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INTERNATIONAL GCSE

Science (Double Award) (9-1)

SAMPLE ASSESSMENT MATERIALS

Pearson Edexcel International GCSE in Science (Double Award) (4SD0)

For first teaching September 2017
First examination June 2019

Pearson

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Edexcel, BTEC and LCCI qualifications

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Acknowledgements

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Contents

Introduction

The Pearson Edexcel International GCSE in Science (Double Award) is designed for use in schools and colleges. It is part of a suite of International GCSE qualifications offered by Pearson.

These sample assessment materials have been developed to support this qualification and will be used as the benchmark to develop the assessment students will take.

General marking guidance

- All candidates must receive the same treatment. Examiners must mark the last candidate in exactly the same way as they mark the first.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than be penalised for omissions.
- Examiners should mark according to the mark scheme – not according to their perception of where the grade boundaries may lie.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification/indicative content will not be exhaustive.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, a senior examiner must be consulted before a mark is given.
- Crossed-out work should be marked unless the candidate has replaced it with an alternative response.

Subject specific marking guidance

Symbols, terms used in the mark scheme

- Round brackets ( ): words inside round brackets are to aid understanding of the marking point but are not required to award the point
- Curly brackets { }: indicate the beginning and end of a list of alternatives (separated by obliques), where necessary, to avoid confusion
- Oblique /: words or phrases separated by an oblique are alternatives to each other and either answer should receive full credit.
- ecf: indicates error carried forward which means that a wrong answer given in an early part of a question is used correctly to a later part of a question.

You will not see 'owtte' (or words to that effect). Alternative correct wording should be credited in every answer unless the mark scheme has specified specific.

The Additional Guidance column is used for extra guidance to clarify any points in the mark scheme. It may be used to indicate:

- what will not be accepted for that marking point in which case the phrase 'do not accept' will be alongside the relevant marking point
- it might have examples of possible acceptable answers which will be adjacent to that marking point

Write your name here

Surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International GCSE (9-1)

Biology

Paper 1

Sample Assessment Materials for first teaching September 2017

Time: 2 hours

Paper Reference
4BI1/1B
4SD0/1B

You must have:
Calculator, 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.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Calculators may be used.
- Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Information

- The total mark for this paper is 110.
- 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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S 5 2 9 1 3 A 0 1 2 8

PEARSON

Answer ALL questions. Write your answers in the spaces provided.

1 The diagram shows a pot containing yoghurt and fruit.

(a) Describe how a named bacterium produced this yoghurt from milk.

(3)

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(b) Suggest the health benefits to a human of adding fruit to the yoghurt.

(2)

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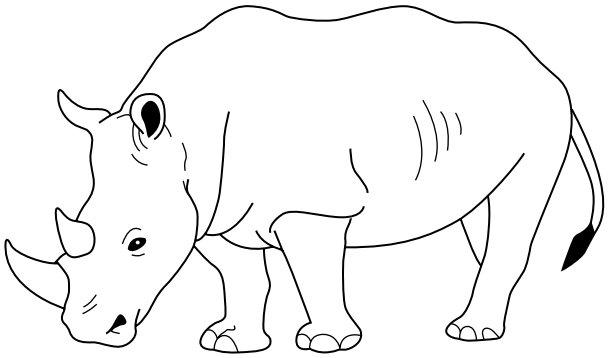
(Total for Question 1 = 5 marks)

2 A rhino is a large mammal that lives in hot parts of Africa.

The drawing shows a rhino.



(a) The rhino feeds on plants and rests in the shade during the day.

(i) Which of the following describes the trophic level of a rhino?

(1)

☐ **A** producer

☐ **B** primary consumer

☐ **C** secondary consumer

☐ **D** tertiary consumer

(ii) Which of the following explains why the rhino rests in the shade during the day?

(1)

☐ **A** it has a large surface area to volume ratio and needs to avoid overheating.

☐ **B** it has a large surface area to volume ratio and needs to gain heat.

☐ **C** it has a small surface area to volume ratio and needs to avoid overheating.

☐ **D** it has a small surface area to volume ratio and needs to gain heat.

(b) The horn of the rhino is valuable in some human cultures. This results in rhinos being killed just for their horn.

This species is at risk of extinction because the mean rate of killing is one rhino every six hours.

In 2016, there were an estimated 25 000 of one species of rhino in Africa.

Calculate the year in which this rhino species would become extinct, assuming the number of births equals the number of natural deaths.

(3)

year = ...

(c) In an effort to protect the rhino from extinction, scientists have produced a heart rate monitor.

The monitor is attached to the rhino. It sends an alarm signal to the nearest police station if the rhino is under stress.

This allows the police to respond quickly to save the rhino from being killed.

(i) Explain how stress affects the heart rate of a rhino.

(2)

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(ii) Describe the evidence the scientists need to find out if this method helps to protect the rhino from extinction.

(2)

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(Total for Question 2 = 9 marks)

3 A study investigates the effect of training on athletic performance.

In the study, the number of capillaries in the muscle tissue of a person is measured before and after a six-week period of training.

(a) The table shows the results.

Mean number of capillaries per mm²	
before training	after training
437	460

(i) Explain how training may affect the athletic performance of this person. Use information from the table to support your answer.

(5)

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(ii) Give **two** ways in which the design of the study could be improved.

(2)

1 .....

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2 .....

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(b) The diameter of a capillary is 8.0 μm and the diameter of the aorta is 25.0 mm.
1000 μm = 1 mm.

(i) Calculate the ratio of the diameter of the aorta to the diameter of the capillary.
Show your working.

(2)

ratio = ...

(ii) Explain why the aorta has a thicker wall than the capillary.

(2)

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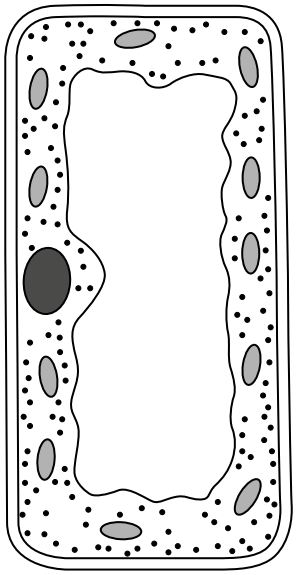
(Total for Question 3 = 11 marks)

4 The diagram shows a cell.



(a) (i) Which type of cell does the diagram show?

(1)

☐ **A** an animal

☐ **B** a bacterium

☐ **C** a fungus

☐ **D** a plant

(ii) The statements below describe conditions required for some molecules to move into this cell.

1. a concentration gradient
2. use of ATP

Which of these statements is correct for the process for osmosis?

(1)

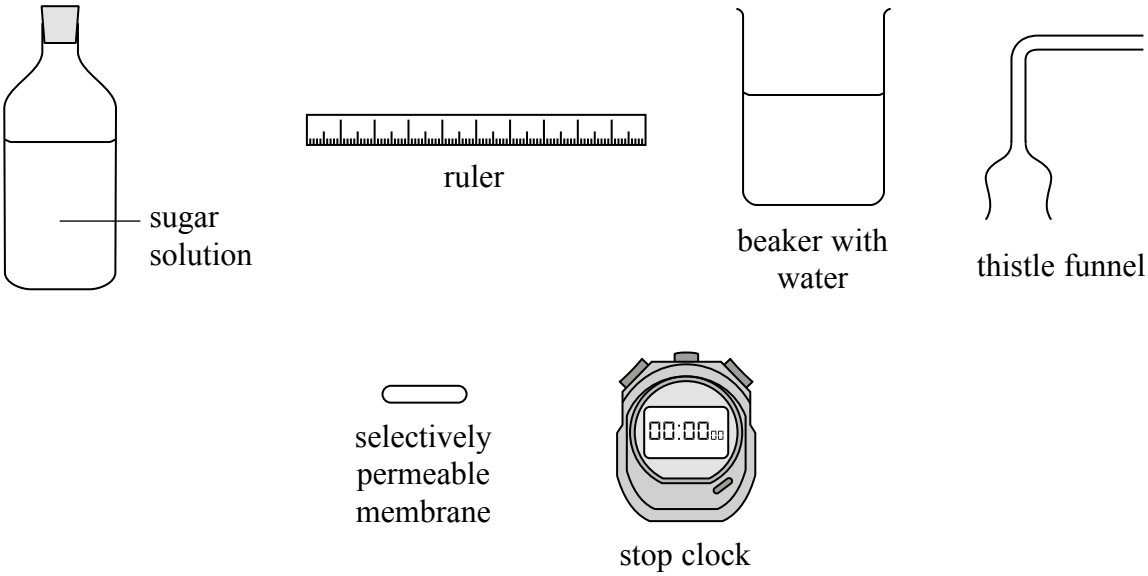
☐ **A** 1 only

☐ **B** 2 only

☐ **C** 1 and 2

☐ **D** neither 1 nor 2

(b) The diagram shows some of the apparatus used to investigate the rate of osmosis.

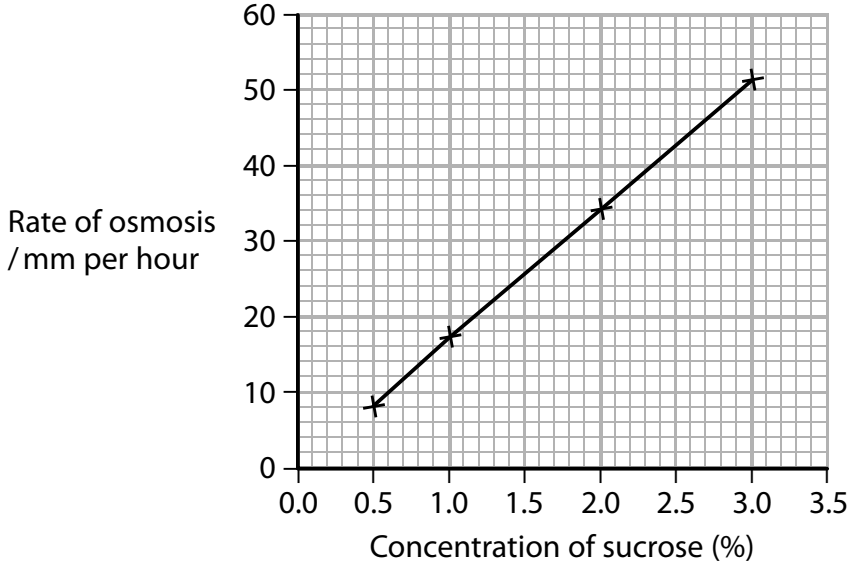


In the space below draw a labelled diagram to show how you would put this apparatus together to investigate the rate of osmosis.

(4)

(c) The apparatus is used to find out the effect of different sucrose concentrations on the rate of osmosis.

The graph below shows the results.



Calculate, using information from the graph, the rate of osmosis in mm per minute that would occur for a sucrose concentration of 2.5%.
Show your working.

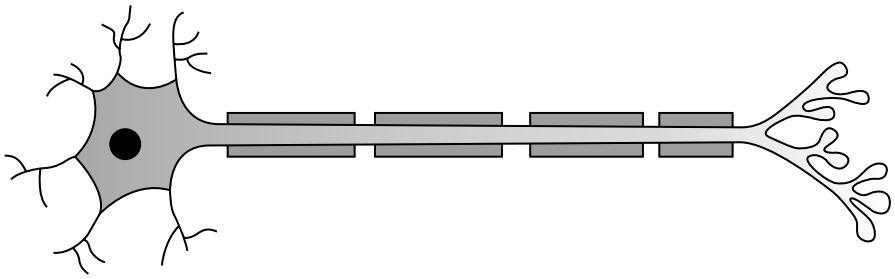
(2)

rate of osmosis = ... mm per minute

(Total for Question 4 = 8 marks)

5 Electrical impulses pass along motor neurones to effectors.

(a) The diagram shows a motor neurone.



The neurone is stimulated by a neurotransmitter to pass an electrical impulse along its length.

(i) Draw a circle around the part of the neurone that is stimulated by the neurotransmitter.

(1)

(ii) The longest motor neurone in the human body passes electrical impulses from the base of the spinal cord to muscle in the big toe. This neurone can be up to 1.3 m in length.

An impulse passes along this neurone at a speed of 1.20×10^2 metres per second.

Calculate the time taken, in seconds, for an impulse to pass along this neurone.

(2)

time = ... s

(iii) All neurones need a supply of energy from respiration.

Name the organelle in this motor neurone that supplies energy.

(1)

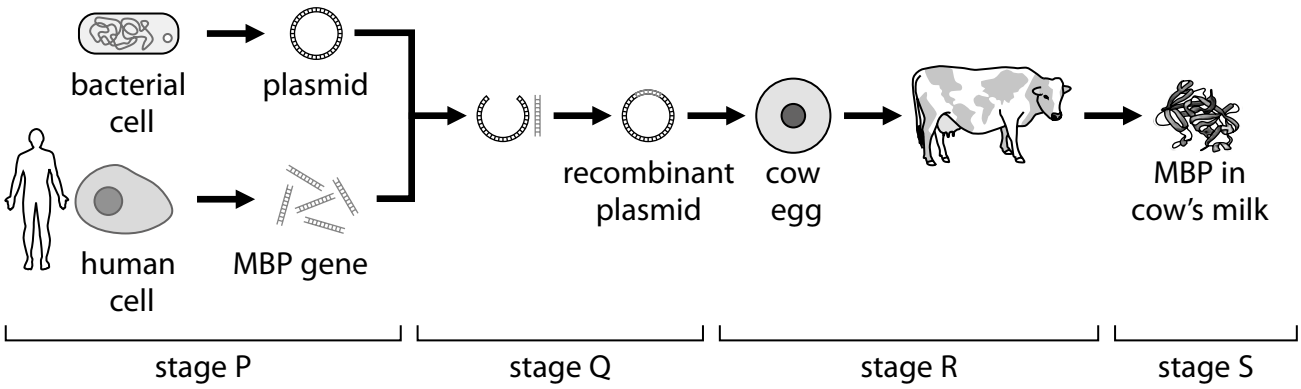
.....

(b) Multiple sclerosis is a disorder in which the insulating layer that surrounds a neurone is gradually destroyed. This prevents the passage of electrical impulses.

Scientists hope to treat multiple sclerosis using a protein called myelin basic protein (MBP).

Transgenic cows can produce large quantities of MBP in their milk.

The diagram shows four stages in the process of creating transgenic cows.



(i) Name the **two** structures in the bacterium that contain DNA.

(2)

1 .....

2 .....

(ii) Name the stage that involves the use of ligase.

(1)

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(iii) Name the stage that involves placing a transgenic embryo into a uterus.

(1)

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(Total for Question 5 = 8 marks)

6 Car exhaust fumes contain air pollutants including carbon monoxide and sulfur dioxide.

(a) Explain why carbon monoxide is a harmful air pollutant.

(2)

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(b) Which of the following is a direct consequence of sulfur dioxide pollution?

(1)

☒ **A** production of acid rain

☒ **B** soil erosion

☒ **C** production of ozone

☒ **D** eutrophication

(c) A species of plant does not grow by the side of roads.

One hypothesis to explain this observation is that sulfur dioxide inhibits seed germination.

