Pearson Edexcel

Additional Assessment Materials Summer 2021

Pearson Edexcel GCSE in Biology (1BI0) Foundation

Resource Set Topic 9: Ecosystems and Material Cycles

Questions

(Public release version)

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Additional Assessment Materials, Summer 2021

General guidance to Additional Assessment Materials for use in 2021

Context

- Additional Assessment Materials are being produced for GCSE, AS and A levels (with the exception of Art and Design).
- The Additional Assessment Materials presented in this booklet are an **optional** part of the range of evidence teachers may use when deciding on a candidate's grade.
- 2021 Additional Assessment Materials have been drawn from previous examination materials, namely past papers.
- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.

Purpose

- The purpose of this resource to provide qualification-specific sets/groups of questions covering the knowledge, skills and understanding relevant to this Pearson qualification.
- This document should be used in conjunction with the mapping guidance which will map content and/or skills covered within each set of questions.
- These materials are only intended to support the summer 2021 series.

3 The effect of temperature on decomposition was investigated.

30 leaves were collected.
The mass of five leaves was recorded and the leaves were placed into a net bag.
This was repeated five more times.

Figure 5 shows one of these bags.

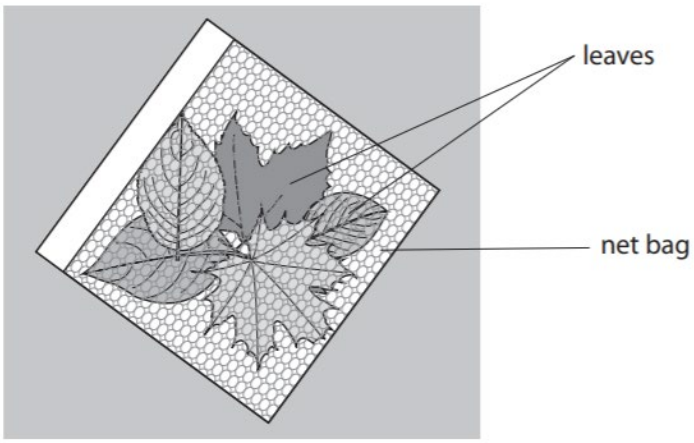


Figure 5

The net bags were then put in trays and covered in soil as shown in Figure 6.

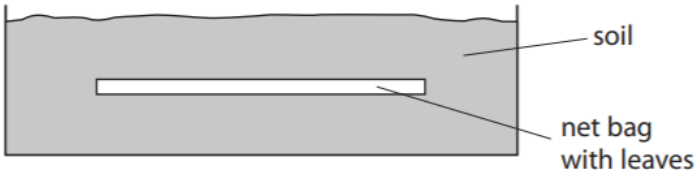


Figure 6

(a) Which type of tray should be used so that the leaves are in the best conditions for decomposition?

(1)

☒ **A** tray with air holes and dry soil

☒ **B** airtight tray with dry soil

☒ **C** tray with air holes and moist soil

☒ **D** airtight tray with moist soil

(b) Each tray was kept at a different temperature.

The mass of the leaves was recorded again after 25 days.

Figure 7 shows the results of this investigation.

temperature in °C	mass of leaves in g		decrease in mass in g	percentage decrease in mass (%)
	at start	after 25 days		
10	5.3	4.9	0.4	7.5
25	4.9	4.2	0.7	14
40	5.2	4.0	1.2	23
55	4.8	3.2	1.6	33
70	5.0	3.7	1.3	26
85	5.4	5.2	0.2	?

Figure 7

(i) Calculate the percentage decrease in mass for the leaves at 85 °C.

Give your answer to two significant figures.

(2)

$\frac{0.2}{5.4} \times 100 = 3.7\%$

3.7 %

(ii) Explain which temperature was the best for the decomposition of the leaves.

(2)

- 55°C
- largest percentage decrease in mass
- optimum temperature for enzymes

(iii) State **two** improvements to the method for this investigation.

(2)

1 use more leaves

2 use same type of soil

4 (a) Plants use nitrate ions to make proteins and chlorophyll.

(i) What effects will a low nitrate ion concentration in soils have on plants?

(1)

☐ **A** reduced growth and darker green leaves

☒ **B** reduced growth and lighter green leaves

☐ **C** increased growth and darker green leaves

☐ **D** increased growth and lighter green leaves

(ii) Which organisms convert nitrogen to nitrate ions during the nitrogen cycle?

(1)

☒ **A** bacteria

☐ **B** mammals

☐ **C** fungi

☐ **D** worms

(c) Algae are green plants.

Figure 10 shows the number of algae in a lake in the United Kingdom during one year.

