Write your name here

Surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number	Candidate Number

Biology B

Advanced
Paper 3: General and Practical Principles in Biology

Monday 26 June 2017 – Morning **Time: 2 hours 30 minutes**	Paper Reference **9BI0/03**

You must have:
Calculator, HB pencil, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Show your working in any calculation questions and include units in your answer where appropriate.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- You may use a scientific calculator.
- In question(s) marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Information

- The total mark for this paper is 120.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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Answer ALL questions.

Write your answers in the spaces provided.

1 Antibiotics are widely used to treat infections.

Some antibiotics are bactericidal.

(a) State what is meant by the term bactericidal.

(1)

(b) The table shows information about five antibiotics.

Antibiotic	Year discovered	Time for first resistant strain of bacteria to be detected / years	Number of different types of each antibiotic that exist today
Penicillin	1928	1	>18
Tetracycline	1945	3	>16
Vancomycin	1953	27	1
Linezolid	1978	1	1
Daptomycin	1985	2	1

Analyse the data to comment on the number of types of each antibiotic that exist today.

(5)

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(c) Describe how you would use aseptic techniques to transfer bacterial cells growing on an agar plate to a tube containing a sterile broth.

(5)

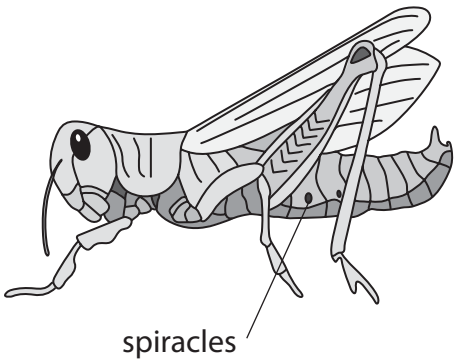
(Total for Question 1 = 11 marks)

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2 Insects such as locusts do not breathe through the mouth.

The gas exchange system of a locust includes air sacs, tracheae and tracheoles.

The diagram shows a locust before dissection.



(a) Describe how you would dissect a locust to ensure that the gas exchange system is clearly visible.

(3)

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(b) A student investigated the effect of different gases on the breathing rate of a locust.

The student blew exhaled air over a locust in a syringe and recorded its breathing rate.

The locust was immediately given pure oxygen and the breathing rate was recorded.

The table shows the results of this investigation.

Treatment	Breathing rate / breaths min^{-1}
Exhaled air	56
Pure oxygen	3

The student concluded that carbon dioxide increased the breathing rate of the locust.

Comment on how the limitations of this method affect the validity of this conclusion.

(5)

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(c) Explain the role of air sacs in the gas exchange system of locusts.

(2)

(d) Locusts have a complex gas exchange system because they are multicellular organisms.

Explain why single-celled organisms do not have a gas exchange system.

(2)

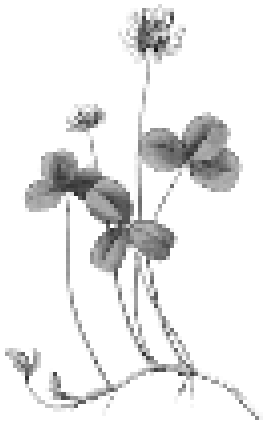
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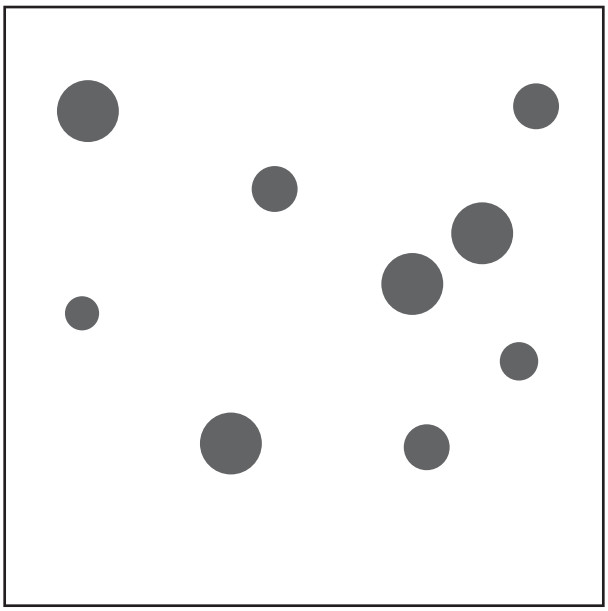
3 The drawing shows a plant called white clover, *Trifolium repens*.