Design an investigation to test this hypothesis.

Your answer should include experimental details and be written in full sentences.

(6)

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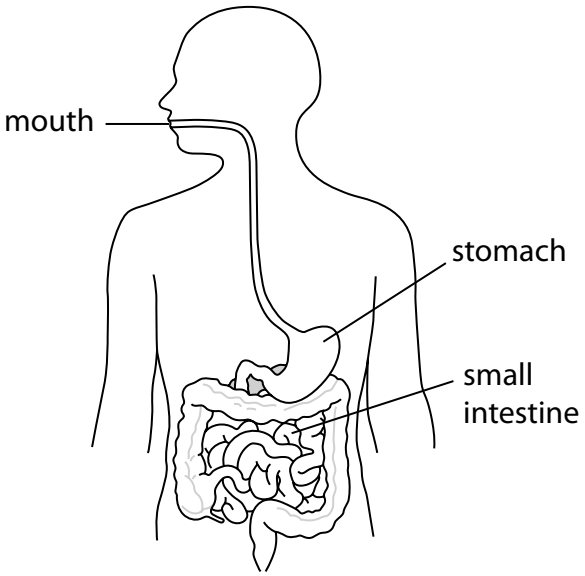
(Total for Question 6 = 9 marks)

7 The diagram shows parts of the human digestive system.



(a) Describe how food passes from the mouth to the stomach.

(2)

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(b) Explain what happens to protein in the stomach.

(4)

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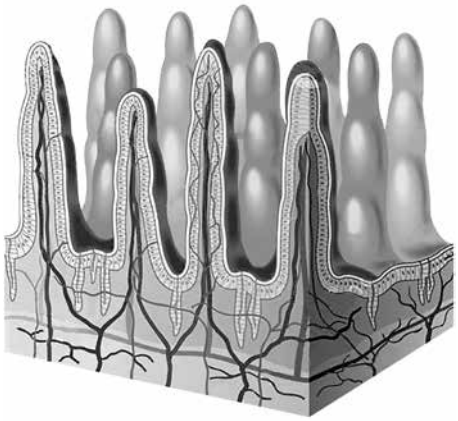
(c) Gluten is a protein found in wheat.

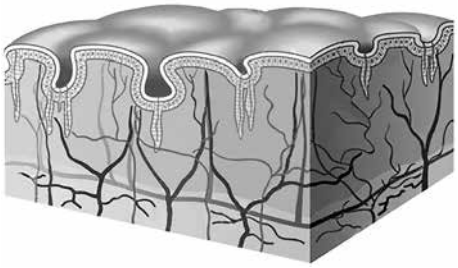
In some people, the lining of the small intestine can be damaged by gluten. This causes a condition called coeliac disease.

The diagram shows the lining of the small intestine of a child unaffected by gluten and a child with coeliac disease.

Unaffected



Coeliac disease



Suggest how coeliac disease could affect the growth of a child.

(4)

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(Total for Question 7 = 10 marks)

8 Male infertility can be caused by reduced sperm production and reduced sperm movement.

Scientists investigated the effect of a drug called letrozole on male infertility.

A large group of infertile men was divided into two smaller groups.

Group 1 received 2.5 mg of letrozole per day for six months and Group 2 received no treatment.

The scientists measured the following at the start of the investigation and after six months:

- sperm concentration
- percentage of moving sperm
- blood testosterone level
- blood oestrogen level
- side effects such as hair loss and skin rash

The table below shows the results.

Factors measured	**Group 1 (letrozole)**		**Group 2 (no treatment)**	
	start	**after 6 months**	**start**	**after 6 months**
sperm concentration / number per cm^3	450	1.4×10^6	475	450
percentage of moving sperm	2	18	2	2
blood testosterone level / arbitrary units	249	1198	266	266
blood oestrogen level / arbitrary units	44	0	44	48
number of men with side effects	0	8	0	0

The scientists concluded that letrozole is a safe and effective treatment for male infertility.

Evaluate this conclusion.

(6)

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(Total for Question 8 = 6 marks)

9 Genetic conditions can be controlled by dominant alleles or by recessive alleles.

(a) Explain **one** difference between a dominant allele and a recessive allele.

(2)

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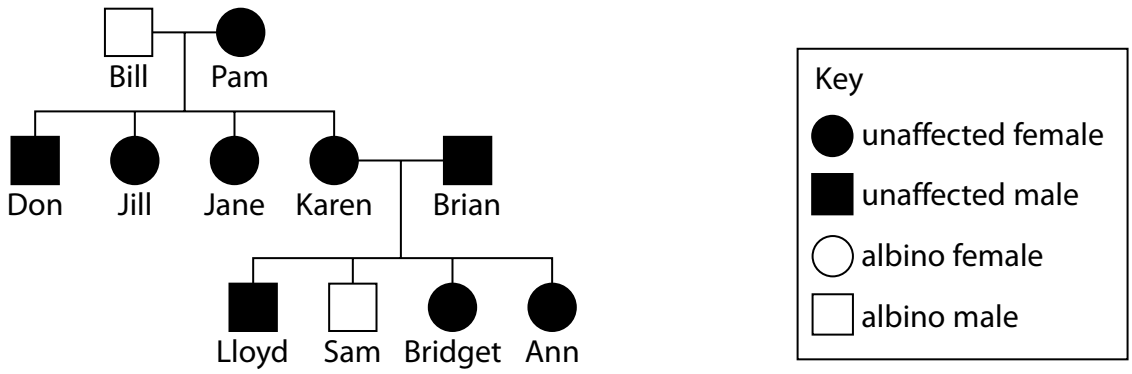
(b) Pedigree analysis can be used to find out if characteristics are controlled by dominant or recessive alleles.

The diagram below shows a family pedigree for albinism.



Explain, using information in the pedigree, whether albinism is controlled by a recessive allele or a dominant allele.

(3)

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(c) Sickle cell anaemia is a genetic condition that results in the formation of abnormal red blood cells.

Sickle cell anaemia is controlled by a gene with two alleles. The allele (N) produces normal red blood cells and the allele (n) produces abnormal red blood cells.

Two parents who are both heterozygous plan to have children.

Use a genetic diagram to show the parent genotypes, the gametes produced and all the possible genotypes and phenotypes of their offspring.

(3)

Parent genotypes

Gametes

Offspring genotypes

Offspring phenotypes

(d) Individuals who are heterozygous for sickle cell anaemia are protected from malaria.

Suggest how this would affect the number of individuals born with sickle cell anaemia in parts of the world where malaria is common.

(4)

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(Total for Question 9 = 12 marks)

10 Plants make sugars by the process of photosynthesis.

(a) (i) Which of the following factors is least likely to limit the rate of photosynthesis?

(1)

☐ **A** carbon dioxide concentration

☐ **B** light intensity

☐ **C** oxygen concentration

☐ **D** temperature

(ii) Which combination of factors is most likely to limit the rate of photosynthesis in the early morning?

(1)

☐ **A** carbon dioxide concentration and soil pH

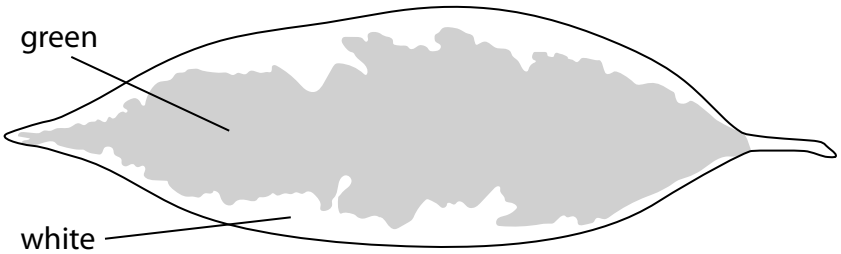
☐ **B** temperature and light intensity

☐ **C** water content of soil and soil pH

☐ **D** water content of soil and light intensity

(b) A student carries out an experiment to investigate the need for chlorophyll in photosynthesis.

He uses a variegated leaf as shown.



The green part of the leaf has cells that contain chlorophyll. The white part of the leaf has cells that do not contain chlorophyll.

(i) Describe the procedure used to test this leaf for starch.

(4)

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(ii) Draw a labelled diagram of the leaf to show its appearance after the student has completed the test for starch.

(2)

(c) Suggest a method the student could use to measure the area of the green part of the leaf.

(2)

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(Total for Question 10 = 10 marks)

11 The data in the table shows how the mean maximum lung volume changes with age for males and females.

Age / years	Mean maximum lung volume / dm^3	
	males	females
7	2.10	2.05
16	4.50	3.70
25	5.20	3.80
50	4.80	3.40
70	3.90	2.80

(a) (i) Plot a bar graph to show this data.

(5)

(ii) Calculate the increase in mean maximum lung volume for males between the ages of 7 and 25.

(1)

increase = ... dm^3

(iii) Explain why the mean maximum lung volume for males and females is similar at age 7 but is different at age 25.

(3)

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(b) The data shows the mean maximum lung volume at each age.

(i) Which of the following would improve the reliability of these mean values?

(1)

☐ **A** using a larger range of ages

☐ **B** measuring more people at each age

☐ **C** measuring lung volume in cm^3

☐ **D** measuring lung volumes in other mammals

(ii) Variation in maximum lung volume exists between males at each age.

Suggest **two** factors that could cause this variation.

(2)

1 .....

2 .....

(Total for Question 11 = 12 marks)

12 Selective breeding has been used by farmers to improve the quality of their animals.

(a) (i) Describe how selective breeding could be used to improve the volume of milk produced by cows.

(3)

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(ii) In recent years farmers have used artificial insemination to fertilise their cows.

In this technique many samples of semen are collected from one bull.

These samples can be used to fertilise cows.

Suggest the advantages of using artificial insemination in selective breeding.

(3)

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(b) Farmers use a variety of methods to improve the growth of their crops.

One method is the use of a glasshouse.

Describe how the use of a glasshouse improves the growth of crops.

(4)

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(Total for Question 12 = 10 marks)

TOTAL FOR PAPER = 110 MARKS

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Paper 1 (4BI1/1B and 4SD0/1B)

Question number	Answer	Mark
1(a)	A description that makes reference to the following three points: • *Lactobacillus* (1) • lactose (1) • lactate/lactic acid (1)	**3**

Question number	Answer	Mark
1(b)	An answer that makes reference to the following points: • fruit provides vitamin C to prevent scurvy (1) • roughage/fibre to help peristalsis (1)	**2**

Total for Question 1 = 5 marks

Question number	Answer	Mark
2(a)(i)	B	**1**

Question number	Answer	Mark
2(a)(ii)	C	**1**

Question number	Answer	Additional guidance	Mark
2(b)	Division • 25 000 ÷ 4 = 6250 days (1) Division • 6250 ÷ 365 = 17.1 years (1) Addition • 2017 + 17.1 years = 2034 (1)	award full marks for correct numerical answer without working	**3**

Question number	Answer	Mark
2(c)(i)	An explanation that makes reference to the following two points: • heart rate increases (1) • because adrenaline is released (1)	**2**

Question Number	Answer	Mark
2(c)(ii)	A description that makes reference to the following two points: • one area where rhino are monitored and one area where they are not/monitored and unmonitored rhinos in same area (1) • count/compare the number of deaths (1)	**2**

Total for Question 2 = 9 marks

Question number	Answer	Mark
3(a)(i)	An explanation that makes reference to the following five points: • training improves performance by increasing the number of capillaries (1) • better supply of oxygen/aerobic (1) • better supply of glucose (1) • respiration/energy/ATP (1) • muscle contraction (1) • better removal of lactic acid/carbon dioxide (1) • can run for longer/equivalent (1)	**5**

Question number	Answer	Mark
3(a)(ii)	An answer that makes reference to two of the following points: • use more people (1) • extend training period (1) • compare different ages/genders (1)	**2**

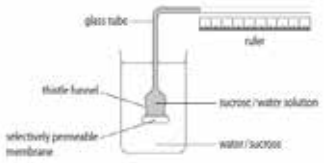
Question number	Answer	Additional guidance	Mark
3(b)(i)	Multiplication • 0.008 (1) Division • 25 ÷ 0.008 = 3125 = 3100 (1)	award full marks for correct numerical answer without working accept 3125 the final answer should reflect the precision of the least precise data (in this case two sig figs)	**2**

Question number	Answer	Additional guidance	Mark
3(b)(ii)	An explanation that makes reference to two of the following points: • wall contains muscle/elastic tissue (1) • blood is under high pressure from the left ventricle (1) • aorta needs to expand (1) • need to transport more blood (1)	allow converse	**2**

Total for Question 3 = 11 marks

Question number	Answer	Mark
4(a)(i)	D	**1**

Question number	Answer	Mark
4(a)(ii)	A	**1**

Question number	Answer	Additional guidance	Mark
4(b)	An answer that makes reference to the following four points: • beaker containing water/sucrose/thistle funnel containing sucrose/water (1) • selectively permeable membrane separating sucrose from water (1) • ruler by tube of thistle funnel (1) • level of liquid shown in the tube (1)		**4**

Question number	Answer	Additional guidance	Mark
4(c)	Identification • 42 (1) Division • 42 ÷ 60 = 0.70 (1)	award full marks for correct numerical answer without working	**2**

Total for Question 4 = 8 marks

Question number	Answer	Mark
5(a)(i)	Circle around dendrites/cell body and dendrites	**1**

Question number	Answer	Additional guidance	Mark
5(a)(ii)	Multiplication • 1.20 × 102 = 120 (1) Multiplication • 1.3 ÷ 120 = 0.0108/1.08 × 10^{-2} (1)	award full marks for correct numerical answer without working	**2**

Question number	Answer	Mark
5(a)(iii)	Mitochondria	**1**

Question number	Answer	Additional guidance	Mark
5(b)(i)	An answer that makes reference to the following points: • chromosome (1) • plasmid (1)	allow nucleoid	**2**

Question number	Answer	Mark
5(b)(ii)	Stage Q	**1**

Question number	Answer	Mark
5(b)(iii)	Stage R	**1**

Total for Question 5 = 8 marks

Question number	Answer	Mark
6(a)	An explanation that makes reference to the following two points: • attaches to haemoglobin (1) • therefore less oxygen transport (1)	**2**

Question number	Answer	Mark
6(b)	A	**1**

Question number	Answer	Mark
6(c)	An answer that makes reference to the following six points: • plus and minus sulphur dioxide (1) • same species of seed/equivalent (1) • more than one seed per treatment/equivalent (1) • number of seeds germinated/calculate percentage germination (1) • air tight container used (1) • same time period (1) • same water/same temperature/equivalent (1)	**6**

Total for Question 6 = 9 marks

Question number	Answer	Mark
7(a)	A description that makes reference to two of the following points: • softened by saliva/bolus (1) • muscle contraction in oesophagus (1) • peristalsis (1)	**2**

Question number	Answer	Mark
7(b)	An explanation that makes reference to four of the following points: • churning/equivalent (1) • digested/broken down (1) • protease/pepsin (1) • amino acids (1) • hydrochloric acid/low pH/optimum pH (1)	**4**