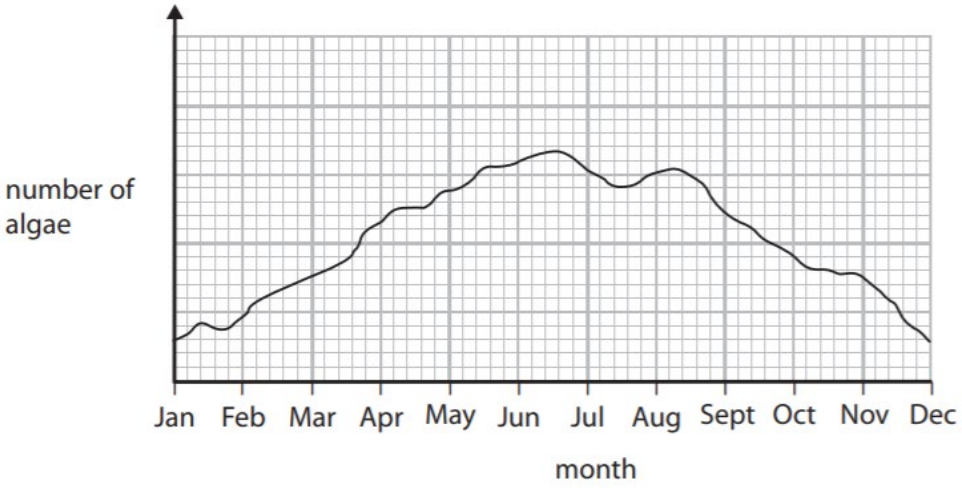


Figure 10

Explain the changes in the number of algae in the lake from February to June.

(3)

- number of algae increases
- increased temperature & light intensity & time of day light
- so more photosynthesis can happen to make more glucose for more growth

5 Figure 11 shows a British glow-worm.

Figure 11

Read the following extract before answering the questions.

Female glow-worms produce bright lights in the summer to attract males.
Glow-worm larvae are predators of slugs and snails, but adult glow-worms do not feed.
Females only have a few weeks to attract a mate and lay eggs, before the females die.

(a) What will happen if the population of snails decreases?

(1)

☒ **A** the population of glow-worms will increase

☒ **B** adult glow-worms will eat more snails

☒ **C** glow-worm larvae will eat more slugs

☒ **D** adult female glow-worms will glow more brightly

(b) Female glow-worms have an enzyme called luciferase.
The glow is produced when this enzyme catalyses a reaction between oxygen and a protein.

A scientist devised a plan to investigate the effect of oxygen concentration on this reaction.

The scientist had:

- five flasks of water each with a different concentration of dissolved oxygen
- a solution of the protein
- a solution of the enzyme.

The first step of this plan is:

Step 1. Add some of the protein solution to each of the five flasks.

(i) Describe the next **two** steps that should be in this plan to obtain results for this investigation.

(2)

Step 2 add set amount of enzyme to each of the flasks

Step 3 time how long the glow lasts

(ii) Which procedure would improve the investigation?

(1)

☒ **A** change the concentration of the protein solution in each flask

☒ **B** change the volume of the protein solution added to each flask

☒ **C** keep the concentration of dissolved oxygen the same in each flask

☒ **D** keep the volume of each solution the same in each flask

(iii) The enzyme luciferase works best at pH 8.

Explain why the activity of the enzyme decreases at pH 5.

(2)

- enzymes are pH sensitive
- enzyme's active site will change shape as it becomes denatured at pH5
- so enzyme not able to bind so easily to substrate, not complementary shapes of substrate and active site

(c) Female glow-worms are found attached to grass plants in a large field.

(i) Describe a sampling technique to find the **mean** number of female glow-worms in 1 m^2 of the field.

(3)

- use a quadrat
- randomly place quadrat
- count number of female glow-worms in quadrat
- use several samples
- total number found ÷ number of samples

(ii) The mean number of female glow-worms in 1 m^2 of the field is 5.

The field has a total area of 800 m^2.

Estimate the number of female glow-worms in the whole field.

(1)

800 x 5 = 4000

4000

10 Since 2003, in France, people have been buying Siberian chipmunks as pets but then releasing them into the wild when they are no longer wanted.

They are now classified as an invasive species.

Figure 25 shows a Siberian chipmunk (*Tamias sibiricus*).

Figure 25

(a) Siberian chipmunks eat acorns, which are the seeds of oak trees.

In Siberia, the natural predators of Siberian chipmunks are wild dogs.

