OCR SPECIMEN **H**

GENERAL CERTIFICATE OF SECONDARY EDUCATION

B762/02

FURTHER ADDITIONAL SCIENCE B

Unit B762/02: module B6, C6, P6 (Higher Tier)

Candidates answer on the question paper.
A calculator may be used for this paper.

OCR Supplied Materials:
None

Other Materials Required:
- Pencil
- Ruler (cm/mm)

Duration: 1 hour 30 minutes

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your centre number and candidate number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Write your answer to each question in the space provided; however, additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- Your quality of written communication is assessed in questions marked with a pencil [✎].
- The number of marks for each question is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **85**.
- This document consists of **36** pages. Any blank pages are indicated.

Examiner's Use Only:			
1		10	
2		11	
3		12	
4		13	
5		14	
6		15	
7		16	
8		17	
9			
Total			

EQUATIONS

energy = mass × specific heat capacity × temperature change

energy = mass × specific latent heat

efficiency = $\dfrac{\text{useful energy output } (\times 100\%)}{\text{total energy input}}$

wave speed = frequency × wavelength

power = voltage × current

energy supplied = power × time

average speed = $\dfrac{\text{distance}}{\text{time}}$

distance = average speed × time

$s = \dfrac{(u+v)}{2} \times t$

acceleration = $\dfrac{\text{change in speed}}{\text{time taken}}$

force = mass × acceleration

weight = mass × gravitational field strength

work done = force × distance

power = $\dfrac{\text{work done}}{\text{time}}$

power = force × speed

KE = $\frac{1}{2}\, mv^2$

momentum = mass × velocity

force = $\dfrac{\text{change in momentum}}{\text{time}}$

GPE = mgh

$mgh = \frac{1}{2} mv^2$

resistance = $\dfrac{\text{voltage}}{\text{current}}$

$v = u + at$

$v^2 = u^2 + 2as$

$s = ut + \frac{1}{2} at^2$

$m_1u_1 + m_2u_2 = (m_1 + m_2)v$

refractive index = $\dfrac{\text{speed of light in vacuum}}{\text{speed of light in medium}}$

magnification = $\dfrac{\text{image size}}{\text{object size}}$

$I_e = I_b + I_c$

$\dfrac{\text{voltage across primary coil}}{\text{voltage across seconday coil}} = \dfrac{\text{number of primary turns}}{\text{number of secondary turns}}$

power loss = (current)^2 × resistance

$V_pI_p = V_sI_s$

Answer **all** the questions.

Section A – Module B6

1 Read the article from a newspaper.

Fighting cholera with potatoes!

Cholera can spread very quickly from person to person. It is a disease caused by bacteria.
It kills 200 000 people a year.

Scientists have used potato plants to make a new medicine.
They hope that this new medicine might stop people getting cholera.

The scientists put a gene into potato plants to make them produce the medicine.
They hope that just eating the potatoes will protect people from the disease.

(a) Cholera often spreads very quickly after natural disasters such as earthquakes.

Explain why earthquakes can cause **cholera** to spread very quickly.

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.... **[2]**

(b) The scientists have put a gene from another species into the potato plant.

Describe how this is done, explaining how different enzymes are used in this process.

✎ *The quality of written communication will be assessed in your answer to this question.*

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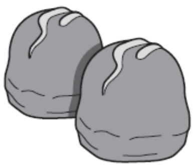
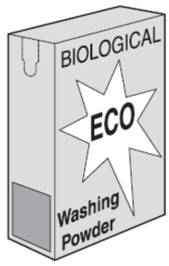
.... **[6]**

[Total: 8]

2 The diagrams show some products made using enzymes.



low sucrose chocolates



biological washing powder

(a) The chocolates are made low in sucrose using sucrase.

How will this affect the taste of the chocolates compared to chocolates high in sucrose?

.... **[1]**

(b) (i) On the packet of biological washing powder there is a warning.

It says that the powder will **not** clean clothes very well if used in areas where the tap water is very acidic.

Explain why.

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.... **[2]**

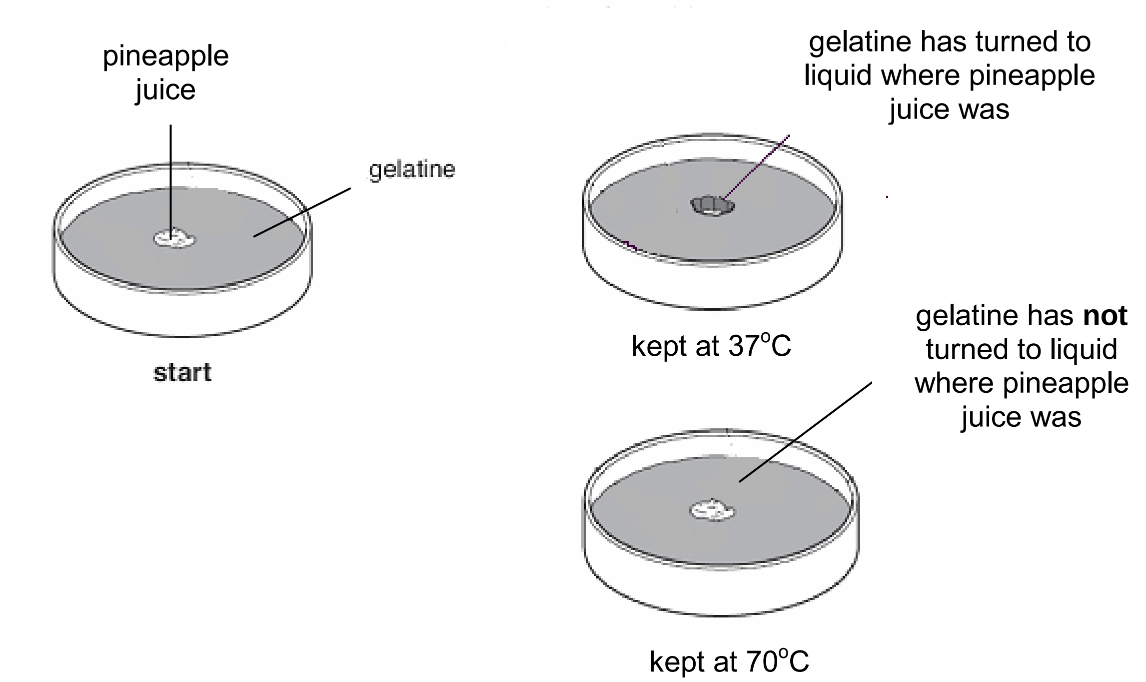
(ii) Gerant decides to do an experiment with pineapple juice.