A student used a 50 cm × 50 cm quadrat to compare the abundance of white clover in a trampled area of grassland and an untrampled area of grassland.

Each area measured 90 m × 45 m.

The diagram shows the distribution of white clover plants in one quadrat from the area of trampled grassland. Each circle represents one clover plant.



(a) (i) Use the results from this quadrat to calculate the total number of white clover plants present in the area of trampled grassland.

(2)

Answer .....

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(ii) The student used the same method to calculate the total number of white clover plants in the area of untrampled grassland.

The student decided that the calculated values were not accurate.

Explain how you would modify the method to obtain more accurate results.

(3)

(b) The student investigated the effect of one abiotic factor on the abundance of white clover plants.

(i) Name one abiotic factor, other than soil water content, that could affect the abundance of white clover plants in these areas.

(1)

(ii) Describe how you would measure the abiotic factor named in (b)(i).

(2)

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(iii) The student obtained the following results for soil water content and the abundance of white clover plants in these two areas of grassland.

Area of grassland	Soil water content (%)	Abundance of white clover plants
Trampled	54.9	low
Untrampled	88.8	high

Explain the effect of trampling on the abundance of white clover plants.

(2)

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(Total for Question 3 = 10 marks)

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4 Mammals produce urea as a nitrogenous waste product.

(a) Describe how urea is produced in mammals.

(2)

(b) Bowman's capsule (renal capsule) in the kidney is involved in the excretion of urea in mammals.

Name the cluster of blood capillaries enclosed by Bowman's capsule.

(1)

(c) The table shows the concentrations of molecules and ions in the blood plasma of the kidney, in the filtrate produced in Bowman's capsule and in the bladder.

Molecule or ion	Blood plasma of kidney (%)	Filtrate produced in Bowman's capsule (%)	Urine in the bladder (%)
Water	90 to 93	94 to 96	96
Protein	7 to 9	0.0	0.0
Glucose	0.10	0.10	0.0
Urea	0.03	0.03	2.0
Sodium	0.32	0.32	0.30 to 0.35
Chloride	0.37	0.37	0.60

(i) Name the process by which this filtrate is produced in Bowman's capsule.

(1)

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(ii) Analyse the data to explain the difference between the protein and the other molecules or ions in the filtrate in Bowman's capsule.

(3)

(iii) Urea and chloride ions both become more concentrated as they pass from Bowman's capsule to the urine in the bladder.

Calculate how many more times urea becomes concentrated compared with chloride ions.

(3)

Answer .....

(iv) Analyse the data to explain the glucose concentration in the bladder.

(2)

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(v) Explain how the loop of Henlé is involved in the production of concentrated urine.

(5)

(Total for Question 4 = 17 marks)

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5 Fluoride ions reduce anaerobic respiration in yeast by inhibiting the action of the enzyme enolase.

