	(eggs per gram)	<250	250 – 750	>750



(i) Briefly describe the dosing plan Jim would carry out in flocks 1 and 2.

Flock 1:
Flock 2:

(ii) Flock 3 have been dosed on two previous occasions however the results of the FEC remain consistently high. Advise Jim on what he should do with flock 3.

(iii) Outline **two** advantages of using faecal egg counts in parasite control.

1.
2.

Question 15

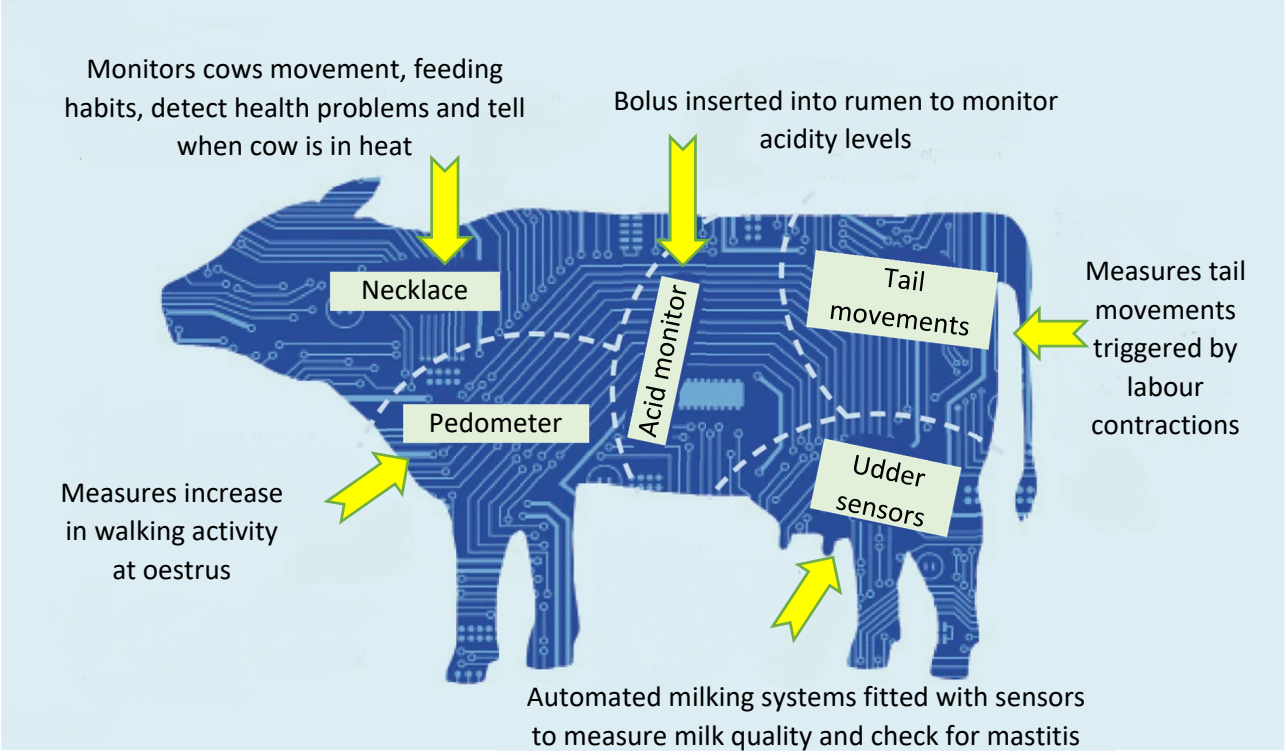
(a) **(i)** Animals maybe synchronised at breeding. Describe how this is carried out for a named animal you have studied.

Named animal:

(ii) Briefly describe **one** safety precaution a farmer should take when handling animals during the breeding season.

(iii) Over recent years the use of sexed semen is increasing in popularity and can now be carried out in the new Irish laboratory in Cork. Sexed semen involves scientists identifying and isolating the X and Y chromosome present in the sperm.
Outline the advantages of using sexed semen on farms.

(b) Analyse the picture of the 'smart cow' and answer the questions which follow.



(Adapted from Financial Times, 2017)

(i) State the optimum pH of the rumen and give a reason for monitoring acidity levels in the rumen.

pH:
Reason:

(ii) Outline **one** advantage of measuring tail movements triggered by labour contractions.