Question number	Answer	Mark
7(c)	An explanation that makes reference to four of the following points: • growth reduced (1) • lack of villi (1) • fewer capillaries/fewer lacteals/less surface area (1) • less absorption of named food molecule (1) • function of named food molecule linked to growth (1)	**4**

Total for Question 7 = 10 marks

Question number	Answer	Additional guidance	Mark
8	An evaluation that makes reference to the following points: • letrozole does improve male fertility (1) • sperm concentration increases/sperm motility increases (1) • letrozole increases testosterone levels/ decreases oestrogen levels (1) • letrozole causes side effects/equivalent (1) • need to know group size (1) • matched groups (1) • need to know other factors controlled (1)	e.g. age, diet, smoking, drugs	**6**

Total for Question 8 = 6 marks

Question number	Answer	Additional guidance	Mark
9(a)	An explanation that makes reference to two of the following points: • dominant allele always expressed (1) • dominant expressed in heterozygote (and homozygote)/recessive allele not expressed in heterozygote (1) • recessive allele only expressed in phenotype of homozygote/equivalent (1)	allow seen/visible	**2**

Question number	Answer	Mark
9(b)	An explanation that makes reference to three of the following points: • Karen and Brian unaffected (1) • they both are heterozygous/carriers/have a recessive allele (1) • Sam is albino (1) • Sam is aa/homozygous recessive (1)	**3**

Question number	Answer	Additional guidance	Mark
9(c)	A genetic diagram including: • parents Nn and Nn (1) • gametes N or n (1) • genotypes of offspring NN Nn Nn nn and phenotypes correctly assigned (1)	allow max 3 for transfer error allow all marks from Punnett square	**3**

Question number	Answer	Additional guidance	Mark
9(d)	An answer that makes reference to the following points: • Nn not affected/killed by malaria/survive (1) • reproduce (1) • so number of Nn individuals increase (1) • so number of nn individuals increases/frequency of (n) allele increases (1)	allow converse for NN	**4**

Total for Question 9 = 12 marks

Question number	Answer	Mark
10(a)(i)	C	**1**

Question number	Answer	Mark
10(a)(ii)	B	**1**

Question number	Answer	Mark
10(b)(i)	A description that makes reference to four of the following points: • place leaf in boiling water (1) • place leaf in boiling ethanol (1) • use water bath/safe heating/no naked flame (1) • place leaf in water (1) • place leaf in iodine solution (1) • blue/black indicates starch; orange/yellow indicates no starch (1)	**4**

Question number	Answer	Additional guidance	Mark
10(b)(ii)	A drawing showing the following: • white part labelled orange/yellow/no starch (1) • green part labelled blue/black/starch (1)	allow approximate shape	**2**

Question number	Answer	Mark
10(c)	A method that includes two of the following points: • trace around the leaf/use transparent paper/equivalent (1) • trace around the green part (1) • put onto squared paper (1) • count the number of squares (1) • reference to both sides of leaf being measured (1)	**2**

Total for Question 10 = 10 marks

Question number	Answer	Mark
11(a)(i)	A graph showing: • y-axis scale half grid and linear (1) • bars drawn with lines (1) • x-axis labelled age and y-axis labelled mean maximum, and x-axis units as years and y-axis units as dm^3 (1) • bars plotted correctly (1) • key males/females (1)	**5**

Question number	Answer	Mark
11(a)(ii)	Subtraction 5.2 − 2.1 = 3.1 (1)	**1**

Question number	Answer	Mark
11(a)(iii)	An explanation that makes reference to three of the following points: • mean maximum lung volume for males is greater than females for 16 and 25 (1) • males grow more than females (1) • greater difference from puberty/equivalent (1) • males continue to grow from 16 to 25 (1)	**3**

Question number	Answer	Mark
11(b)(i)	B	**1**

Question number	Answer	Mark
11(b)(ii)	An explanation that makes reference to two of the following points: • different body mass/size (1) • taking more exercise/equivalent (1) • smoking (1) • asthma/lung disease/equivalent (1) • genetics/inheritance (1)	**2**

Total for Question 11 = 12 marks

Question number	Answer	Mark
12(a)(i)	A description that makes reference to three of the following points: • use information about milk yield of daughters/mothers (1) • to select bulls as male parents (1) • mate with cows with high milk yield (1) • repeat over generations (1)	**3**

Question number	Answer	Mark
12(a)(ii)	An answer that makes reference to three of the following points: • cheaper/quicker to transport sperm than live bulls (1) • can use semen to mate with many cows (1) • can store semen after bull has died (1) • safer (for cows) (1)	**3**

Question number	Answer	Additional guidance	Mark
12(b)	A description that makes reference to four of the following points: • control light intensity/use artificial lighting (1) • use heaters to increase temperature (1) • provide additional carbon dioxide (1) • provide additional minerals (1) • control water supply (1) • reduce damage by pests/use biological control (1)	ignore nutrients	**4**

Total for Question 12 = 10 marks

TOTAL FOR PAPER = 110 MARKS

Write your name here

Surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International GCSE (9 - 1)

Chemistry

Paper 1

Sample Assessment Materials for first teaching September 2017

Time: 2 hours

Paper Reference
4CH1/1C
4SD0/1C

You must have:
Calculator, 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.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Calculators may be used.
- Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Information

- The total mark for this paper is 110.
- 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

S52915A

S 5 2 9 1 5 A 0 1 3 2

PEARSON

The Periodic Table of the Elements

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

**** The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

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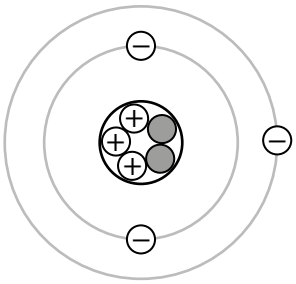
Answer ALL questions. Write your answers in the spaces provided.

1 The diagram shows the structure of an atom.



(a) Name the central part of an atom.

(1)

.....

(b) Name the positively charged particles in an atom.

(1)

.....

(c) State how the diagram shows that this atom is neutral.

(1)

.....

.....

(d) Give the mass number of this atom.

(1)

.....

(e) Give the name of the element containing this atom.
Use the Periodic Table to help you.

(1)

.....

(Total for Question 1 = 5 marks)

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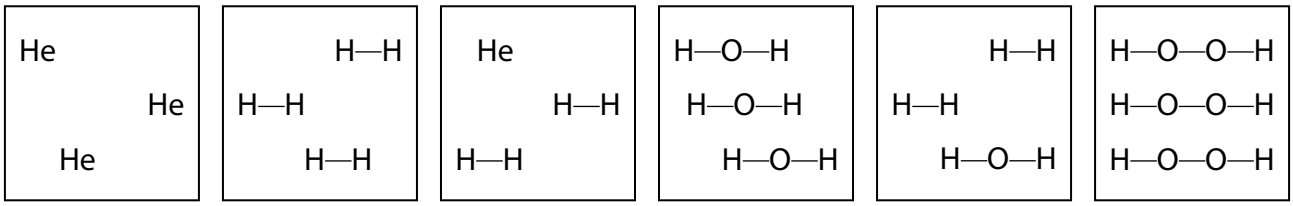
2 Substances can be classified as elements, compounds or mixtures.

(a) Each of the boxes in the diagram represents either an element, a compound or a mixture.



box 1 box 2 box 3 box 4 box 5 box 6

(i) Explain which **two** boxes represent an element.

(2)

.....

.....

.....

.....

(ii) Explain which **two** boxes represent a mixture.

(2)

.....

.....

.....

.....

(b) The list gives the names of some methods used in the separation of mixtures:

- chromatography
- crystallisation
- distillation
- filtration

Use names from the list to choose a suitable method for each separation.

Each name may be used once, more than once or not at all.

(i) Separating water from sodium chloride solution.

(1)

.....

(ii) Separating the blue dye from a mixture of blue and red dyes.

(1)

.....

(iii) Separating potassium nitrate from potassium nitrate solution.

(1)

.....

(Total for Question 2 = 7 marks)

3 Ammonium chloride decomposes in a reversible reaction. The equation for this reaction is

$$NH_4Cl(s) \rightleftharpoons NH_3(g) + HCl(g)$$

(a) State how the equation shows that the reaction is reversible.

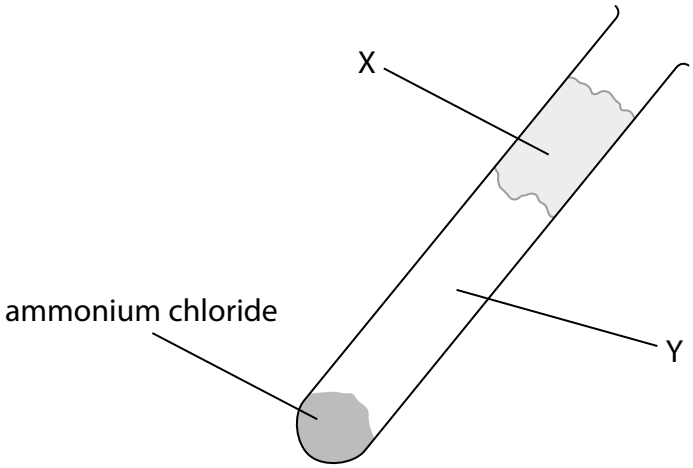
(1)

.....

.....

(b) Some ammonium chloride is heated gently in a test tube.

The diagram shows the test tube after it has been heated gently for a short time.



(i) Identify solid **X** and the two gases formed in region **Y** of the test tube.

(2)

Solid **X** .....

Gases in region **Y** .....

.....

(ii) Which change of state occurs in the test tube during heating?

(1)

☐ **A** condensing

☐ **B** evaporating

☐ **C** melting

☐ **D** subliming

(c) An experiment involving ammonium chloride can be used to show the process of diffusion.

The diagram shows the apparatus at the start of the experiment.

At the end of the experiment, a white solid forms in the test tube.

Explain which position, **A**, **B** or **C**, shows where the white solid forms.

(3)

.....

.....

.....

.....

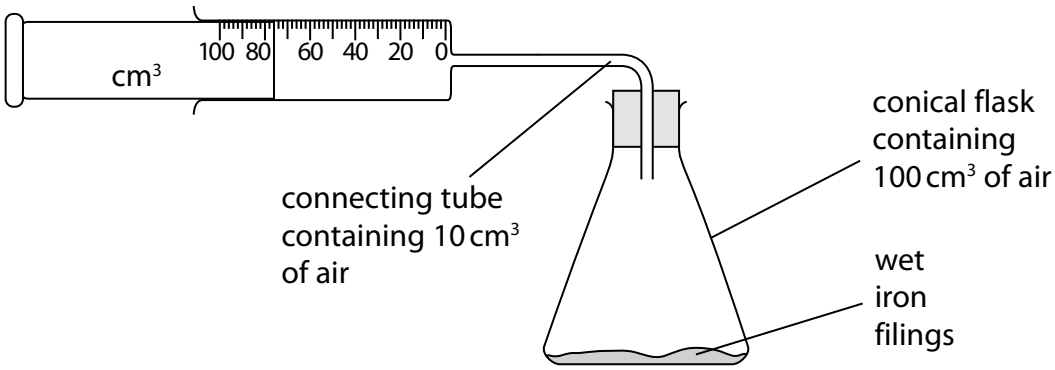
.....

.....

(Total for Question 3 = 7 marks)

4 The percentage by volume of oxygen in air can be found by using the rusting of iron.

A student sets up this apparatus to measure the volume of oxygen in a sample of air.

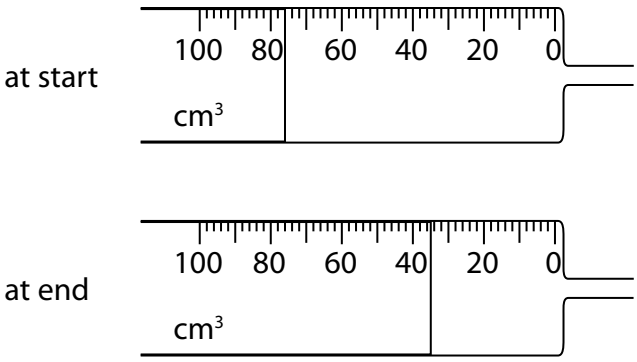


An excess of wet iron filings is used.

At the start of each experiment, the reading on the syringe is recorded and the apparatus is then left for a week so that the reaction is complete.

The reading on the syringe is then recorded again.

(a) The diagram shows the readings in one experiment.



Complete the table to show:

- the syringe reading at the end of this experiment
- the volume of oxygen used in the experiment.

(2)

syringe reading at start / cm^3	76
syringe reading at end / cm^3	
volume of oxygen used / cm^3	

(b) The table shows the results recorded by a different student in her experiment.

volume of air in conical flask / cm^3	100
volume of air in connecting tube / cm^3	10
original volume of air in syringe / cm^3	80
final volume of air in syringe / cm^3	43

Calculate the percentage of oxygen in air using these results.

(3)

percentage of oxygen = ... %

(c) The table shows some possible causes of anomalous results in this experiment.

Use terms from the box to complete the table, showing possible causes and their effects on the volume of oxygen used in this experiment.

decreased	increased	no effect

Each term may be used once, more than once, or not at all.

(3)

Possible cause	Effect on volume of oxygen used
wet iron filings not in excess	
apparatus left for 1 hour instead of 1 week	
apparatus left in a warmer place for 1 week	

(Total for Question 4 = 8 marks)

5 A metal is added to copper(II) sulfate solution.

A displacement reaction only occurs if the metal added is more reactive than copper.

metal + copper(II) sulfate → metal sulfate + copper

Displacement reactions are exothermic. The more reactive the metal added, the greater the temperature rise.

A student uses the following method in an experiment to compare the reactivities of different metals:

- pour some copper(II) sulfate solution into a boiling tube and record its temperature using a thermometer
- add some metal to the tube and stir with the thermometer
- record the maximum temperature of the contents of the tube.

He repeats the method using the same amount, in moles, of different metals.

(a) To make the experiment valid, he starts with the copper(II) sulfate solution and the added metal at the same temperature.

State **two** other variables that must be controlled if the experiment is to be valid.

(2)

1 .....

.....

2 .....

.....

(b) Another student uses the same method three times for each of the metals **E**, **F**, **G** and **H**. The table shows her results for these metals.

Metal	Temperature increase / °C			Mean temperature increase / °C
	1	2	3	
E	7.0	4.0	8.0	7.5
F	0.0	0.0	0.0	0.0
G	6.0	5.0	5.4	
H	5.5	11.0	12.0	

(i) The student calculates the mean temperature increase for metals **E** and **F**. She does not include anomalous values in her calculations.

Calculate the mean temperature increase for metals **G** and **H**, ignoring any anomalous values. Write your answers in the table.

(2)

(ii) Explain which metal is the most reactive.

(2)

.....

.....

(iii) Explain which metal is less reactive than copper.

(2)

.....

.....

(Total for Question 5 = 8 marks)

6 This question is about the elements in Group 1 of the Periodic Table and their reactions with water.

(a) State why sodium and potassium are in Group 1 of the Periodic Table.

(1)

.....

.....

(b) A reaction occurs when a small piece of sodium is added to a large volume of water in a trough.

(i) Give **two** observations that you would make during this reaction.