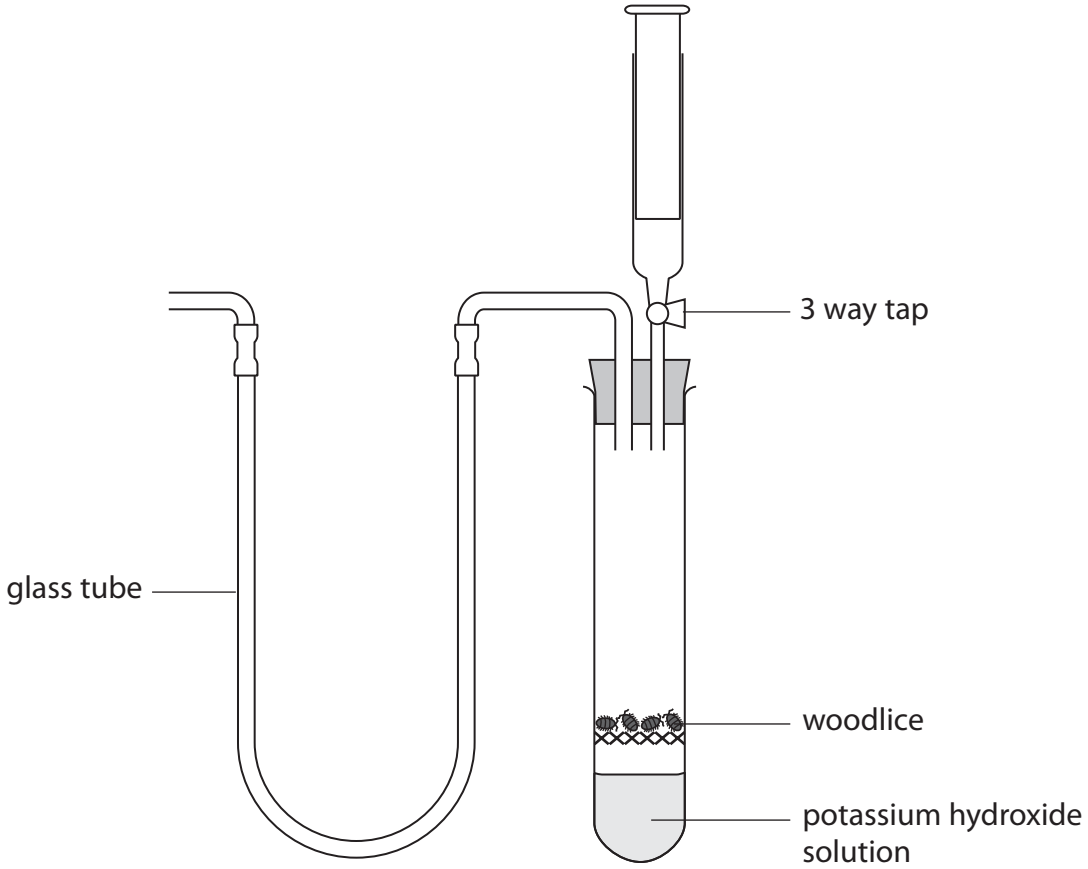
Fluoride ions combine with magnesium ions and phosphate ions to resemble the substrate of enolase.

(a) Name the type of inhibition produced by fluoride ions.

(1)

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*(b) The diagram shows some apparatus that can be used to measure the rate of respiration in small animals such as woodlice.



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Discuss how you would modify this apparatus and use it to find out if fluoride ions have a significant effect on the rate of anaerobic respiration in yeast.

(9)

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(Total for Question 5 = 10 marks)