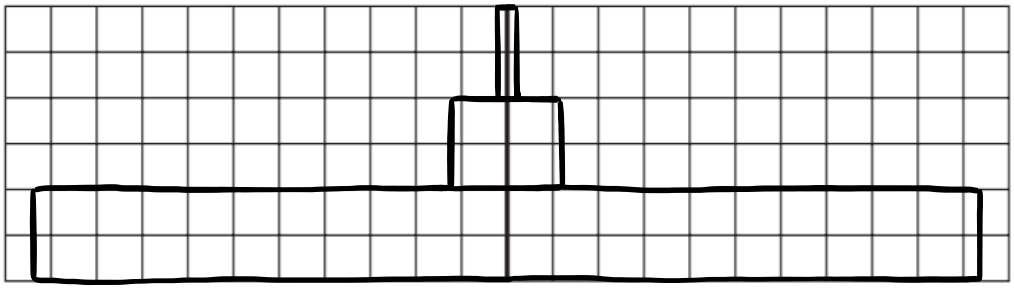
(i) Figure 26 shows the biomass of three organisms in a food chain from one area of Siberia.

organisms	biomass in kg
acorns	20 650
chipmunks	2 200
wild dogs	230

Figure 26

Draw a pyramid of biomass for this food chain.

(2)



(ii) In France, Siberian chipmunks have very few natural predators.

Describe how this affected the Siberian chipmunk population in France.

(2)

- few chipmunks are killed due to lack of predators
- so number of chipmunks in France will increase
- so more chipmunks can reproduce

(iii) The percentage of energy transferred from the acorns to the chipmunks is 9.5%.

The energy contained in the acorns is 97 500 kJ.

Calculate the amount of energy transferred to the chipmunks.

Give your answer to the nearest whole number.

(3)

$97500\text{ kJ} \times \frac{95}{1000} = 9262.5\text{ kJ}$

$\approx 9263\text{ kJ}$

9263 kJ

(b) The black-legged tick (*Ixodes scapularis*) is a parasite that feeds on the blood of animals including Siberian chipmunks and humans.

The tick transmits the Lyme disease pathogen.

Figure 27 shows the number of cases of Lyme disease in humans in France in 2003 and 2015.

Number of cases of Lyme disease in humans in France	
2003	**2015**
9500	27 000

Figure 27

(i) Calculate the percentage increase in the number of cases of Lyme disease in humans in France from 2003 to 2015.

(2)

$\frac{27000 - 9500}{9500} \times 100 = 184.2\%$

184.2 %

(ii) Explain why there has been an increase in the number of cases of Lyme disease in humans in France.

(2)

- number of chipmunks in wild have increased so ticks have more food so more ticks
- so humans are more likely to be bitten and contact Lyme disease

1 (a) Figure 1 shows the water cycle.

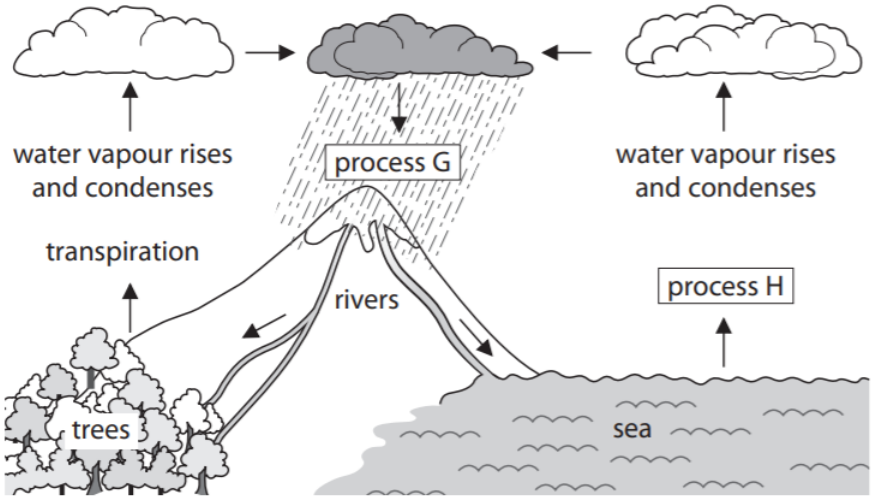


Figure 1

(i) Name process G and process H.

(2)

process G precipitation

process H evaporation

(ii) What causes the water vapour to condense and form clouds?

(1)

- [x] **A** the water vapour cools down
- [ ] **B** the water vapour heats up
- [ ] **C** the temperature of the water vapour stays the same
- [ ] **D** the trees absorb more water

(b) Water from rivers is treated before it is safe to drink.

Use words from the box to complete the sentences.

(2)

filtering	fish	heating
mud	pathogens	stirring

During water treatment, the solids in river water are removed by filtering.

Chlorine is then added to the water to kill pathogens.

(c) Figure 2 shows the Canary Islands.

