2023.M40 v2

2023L024A1EL

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination 2023

Agricultural Science

Higher Level

Monday 19 June Afternoon 2:00 - 4:30

300 marks

Examination Number

Day and Month of Birth

For example, 3rd February is entered as 0302

Centre Stamp

The 2023 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 **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 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 any **ten** questions.

Each question carries 10 marks.

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

(a) **(i)** Identify each of the following breeds of animals.

A

B

C

A:
B:
C:

(ii) Breed **C** is a dual-purpose breed.
Explain the underlined term.

(iii) Todd wanted to purchase a purebred bull.
Explain the importance of using a purebred sire in a beef herd.

Or

(b) **(i)** Identify each of the following breeds of animals.

D

E

F

D:
E:
F:

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

Fleckvieh Cattle

This Austrian breed is renowned for exceptional fertility, longevity, calving ease, a low somatic cell count, strong feet, and overall good health traits.

This breed reportedly milks roughly 6,000kg in their first lactation and over 7,000kg in their later lactations.

They have an estimated milk fat of 4.2% and protein of 3.7%.

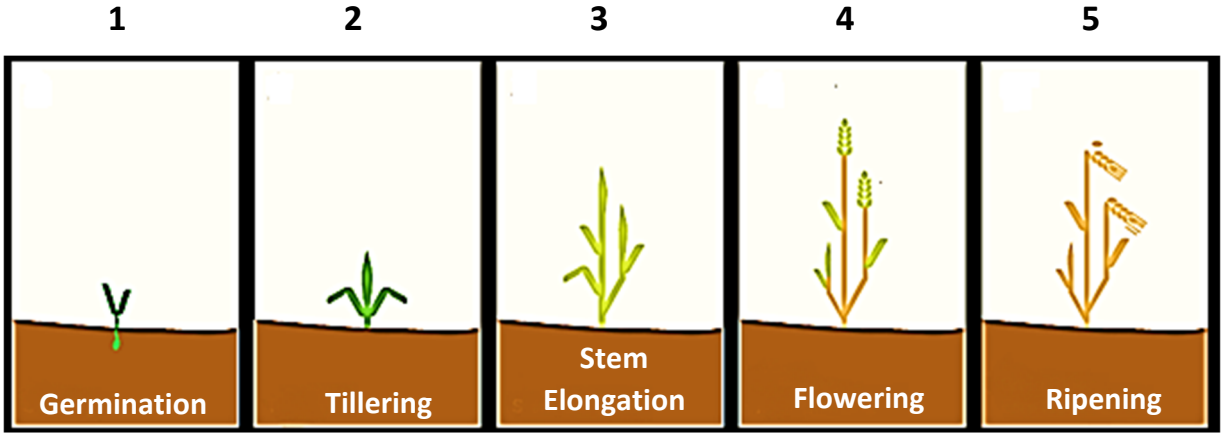
(Adapted from thatsfarming.com, 2020)

Using evidence from the article, suggest which Irish cattle industry this breed is most suited.

Industry:
Evidence:

Question 2

The diagram shows an example of the growth cycle of the food crop barley.



(a) Explain what happens at any **two** of the following stages in any named plant you have studied.

Named plant:	

Germination	
Stem Elongation	
Flowering	

(b) Identify any **two** of the weeds that can be found in Irish fields using the list below.

Chickweed	Charlock	Shepard's Purse

Question 3

Calcium is an important element required by both plants and animals.

(a) State **one** source of calcium for **either** plants or animals.

Plant or animal:

(b) Outline **one** process by which calcium becomes available to plants.

(c) Explain **one** symptom of a named calcium deficiency in cows.

Name:
Symptom:

Question 4

Performance testing is carried out on bulls by the Irish Cattle Breeding Federation (ICBF) in Tully, Co. Kildare.

(a) When bulls arrive at the test centre, they enter a pre-isolation area where they are clipped, dosed, treated for lice, and sorted into pens based on breed and weight.
Suggest **one** reason for any **three** treatments listed below.