(2)

1 .....

.....

2 .....

.....

(ii) After the reaction has finished, a few drops of universal indicator are added to the solution in the trough.

Explain the final colour of the universal indicator.

(2)

.....

.....

.....

(iii) What is the most likely pH value of the solution in the trough after the reaction is complete?

(1)

☐ **A** 2

☐ **B** 5

☐ **C** 8

☐ **D** 12

(c) Give the name of a Group 1 metal that is less reactive than sodium.

(1)

.....

(d) A small piece of potassium is added to a large volume of water in a trough.

Give **one** observation that is made when potassium is added to water that is **not** made when sodium is added to water.

(1)

.....

.....

(e) Complete the equation for the reaction of rubidium with water.
State symbols are not required.

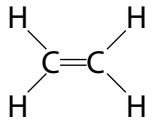
(1)

.....Rb + ...H_2O → .....RbOH + ...H_2

(Total for Question 6 = 9 marks)

7 This question is about hydrocarbons.

(a) The table shows the formulae of some hydrocarbons.

A CH_4	**B** 	**C** $CH_3—CH_2—CH_3$
D $CH_3—CH(CH_3)—CH_3$	**E** $CH_3CH{=}CH_2$	**F** $CH_3CH_2CH_2CH_3$

(i) Give the letters that represent hydrocarbons with the general formula C_nH_{2n}

(1)

.....

.....

(ii) State why **B** is the only hydrocarbon shown as a displayed formula.

(1)

.....

(iii) Explain which **two** letters represent isomers.

(3)

.....

.....

.....

.....

(iv) How many of the hydrocarbons are members of the homologous series of alkanes?

(1)

.....

(b) Many hydrocarbons are used as fuels. There are problems associated with this use.

(i) Explain how the combustion of a hydrocarbon can lead to the formation of a poisonous gas.

(2)

.....

.....

.....

.....

(ii) State why this gas is poisonous to humans.

(1)

.....

.....

(c) Fuels used in cars often have sulfur compounds removed.

Explain how the combustion of these fuels in car engines still leads to the formation of acid rain.

(4)

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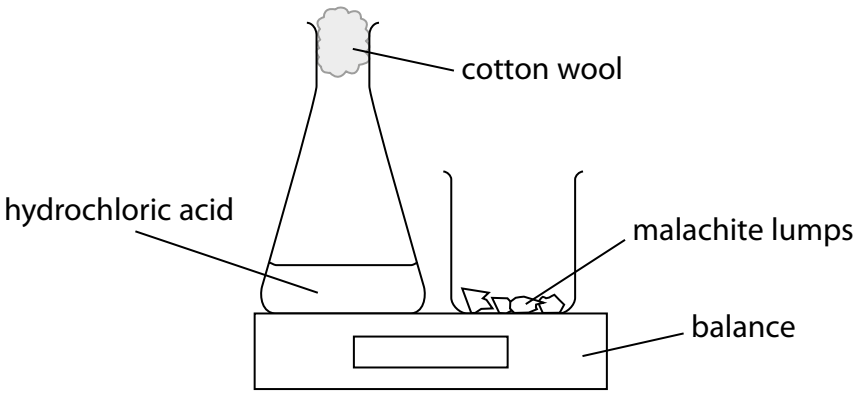
(Total for Question 7 = 13 marks)

8 The copper(II) carbonate in the mineral, malachite, reacts with hydrochloric acid according to this equation.

$$CuCO_3(s) + 2HCl(aq) \rightarrow CuCl_2(aq) + H_2O(g) + CO_2(g)$$

Some students investigate the effect of changing the concentration of acid on the rate of this reaction. The diagram shows the apparatus they use.



This is the method they use:

- set the balance to zero
- add an excess of malachite lumps to the conical flask and replace the cotton wool
- start a timer and record the balance reading after one minute.

The experiment is repeated using different concentrations of hydrochloric acid. The mass and number of malachite lumps are kept the same in each experiment.

(a) The table shows the results obtained in one series of experiments.

concentration of hydrochloric acid / mol/dm^3	0.6	0.8	1.0	1.6	1.8	2.0
balance reading / g	–0.20	–0.27	–0.44	–0.54	–0.60	–0.67

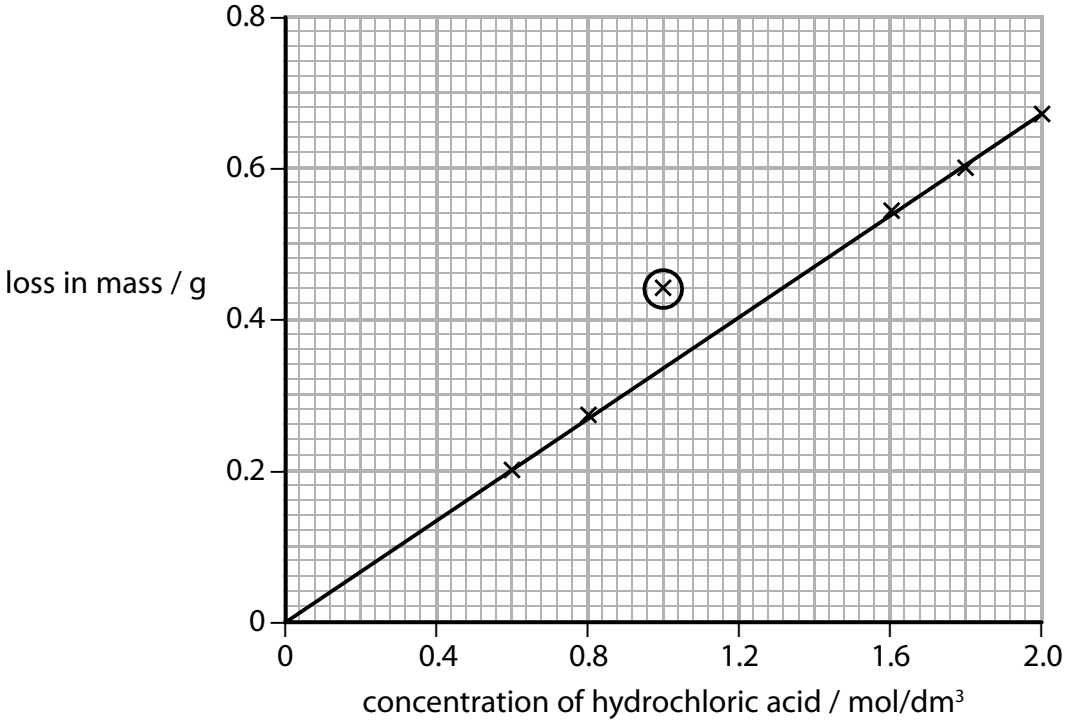
State why the balance readings have negative values.

(1)

.....

.....

(b) The graph shows the results of this series of experiments.



The circled point indicates an anomalous result.

(i) Suggest **one** mistake the students could have made to produce this result.

(1)

.....

(ii) State the relationship shown by the graph.

(1)

.....

.....

(c) Explain why an increase in the concentration of the acid causes an increase in the rate of the reaction. You should use the particle collision theory in your answer.

(2)

.....

.....

.....

.....

(Total for Question 8 = 5 marks)

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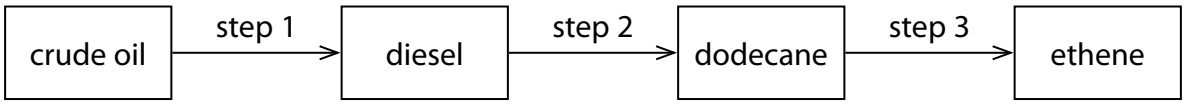
9 The flow chart shows how ethene can be obtained industrially from crude oil.



(a) Step 1 involves the use of a tall column.

Describe how the diesel fraction is obtained from the crude oil in step 1.

(5)

.....

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.....

(b) In step 2, saturated compounds such as dodecane are obtained from the mixture of hydrocarbons in the diesel fraction.

Explain why dodecane is described as a **saturated hydrocarbon**.

(3)

.....

.....

.....

.....

.....

.....

(c) Which of these formulae is that of an alkane?

(1)

☒ **A** C_7H_{12}

☒ **B** C_9H_{18}

☒ **C** $C_{11}H_{24}$

☒ **D** $C_{13}H_{30}$

(d) In step 3, cracking is used to convert alkanes into alkenes.

Complete the equation to show the reaction in which one molecule of dodecane is converted into two molecules of ethene and one molecule of another hydrocarbon.

(1)

$$C_{12}H_{26} \rightarrow 2C_2H_4 + \text{.....}$$

(e) Alkanes and alkenes both react with halogens, but in different ways.
The equations for two examples of these different reactions are shown.

equation 1 $C_2H_6 + Cl_2 \rightarrow C_2H_5Cl$ + compound X

equation 2 $C_2H_4 + Br_2 \rightarrow C_2H_4Br_2$

(i) State the condition needed for the reaction in equation 1 to occur.

(1)

.....

(ii) Deduce the formula of compound X.

(1)

.....

(iii) Draw a dot-and-cross diagram to represent a molecule of C_2H_5Cl

Show only the outer electrons of each atom.

(2)

(iv) Equation 2 shows an example of an addition reaction.

State the type of reaction shown by equation 1.

(1)

.....

(f) Alkenes can be distinguished from alkanes using bromine water.

(i) What colour change occurs in the reaction between propene and bromine water?

(1)

☐ **A** colourless to orange

☐ **B** colourless to green

☐ **C** green to colourless

☐ **D** orange to colourless

(ii) A compound formed in the reaction between propene and bromine water has the percentage composition by mass

C = 25.9%, H = 5.0%, Br = 57.6% and O = 11.5%

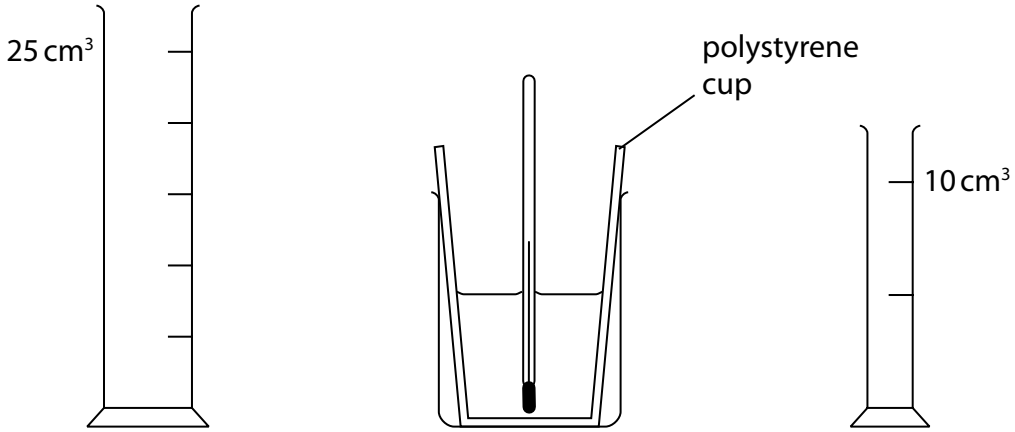
Calculate the empirical formula of this compound.

(3)

empirical formula = ...

(Total for Question 9 = 19 marks)

10 When aqueous solutions of potassium hydroxide and nitric acid are mixed together, an exothermic reaction occurs. The diagram shows the apparatus used in an experiment to measure the temperature increase.



This is the student's method;

- use the larger measuring cylinder to add 25 cm^3 of aqueous potassium hydroxide to the polystyrene cup
- record the steady temperature
- use the smaller measuring cylinder to add 5 cm^3 of dilute nitric acid to the cup, stir the mixture with the thermometer
- record the highest temperature of the mixture
- continue adding further 5 cm^3 portions of dilute nitric acid to the cup, stirring and recording the temperature, until a total volume of 35 cm^3 has been added.

(a) A teacher advises the student to use a 50 cm^3 burette instead of the 10 cm^3 measuring cylinder.

Suggest **two** reasons why it would be better to use a burette instead of a measuring cylinder to add the acid in this experiment.

(2)

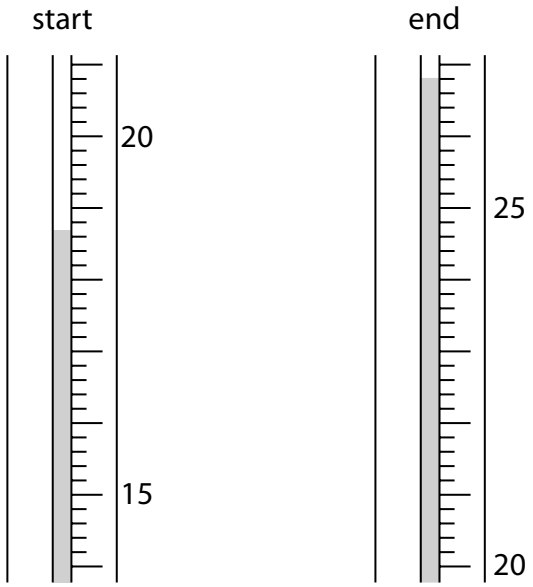
1 .....

.....

2 .....

.....

(b) The diagram shows the thermometer readings at the start and at the end of one experiment.



Complete the table to show:

- the thermometer reading at the start of the experiment
- the temperature rise in the experiment.

(2)

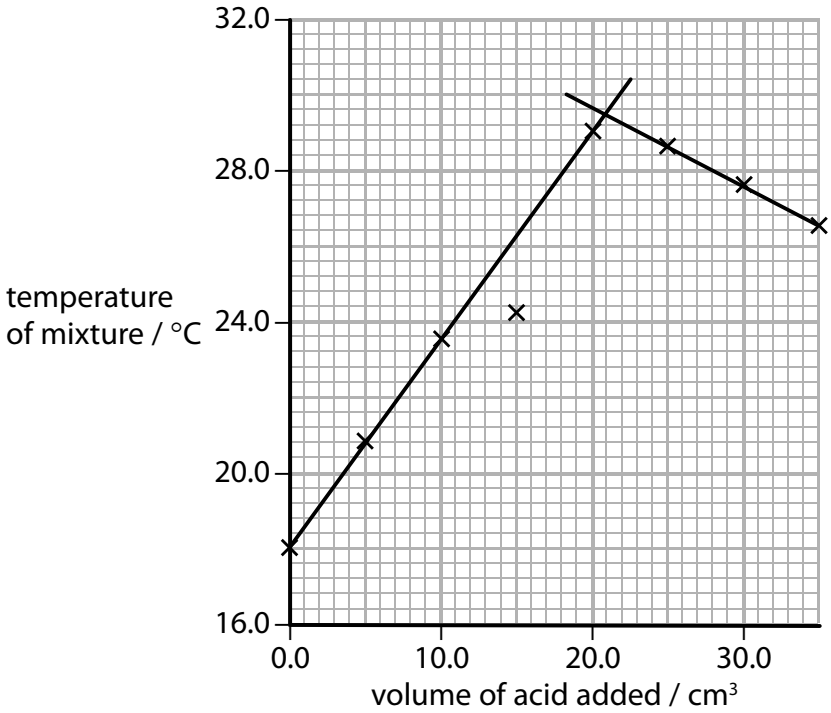
thermometer reading at end / °C	26.8
thermometer reading at start / °C	
thermometer rise / °C	

(c) Another student uses the same method, adding the dilute nitric acid from a burette.