(iii) Farmers can determine the movement of their cows using the pedometer where increased activity indicates a cow is in heat.
State the duration of oestrus **and** advise the farmer of the best time for insemination.

Duration of oestrus:
Timing of insemination:

(iv) Udder sensors can check the quality of milk. Outline **two** advantages of this technology.

1.
2.

(c) There has been increased investment in animal housing and technology on Irish farms in recent years to improve animal welfare and performance.




(i) List **three** harmful gases that can build up in animal housing.

1.
2.
3.

(ii) Outline **one** piece of technology that has been installed in animal housing that you have studied that improves the welfare of the animals.

Question 16

(a) An investigation looking at milk production from grass and white clover systems over the course of a year was carried out by Teagasc researchers in Moorepark.

	Investigation Design		
	Treatment 1	**Treatment 2**	**Treatment 3**
	Grass only sward + 250kg N/ha per year	Grass + Clover sward + 150kg N/ha per year	Grass + Clover sward + 100kg N/ha per year
Common to all treatments	Post grazing height of 4cm		
	18 cows per treatment with stocking rate of 2.74 cows/ha		
	Concentrate feeding of 535kg/cow/year		
	Milk yield, % fat, % protein of each cow was recorded		

(i) Identify **one** example of each of the following in this investigation:

Independent Variable	Dependent Variable	Control

(ii) State **one** way this investigation could be made more accurate.

(iii) State with reason why this is a scientifically reliable investigation.

(b) The table shows the results of the investigation. Analyse the data and answer the questions which follow.

	Treatment 1	**Treatment 2**	**Treatment 3**
Milk yield (kg/cow)	5934	5998	6076
Fat content (%)	4.97	5.09	5.03
Protein content (%)	3.71	3.83	3.80

(i) Identify which treatment produced the highest amount of milk.

(ii) From your knowledge of milk price, state with reason which treatment would result in a higher milk price for the farmer.

Treatment:
Reason:

(iii) Nitrogen (N) fertiliser prices continues to rise in 2022. Apart from adding clover to the sward, outline **one** way a dairy farmer could reduce N requirement on their farm.

(c) **(i)** Describe using a labelled diagram a named grazing system that could have been used to manage the swards in the trial in part (a).

Named grazing system:

Labelled diagram:

(ii) Describe with the aid of a labelled diagram how to isolate and grow bacteria from the root nodules of clover.

Labelled diagram:

Question 17 Answer both (a) **and** (b) with **either** (c) **or** (d).

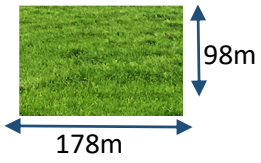
(a) Earthworms are essential on all farms.

(i) Describe using a labelled diagram the activity of earthworms in a soil.

Labelled diagram:

(ii) In relation to the activity of earthworms described in part (i) above, justify the benefits these activities contribute to soil productivity.

(iii) Using a quadrat Kate determined the number of earthworms in her permanent pasture as shown in the table below. Estimate the total number of earthworms.

Area of Field
Permanent Pasture 

Number of Earthworms/0.25m² Quadrat			
1	2	3	4
28	45	23	19

Estimation:

(iv) Suggest **one** reason for a high concentration of earthworms in quadrat 2.

(b) Plant breeding is the science of changing the traits of plants in order to produce desired characteristics in a direction favourable to peoples' needs. Scientists work on selecting the high yielding plants and breeding these.

(i) Outline **two** reasons why scientists select the plants with the highest yield for breeding.

1.

2.

(ii) Scientists genotype the plants and cross two high yielding plants to achieve good hybrid vigour. Explain the underlined terms.

Genotype:
Hybrid vigour:

(c) A farmer is carrying out research on which barley variety to grow which would suit his mixed farming (pig and sheep) enterprise and his results are shown in the table.

Analyse the table and answer the questions which follow.

Hybrid Winter Barley Variety	Straw Height (cm)	Relative Yield	Grain Protein (%)
Bazooka	102.2	109	11.3
Belfry	95.4	110	10.9

(Adapted from DAFM, 2021)

(i) State with reason which variety would suit the diet of his enterprise.

Variety:
Reason:

(ii) Describe how plant geneticists would carry out the hybridising process between two plants.

Or

(d) Read the article and answer the questions which follow.