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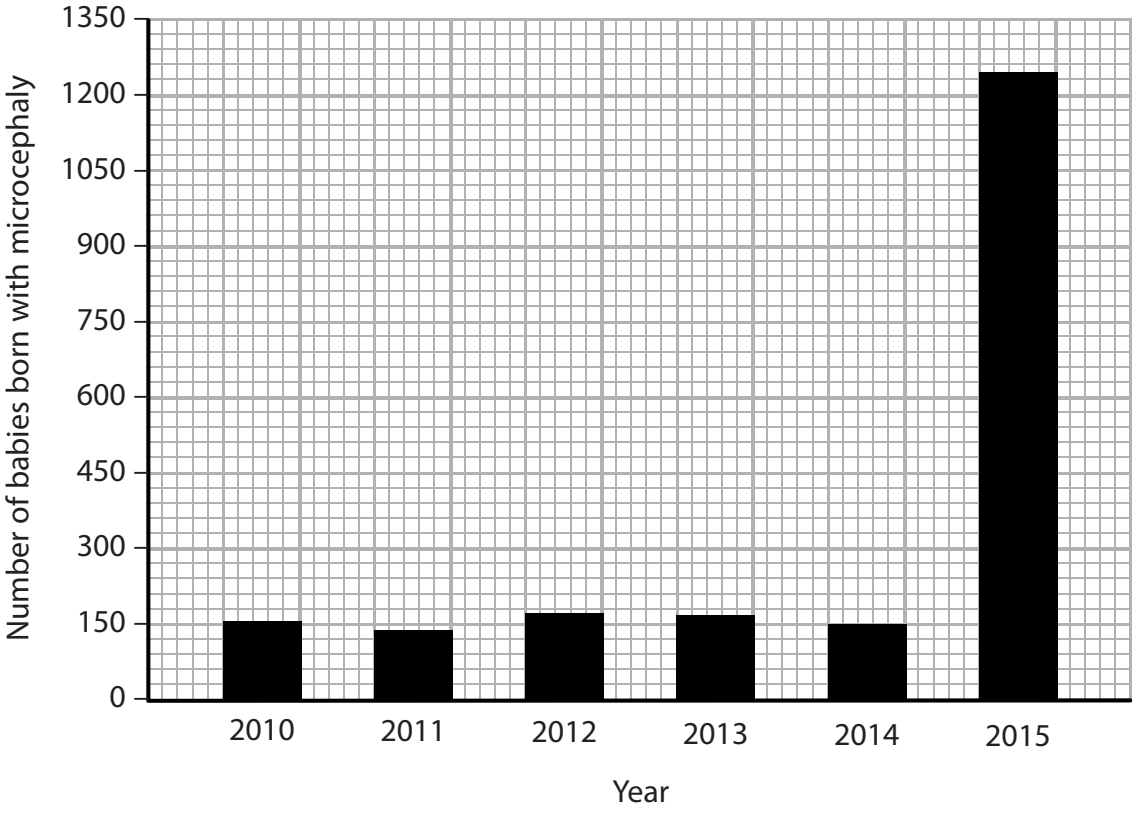
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6 In February 2016, the World Health Organisation (WHO) declared a public health emergency because of the spread of the Zika virus.

The mild symptoms, such as joint pains, headaches and a slight temperature increase lasted only a few days. However, Zika virus has been linked to a birth defect called microcephaly.

The graph shows the number of babies born with microcephaly in Brazil from 2010 to 2015.



(a) Calculate the percentage increase in the number of babies born with microcephaly in 2015 compared with 2014.

(2)

Answer ..... %

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(b) Zika virus is transmitted to humans by infected mosquitoes.

(i) Explain why another type of drug, rather than antibiotics, has to be used to treat Zika virus infections.

(2)

(ii) Scientists have suggested that genetically modified (GM) mosquitoes could be used to help combat the spread of the Zika virus.

Mosquito eggs are injected with DNA, from GM mosquitoes. This DNA contains a gene for fluorescence. However, only one in a few thousand injected eggs results in a GM mosquito.

Explain how this procedure could help in the production of large numbers of GM mosquitoes.

(4)

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(iii) Explain why the Brazilian government has advised people to use mosquito nets, even if they have already contracted the Zika virus.

(2)

(c) Scientists have discovered that the Zika virus genome is made of RNA.

This RNA codes for:

- capsid protein with 105 amino acids
- pre-membrane protein with 187 amino acids
- envelope protein with 505 amino acids
- seven nonstructural proteins

(i) State how many bases are needed to code for the capsid protein.

(1)

(ii) Unlike human immunodeficiency virus (HIV), Zika is not a retrovirus.

Describe what happens to the Zika RNA once it is in the cell.

(2)

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(d) During the replication of the Zika virus, the ten proteins that are coded for in the RNA are produced as a single polyprotein molecule.

Explain how this polyprotein molecule is converted into ten separate protein molecules.

(2)

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(Total for Question 6 = 15 marks)

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7 Cystic fibrosis is a recessive inherited condition where the cells in the lungs produce sticky mucus. This mucus builds up in the airways, causing breathlessness and chest infections.