The table shows his results.

volume of acid added / cm^3	0.0	5.0	10.0	15.0	20.0	25.0	30.0	35.0
temperature of mixture / °C	18.0	20.8	23.5	24.2	29.0	28.6	27.6	26.5

This is the student's graph.



The point where the lines cross represents complete neutralisation.

(i) Identify the maximum temperature reached during the experiment.

(1)

maximum temperature = ... °C

(ii) Identify the volume of dilute nitric acid that exactly neutralises the 25 cm^3 of aqueous potassium hydroxide.

(1)

volume = ... cm^3

(d) Another student records these results.

volume of aqueous potassium hydroxide	= 20.0 cm^3
starting temperature of aqueous potassium hydroxide	= 18.5 °C
maximum temperature of mixture	= 30.0 °C
volume of dilute nitric acid	= 20.0 cm^3

Calculate the heat energy released in this experiment.

c = 4.2 J/g / °C

mass of 1 cm^3 of mixture = 1 g

(4)

heat energy = ... J

(e) In another experiment, the heat energy released is 1600 J when 0.040 mol of potassium hydroxide is neutralised.

Calculate the value of ΔH, in kJ/mol, for the neutralisation of potassium hydroxide.

(2)

ΔH = ... kJ/mol

(Total for Question 10 = 12 marks)

11 Many different salts can be prepared from acids.

(a) The table shows the reactants used in two salt preparations.

Complete the table to show the name of the salt formed and the other product(s) in each case.

(4)

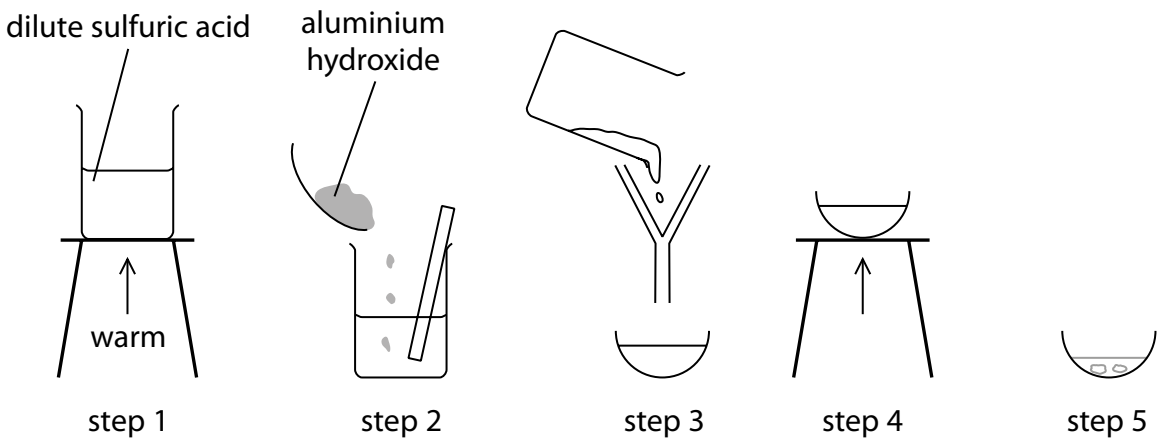
Reactants	Name of salt formed	Other product(s)
zinc + hydrochloric acid		
calcium carbonate + nitric acid		

(b) A student uses the reaction between aluminium hydroxide and dilute sulfuric acid to prepare a pure, dry sample of aluminium sulfate crystals.

The equation for the reaction used to prepare this salt is

$$2Al(OH)_3 + 3H_2SO_4 \rightarrow Al_2(SO_4)_3 + 6H_2O$$

The diagram shows the steps in the student's method.



(i) State **two** ways to make sure that all the acid is reacted in step 2.

(2)

1 .....

.....

2 .....

.....

(ii) State the purpose of filtration in step 3.

(1)

.....

.....

(iii) In step 5, the basin is left to cool to room temperature to allow crystals of aluminium sulfate to form.

State **one** method of drying these crystals.

(1)

.....

.....

(c) The student records this information about the reagents she uses in her preparation.

mass of aluminium hydroxide = 3.9 g

amount of sulfuric acid = 0.090 mol

Determine which reagent is in excess, making use of this information and the equation in part (b).

(3)

reagent used in excess = ...

(d) Another student prepares 0.25 mol of aluminium sulfate. The formula of aluminium sulfate is $Al_2(SO_4)_3$

Calculate the mass of aluminium sulfate prepared.

(3)

mass = ... g

(e) The equation for another reaction used to prepare a sample of a salt is

$$PbO + 2HNO_3 \rightarrow Pb(NO_3)_2 + H_2O$$

In one experiment, the amount of lead(II) oxide used was 0.75 mol and the amount of nitric acid used was 1.5 mol. At the end of the experiment, the mass of lead(II) nitrate obtained was 209 g.

Calculate the percentage yield of lead(II) nitrate in this experiment.

[M_r of lead(II) nitrate = 331]

(3)

percentage yield = ... %

(Total for Question 11 = 17 marks)

TOTAL FOR PAPER = 110 MARKS

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Paper 1 (4CH1/1C and 4SD0/1C)

Question number	Answer	Mark
1(a)	Nucleus	**1**

Question number	Answer	Mark
1(b)	Proton	**1**

Question number	Answer	Additional guidance	Mark
1(c)	Equal numbers of protons and electrons	accept equal numbers of positive and negative particles/charges	**1**

Question number	Answer	Mark
1(d)	5	**1**

Question number	Answer	Mark
1(e)	Lithium	**1**

Total for Question 1 = 5 marks

Question number	Answer	Additional guidance	Mark
2(a)(i)	An explanation that makes reference to the following two points: • boxes 1 and 2 (1) • because they both have only one type of atom/molecule (1)	accept other indications, e.g. only He and only H-H accept species in place of atom/molecule second mark can be awarded if only box 1 or box 2 identified	**2**

Question number	Answer	Additional guidance	Mark
2(a)(ii)	An explanation that makes reference to the following two points: • boxes 3 and 5 (1) • because they both have two different molecules (1)	second mark can be awarded if only box 3 or box 5 identified	**2**

Question number	Answer	Mark
2(b)(i)	Simple distillation	**1**

Question number	Answer	Mark
2(b)(ii)	Chromatography	**1**

Question number	Answer	Mark
2(b)(iii)	Crystallisation	**1**

Total for Question 2 = 7 marks

Question number	Answer	Mark
3(a)	Reversible arrow	1

Question number	Answer	Additional guidance	Mark
3(b)(i)	• (X) ammonium chloride (1) • (Y) ammonia and hydrogen chloride (1)	accept formulae	2

Question number	Answer	Mark
3(b)(ii)	D (subliming)	1

Question number	Answer	Additional guidance	Mark
3(c)	An explanation that makes reference to the following three points: • C (1) • because ammonia molecules have lower mass or smaller M_r (hence travel faster) (1) • and so travel further in the same time (1)	accept reverse arguments for hydrogen chloride	3

Total for Question 3 = 7 marks

Question number	Answer	Additional guidance	Mark
4(a)	• 35 (1) • 41 (1)	final answer consequential on syringe readings	**2**

Question number	Answer	Additional guidance	Mark
4(b)	• Calculation of volume of oxygen used • Calculation of original volume of air • Calculation of percentage Example calculation: 80 − 43 = 37 (cm^3) (1) 100 + 10 + 80 = 190 (cm^3) (1) (37 × 100) ÷ 190 (= 19.47%) = 19% (1)	accept 19.47% or 19.5%	**3**

question number	answer	mark
4(c)	• Decreased (1) • Decreased (1) • No effect (1)	**3**

Total for Question 4 = 8 marks

Question number	Answer	Mark
5(a)	Any two of: • concentration of copper(II) sulfate solution (1) • volume of copper(II) sulfate solution (1) • particle size of metal (1)	**2**

Question number	Answer	Additional guidance	Mark
5(b)(i)	• (G) 5.5 (°C) (1) • (H) 11.5 (°C) (1)	accept 5.47	**2**

Question number	Answer	Mark
5(b)(ii)	An explanation that makes reference to the following two points: • H (1) • because of the biggest temperature increase (1)	**2**

Question number	Answer	Additional guidance	Mark
5(b)(iii)	An explanation that makes reference to the following two points: • F (1) • because there is no temperature increase (1)	accept there is no reaction	**2**

Total for Question 5 = 8 marks

Question number	Answer	Additional guidance	Mark
6(a)	The atoms of both elements have one electron in the outer shell	accept highest energy level in place of outer shell	**1**

Question number	Answer	Additional guidance	Mark
6(b)(i)	A description that makes reference to any two of the following points: • sodium floats/moves across the water (1) • sodium melts (1) • sodium disappears/gets smaller (1) • effervescence/fizzing/bubbles/gas given off (1) • white trail (1)	accept forms a ball accept sodium dissolves ignore name of gas	**2**

Question number	Answer	Additional guidance	Mark
6(b)(ii)	An explanation that makes reference to the following points: • (final colour is) purple/blue (1) • because the solution is alkaline (1)	accept sodium hydroxide forms/ solution has high pH	**2**

Question number	Answer	Mark
6(b)(iii)	D (12)	**1**

Question number	Answer	Mark
6(c)	Lithium	**1**

Question number	Answer	Additional guidance	Mark
6(d)	Potassium catches fire	accept lilac/purple/violet flame	**1**

Question number	Answer	Additional guidance	Mark
6(e)	**2**Rb + **2**H_2O → **2**RbOH + H_2 (1)	accept multiples and fractions	**1**

Total for Question 6 = 9 marks

Question number	Answer	Mark
7(a)(i)	B and E	1

Question number	Answer	Mark
7(a)(ii)	(the only one that shows) All atoms and all bonds	1

Question number	Answer	Mark
7(a)(iii)	• D and F (1) • they have the same molecular formula/the same number of each type of atom (1) • but different structures/atoms joined together in different ways/different structural formulae (1)	3

Question number	Answer	Mark
7(a)(iv)	4	1

Question number	Answer	Mark
7(b)(i)	An explanation that makes reference to the following points: • incomplete combustion/lack of oxygen (1) • leads to the formation of carbon monoxide (1)	2

Question number	Answer	Mark
7(b)(ii)	It reduces the capacity of blood to transport oxygen	1

Question number	Answer	Additional guidance	Mark
7(c)	An explanation that makes reference to the following points: • nitrogen in the air and oxygen react (1) • at high temperatures (1) • which causes the formation of nitrogen oxide(s) (1) • oxides then react with water (vapour) in the atmosphere to form nitric acid (1)	accept equation and formulae such as $NO/NO_2/NO_x$ accept nitrous acid and formulae	4

Total for Question 7 = 13 marks

Question number	Answer	Mark
8(a)	One reaction product is a gas and so escapes from the flask	**1**

Question number	Answer	Mark
8(b)(i)	Any one of: • balance reading recorded too late • acid concentration greater than recorded	**1**

Question number	Answer	Mark
8(b)(ii)	Loss in mass directly proportional to acid concentration	**1**

Question number	Answer	Additional guidance	Mark
8(c)	An explanation that makes reference to the following two points: • more particles in the same volume (1) • so collide more frequently (with malachite) (1)	accept particles closer together	**2**

Total for Question 8 = 5 marks

Question number	Answer	Mark
9(a)	A description that makes reference to five of the following points: • crude oil is heated/vaporised (1) • the vapour enters the lower part of the column (1) • there is a temperature gradient up the column (1) • the vapour in the diesel fraction rises up the column until it condenses (1) • at a height where its boiling point is lower than the temperature in the column (1) • so the diesel fraction is removed (1)	**5**

Question number	Answer	Additional guidance	Mark
9(b)	An explanation that makes reference to the following three points: • dodecane contains hydrogen and carbon (1) • only/and no other elements (1) • and contains only single bonds (1)	accept does not contain double bonds/multiple bonds	**3**

Question number	Answer	Mark
9(c)	C	**1**

Question number	Answer	Mark
9(d)	C_8H_{18}	**1**

Question number	Answer	Additional guidance	Mark
9(e)(i)	Ultraviolet radiation	accept ultraviolet light	**1**

Question number	Answer	Mark
9(e)(ii)	HCl	**1**

Question number	Answer	Additional guidance	Mark
9(e)(iii)	• All 6 atoms with a dot and cross representing each bonding pair of electrons (1) • 3 lone pairs of electrons on Cl and none on any of the H atoms (1)	accept 2 dots or 2 crosses for each bond accept any combination of dots and crosses	**2**

Question number	Answer	Mark
9(e)(iv)	Substitution	**1**

Question number	Answer	Mark
9(f)(i)	D	**1**

Question number	Answer	Mark
9(f)(ii)	• Dividing percentages by atomic masses (1) • Dividing results by smallest value OR obtaining ratio (1) • Writing empirical formula (1) Example calculation: C: 25.9 / 12 = 2.16 → 3 H: 5.0 / 1 = 5.0 → 7 Br: 57.6 / 80 = 0.72 → 1 O: 11.5 / 16 = 0.72 → 1 C_3H_7BrO accept symbols in any order	**3**

Total for Question 9 = 19 marks

Question number	Answer	Mark
10(a)	• Increment in volume smaller/more precise (1) • Avoids refilling the measuring cylinder (1)	**2**

Question number	Answer	Additional guidance	Mark
10(b)	thermometer reading at end/°C: (26.8) thermometer reading at start/°C: 18.7 temperature rise/°C: 8.1	1 mark for temperature at start 1 mark for temperature rise consequential on readings	**2**

Question number	Answer	Mark
10(c)(i)	29.5	**1**

Question number	Answer	Mark
10(c)(ii)	20.8	**1**

Question number	Answer	Mark
10(d)	• Calculation of volume/mass of mixture • Calculation of temperature increase • Substitution of values into $q=mc\Delta T$ • Calculation of heat energy released with unit Example calculation: 20.0 + 20.0 = 40.0 (cm^3) (1) 30.0–18.5 = 11.5 (°C) (1) q = 40.0 × 4.2 × 11.5 (1) q = 1900 J (1) (accept 1932 J)	**4**

Question number	Answer	Mark
10(e)	• Setting out of ΔH calculation • Division by 1000 to obtain answer in kJ/mol Example calculation: 1600 ÷ 0.040 (1) = −40 (kJ/mol) (1)	**2**

Total for Question 10 = 12 marks

Question number	Answer	Mark
11(a)	1 mark for each box completed correctly Reactants: (zinc + hydrochloric acid); Name of salt formed: zinc chloride; Other product(s): hydrogen Reactants: (calcium carbonate + nitric acid); Name of salt formed: calcium nitrate; Other product(s): water + carbon dioxide	**4**

Question number	Answer	Mark
11(b)(i)	• Use excess aluminium hydroxide (1) • Stir (thoroughly) (1)	**2**

Question number	Answer	Mark
11(b)(ii)	To remove unreacted aluminium hydroxide/solid	**1**