He puts a small amount of the pineapple juice in a dish containing a jelly called gelatine.

Gelatine is a protein. When gelatine is digested it turns to liquid.

He keeps the dish at 37°C.

He repeats this with another dish but keeps this dish at 70°C.



Explain the results of Gerant's experiment.

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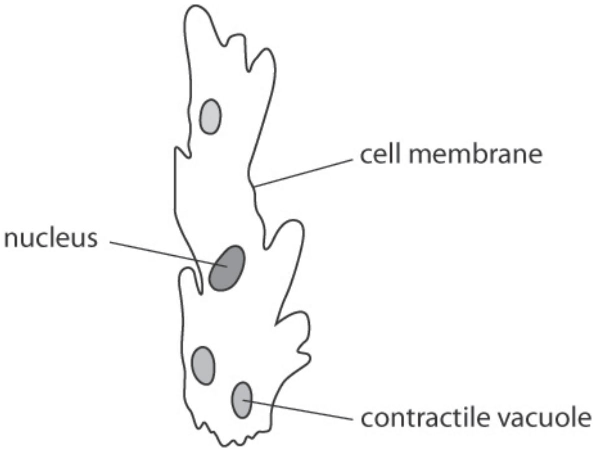
.... **[4]**

[Total: 7]

3 Amoeba is the name of a group of single-celled organisms.

Look at the diagram of *Amoeba lacerate*. It lives in rivers.

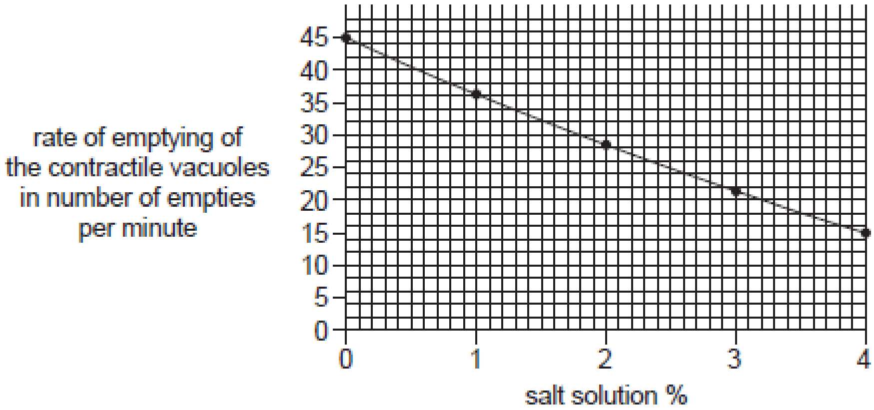


An experiment is performed on *Amoeba lacerata.*

The amoeba is placed in salt solutions of different concentrations.

The rate of emptying of its contractile vacuoles is then measured.

The graph shows the results.



(a) The contractile vacuoles empty at different rates in different salt solutions.

Explain these results.

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.... **[3]**

(b) The experiment counted the number of ‘empties’ per minute as a measure of how quickly the amoeba removed water.

Suggest **one** reason why this data might **not** be a valid measurement of how quickly the amoeba removed water.

....

.... **[1]**

[Total: 4]

4 Chris wants to make some home-made wine.

Home wine kit

Contents: yeast,
dried grape juice containing
2 kg of sugar.

Add to 10 litres of water.

She buys two identical kits.

To one kit she adds no extra sugar.

To the second kit she adds 1kg of **extra** sugar.

She adds 10 litres of water to each, as in the instructions.

She then allows each one to ferment and produce a batch of wine.

(a) Chris has a table showing the maximum concentration of alcohol that can be made from different starting concentrations of sugar.

starting concentration of sugar in kg per litre	maximum final alcohol concentration %
0.10	5.6
0.15	8.4
0.20	11.2
0.25	13.6
0.30	15.6

What is the maximum final alcohol concentration for the wine that has extra sugar added?

Show how you worked out your answer.

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concentration = ...% **[2]**

(b) Look at the table.

Chris thinks that the starting concentration of sugar will be in direct proportion to the alcohol concentration in the wine.

(i) Does the data support her idea? Explain your answer.