Clipped	
Worm dosed	
Treated for lice	
Sorted into pens based on breed and weight	

(b) Outline the importance of performance testing to the beef or dairy industry in Ireland.

Beef or dairy industry:

Question 5

Soil testing is essential to determine the nutrient requirement of the soil.

(a) Briefly describe how to collect soil samples for soil testing.

(b) 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.

(c) With record high fertiliser prices, outline how soil testing can improve the economic sustainability of the farm.

Question 6

Lameness is a painful disease that results in suffering for sheep, and damages the sustainable and welfare friendly image of Irish agriculture.

(a) State the name of the disease that can cause lameness in sheep.

(b) Briefly describe the symptoms of the disease stated in part (a).

(c) Outline the treatment for the disease stated in part (a).

(d) Briefly describe **one** negative financial implication lameness has for a sheep farm.

Question 7 Answer **either** (a) **or** (b).

Liam and Joan are goat dairy farmers in County Sligo.

(a) Complete the table to show how goat dairy farming compares to cow dairy farming.

The first one has been done as an example.

	Goat	**Cow**
Main breeds	*Saanen and Alpine*	*Holstein Friesian and Jersey*
Lactation length (days)	300	
Gestation length (days)	150	
Oestrus length (hours)	12 – 48	
Breeding programme	High yielding goats don't have to be bred each year	

Or

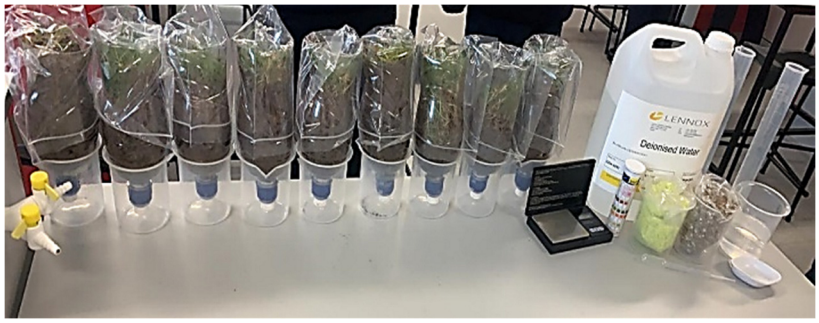
(b) Some dairy farmers can receive a sustainability bonus if they are taking actions to improve sustainability on their farm.
Describe actions these dairy farmers could do to improve their sustainability and receive the bonus.

The first one has been done as an example.

Action	**Description**
Use protected urea	*Reduces nitrogen loss and greenhouse gases emissions while maintaining the yield when compared with unprotected urea*
1.	
2.	

Question 8

An agricultural science student wanted to see if the amount of nitrates being leached into water from spreading protected urea is less than unprotected urea. He set up his investigation as shown in the diagram.

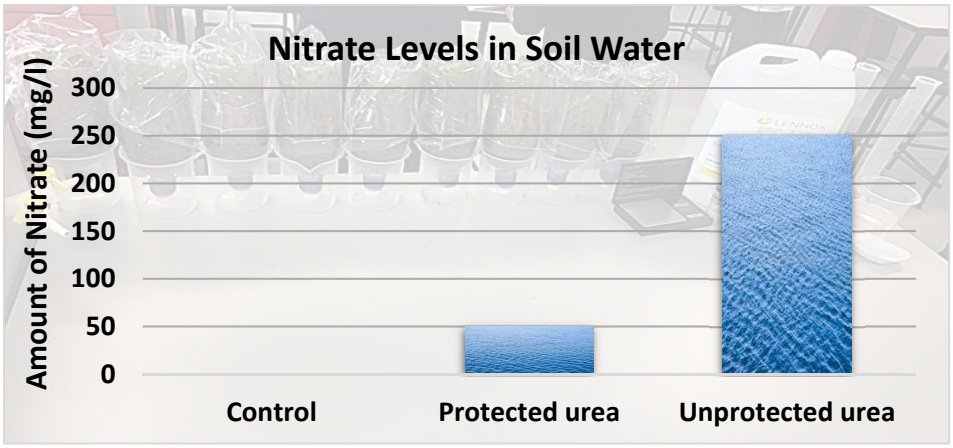


(a) State the independent and dependent variable in this investigation.