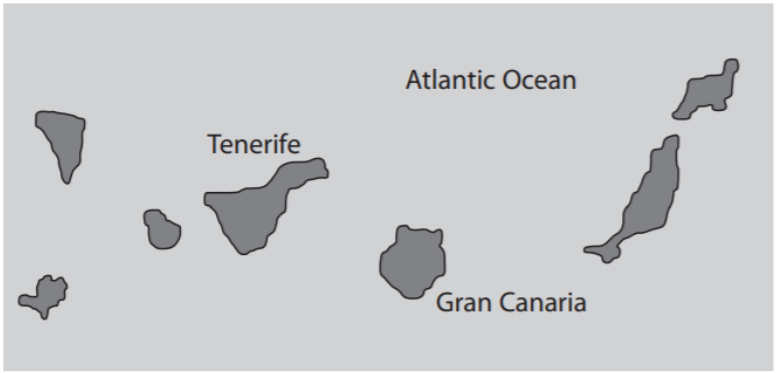


Figure 2

The Canary Islands do not have enough fresh water.

Describe how seawater can be turned into drinking water.

(2)

- sea water heated until it boils
- salt remains in liquid and steam is cooled & condensed to make potable water
- distillation process

5 Figure 8 shows an area of nettle plants.

(Source: © stevemart/Shutterstock)

Figure 8

Grass does not grow among the nettles.

(a) Explain why grass does not grow where there are nettles.

(2)

- nettle requires more nutrients & water from soil, space in soil, sunlight than grass
- grass avoids growing near nettles to reduce competition when growing

(b) Figure 9 shows caterpillars eating nettle leaves.

(Source: © bbbb/Shutterstock)

Figure 9

A caterpillar has a body mass of 6.0 grams.
One week later, its body mass had increased to 7.5 grams.
Caterpillars convert 10% of food eaten into body mass.

(i) Calculate the mass of nettles that the caterpillar ate.

(2)

$7.5g - 6.0g = 1.5g$

$\text{mass} \times \frac{10}{100} = 1.5g$

mass = 15g

15 grams

(ii) Describe what happens to food eaten that is not converted into the body mass of the caterpillar.

(2)

- food used for respiration to release energy for movement & heat
- some parts of food undigested and wasted

(c) Devise a method a scientist could use to investigate how temperature affects nettle growth.

(4)

- plant nettles in an optimal conditioned soil and atmosphere
- divide nettles into groups where 3 each
- measure initial height of nettles
- apply different temperature to each group which increases in a set interval of 5°C
- measure final grown nettle heights after 1 week and calculate mean for each temperature

7 The increasing human population is affecting farming and the habitats of animals.

Figure 12 shows the human population of the UK from 1960 to 2018.

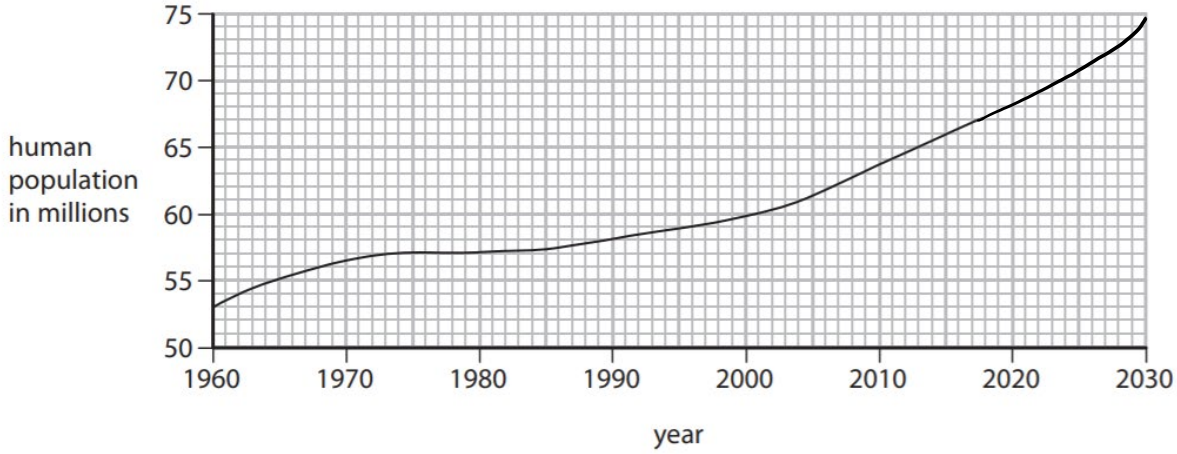


Figure 12

(a) Extend the line to estimate the human population of the UK in 2030 if this trend continues.