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.... **[2]**

(ii) Would you expect the alcohol concentration to continue to increase as more sugar is added? Explain your answer.

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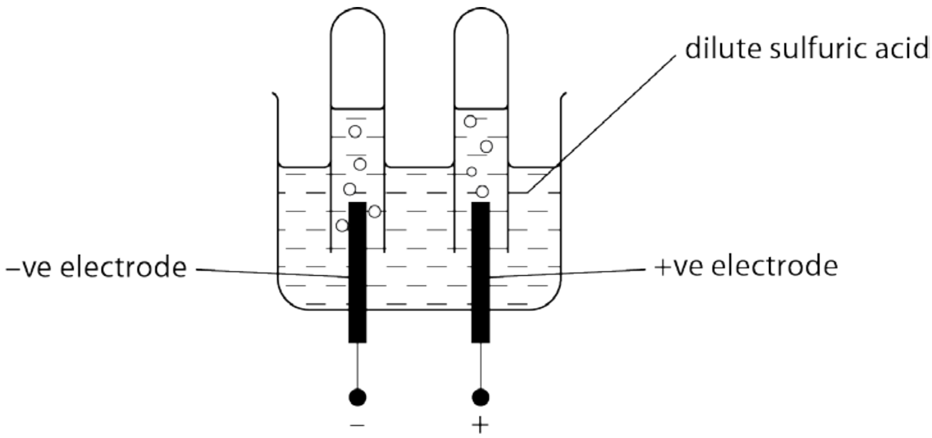
.... **[2]**

[Total: 6]

Section B – Module C6

5 Harry investigates the electrolysis of dilute sulfuric acid.

Look at the apparatus he uses.



(a) Bubbles of gas are made at both electrodes.

Hydrogen is one of the gases made.

Write down the name of the **other** gas made during the electrolysis.

.... **[1]**

(b) Hydrogen is made when hydrogen ions, H^+, gain electrons.

Construct the **balanced symbol equation** for this process.

Use e^- to represent an electron.

.... **[1]**

(c) Harry measures the time it takes to fill the test tube with hydrogen.

He does four experiments.

He changes the current used and the temperature of the dilute sulfuric acid.

He keeps everything else the same.

Look at his table of results.

experiment number	**temperature of dilute sulfuric acid in °C**	**current used in amps**	**time taken to fill the test tube with hydrogen in seconds**
1	10	1.0	60
2	15	1.0	60
3	15	2.0	30
4	15	4.0	15

Harry does another experiment.

This time he uses dilute sulfuric acid at a temperature of 20°C and a current of 3.0 amps.

Predict how long it will take to fill the test tube with hydrogen.

Explain your answer.

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....

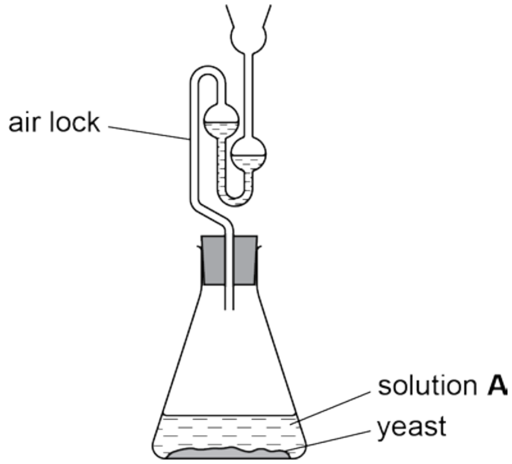
time = ...seconds **[2]**

[Total: 4]

6 Sarah and Daniel investigate fermentation.

Look at the diagram.

It shows the apparatus they use.



(a) Ethanol is made by fermentation.

Yeast and solution **A** are used to make ethanol.

Write the **word** equation for fermentation.

.... **[1]**

(b) Fermentation works best at temperatures between 25–50°C.

Explain why.

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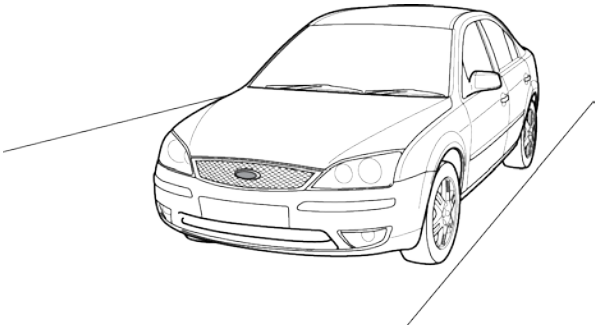
.... **[2]**

(c) Write down the **molecular formula** of ethanol.

.... **[1]**

[Total: 4]

7 Look at the picture of a car.



(a) Some of the car body is made of iron.

One disadvantage of using iron is that it rusts.

Write a **word** equation for the rusting of iron.

.... **[1]**

(b) Look at the equations.

These are two processes that happen during rusting.

$$Fe\ -\ 2e^{-}\ \rightarrow\ Fe^{2+}$$

$$O_2\ +\ 2H_2O\ +\ 4e^{-}\ \rightarrow\ 4OH$$

Rusting is a redox reaction.

Explain why using information from **both** equations.