Independent:
Dependent:

(b) Outline why it was important to carry out the test three times for each fertiliser.

(c) The student tested the leachate using nitrate strips and recorded the results shown below.



Analyse the graph and briefly describe the conclusion the student made from his investigation.

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

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

The *Farmdroid* has landed in Ireland

The *Farmdroid*, which won the National Ploughing Championship 2022 machine of the year is a fully functioning solar powered field vehicle that automates sowing and mechanical weeding. The core principle of the machine is that it relies on GPS location data to go about its daily tasks.

The tasks of sowing and mechanical weed control in crops are guided by precision GPS. Using this GPS, the *Farmdroid* can sow the seeds far enough apart to note and record where each individual seed has been planted in a field. The company claims that accuracy is to within 8mm, allowing even pre-emergence hoeing of the soil both between the rows and in between the plants themselves in most crops.

(Adapted from Agriland, 2022)

(i) Explain the underlined term.

(ii) Explain how the *Farmdroid* can benefit the environment and the farmer.

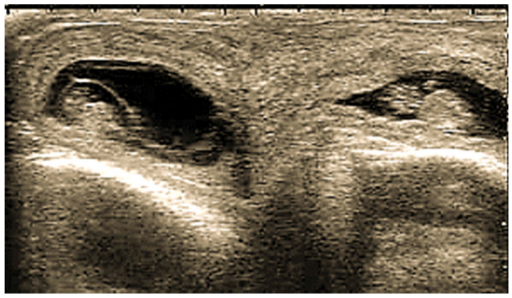
(iii) Apart from GPS, outline **one** piece of technology that you have studied that would benefit both the farmer and the environment.

Or

(b) Scanning female animals to determine if they are pregnant is an important job that is carried out on farms.

(i) Briefly describe the benefits of pregnancy scanning in animals.

(ii) Jack was scanning beef heifers and scanned a heifer carrying twins.

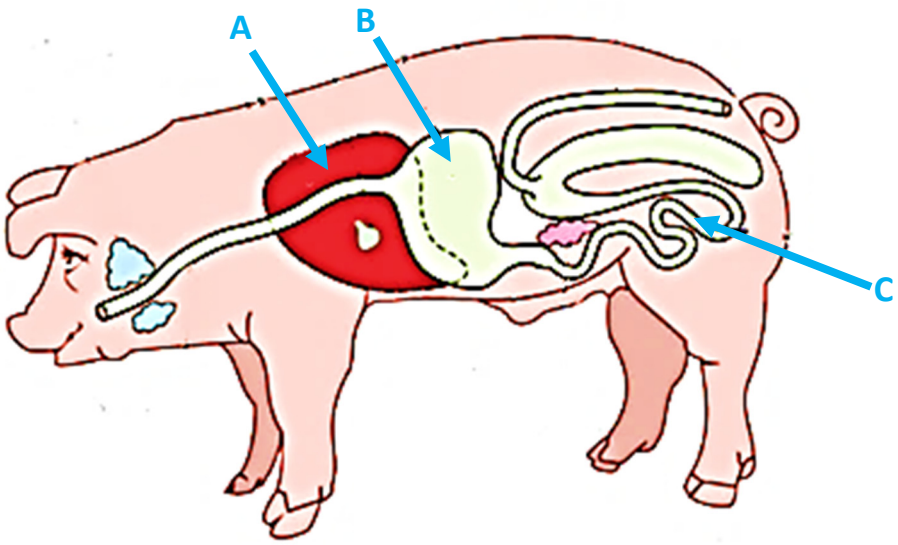


Describe the management implications for this heifer under the headings which follow.

Feeding in late gestation:
Calving:

Question 10 Answer **either** (a) **or** (b).

(a) **(i)** Label the diagram below of the monogastric digestive system.



A:
B:
C:

(ii) Outline the role of microorganisms in the monogastric digestive system.

Or

(b) The table shows the composition of different pig rations.
Analyse the data and answer the questions which follow.