(1)

75 million

(b) Food security means that a population has enough safe and healthy food.

Which of these would improve food security?

(1)

☒ **A** increased reforestation

☒ **B** increased animal farming

☒ **C** increased human population

☒ **D** increased crop yield

(c) A scientist tested three samples of different foods.

Figure 13 shows the results.

food sample	result of adding iodine solution	result of boiling with Benedict's solution	result of adding Biuret solution	result of emulsion test
E	black	blue	blue	clear
F	brown	orange	purple	clear
G	brown	orange	purple	cloudy

Figure 13

(i) Name the food group in sample E.

(1)

starch

(ii) Name the food groups in sample F.

(1)

sugar, protein

(iii) The emulsion test shows that food sample G contained fat.
Describe how fat is digested in the body.

(2)

- lipase enzyme
- fat broken down into fatty acids and glycerol
- in small intestine

*(d) Figure 14 shows a field of a crop in one area of Africa.

The crop cannot be eaten by people.

The crop is used to produce biofuel.

(Source: © KAMBOU SIA/Stringer/Getty Images)

Figure 14

Describe the advantages and disadvantages of growing this crop to produce biofuel.

(6)

ADVANTAGES

- reduces carbon dioxide emissions as biofuel is renewable source of energy so reduces global warming :
  carbon neutral where plants absorb CO_2 for photosynthesis and burning biofuel emits CO_2 trapped into the atmosphere
- constant supply present so reduces reliance on fossil fuels

DISADVANTAGES

- uses a large area of land which could be used to grow crops for human food
- requires lots of labour

8 (a) A student was investigating the populations of organisms in a garden.

Figure 15 shows the estimates of the number and biomass of some of the organisms in the garden.

organism	number	mean biomass of each organism in grams	biomass of population in grams
cabbages (plants)	80	70	5600
earthworms	620	3.4	?
slugs	30	4.1	123
hedgehogs	1	620	620
squirrels	2	600	1200

Figure 15

(i) Calculate the biomass of the population of earthworms in the garden.

(1)

620 x 3.4 = 2108 g

2108g

(ii) Hedgehogs eat slugs and earthworms.
Slug pellets were used to kill the slugs.

Explain how killing the slugs would affect the population of earthworms in this garden.

(2)

- hedgehogs can only prey on earthworms for survival and eat more to meet demand that was once shared with slugs
- decrease earthworm population

(iii) Describe a method that could be used to estimate the population of slugs in the garden.

(3)

- mark-release-recapture method
- capture a certain number of slugs
- mark or label them which won't be lost or be rubbed off nor should be toxic or make them more liable to predation then release them
- recapture same number after a certain time and count how many marked
- estimated population size = total of 1st sample x total of 2nd sample divided by number marked which is recaptured

(b) Explain how cabbages, earthworms and squirrels contribute to the carbon cycle.

(3)

- cabbage leaves absorb CO_2 for photosynthesis to make glucose for respiration & growth
- earthworms feed on cabbages so carbon present in organic form in body
- squirrels, earthworms respire, giving out CO_2 into the atmosphere & they are decomposed by microorganisms which also give out CO_2

(c) State **three** ways the concentration of nitrates in soil can be increased.

(3)

1 plant more plants with nodules to increase number of nitrogen-fixing bacteria

2 plough the field to aerate the soil to avoid growth of denitrifying bacteria

3 increase ammonium content to increase number of nitrifying bacteria

2 The animal shown in Figure 3 is a tick burrowing into the skin of a human.

Figure 3

(a) Use words from the box to complete the sentences.

(2)

enzymes	food	herbivores
parasites	producers	prey

(i) The tick burrows into the skin to obtain ..food.. .

(ii) When a tick burrows into human skin the tick benefits but the human is harmed.

This means that ticks are classed as ..parasites.. .

(b) When skin is cut a blood clot forms.

Which part of the blood starts the clotting process?

(1)

☒ **A** red blood cells

☒ **B** water

☒ **C** platelets

☒ **D** white blood cells

(c) Figure 4 shows a bird called an oxpecker eating ticks that are living on a zebra.

© MartinMaritz/Shutterstock

Figure 4

(i) Name the type of relationship where both the oxpecker and the zebra benefit.

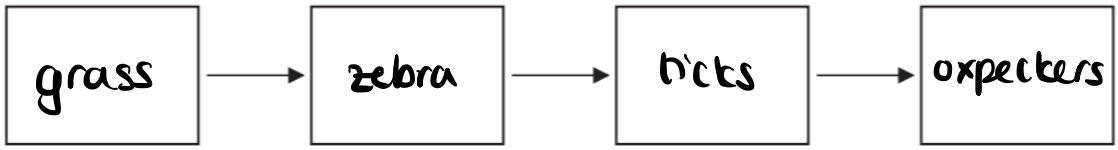
(1)

mutual

(ii) Zebras eat grass.