Question number	Answer	Mark
11(b)(iii)	Any one of: • leave in a warm place (1) • use filter paper or paper towel (1)	**1**

Question number	Answer	Mark
11(c)	• Calculation of M_r of aluminium hydroxide • Calculation of amount of aluminium hydroxide • Reference to 2 : 3 ratio in equation AND statement that sulfuric acid is in excess Example calculation: 27 + (3 × 17) = 78 (1) 3.9 ÷ 78 = 0.05 mol (1) This is more than 3/2 times amount of aluminium hydroxide, so sulfuric acid is in excess (1) (accept other valid methods of calculation)	**3**

Question number	Answer	Mark
11(d)	Calculation of M_r of aluminium sulfate setting out calculation of mass final answer Example calculation: (27 × 2) + (32 × 3) + (16 × 12) = 342 (1) mass = 342 x 0.25 (1) 85.5 g (1)	**3**

Question number	Answer	Additional guidance	Mark
11(e)	• Calculation of amount of lead(II) nitrate • Percentage method • Percentage answer Example calculation: 209 ÷ 331 = 0.631 mol (1) $\frac{0.631 \times 100}{0.75}$ (1) = 84% (1)	allow full credit for calculations using masses	**3**

Total for Question 11 = 17 marks

TOTAL FOR PAPER = 110 MARKS

Write your name here

Surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International GCSE (9 - 1)

Physics

Paper 1

Sample Assessment Material for first teaching September 2017

Time: 2 hours

Paper Reference
4PH1/1P
4SD0/1P

You must have:
Calculator, 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.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Calculators may be used.
- Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Information

- The total mark for this paper is 110.
- 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

S52917A

S 5 2 9 1 7 A 0 1 2 8

PEARSON

EQUATIONS

You may find the following equations useful.

energy transferred = current × voltage × time $\qquad E = I \times V \times t$

$$\text{frequency} = \frac{1}{\text{time period}} \qquad f = \frac{1}{T}$$

$$\text{power} = \frac{\text{work done}}{\text{time taken}} \qquad P = \frac{W}{t}$$

$$\text{power} = \frac{\text{energy transferred}}{\text{time taken}} \qquad P = \frac{W}{t}$$

$$\text{orbital speed} = \frac{2\pi \times \text{orbital radius}}{\text{time period}} \qquad V = \frac{2 \times \pi \times r}{T}$$

$$(\text{final speed})^2 = (\text{initial speed})^2 + (2 \times \text{acceleration} \times \text{distance moved}) \qquad v^2 = u^2 + (2 \times a \times s)$$

pressure × volume = constant $\qquad p_1 \times V_1 = p_2 \times V_2$

$$\frac{\text{pressure}}{\text{temperature}} = \text{constant} \qquad \frac{p_1}{T_1} = \frac{p_2}{T_2}$$

Where necessary, assume the acceleration of free fall, g = 10 m/s^2.

Answer ALL questions. Write your answers in the spaces provided.

1 (a) Which of these objects orbits a planet?

(1)

☒ **A** comet

☒ **B** dwarf star

☒ **C** galaxy

☒ **D** moon

(b) What is the correct name for our galaxy?

(1)

☒ **A** Crab Nebula

☒ **B** Milky Way

☒ **C** Solar System

☒ **D** Universe

(c) Which of these objects has the largest mass?

(1)

☒ **A** artificial satellite

☒ **B** comet

☒ **C** Earth

☒ **D** Sun

(d) Which of these stars is the coolest?

(1)

☒ **A** blue star

☒ **B** orange star

☒ **C** red star

☒ **D** yellow star

(Total for Question 1 = 4 marks)

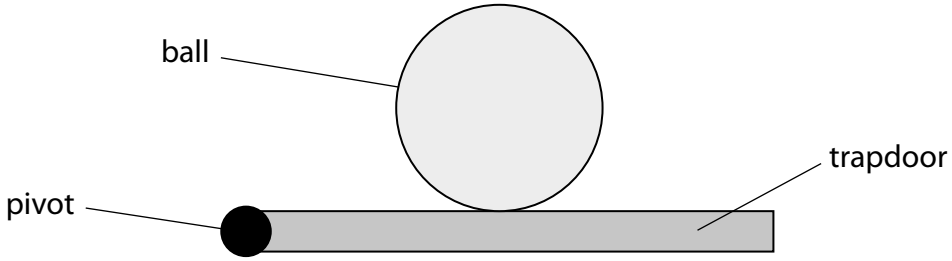
2 This question is about the motion of a ball.

(a) A ball is at rest on a trapdoor.

Complete the diagram to show the forces acting on the ball.

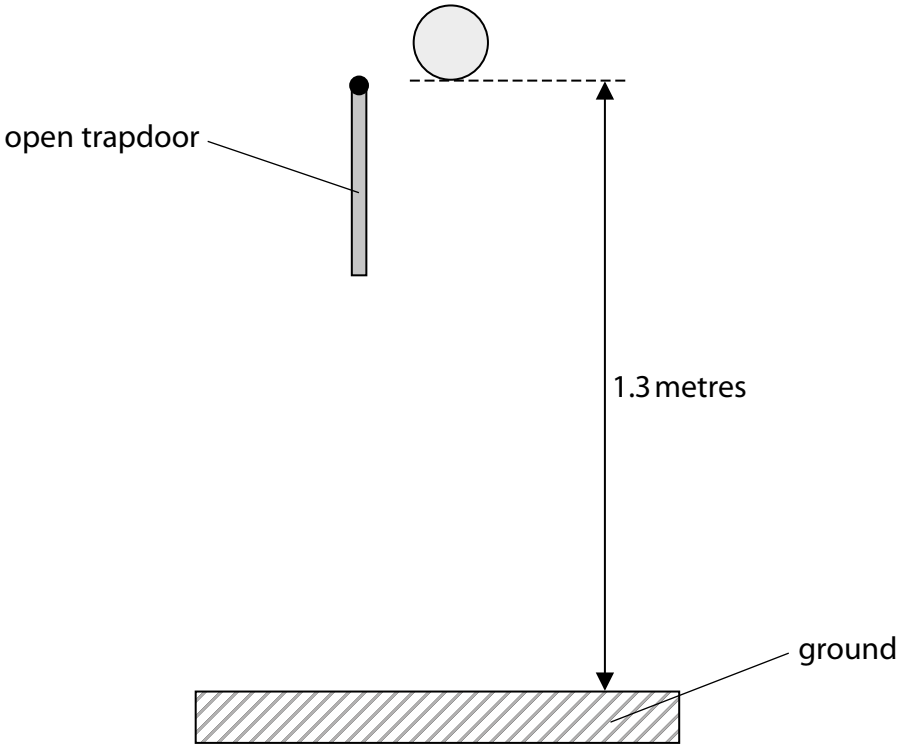
Label the forces.

(3)



(b) The trapdoor swings open and the ball falls to the ground.

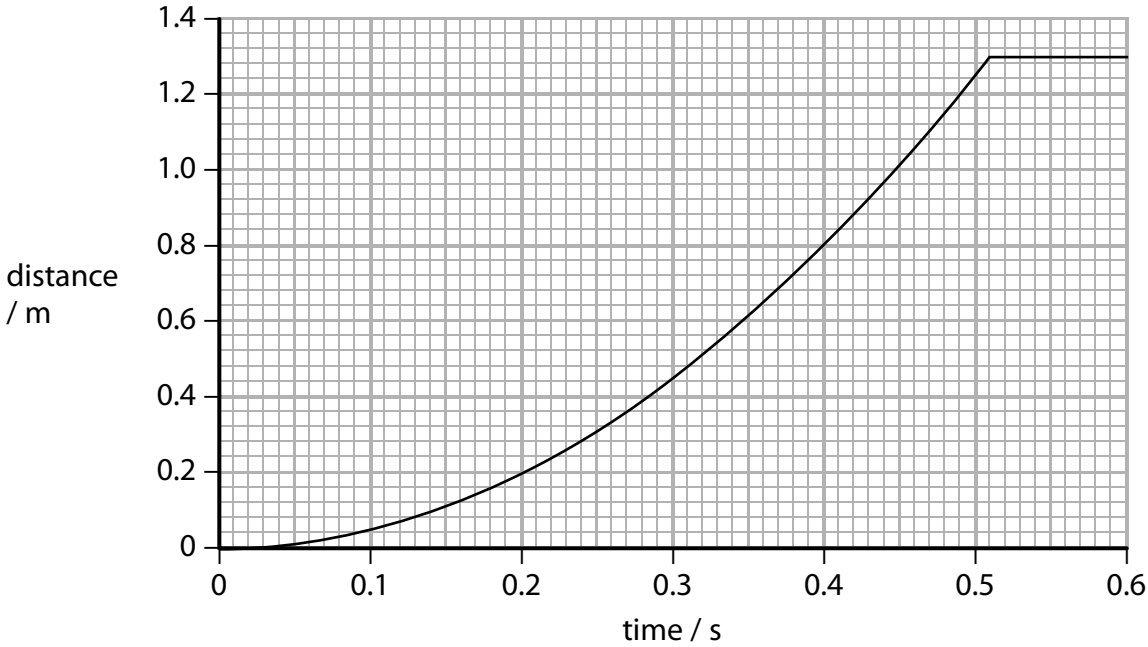
The ball does not bounce when it hits the ground.



Show that the final speed of the ball at the instant before it hits the ground is about 5 m/s.

(3)

(c) The graph shows how the distance travelled by the ball changes with time.



(i) Determine the time taken for the ball to hit the ground.

(1)

.....

.....

(ii) State the equation relating average speed, distance moved and time taken.

(1)

(iii) Calculate the average speed of the ball after 0.40 s.

(1)

average speed = ... m/s

(iv) Explain how the graph shows that the ball accelerates when it falls.

(3)

.....

.....

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.....

.....

(Total for Question 2 = 12 marks)

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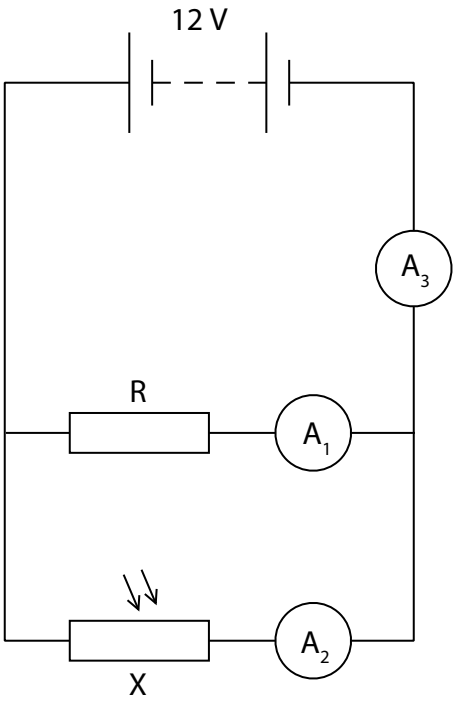
TURN OVER FOR QUESTION 3

3 A 12V battery is connected to a component, X, and a fixed resistor, R, as shown.



(a) (i) State the name of component X.

(1)

.....

(ii) Draw a voltmeter on the circuit diagram connected to show the voltage of component X.

(2)

(b) The voltage across component X is 12 V.

The resistor R has a value of 840 Ω.

Show that the current in ammeter A_1 is approximately 0.01 A.

Use the equation

voltage = current × resistance

(2)

(c) When the circuit is placed in daylight, the current in A_2 is 0.011 A.

(i) Calculate the value of the current through A_3.

(1)

current = ... A

(ii) Explain what happens to the current through A_3 when the circuit is placed in a darkened room.

(2)

.....

.....

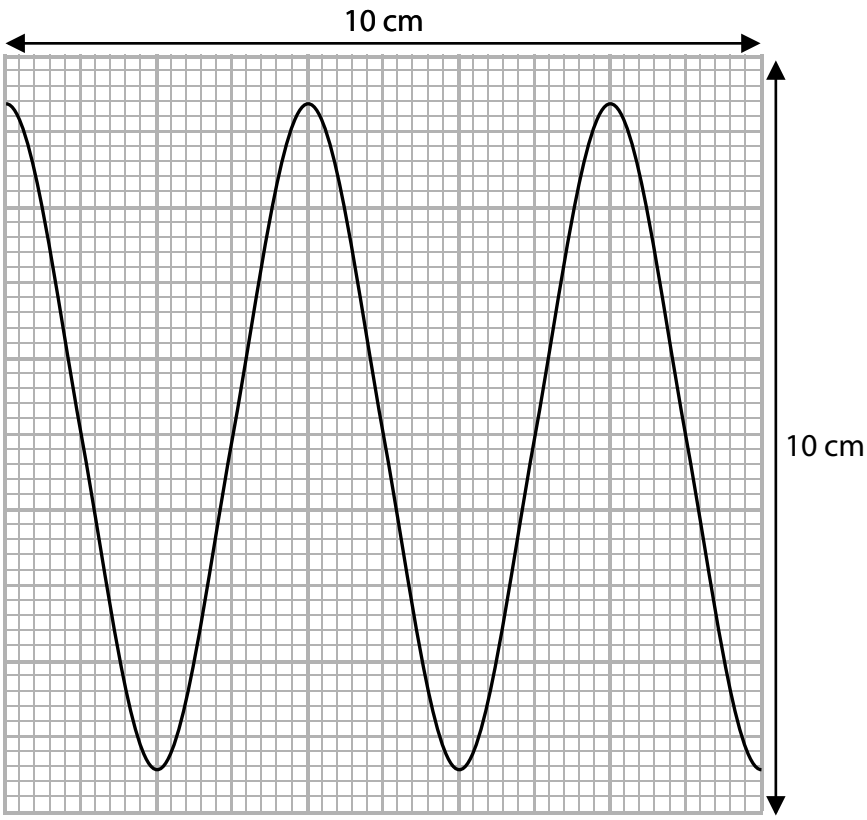
.....

.....

(Total for Question 3 = 8 marks)

4 This question is about waves.

(a) The diagram shows a wave.



(i) What is the wavelength of the wave?

(1)

☐ **A** 4.0 cm

☐ **B** 4.4 cm

☐ **C** 5.0 cm

☐ **D** 8.8 cm

(ii) What is the amplitude of the wave?

(1)

☐ **A** 4.0 cm

☐ **B** 4.4 cm

☐ **C** 5.0 cm

☐ **D** 8.8 cm

(b) The diagram shows the types of radiation in the electromagnetic spectrum.

radio waves	microwaves	infrared	visible light	ultraviolet	x-rays	gamma rays

(i) Which of the following statements about electromagnetic waves is correct?

(1)

☐ **A** they all have the same amplitude

☐ **B** they all have the same frequency

☐ **C** they all have the same speed in free space

☐ **D** they all have the same wavelength

(ii) Electromagnetic waves have many different uses.

Explain the uses of **three** different radiations in the electromagnetic spectrum.

(6)

1 .....

Use .....

.....

2 .....

Use .....

.....