Ingredients	Pig Weight		
	15 – 30kg	**30 – 60kg**	**Over 60kg**
Soya bean	25	20	15
Rice bran	25	40	35
Maize	20	25	30
Broken rice	5	5	5
Wheat bran	20	15	10
Crude protein (%)	16	15	14

(i) Explain the function of soya bean and rice bran in pig diets.

Soya bean:
Rice bran:

(ii) Outline **one** reason for the decreasing crude protein in the different pig rations.

(iii) There is no grass included in the diet of the monogastric animal.
Briefly describe why this is the case.

Question 11

Tim wants to improve the reproductive performance of his suckler cows on a grass-based system. He carried out research and found the key performance indicators (KPI) for a spring calving herd.

(Adapted from Teagasc, 2022)

Key Performance Indicators (KPI)	National Average	National Target
Calves / cow / year	0.86	0.95
Calving interval (days)	396	365
6-week calving rate (%)	55	80

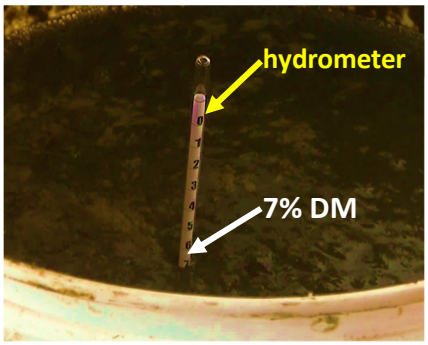
(a) Achieving a target of 0.95 will require excellent cow and calf management. Outline ways Tim can achieve this target.

(b) Briefly explain ways Tim can achieve the 6-week calving rate target of 80%.

Question 12

On farm testing of slurry using a hydrometer is the quickest way of determining the value of slurry on the farm. The dry matter (DM) content of the slurry sample is 7%, as shown in the picture. Analyse the table below and answer the questions which follow.

Dry Matter (%)	N kg/m^3	P kg/m^3	K kg/m^3
2 (very dilute)	0.40	0.21	1.40
4 (watery)	0.70	0.35	2.10
6 (typical)	1.00	0.50	3.50
7 (thicker)	1.10	0.60	4.00



(*Adapted from Teagasc, 2022)*

(a) State the N content of this slurry sample.

(b) Suggest **one** reason for a dry matter (DM) content of 2% in a slurry sample.

(c) Briefly explain why the nutrient content of slurry is higher in the 7% DM slurry.

(d) Outline a safety precaution taken by the farmer when taking the sample of slurry for testing.

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).

Soil is the most important asset on any farm and the type of soil depends on its formation.

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

Factor	Description
1.	
2.	

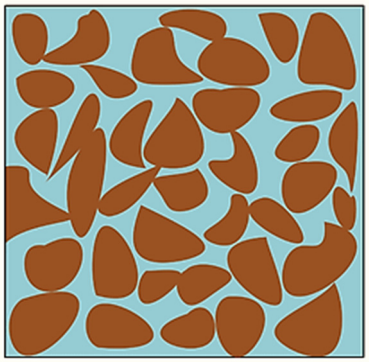
(ii) Draw a labelled diagram of a podzol soil profile.

Labelled diagram:

(b) The diagram below shows the soil water level in soil samples. Brown represents soil particles, blue represents water and white represents air spaces.

(i) Identify the soil water content level for each diagram using the words in the box below.

Permanent wilting point	Field capacity	Saturation

A	B	C
		

(ii) Briefly describe the implications for a farmer of any **two** of the following.

Field capacity:

Saturation:

Permanent wilting point:

(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 a brown earth soil sample and outline the expected result in this investigation.

Labelled diagram:

Or

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

VistaMilk using satellites to collect real-time data on farm soils

Satellites are being used to collect real-time information about soil moisture on Irish farms by *VistaMilk*, the research centre at Teagasc, Moorepark.

The research project is utilising imagery from the European Space Agency's *Sentinel* satellites to map soil moisture in Ireland, with the capability of focusing in on areas as small as $10m^2$.