Complete the food chain that includes zebras, ticks, oxpeckers and grass.

(2)



(d) Figure 5 shows the maximum numbers of oxpeckers observed on four types of mammal.

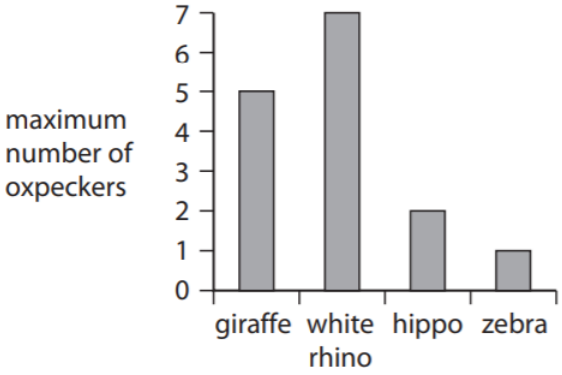


Figure 5

(i) Describe the difference in the maximum number of oxpeckers on the white rhino and on the hippo.

(2)

- much greater maximum number of oxpeckers on white rhino than on hippo
- 5 oxpeckers greater, 3.5 times greater

(ii) Give **one** reason why more oxpeckers were observed on giraffes than on zebras.

(1)

giraffes are taller so larger so has greater total skin surface area where ticks can parasite on so more oxpeckers

(b) Figure 7 shows fungus growing on strawberries.

The fungus is decomposing the strawberries.

Figure 7

A scientist investigated the effect of temperature on the decomposition of strawberries.

The scientist spread fresh strawberries on six trays.

Each tray was kept at a different temperature.

After five days the scientist measured the area of fungus that had grown on each tray of strawberries.

The results are shown in Figure 8.

temperature in °C	area of fungus after 5 days in cm^2
5	8
10	25
15	36
20	48
25	60
30	72

Figure 8

(i) The mean rate of growth of fungus at 25 °C was 12 cm^2 per day.

Calculate the mean rate of growth of fungus at 30 °C.

(2)

$\frac{72\,cm^2}{5\,days} = 14.4$

14.4 cm^2 per day

(ii) State the effect of temperature on the growth of fungus on strawberries from 5 °C to 30 °C.

(1)

increase in temperature leads to more growth of fungus

(c) Decomposition of strawberries can be prevented by boiling the strawberries with sugar to make jam.

(i) Enzymes in the fungus caused decomposition.

Explain how boiling stops the enzymes from working.

(2)

- very high temperature denatures enzymes
- change shape of active sites so no longer complementary to substrate
- no more enzyme-substrate complexes form so no more reaction occurs

(ii) Cells from a fungus can land on jam.

The sugar solution inside the jam is more concentrated than the sugar solution inside the fungus cells.

State how osmosis causes the fungus cells to die.

(1)

- water potential in fungus is greater in fungus than in jam
- water molecules move out of fungus cells down the water potential gradient via osmosis so fungus cells shrink & lack water, dying

4 A scientist investigated the distribution of invertebrates found in a garden.

(a) Figure 9 shows an invertebrate about to fall into a pitfall trap.

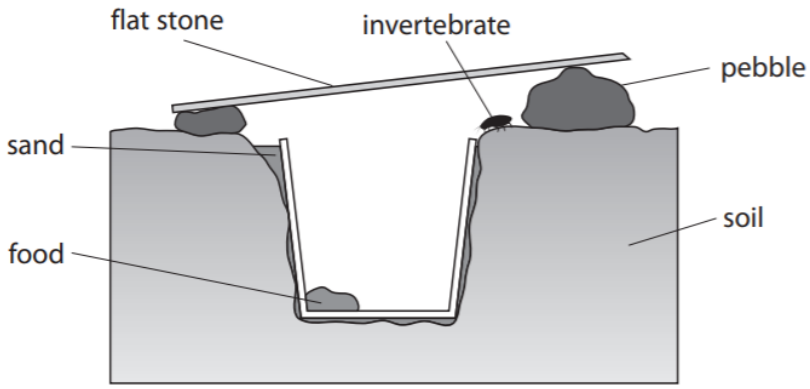


Figure 9

The steps the scientist used to set up the pitfall trap are shown below.

The steps are not in the correct order.