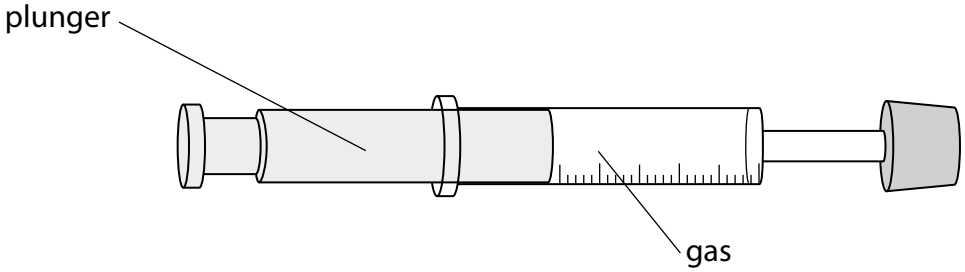
3 .....

Use .....

.....

(Total for Question 4 = 9 marks)

5 A gas is contained inside a sealed syringe.



(a) The plunger is pushed so that the gas is compressed and its volume reduces at constant temperature.

(i) Before compression, the gas pressure is 100 kPa and the volume of the gas is 7.5 cm^3.

After compression, the volume of the gas is 5.0 cm^3.

Calculate the pressure of the gas after compression.

(3)

pressure = ... kPa

(ii) Explain why decreasing the volume changes the pressure of the gas in the syringe.

You should use ideas about particles in your answer.

(3)

.....

.....

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(b) The plunger of the syringe is released and the gas returns to its original pressure of 100 kPa.

The plunger is then held in position so that the volume of the gas cannot change.

The gas is now heated and its temperature increases.

(i) Describe how the average kinetic energy of the gas particles changes when the temperature of the gas increases.

(3)

.....

.....

.....

.....

.....

.....

(ii) The temperature of the gas increases from 20 °C to 65 °C.

Calculate the pressure of the gas after it is heated.

(4)

pressure = ... kPa

(Total for Question 5 = 13 marks)

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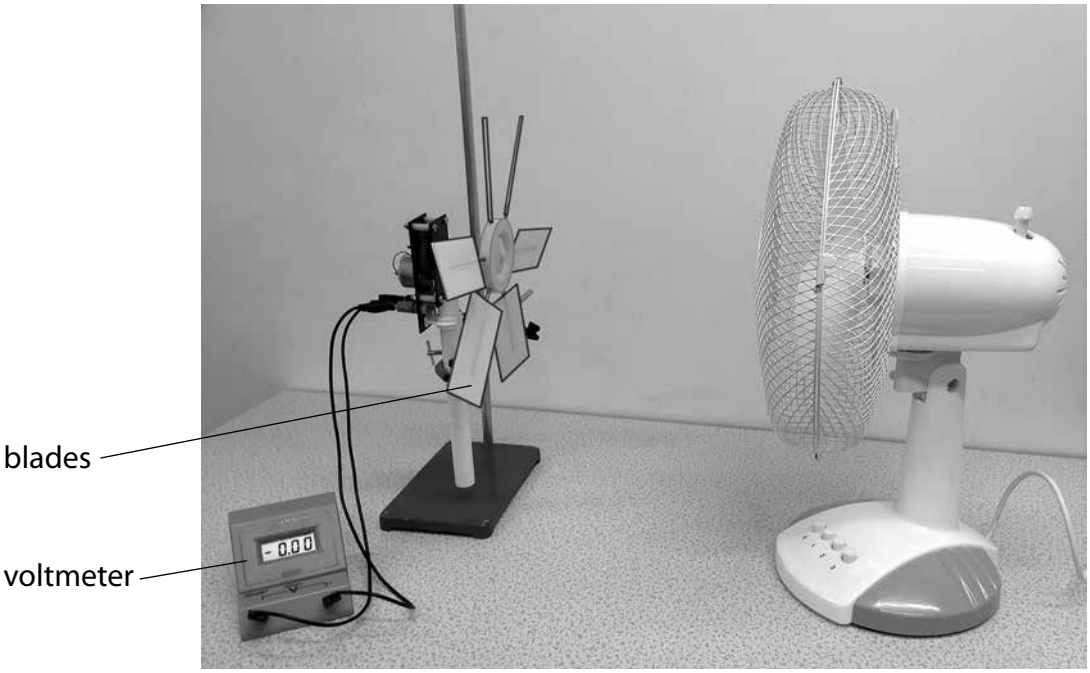
6 A student investigates a wind turbine.

The student places an electric fan in front of the wind turbine.

The wind turbine is connected to a voltmeter.

When the wind turbine turns, it generates a voltage.



(a) The student decides to investigate how the angle of the blades of the wind turbine affects the voltage it generates.

State **two** control variables for this investigation.

(2)

1 .....

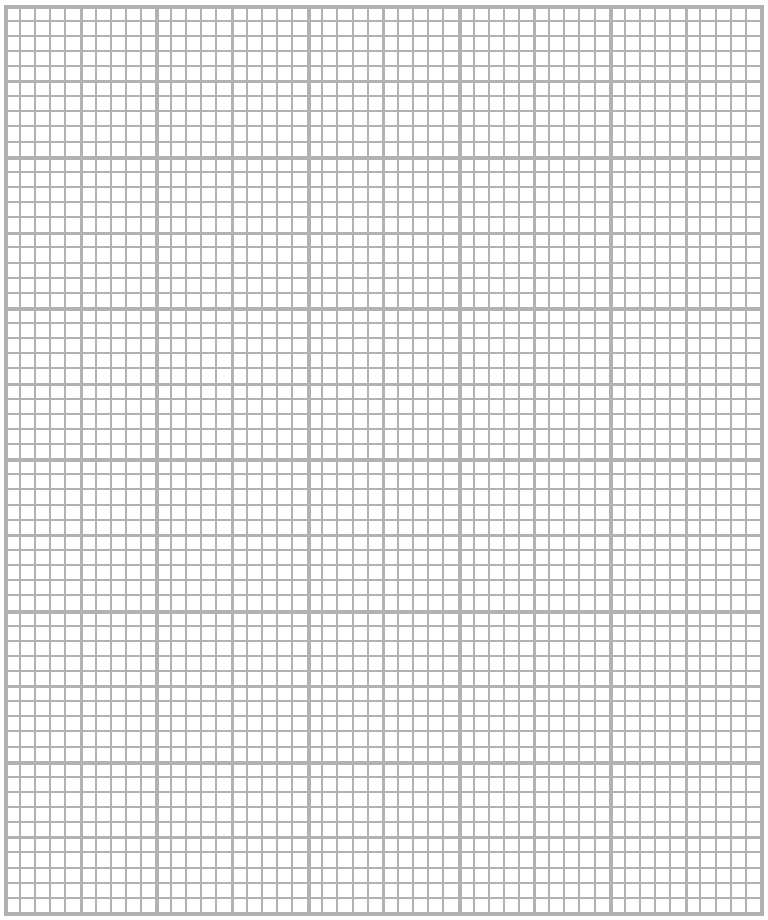
2 .....

(b) The student obtains the following results.

Blade angle / degree	Voltage / V
0	0.0
10	2.0
20	2.2
30	2.0
40	1.7
50	1.4
60	1.0
70	0.6
80	0.2
90	0.0

(i) Plot the student's results on the grid.

(3)



(ii) Draw a curve of best fit on the graph.

(2)

(iii) Describe the relationship between the blade angle and the voltage.

(2)

.....

.....

.....

.....

(c) The student decides to change the investigation to see how the voltage is affected by the number of blades.

(i) State the type of graph the student should use to display the results.

(1)

.....

(ii) Justify your choice of graph.

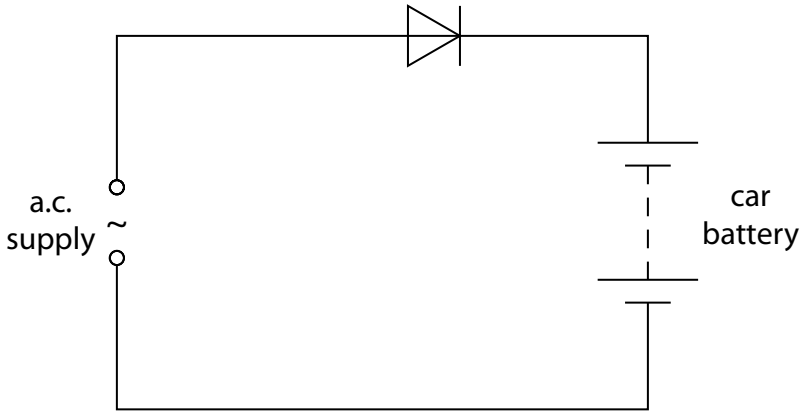
(1)

.....

.....

(Total for Question 6 = 11 marks)

7 The circuit shows a car battery charging from an alternating current (a.c.) supply.



(a) Sketch a graph to show what is meant by a.c.

(2)

(b) State the reason why the circuit contains a diode.

(1)

.....

.....

(c) The 12 V car battery is connected to two identical filament lamps so that the voltage across each lamp is 6.0 V.

(i) Draw the circuit diagram.

(2)

(ii) State the equation relating power, current and voltage.

(1)

.....

(iii) The power of each lamp is 330 mW.

Calculate the current in a lamp.

(2)

current = ... A

(Total for Question 7 = 8 marks)

8 Sound travels as a wave.

(a) Which of these statements about sound waves is **incorrect**?

(1)

☒ **A** they can be reflected

☒ **B** they can travel through a vacuum

☒ **C** they can be refracted

☒ **D** they transfer energy

(b) Sound waves are a type of wave known as longitudinal waves.

(i) Name the other type of wave.

(1)

.....

(ii) Give **one** example of this other type of wave.

(1)

.....

(c) A buzzer produces a sound wave of frequency 2.9 kHz and wavelength 12 cm.

(i) State the equation relating wave speed, frequency and wavelength.

(1)

.....

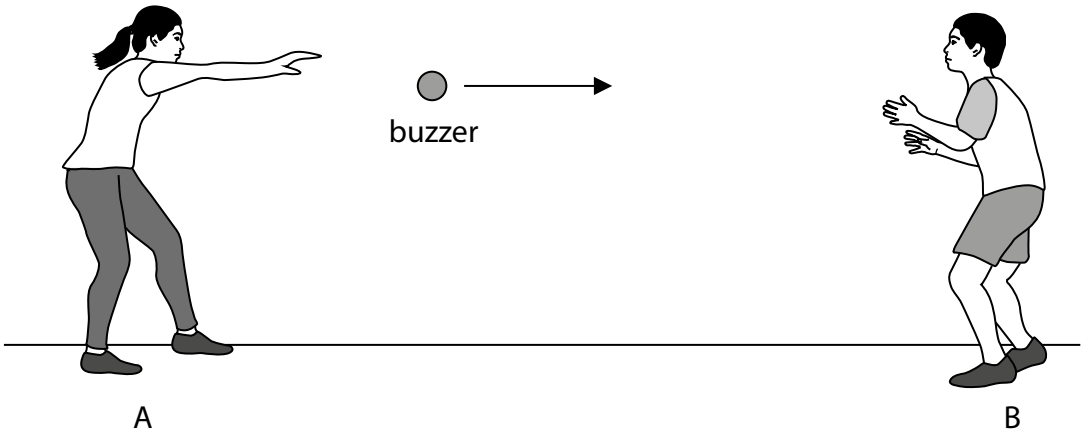
(ii) Calculate the speed of the sound wave.

(3)

speed = ... m/s

(d) Two students investigate the Doppler effect by throwing a buzzer to each other.

Student A throws the buzzer to student B.



When the buzzer is thrown, student A notices that the sound produced changes.

Explain how the sound heard by student A changes.

You may include a diagram in your answer.

(3)

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(Total for Question 8 = 10 marks)

9 This is a question about nuclear energy.

(a) Nuclear fusion can take place between different isotopes of hydrogen to produce an isotope of helium.

(i) Complete the nuclear equation for this process.

(2)

$$^{2}_{1}H + ^{3}_{1}H \longrightarrow \square\,^{}_{2}He + ^{1}_{}n\,\square$$

(ii) This process also results in the release of energy.

State where the fusion process takes place naturally.

(1)

.....

(iii) Explain why the isotopes of hydrogen must be heated to a very high temperature for fusion to take place.

(3)

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(b) Nuclear fission also results in a release of energy.

Explain how nuclear fission differs from nuclear fusion.

(2)

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(Total for Question 9 = 8 marks)

10 The International Space Station (ISS) is a satellite that orbits the Earth at a height of 409 km above the surface of the Earth.

The ISS has an orbital speed of 7.66 km/s and a period of 92.7 minutes.

(a) (i) Calculate the orbital radius of the ISS.

Give your answer to 3 significant figures.

(4)

orbital radius = ... km

(ii) Calculate the radius of the Earth using your value for the orbital radius.

(1)

Earth radius = ... km

(Total for Question 10 = 5 marks)

11 Main sequence stars can vary in brightness, colour and mass.

Describe the evolution of both low mass stars and high mass stars after they join the main sequence.

(6)

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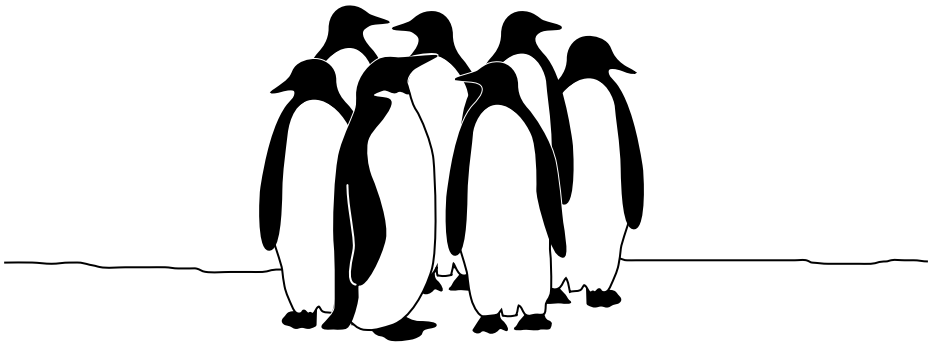
(Total for Question 11 = 6 marks)

12 Penguins are adapted to survive in cold conditions.

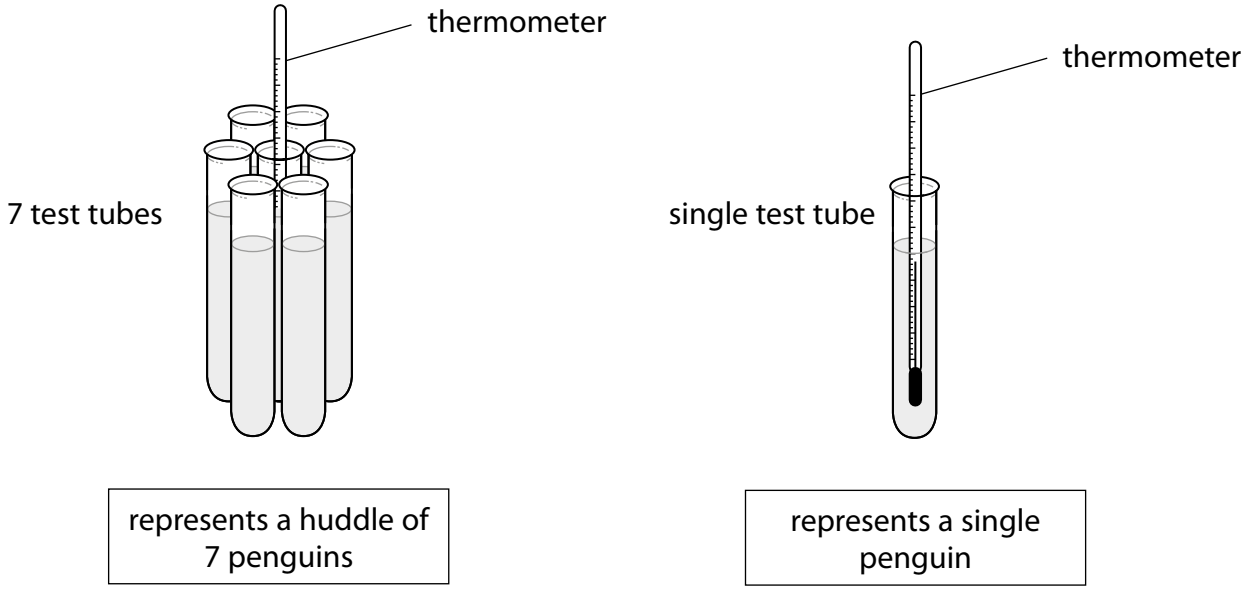
The adaptations help them to maintain a constant body temperature of 39 °C.
Penguins also crowd together in groups of many penguins.