The data gathered could be used to help farmers make decisions about which fields to allow their livestock feed in while maintaining optimal grazing and grass growth, which requires drainage or even wetting, and potentially when to add or reduce use of fertilisers and slurry.

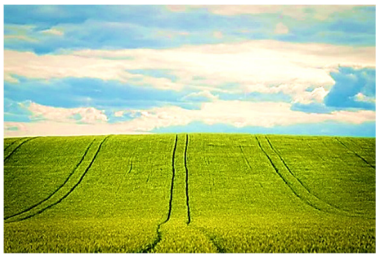
The data collected can be used to identify areas of a farm that are adversely affected by prolonged periods of wet or dry weather.

(Adapted from Farmers Journal, 2022)

(i) Explain how the data gathered could help management decisions on the farm in relation to the drainage or wetting of land.

(ii) State the functions of soil moisture (water).

Question 14



Stuart is a tillage farmer who operates a 220 hectare farm in Co. Waterford. He sows a variety of crops and plants his winter cereals using direct drilling.

(a) Explain the underlined term and outline **one** advantage of this method of planting.

Direct drilling:
Advantage:

(b) He planted three fields of winter oilseed rape in mid-August, using a different variety in each of the three fields. It was undersown with Berseem clover at a rate of 1.6kg/ha as a companion crop. Applying your knowledge of crop production, answer the questions which follow.

(i) Briefly describe why he chose to plant a different variety of oilseed rape in each field.

(ii) Explain the underlined term.

(iii) Outline the advantages of sowing clover with the oilseed rape.

(iv) Berseem clover is an annual plant.
Explain the underlined term.

(v) Give another example of an annual plant that you have studied.

(c) Read the following extract and answer the questions which follow.

> An easy tool to examine successful plant establishment is using a plant count. Calculating % establishment can help to examine if sowing conditions were appropriate and what can be done next season in order to improve plant count numbers (e.g. higher seeding rate).
>
> *(Adapted from Farmers Journal, 2022)*

(i) Describe how to carry out a plant count in a 2 hectare field.

(ii) Briefly explain advantages of carrying out a plant count in a newly sown or reseeded field.

(iii) Plants counts are easiest to carry out when plants are at the one to two leaf stage. When plants start to tiller out, it becomes very difficult to count them. Explain why it becomes difficult to count the plants at this stage.

(iv) Teagasc recommends a seeding rate of 350 seeds/m^2 to establish 300 plants/m^2. Describe a scientific reason why the recommended seeding rate is higher than the expected establishment rate.

Question 15

A secondary school recently designed and installed a new school garden and polytunnel. The school principal received a donation of top soil for the raised beds. The agricultural science class were tasked with finding out the best crops to sow. The students carried out a number of investigations to determine soil type and its suitability to grow specific crops.

(a) The first investigation the students carried out was to determine the soil texture.
Describe how they carried out this investigation to determine the soil texture.

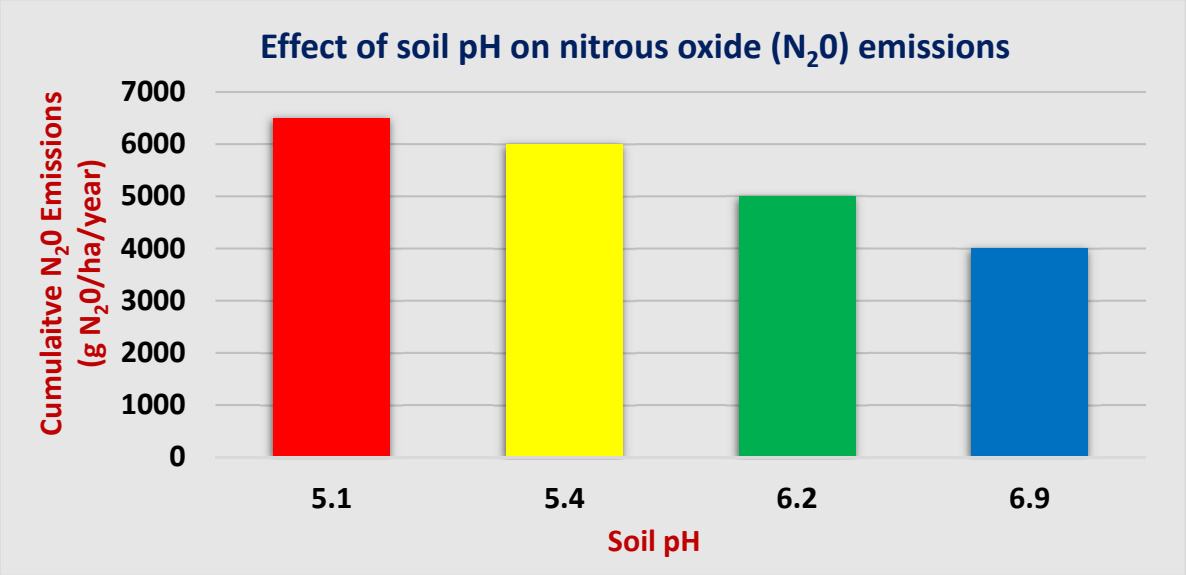
(b) The students carried out a soil pH investigation using universal indicator.