1. put some sand around the beaker
2. put a beaker, baited with food, in the hole
3. place a flat stone on pebbles over the beaker
4. check the pitfall trap each day
5. dig a hole in the garden

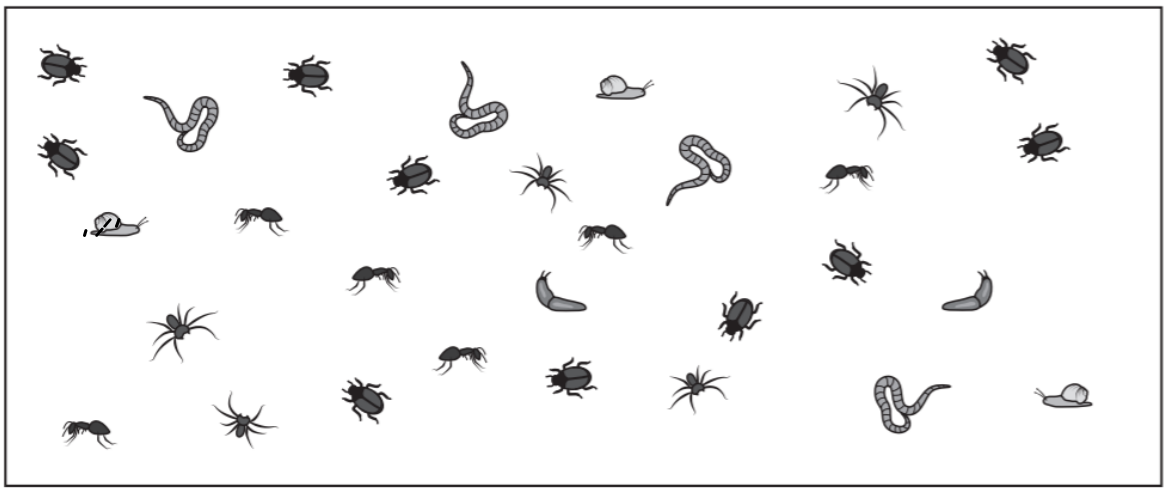
Complete the steps in the correct order, from left to right.

The first number has been written in for you.

(2)

5	2	1	3	4

(b) Figure 10 shows 30 invertebrates that the scientist collected.



key					
					
beetle	snail	ant	spider	slug	worm

Figure 10

(i) Complete the table by filling in the tally and number for the spiders and worms.

(2)

invertebrate	tally	number of invertebrates
ant	𝍸 |	6
beetle	𝍸 𝍸	10
slug	||	2
snail	|||	3
spider	𝍸	5
worm	1111	4

(ii) The scientist selected an invertebrate at random to observe it in more detail.

State the probability that the invertebrate selected is an ant.

Give your answer in its simplest form.

(2)

total = 6 + 10 + 2 + 3 + 5 + 4 = 30

ant = 6

$\frac{6}{30} = \frac{1}{5}$

$\frac{1}{5}$

(iii) State how the type of food used to bait the pitfall trap could affect the number of different invertebrates caught.

(1)

different invertebrate feed on different types of food so varying strength of attraction

(c) The scientist also counted the number of snails in four 1 m^2 areas of the garden.

The garden had a total area of 40 m^2.

Describe how the scientist can use this information to estimate the number of snails in the garden.

(2)

- calculate the mean number of snails
- multiply mean of number of snails with 40 as an estimate

8. (c) Figure 19 shows water lilies growing in a lake in Europe.

© lynn gladwell/123RF

Figure 19

(i) One water lily plant was brought from America 10 years ago and planted in the lake shown in Figure 19.

Explain why this non-indigenous plant now covers the whole surface of the lake.

(3)

- one water lily plant starts a colony in that lake by reproducing as it extends its roots into water
- it spreads its pollen via insects such as bees and around the lake where plenty water supply thus optimal condition for growth

(ii) Explain how the water lilies will affect the biodiversity of this lake.

(3)

- water lilies will take up most nutrients in lake water so other plants can't grow so die
- water lilies cover surface of lake, blocking sun light from passing through to reach water plants in water so they can't photosynthesise to make food so die
- biodiversity decreases