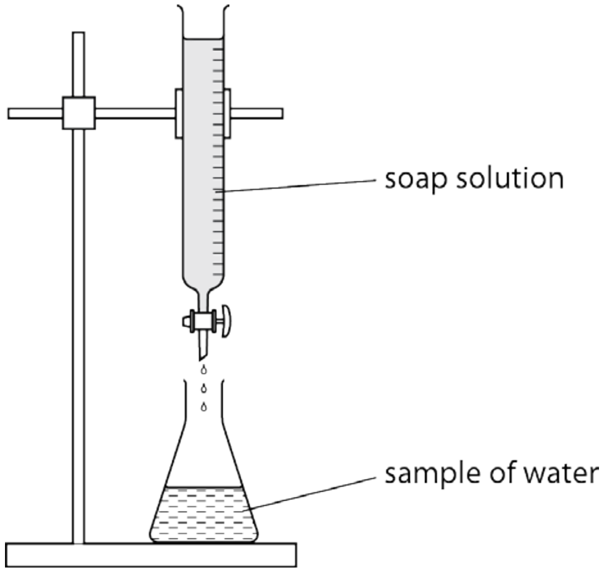
....

.... **[1]**

[Total: 2]

8 This question is about hardness in water.

Luke and Henry investigate the hardness of three different samples of water.



They do this by adding drops of soap solution to each 50 cm^3 sample of water.

They add soap until lather remains on the surface after shaking.

Look at their table of results.

sample of water	volume of soap added in cm^3
tap water	30
river water	28
boiled tap water	15
distilled water	5

Tap water contains **both** temporary hardness and permanent hardness.

Explain how you can tell from the results.

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....**[2]**

[Total: 2]

9 In 1950 research scientists thought that CFCs were very useful compounds.

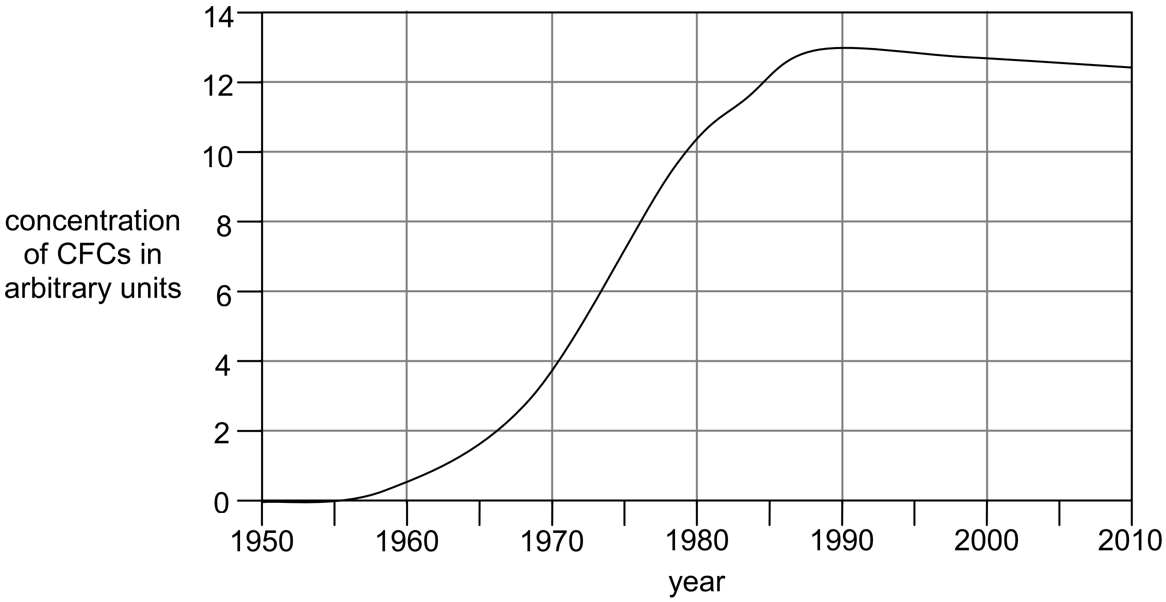
Many CFCs were used as aerosol propellants.

By 1980 some scientists believed that CFCs in the air were causing environmental damage.

CFCs enter the air when aerosol cans are used or thrown away.

(a) Look at the graph.

It shows how the concentration of CFCs in the air has changed since 1950.



The UK government has now banned the use of CFCs.

(i) Use the graph to estimate in which year the ban on the use of CFCs started.

.... **[1]**

(ii) It took a long time for scientists to convince the UK government to ban CFCs.

Suggest why.

....

.... **[2]**

(iii) Research scientists have estimated that the mean decrease in concentration of CFCs will be about 1.35 arbitrary units every ten years.

Estimate when the concentration of CFCs in the air falls to zero.

....

....

year = ... **[2]**

(b) Ozone molecules in the upper atmosphere break down when they absorb ultra violet light to make oxygen atoms and oxygen molecules.

(i) Construct the **balanced symbol** equation for this reaction.

....**[1]**

(ii) The breakdown of CFCs only occurs in the upper atmosphere and not at ground level.

Suggest why.