(i) State the optimum pH of a soil for crop growth.

(ii) The students found it hard to accurately determine the pH of the soil filtrate. Suggest another way the students could determine the pH of the soil filtrate more accurately.

(iii) Farmers can improve the soil quality by liming to adjust the soil pH level. Briefly describe other benefits of liming the soil.

(c) Analyse the graph showing the effect soil pH has on nitrous oxide (N_20) emissions and answer the questions which follow.



(i) State the soil pH that produces the least amount of N_20 emissions.

(ii) Discuss the relationship between pH and N_20 emissions on the graph and its implications for ongoing farming practice.

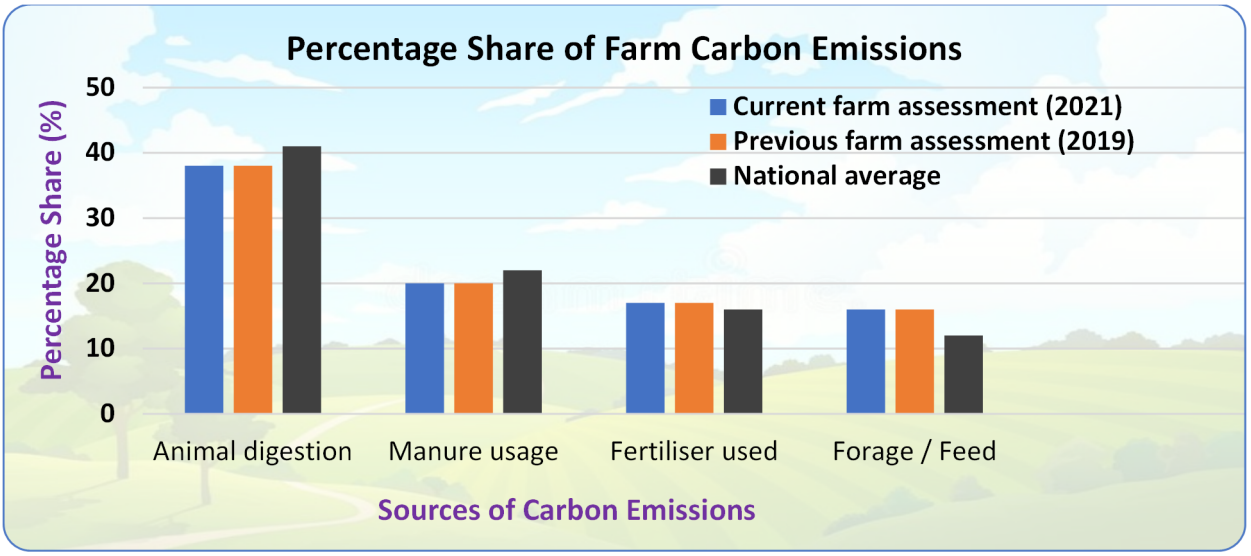
(d) The students wanted to sow a food crop in their school polytunnel or garden or field. For a named food crop (other than grass) that you have studied, describe its production under the headings which follow.