People with cystic fibrosis often need treatments such as physiotherapy and antibiotics.

(a) The incidence of babies born with cystic fibrosis in Australia is 1 in 2500.

Use the Hardy Weinberg equation, $p^2 + 2pq + q^2 = 1$, to calculate the percentage of Australians who are carriers of cystic fibrosis.

(4)

Answer ..... %

(b) A woman is a carrier of the cystic fibrosis allele. Her partner does not have cystic fibrosis and is not a carrier.

Use a genetic cross to determine the probability of this woman producing a child who is also a carrier.

(4)

Probability .....

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(c) Australian scientists observed that people with cystic fibrosis who went surfing had fewer symptoms than people with cystic fibrosis who did not go surfing.

The scientists carried out a trial on 164 people with cystic fibrosis.

These people were placed at random into either the experimental group or the control group.

The experimental group inhaled a fine spray of 7.0% salt solution and the control group inhaled a fine spray of 0.9% salt solution.

The scientists found that the mucus in the experimental group contained more water and became less sticky than the mucus in the control group.

(i) Explain why only the fine spray of 7.0% salt solution resulted in mucus that contained more water.

(2)

(ii) Explain why the control group inhaled a fine spray of 0.9% salt solution, rather than a fine spray of pure water.

(2)

(Total for Question 7 = 12 marks)

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8 (a) A student investigated the effect of ethanol on plant cell membranes.

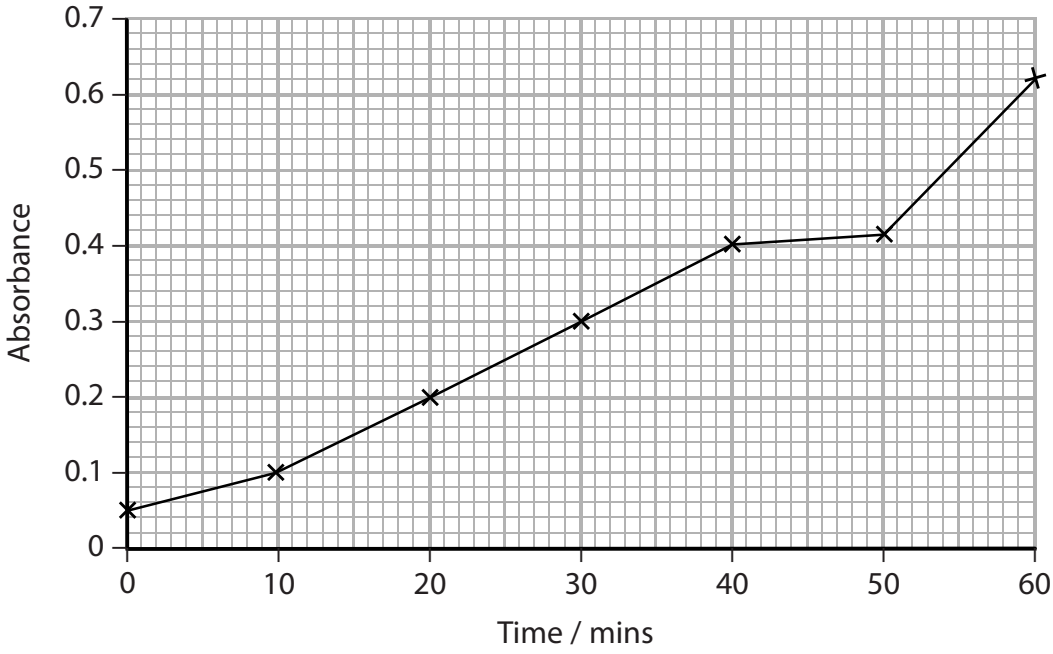
Step 1: The student cut leaf discs from leaves, using a cork borer.

Step 2: These leaf discs were then added to a boiling tube containing 10 cm^3 of 40% ethanol solution. The pigments in the leaf discs dissolved in the ethanol, producing a green solution.

Step 3: The boiling tube was shaken and the amount of red light absorbed by this solution (absorbance) was measured at the start.