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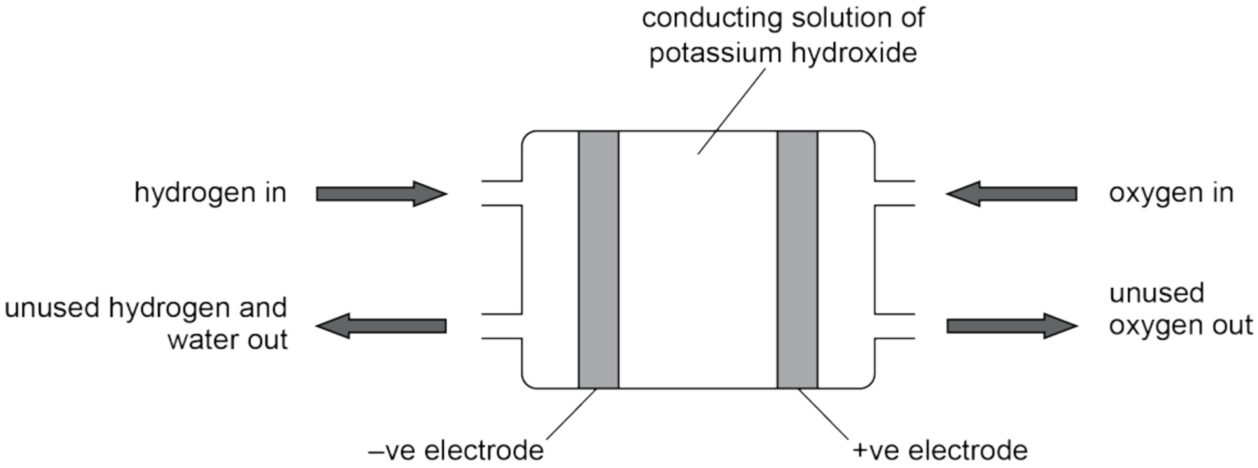
....**[1]**

[Total: 7]

10 Look at the diagram of an oxygen-hydrogen fuel cell



Potassium hydroxide solution contains potassium ions, K^+, and hydroxide ions, OH^-. Water, H_2O, is made in this type of fuel cell.

Construct the electrode equations for the reactions that take place in this oxygen-hydrogen fuel cell.

Use these equations and your own understanding to explain the advantages and disadvantages of producing electricity using an oxygen-hydrogen fuel cell.

✎ *The quality of written communication will be assessed in your answer to this question.*

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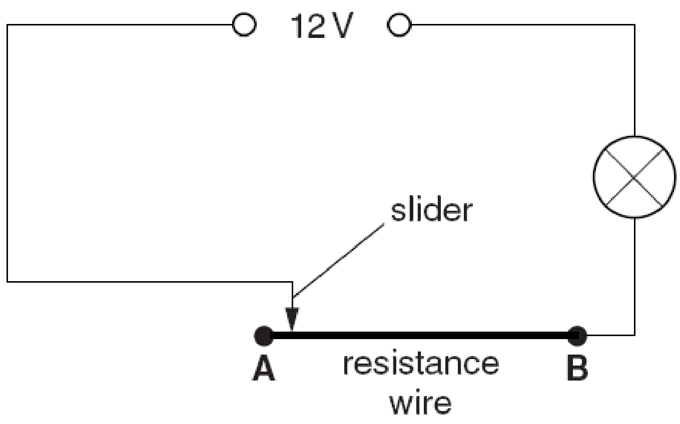
.... **[6]**

[Total: 6]

Section C – Module P6

11 Sally does some experiments with electricity.

(a) Look at the diagram. The resistance wire is used to control the bulb.



(i) Sally puts the slider at position **A**. The bulb lights up.

She moves the slider from position **A** to position **B**.

Explain how this affects the brightness of the bulb.

....

.... **[1]**

(ii) Sally leaves the slider at position **B**.

The bulb carries a current of 1.5A. The resistance of the bulb is 6Ω.

Calculate the voltage across the bulb.

Put a tick (✓) in the box beside the correct answer.

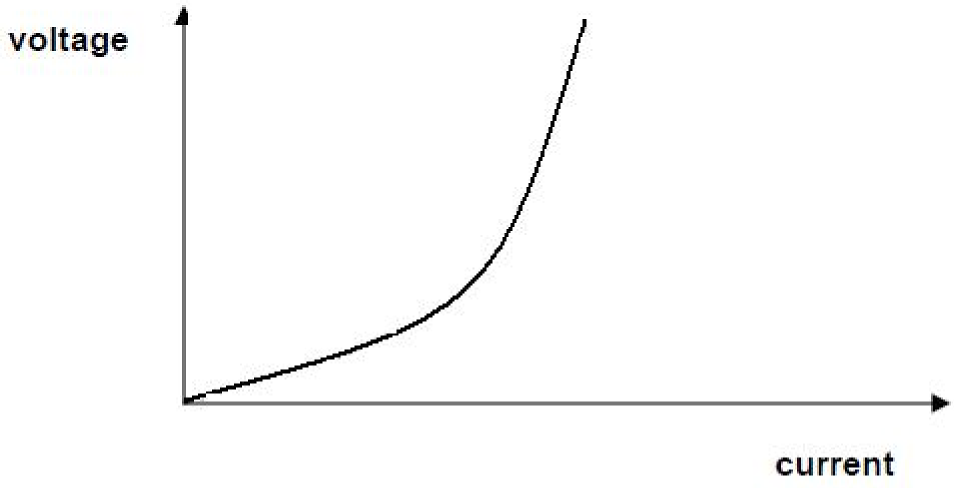
voltage in V	**tick the correct box**
0.5	
2.0	
3.0	
9.0	
18.0	

[1]

(iii) Sally increases the voltage in her circuit.

This changes the current in the bulb.

Look at the graph of her results.



She expects a straight line graph.