UK decides to push towards gene editing technologies

The British government outlined new plans to unlock the power of gene editing (GE) as a suite of tools to help farmers grow more resistant, nutritious and productive crops.

GE makes plant breeding faster, more precise and more efficient, with the aim to produce new varieties that are more nutritious, more resistant to pests, diseases and viruses, more productive and carry traits that are more beneficial to the environment.

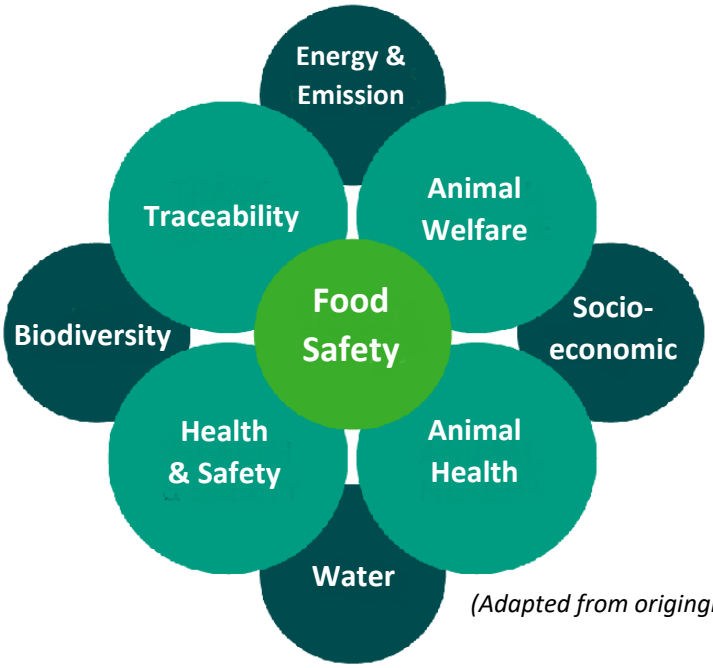
(Adapted from Irish Farmers Journal, 2021)

(i) Briefly explain the principles of gene editing.

(ii) Outline reasons why producing more disease resistant, pest resistant and nutritious varieties are potentially beneficial in feeding the increasing world population.

Question 18

(a) *Origin Green* is Ireland's pioneering food and drink sustainability programme. On-farm assessments constitute a key component of the programme. Analyse the diagram showing the key components of the programme and answer the questions which follow.



(Adapted from origingreen.ie, 2021)

(i) Briefly describe how each of the following key components relate to food safety.

Animal Welfare:

Health and Safety:

Animal Health:

Traceability:

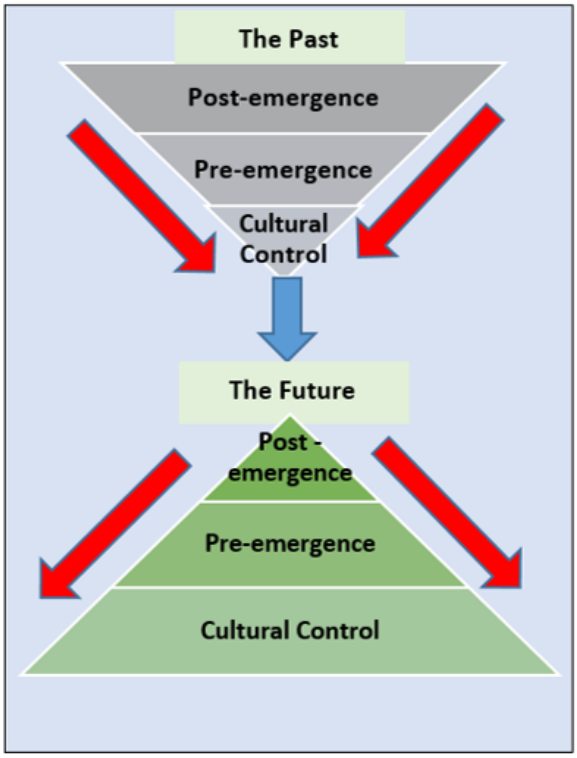
(ii) Briefly explain **two** ways a named livestock or tillage enterprise could reduce their energy and emissions on the farm.

Named livestock or tillage enterprise:
1.
2.

(b) The diagram below shows an 'Integrated Management System' for controlling weeds.

Analyse the diagram and answer the questions which follow.