Named food crop:	
Seedbed preparation	
Disease prevention	

Question 16 Answer both (a) **and** (b) with **either** (c) **or** (d).

As part of the governments' climate action plan targets, agriculture has to reduce its greenhouse gas emissions by 25% by 2030.

(a) Anna and Lucy examined the percentage share of the carbon emissions from their beef enterprise which they received through their Bord Bia farmer feedback report.
The graph highlights where the emissions are coming from on their farm.
Analyse the graph and answer the questions which follow.



(Adapted from Teagasc, 2022)

(i) Identify the main source of carbon emissions on the farm.

(ii) State with reason if the main source of emissions is above or below the national average for the enterprise.

State:
Reason:

(iii) Comment on the overall carbon emissions on the farm since Anna and Lucy joined the scheme and justify your answer.

(b) **(i)** 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.

(ii) List **two** other potential sources of carbon emissions on the farm.

1.
2.

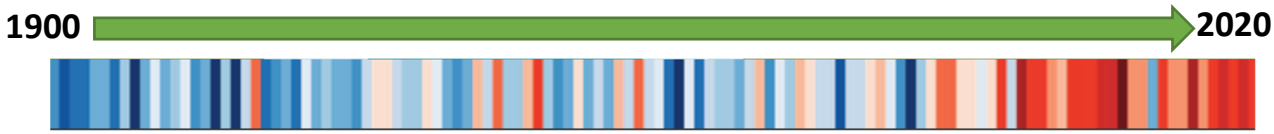
(c) Soil holds the largest portion of active carbon on earth.

Draw a labelled diagram of the carbon cycle.

Labelled diagram:

Or

(d) The timeline shows a visual representation of the change in temperature in Ireland as measured over the past 120 years. Each stripe represents the average temperature over a year. The blue indicates cooler than average temperatures, and red warmer than average temperature.



(i) Describe **three** impacts of warmer than average temperatures will have on agriculture in Ireland.

(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.

Question 17

(a) Due to the rise in fertiliser prices, Mark has decided to reseed 20% of his 150 hectare dairy and beef farm. He has spent a lot of time researching the best method of reseeding his land and which sward composition would best suit his soil type and farming enterprise. As part of his research he learned it takes about 11 months for a new sward to become fully established. Therefore, the management of the reseeded land in this period is important.

(i) Describe the management of the reseeded land at the following stages:

First 8 weeks following sowing	
Second grazing onwards	
Autumn	
Second year	

(ii) The process of grass tillering is critical for successful sward establishment. Explain ways plants can be encouraged to tiller.

(b) In his research Mark found that most perennial ryegrass grass mixtures are made up of a hybrid mix of diploid and tetraploid varieties. The differences between these grasses is shown in the table below.

Diploid Varieties	Tetraploid Varieties
Tall upright growth	Close to ground growth
Create more 'open' sward	Create a denser sward with less 'open' spaces
Higher digestibility value	Generally lower digestibility and yield

(i) Describe the reasons for including a hybrid seed mixture in his reseeding plan.

(ii) Outline reasons for including a variety of heading out dates in the grass seed mixture when reseeding swards.

(iii) Identify any **two** of the plant species commonly found in Irish multi species seed mixtures.

A	B	C
		

(c) Grass has the ability to reproduce sexually and asexually.
Explain, with the aid of a labelled diagram, how a grass plant reproduces either sexually or asexually.

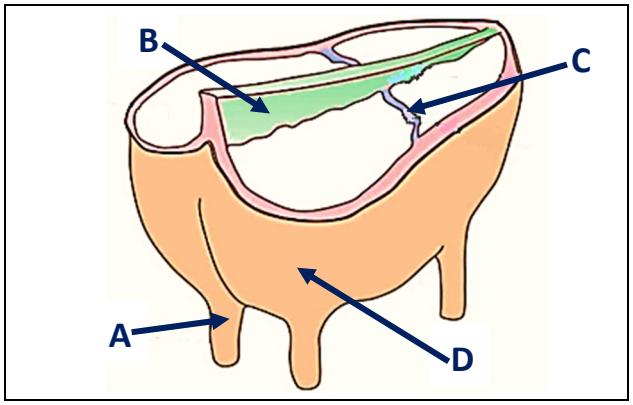
Type of reproduction:

Labelled diagram:

Question 18

Jenny and John are farming a 230 cow dairy farm in Co. Cork. They are looking at the overall quality of their milk and in particular the somatic cell count (SCC) figures from their recent milk report.