(a) A student wants to investigate how the temperature of a penguin is affected when they crowd together in groups.

She uses this apparatus.

Each test tube represents a penguin.



(i) These statements describe the method she should use.

The statements are in the wrong order.

Put them into the correct order by numbering the boxes.

Some have been done for you.

(3)

Statements	**Order**
record the data in a table	8
take the temperature of the two test tubes	
tie 7 test tubes together	1
heat the water to 90 °C	2
take the temperatures every minute	
place equal volumes of water in all test tubes	
put thermometers into the middle test tube and single test tube	
record data for 15 minutes	

(ii) The student draws a table to record her results.

Add suitable headings to her table.

(2)

Time/	.....	
	.....	.....

(iii) Predict how the temperature change for the single test tube will differ from the temperature change for the group of test tubes.

(1)

.....

.....

(iv) Draw a sketch graph of the results you predict the student will obtain.

Label and use the axes below.

(4)

(v) Explain your prediction using ideas about thermal energy transfer.

(3)

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(b) Here are two adaptations that help penguins to maintain a constant body temperature.

- Most of their bodies are covered with layers of fat.
- They have flat overlapping feathers.

Explain why these features help penguins to maintain a constant body temperature.

(3)

Layers of fat.....

.....

.....

.....

Flat overlapping feathers.....

.....

.....

(Total for Question 12 = 16 marks)

TOTAL FOR PAPER = 110 MARKS

Paper 1 (4PH1/1P and 4SD0/1P)

Question number	Answer	Mark
1(a)	D	**1**

Question number	Answer	Mark
1(b)	B	**1**

Question number	Answer	Mark
1(c)	D	**1**

Question number	Answer	Mark
1(d)	C	**1**

Total for Question 1 = 4 marks

Question number	Answer	Additional guidance	Mark
2(a)	• downward arrow labelled 'weight' (1) • upward arrow labelled 'reaction' (1) • both arrows of approximately equal length and drawn in line within ball (1)	ignore 'gravity' allow 'gravitational force', 'force due to gravity' allow 'normal reaction force', 'normal contact force'	**3**

Question number	Answer	Additional guidance	Mark
2(b)	Process should include: • substitution • rearrangement • evaluation to at least 2 significant figures (s.f.) e.g. $v^2 = 0 + (2 \times 10 \times 1.3)$ (1) $v = \sqrt{2 \times 10 \times 1.3}$ (1) $v = 5.1$ (m/s) (1)	allow 5.10, 5.099, 5.09	**3**

Question number	Answer	Additional guidance	Mark
2(c)(i)	0.51 (seconds)	allow value in range 0.50–0.52 (seconds)	**1**

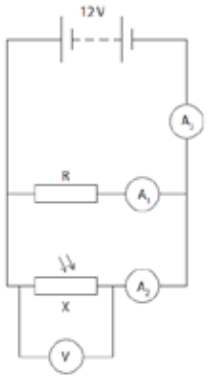
Question number	Answer	Additional guidance	Mark
2(c)(ii)	Average speed = distance moved/time taken	allow in accepted symbols or rearranged.	**1**

Question number	Answer	Additional guidance	Mark
2(c)(iii)	(Speed =) 2.0 (m/s)	accept 2	**1**

Question number	Answer	Mark
2(c)(iv)	An explanation that makes reference to the following points: • gradient is equal to the {speed/velocity} of the ball (1) • gradient is increasing over time (1) • (therefore) the {speed/velocity} is increasing with time (1)	**3**

Total for Question 2 = 12 marks

Question number	Answer	Mark
3(a)(i)	An LDR (light-dependent resistor)	1

Question number	Answer	Mark
3(a)(ii)	• correct symbol (1) • correct position in parallel with X (1)  	2

Question number	Answer	Additional guidance	Mark
3(b)	rearrangement • $I = V/R$ (1) substitution • I = 12/840 (= 0.014 (A)) (1)	0.01429 (A) some evidence of working required for two marks	2

Question number	Answer	Additional guidance	Mark
3(c)(i)	correct addition of current in A_1 with current in A_2 = 0.021 (A) (1)	ecf from 3(b) 0.025 (A) award full marks for correct numerical answer without working	1

Question number	Answer	Mark
3(c)(ii)	An explanation that makes reference to the following points: • resistance of LDR increases (1) • hence current in A_2/A_3 decreases (1)	2

Total for Question 3 = 8 marks

Question number	Answer	Mark
4(a)(i)	A	**1**

Question number	Answer	Mark
4(a)(ii)	B	**1**

Question number	Answer	Mark
4(b)(i)	C	**1**

Question number	Answer	Additional guidance	Mark
4(b)(ii)	2 marks max. available for each named part of the spectrum for each use: • 1 mark for a simple use • 1 mark for a supporting description e.g. for gamma rays: • used to sterilise medical tools (1) • (because) gamma kill bacteria (1) for x-rays: • used to photograph bones (1) • (because) x-rays can penetrate soft tissues but not bone (1) for ultraviolet: • used for detecting security ink (1) • (because) it fluoresces with ultraviolet lighting (1) for infrared: • used for optical fibre communications (1) • (because) they can undergo total internal reflection (1) for micro waves: • used for satellite communications (1) • (because) microwaves can penetrate Earth's atmosphere (1) for radio waves: • used for long-range communications (1) • (because) they can be reflected from the Earth's atmosphere (1)	no mark for simply naming a part of the spectrum	**6**

Total for Question 4 = 9 marks

Question number	Answer	Mark
5(a)(i)	Process should include: • substitution • rearrangement • evaluation e.g. 100 × 7.5 = p_2 × 5.0 (1) p_2 = (100 × 7.5)/5.0 (1) (p_2 =) 150 (kPa) (1)	**3**

Question number	Answer	Additional guidance	Mark
5(a)(ii)	An explanation that makes reference to the following points: • particles collide with walls (of container) (1) And any two from: • more frequently/time between collisions is less (1) • (resulting in) larger force (1) • (over a) smaller surface area (1)	allow 'more often'	**3**

Question number	Answer	Additional guidance	Mark
5(b)(i)	A description that makes reference to the following points: • (average kinetic energy) increases (1) • in (direct) proportion to (1) • Kelvin temperature (1)	dependent on point 1 dependent on point 1	**3**

Question number	Answer	Additional guidance	Mark
5(b)(ii)	Process should include: • conversion of temperatures to Kelvin scale (1) • rearrangement (1) • substitution (1) • evaluation (1) e.g. 20 °C = 293 K OR 65 °C = 338 K (1) (p_1/T_1)/T_2= p_2 (1) p_2 = (100 x 338)/293 (1) (p_2 =) 115 (kPa) (1)	not converting to Kelvin gains 2 marks max. 100/293 = p_2/338 allow 115.358…	**4**

Total for Question 5 = 13 marks

Question number	Answer	Additional guidance	Mark
6(a)	Any two control variables (2) e.g. • distance between fan and turbine • fan speed • number of turbine blades • turbine angle • fan angle • orientation of fan with respect to turbine	ignore type of fan/turbine	**2**

Question number	Answer	Additional guidance	Mark
6(b)(i)	Scale (1) Axes (1) Plotting (1)	both axes should occupy at least 50% of the grid both axes should be labelled with quantity and unit orientation unimportant points should be accurate within 1mm. −1 mark for each error	**3**

Question number	Answer	Additional guidance	Mark
6(b)(ii)	• curve starting at (0,0) (1) • smooth curve to a peak at (20, 2.2) (1)	curve should be smooth with roughly equal distribution of points either side	**2**

Question number	Answer	Additional guidance	Mark
6(b)(iii)	A description containing any two from: • voltage increases, then decreases as blade angle is increased (1) • maximum voltage when blade angle is 20° (1) • non-linear relationship (1)	allow range of 15°–25°	**2**

Question number	Answer	Mark
6(c)(i)	Bar chart	**1**

Question number	Answer	Mark
6(c)(ii)	(Number of blades) is a discrete/discontinuous variable	**1**

Total for Question 6 = 11 marks

Question number	Answer	Mark
7(a)	• Axes shown with either voltage or current against time AND more than one wavelength shown (1) • Continuous curve drawn that alternates to + and −, and has approximately equal displacement on either side of x-axis (1)	2

Question number	Answer	Additional guidance	Mark
7(b)	A diode only allows current in one direction	allow answers which describe what would happen to a battery with a.c.	1

Question number	Answer	Additional guidance	Mark
7(c)(i)	• All circuit symbols correct (1) • Bulbs shown in series (1)	allow cell for battery reject power supply symbol	2

Question number	Answer	Additional guidance	Mark
7(c)(ii)	Power = current × voltage	allow rearrangement and correct symbols, e.g. $P = I \times V$	1

Question number	Answer	Additional guidance	Mark
7(c)(iii)	Process includes: • rearrangement • evaluation e.g. $I = P/V$ (1) = 0.33/6.0 = 0.055 (A) (1)	1 mark max if incorrect V is used	2

Total for Question 7 = 8 marks

Question number	Answer	Mark
8(a)	B	**1**

Question number	Answer	Additional guidance	Mark
8(b)(i)	Transverse	allow any recognisable spelling	**1**

Question number	Answer	Additional guidance	Mark
8(b)(ii)	Any transverse wave e.g. electromagnetic named part of EM spectrum (surface) water waves waves on a rope seismic S waves	ignore waves on a slinky unless correctly clarified	**1**

Question number	Answer	Additional guidance	Mark
8(c)(i)	wave speed = frequency × wavelength	equation can be given in words or symbols	**1**

Question number	Answer	Additional guidance	Mark
8(c)(ii)	• Conversion of kHz to Hz OR cm to m • Substitution • Evaluation e.g 2.9 kHz = 2900 Hz (1) (v =) 2900 x 0.12 (1) (v =) 350 (m/s) (1)	seen anywhere allow 348 (m/s) 0.348, 0.35, 34800, 35000 gains 2 marks 34.8, 35 gains 1 mark	**3**

Question number	Answer	Additional guidance	Mark
8(d)	An explanation including: • frequency decreases (1) • wavelength increases (1) • (because) wave speed is constant (1)	Ignore references to volume or loudness Allow 'pitch' for frequency	**3**

Total for Question 8 = 10 marks

Question number	Answer	Mark
9(a)(i)	4 (1) 0 (1)  	**2**

Question number	Answer	Additional guidance	Mark
9(a)(ii)	(Centre of) stars	allow the Sun	**1**

Question number	Answer	Mark
9(a)(iii)	An explanation that makes reference to the following points: • hydrogen nuclei repel (1) • need a high speed/kinetic energy (1) • to get close enough to fuse together (1)	**3**

Question number	Answer	Additional guidance	Mark
9(b)	An explanation that makes reference to the following points: • when fission occurs a large nucleus splits into smaller nuclei (1) • but when fusion occurs small nuclei fuse together to form a larger nucleus (1)	allow 'heavier', 'lighter' allow specific correct named isotopes	**2**

Total for Question 9 = 8 marks

Question number	Answer	Mark
10(a)(i)	Process includes: • rearrangement (1) • substitution (1) • evaluation of orbital radius (1) • answer to 3 s.f. (1) e.g. $r = v \times T/2\pi$ (1) $r = (7.66 \times 92.7 \times 60)2\pi$ (1) $r = 6781$ (km) (1) $r = 6780$ (km) (1)	**4**

Question number	Answer	Additional guidance	Mark
10(a)(ii)	Earth radius = r − 409 = 6370 (km)	Allow ecf Allow 6 371 (km) Allow 6 372 (km)	**1**

Total for Question 10 = 5 marks

Question number	Answer	Additional guidance	Mark
11	A description that makes reference to six of the following points: • **all** main sequence stars fuse H into He (1) • lower mass stars stay on the MS line for longer (1) • lower mass stars become red giants (1) • higher mass stars become red super giants (1) • red giant becomes a white dwarf (1) • supergiant becomes a supernova (1) • supernova becomes a neutron star (1) • supernova becomes a black hole (1)	accept numerical values allow red giant to planetary nebula	**6**

Total for Question 11 = 6 marks

Question number	Answer	Mark
12(a)(i)	• answer 3 correct (1) • answers 4 and 5 in either order (1) • answers 6 and 7 in either order (1)	3

Statements	Order
record the data in a table	8
take the temperature of the two test tubes	5
tie 7 test tubes together	1
heat the water to 90 °C	2
take the temperatures every minute	6
place equal volumes of water in all test tubes	3
put thermometers into the middle test tube and single test tube	4
record data for 15 minutes	7

Question number	Answer	Mark
12(a)(ii)	• correct units shown (1) • temperature and indication of two different thermometers' readings (1)	2

Question number	Answer	Mark
12(a)(iii)	The single test tube will cool faster/RA	1

Question number	Answer	Mark
12(a)(iv)	• correct labels on axes (x = time, y = temperature) (1) • both lines start on y-axis at the same temperature (1) • both lines show that temperature decreases with time (1) • line for single tt thermometer is below other line at all points (1)	4

Question number	Answer	Additional guidance	Mark
12(a)(v)	An explanation that makes reference to the following three points: • thermal energy loss by convection is reduced because of the air pockets in the 7 tt (1) • causes the single tt to lose more thermal energy/RA (1) • radiation loss is the same for both (1) • conduction losses for 7 tt are not high/layer of tt acts as an insulator (1)	allow heat for thermal energy accept alternative descriptions of 7 tt e.g. huddle	**3**

Question number	Answer	Mark
12(b)	**Fat** Acts as an insulator so keeps penguins warm(1) **Feathers** Feathers trap pockets of air (1) and either reduce thermal energy loss by convection (1) or air is a poor conductor so thermal energy loss is reduced (1)	**3**

Total for Question 12 = 16 marks

TOTAL FOR PAPER = 110 MARKS

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