The graph is curved because the resistance of the bulb increases.

Use kinetic theory to explain why the resistance of the bulb increases.

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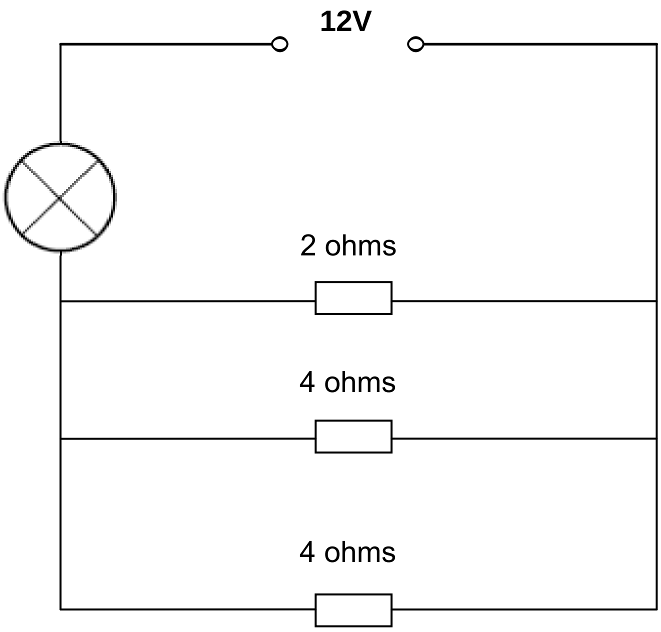
.... **[3]**

(b) Sally builds another circuit.

This time she uses three resistors.

Look at the diagram.



Calculate the **total resistance** of the three resistors.

Show your working.

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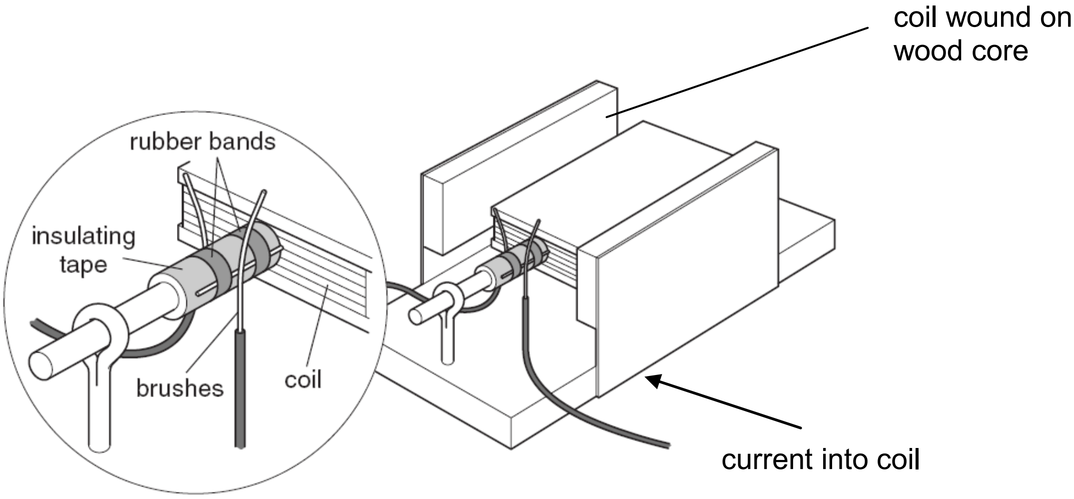
answer .... Ω **[2]**

[Total: 7]

12 Declan builds an electric motor.

Look at the diagram of his electric motor.



Declan connects the motor to a DC power supply.

It spins round slowly. Declan wants to make the motor spin **faster** in the **opposite** direction.

Explain how the forces on the current-carrying coil in the magnetic field cause the coil to rotate and how Declan could make the motor spin faster **and** in the opposite direction.

✐ *The quality of written communication will be assessed in your answer to this question.*

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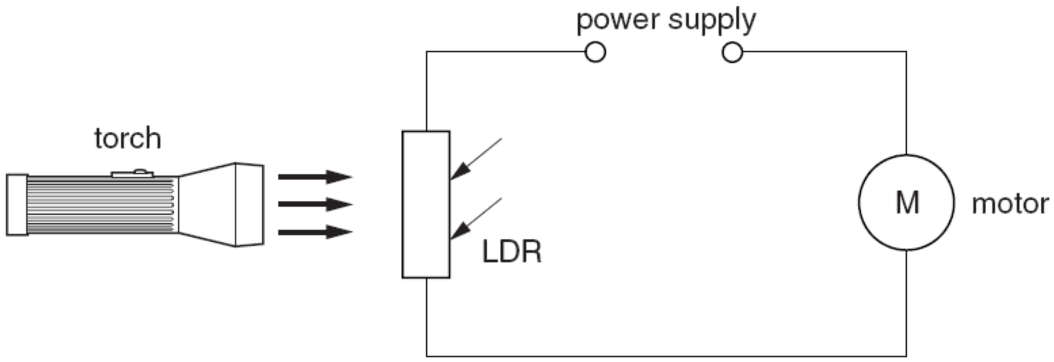
.... **[6]**

[Total: 6]

13 (a) Dan builds a circuit using an LDR.

Look at the diagram.



Dan switches on the torch.

Describe what effect this will have in the circuit.