Step 4: The absorbance was measured every 10 minutes, for an hour.

The graph shows the results of this investigation.



(i) Explain why red light was used in this investigation.

(2)

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(ii) Explain the absorbance value at 0 minutes.

(2)

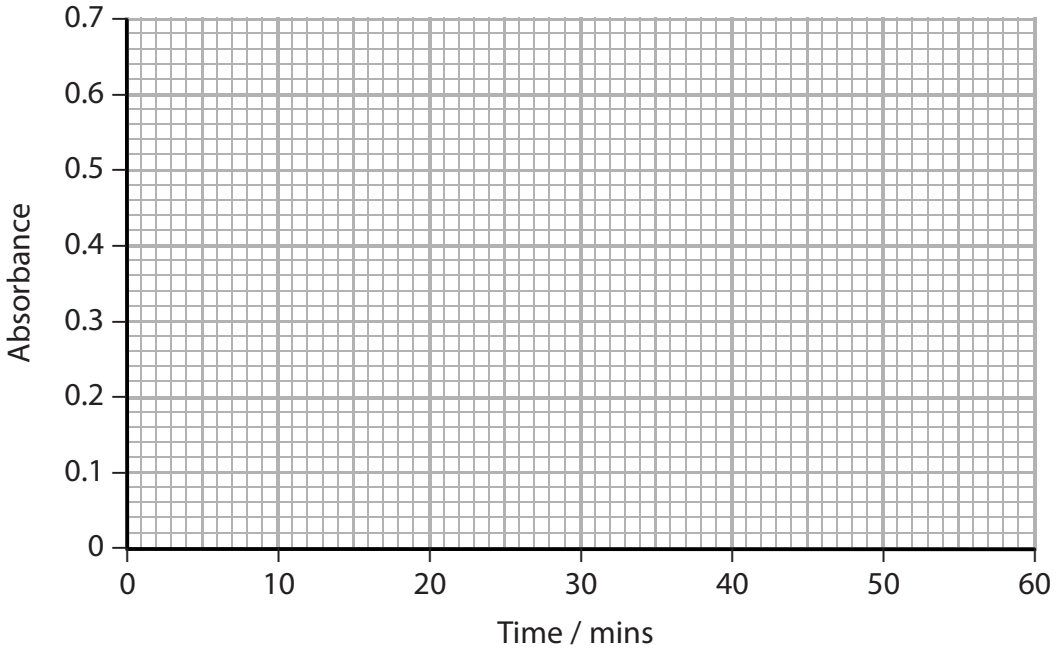
(iii) Explain the effect of ethanol on plant cell membranes.

(2)

(b) The student also carried out a control, using water instead of 40% ethanol.

Draw a line on the graph to show the results for this control.

(2)



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(c) The student then investigated the effect of ethanol concentration on leaves from different plant species.

Justify the modifications to the procedure in part (a) that will be required to obtain valid data.

(5)

(Total for Question 8 = 13 marks)