Examples of Cultural Control Options
Increased seed rates
Cover crops
Competitive crops
Roguing
Crop rotation
Whole cropping
Crop destruction
On-farm hygiene
Machinery hygiene

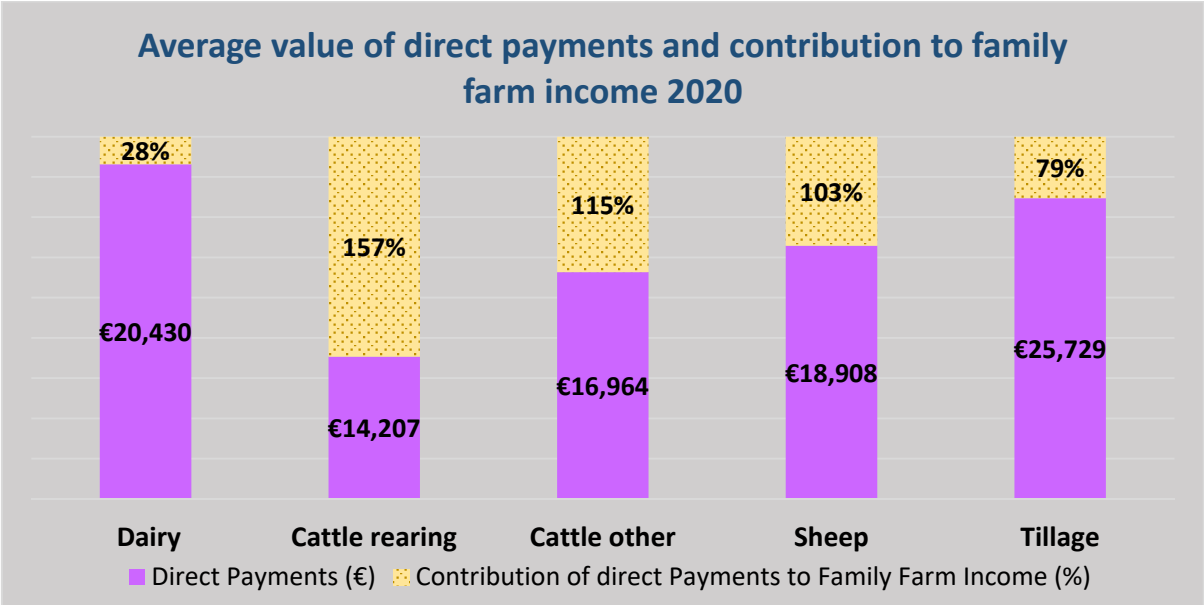


(Adapted from Teagasc, 2021)

(i) Explain pre-emergence weed control.

(ii) You have been asked to address a group of tillage farmers. Using the 'Integrated Management System' for controlling weeds (outlined on previous page), provide advice to them on the future of weed control on their farms.

(c) Analyse the graph on the contributions direct payments from the EU made to the family farm income per agricultural enterprise.



(Adapted from Teagasc National Farm Survey, 2021)

(i) Identify which enterprise relies heaviest on direct payments.
State a reason for your answer.

Enterprise:
Reason:

(ii) Identify which enterprise relies the least on direct payments.
State a reason for your answer.

Enterprise:
Reason:

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

Acknowledgements

Images

Image on page 3	pixabay.com
Images on page 5	britishpigs.org.uk; learningnaturalfaarming.com; horsebreedpictures.com; happychickencoop.com; thatsfarming.com; agriland.ie
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Image on page 36	farmersjournal.ie
Image on page 37	origingreen.ie
Image on page 38	teagasc.ie

Text

Text on page 7	*Avian flu detected in turkey flock in Co. Monaghan*. < https://www.rte.ie/news/ireland/2021/1120/1262143-avian-flu> (20 November 2021).
Text on page 13	*Sustainability*. www.seasolutions.ie; *Seaweed Supplementation to Reduce Methane in Ruminants.* < https://www.teagasc.ie/news--events/news/2021/seaweed-supplementation.php> (15 November, 2021).
Text on page 36	Doyle, A. U*K decides to push towards gene editing.* www.farmersjournal.ie/uk-decides-to-push-towards-gene-editing-technologies-651221 (1st October 2021).

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Leaving Certificate – Higher Level

Agricultural Science

Monday 20 June

Afternoon 2:00 - 4:30