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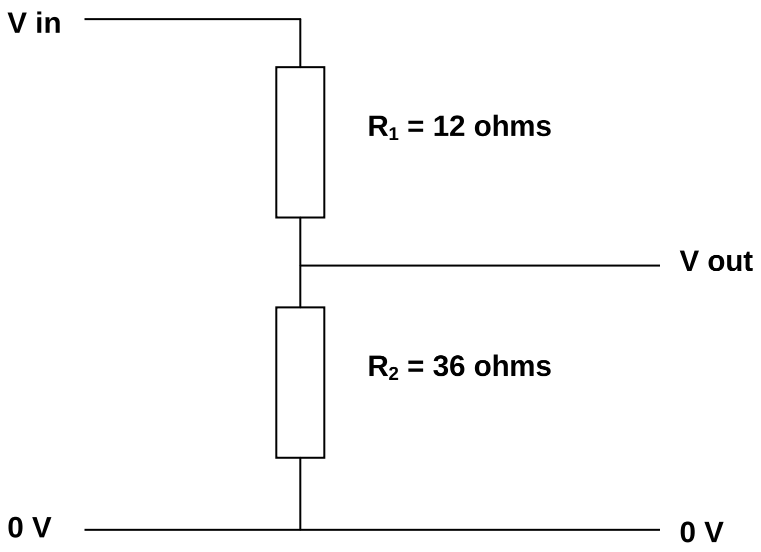
.... **[2]**

(b) Dan uses a potential divider in a circuit.

Look at the information in the diagram.



The **input** voltage = 5 V.

Calculate the **output** voltage.

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....

answer .... V **[2]**

[Total: 4]

14 Bill has a programmable washing machine.

A combination of logic gates controls the motor in the washing machine.

The motor in the washing machine runs on a 230 V mains voltage.

A relay is connected between the logic gates and the motor circuit.

230V

Diagram deleted (not shown on track changes)

Explain why the relay is needed.

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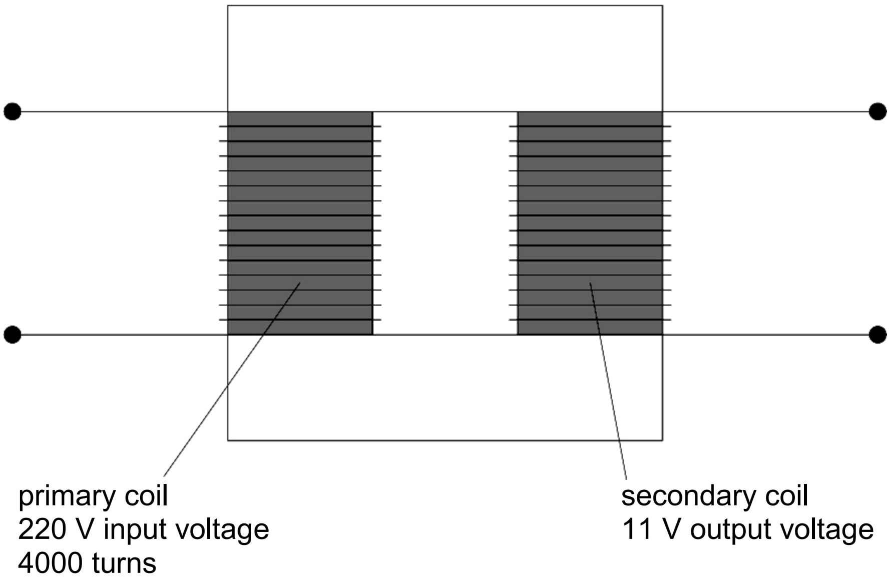
.... **[2]**

[Total: 2]

15 This question is about transformers and power transmission.

Look at the diagram of a transformer.



(a) Calculate the number of turns in the secondary coil.

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....

answer .... turns **[2]**

(b) A town requires 100 000 000 W of electrical power from a power station.

Transformers at the power station step up the voltage to thousands of volts.

Look at the information in the table about transmission of power to the town.

The information compares two possible supply voltages (20 000V and 400 000V).

power requirements of town (W)	100 000 000	
supply voltage (V)	20 000	400 000
current needed (A)	5 000	250
power loss in cables due to heating (W)	75 000 000	187 500
efficiency of transmission (%)	57.1	99.8

It is more efficient to transmit at 400 000V.

Explain why.

Use relevant equations in your answer.

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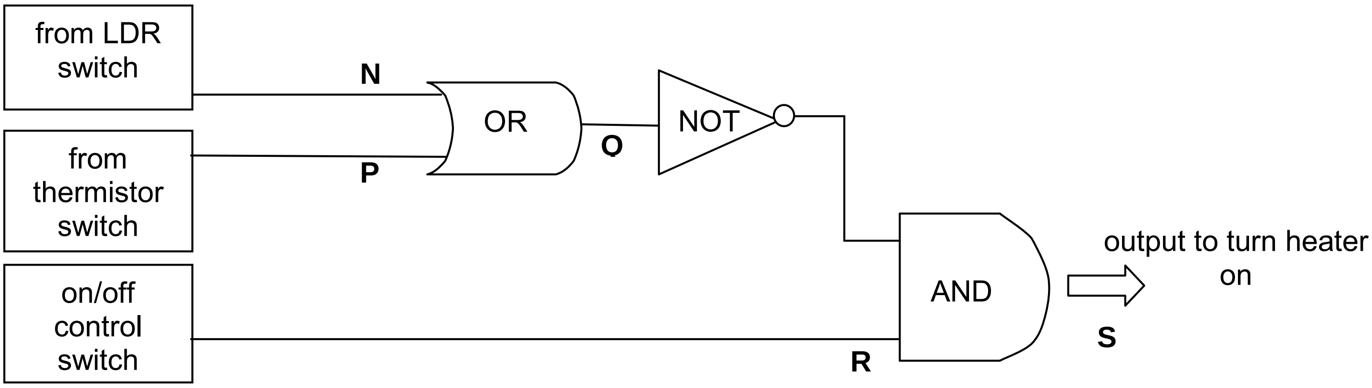
.... **[3]**