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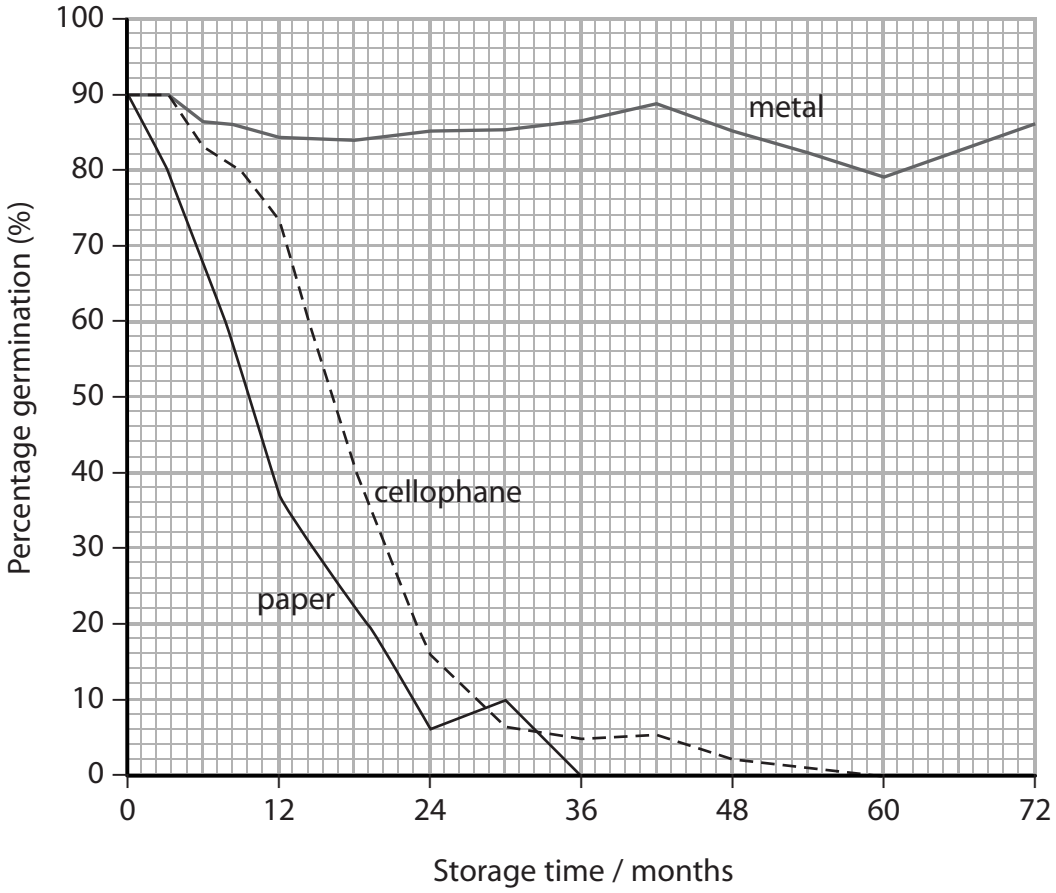
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9 Seed banks store seeds for future use. Seeds can be stored for a long time if the seeds are kept dry with a moisture content of less than 8%.

The seeds are stored in closed containers. The percentage germination of the seeds is measured to test their viability during storage.

At the Millennium Seed Bank, the seeds are stored in closed glass containers at 15% relative humidity at a temperature of –20 °C.

The graph shows the percentage germination of seeds kept in three different closed containers: metal, cellophane and paper. They were kept for 72 months at a temperature of –20 °C.



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(a) Analyse the data to explain why seeds are stored in glass containers in the Millennium Seed Bank.

(4)

(b) Each time the seeds are tested for viability, 50 seeds are used.

State why 50 seeds are used.

(1)

(c) Calculate the rate of change in viability of the seeds stored in a cellophane container for the first two years.

(2)

Answer .....

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(d) Seeds from other parts of the world are stored in seed banks.

(i) Explain how the viability test would be different for these seeds from other parts of the world.

(3)

(ii) Explain why plants grown from these germinating seeds may not flower at the same time of year as they would have done in their country of origin.

(2)

(Total for Question 9 = 12 marks)

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10 (a) Devise an experiment, which uses changes in mass, to compare the water potential of carrot tissue with the water potential of potato tissue.

(5)

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(b) The photograph shows *Salicornia*, a plant growing on salt marshes close to the sea. *Salicornia* colonises bare mud containing seawater.



A student sampled *Salicornia* plants at the river mouth by the sea and at different distances upstream. Samples of the water in the mud were also taken.

The salt concentration of the plants and the water in the mud were measured.

The results are shown in the table.

Distance upstream from sea / km	Salt concentration / arbitrary units	
	***Salicornia* plants**	**Water in the mud**
0.0	60.0	2.8
1.6	60.0	1.1
4.8	55.0	0.6
8.0	75.0	0.2

Analyse the data to explain how *Salicornia* is adapted to life in salt marshes.

(3)

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(Total for Question 10 = 8 marks)

TOTAL FOR PAPER = 120 MARKS

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