(a) **(i)** Label any **three** parts of the structure of the udder.



A	
B	
C	
D	

(ii) Briefly describe the symptoms of mastitis in cows.

(iii) Explain the treatment of mastitis in cows.

(iv) Briefly describe ways farmers can reduce mastitis in cows.

(v) Jenny tested the milk quality from various samples of milk to see which cow had high SCC using the cow side California Mastitis Test (CMT). The steps involved in carrying out the test are shown in the table. Assist Jenny in placing each step in the correct order by matching the correct letter to the number in the box.

A

Take a sample of milk from each quarter onto each well of the paddle

B

Add equal amounts of CMT solution and rotate in circular motion

C

High cell count mixture will thicken to a gel

D

Pour off excess milk

1		2		3		4	

(b) You have been invited to visit the farm to advise Jenny and John on how to improve their milk quality.

(i) The table below shows the milk composition in the morning and evening on their farm. Analyse the table and outline the reasons for the difference.

	Fat (%)	Protein (%)	Lactose (%)	Water (%)
Morning Milk (8am milking)	3.12	2.97	4.13	85.70
Evening Milk (5pm milking)	4.75	3.25	4.50	84.90

(ii) As part of the inspection you look at the factors affecting milk quality. Describe the factors you would be looking for in your inspection.

Factors	Description

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

Acknowledgements

Image(s)

Page 3 bullbank.ie; norbreckgenetics.com; thatsfarming.com
Page 4 naturerules1.fandom.com; agriland.ie; farmweek.com; fleckviehirl.com
Page 5 waterfordwhisky.com; adama.com; notcutts.co.uk; ulsterwildlife.org
Page 6 pixabay.com
Page 7 teagasc.ie
Page 8 pixabay.ie
Page 9 ahdb.org.uk
Page 10 teagasc.ie
Page 11 State Examinations Commission
Page 12 agriland.ie
Page 13 teagasc.ie; eimedical.com
Page 14 quizlet.com
Page 15 allaboutfeed.net
Page 16 irishexaminer.com
Page 17 teagasc.ie
Page 20 pixabay.com
Page 21 researchgate.net
Page 23 farmersjournal.ie
Page 24 pixabay.com
Page 25 goseed.com
Page 27 State Examinations Commission
Page 30 teagasc.ie
Page 32 pixabay.com
Page 33 independent.ie
Page 34 bradygroup.ie
Page 35 State Examinations Commission
Page 36 cropscience.bayer.co.uk; gardenerspath.com; fruithillfarm.com
Page 37 m2-magazine.org; istockphoto.com
Page 38 youtube.com

Text

Page 4 *Fleckvieh – dairy calves that would benefit the beef sector.* https://thatsfarming.com/latest-news/fleckvieh-dairy-calves-that-would-benefit-the-beef-sector/, (24 December 2020).
Page 12 Roberts, J. *The Farmdroid has Landed in Ireland*. <https://www.agriland.ie/farming-news/the-farmdroid-has-landed-in-ireland/, (8 September 2022).
Page 23 Forde, A. *VistaMilk using Satellites to Collect Real-Time Data on Farm Soils* https://www.farmersjournal.ie/vistamilk-using-satellites-to-collect-real-time-data-on-farm-soils-724360, (21 September 2022).
Page 25 Walsh, S. *Plant counts can help to improve establishment* https://www.farmersjournal.ie/plant-counts-can-help-to-improve-establishment-691356, (20 April 2022).

Do not write on this page

Leaving Certificate – Higher Level

Agricultural Science

Monday 19 June

Afternoon 2:00 - 4:30