10 Figure 24 shows the world human population from 1800 to 2015.

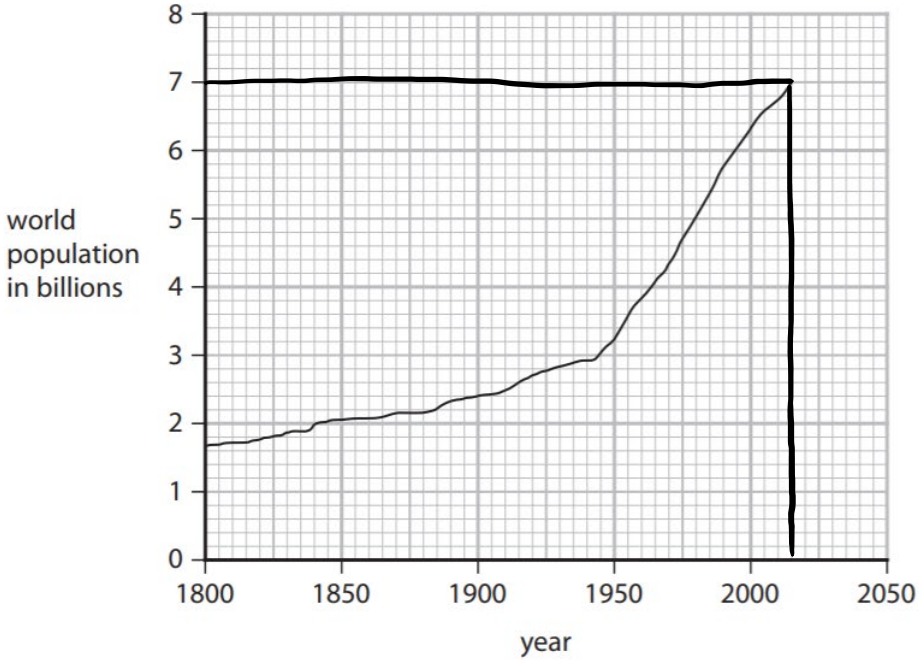


Figure 24

(a) In 2015, 13% of the world human population were classified as malnourished.

Calculate, using Figure 24, how many people were classified as malnourished in 2015.

(2)

$7 \text{ billion} \times \frac{13}{100} = 0.91 \text{ billion}$

0.91 billion

(b) Protein is an important nutrient in meat.

Describe the laboratory test for protein.

(2)

- make solution containing protein
- add biuret solution
- colour change from blue to purple shows the presence of protein

(c) Figure 25 shows the mass of meat eaten in the world from 1980 to 2010.

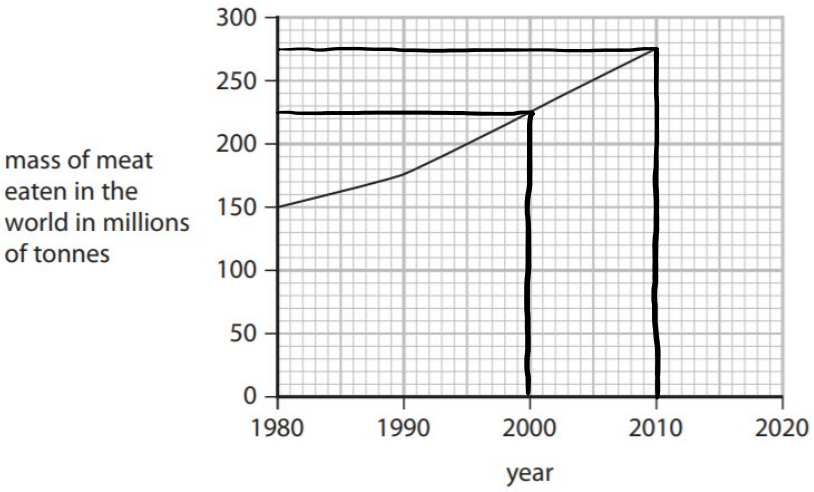


Figure 25

Calculate the rate of increase in the mass of meat eaten in the world from 2000 to 2010.

(2)

$\frac{275 - 225}{2010 - 2000} = 5$

5 millions of tonnes per year

(d) Figure 26 shows an energy pyramid.

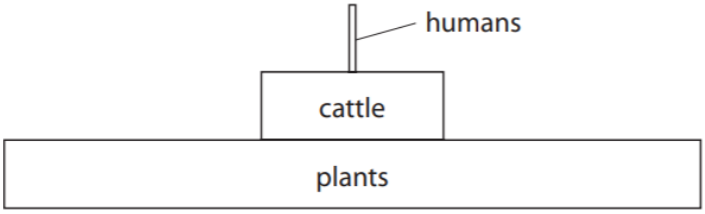


Figure 26

(i) Explain why the area labelled cattle is smaller than the area labelled plants.

(2)

- cattles feed off from plants
- cattles are in the higher trophic level (2nd) than plants (1st) as plants are producers and cattles are primary consumers
- energy lost after each trophic level thus less available for next trophic level so smaller

(ii) The World Health Organisation uses this definition of food security.

> *'When all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life'*

Explain how a large increase in the mass of meat eaten will decrease food security in the future.

(3)

- meat doesn't contain much nutrients thus not nutritious
- eating an increased mass of meat also leaves with less meat in the future
- meals using meat is also not always safe due to diseases it can carry with other risks
- hence will decrease food security

TOTAL = 115 MARKS