[Total: 5]

16 A farmer grows strawberries in large greenhouses.

He wants to protect the strawberry plants if it becomes cold at night.

Look at the circuit diagram.



Truth tables can explain how an electronic system works.

Complete the truth table for the above system.

inputs			Q	S
N	**P**	**R**		
0	**0**	**0**		
0	**1**	**0**		
0	**0**	**1**		
1	**0**	**0**		
1	**1**	**1**		

[1]

[Total: 1]

Section D

17 (a) Amy measures her resting pulse rate.

She counts her pulse for 15 seconds. She does this three times.

Amy uses each measurement to calculate her pulse rate in **beats per minute** (bpm).

She now has three values for her pulse rate in bpm.

The table shows her results.

	number of pulses in 15 seconds	pulse rate in beats per minute
1st measurement	18	72
2nd measurement	17	68
3rd measurement	19	76

Neil measures his resting pulse rate.

He counts his pulse for 60 seconds (1 minute).

He does this three times.

The table shows his results.

	pulse rate in beats per minute
1st measurement	66
2nd measurement	67
3rd measurement	65

Compare the methods used by Amy and Neil for measuring pulse rate.

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....

.... **[2]**

(b) Neil and Amy want to compare their fitness levels.

First, they measure their resting pulse rates.

Then they exercise by doing press-ups for one minute.

Then they measure their pulse rates every minute for five minutes.

The table shows their results.

		pulse rate in bpm					
	resting pulse rate in bpm	straight after exercise	1 min after exercise	2 min after exercise	3 min after exercise	4 min after exercise	5 min after exercise
Neil	66	110	82	68	66	66	66
Amy	72	128	114	102	92	84	78

Look at the table.

Who is the fittest, Neil or Amy?

Explain your answer using data from the table.

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.... **[2]**

(c) Amy looks at some data for 1578 teenage girls.

The girls were divided into 5 groups depending on their Body Mass Index (BMI) scores.

Each group carried out 4 fitness tests.

The table shows the **mean** results for each group.

fitness tests	very underweight	underweight	normal weight	overweight	obese
	BMI <17	BMI 17-18.4	BMI 18.5-24.9	BMI 25.0-29.9	BMI ≥30
push-ups in count per min	30.4	29.4	27.9	23.9	17.3
sit-ups in count per min	30.0	31.7	31.9	30.1	22.4
sit-and-reach in cm	30.2	32.0	32.4	32.6	31.0
distance run in 9min in m	1371.9	1382.1	1358.5	1242.9	1140.0

K-K Mak et al. BMC Public Health 2010, 10:88

(i) Amy says that people with lower BMIs have higher fitness levels.

Is Amy correct? Explain your answer.

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....**[3]**

(ii) Amy's BMI is 29.3.

Amy uses the table to predict that she will do 30.1 sit-ups in a minute in a sit-up test.

Is this a reasonable prediction for Amy for this test?

Explain your answer.

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....**[3]**

[Total: 10]

[Paper Total: 85]

END OF QUESTION PAPER

PERIODIC TABLE

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.

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SPECIMEN **H**

GENERAL CERTIFICATE OF SECONDARY EDUCATION

B762/02

FURTHER ADDITIONAL SCIENCE B

Unit B762/02: modules B6, C6, P6 (Higher Tier)

MARK SCHEME

Duration: 1 hour 30 minutes

MAXIMUM MARK 85

This document consists of 16 pages

Guidance for Examiners

Additional guidance within any mark scheme takes precedence over the following guidance.

1. Mark strictly to the mark scheme.
2. Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise.
3. Accept any clear, unambiguous response which is correct, e.g. mis-spellings if phonetically correct (but check additional guidance).
4. Abbreviations, annotations and conventions used in the detailed mark scheme:

   / = alternative and acceptable answers for the same marking point
   (1) = separates marking points
   not/reject = answers which are not worthy of credit
   ignore = statements which are irrelevant – applies to neutral answers
   allow/accept = answers that can be accepted
   (words) = words which are not essential to gain credit
   <u>words</u> = underlined words must be present in answer to score a mark
   ecf = error carried forward
   AW/owtte = alternative wording
   ora = or reverse argument

   e.g. mark scheme shows 'work done in lifting / (change in) gravitational potential energy' (1)
   work done = 0 marks
   work done lifting = 1 mark
   change in potential energy = 0 marks
   gravitational potential energy = 1 mark

5. If a candidate alters his/her response, examiners should accept the alteration.
6. Crossed out answers should be considered only if no other response has been made. When marking crossed out responses, accept correct answers which are clear and unambiguous.

Question			Expected answers	Marks	Additional guidance
1	(a)		because earthquakes damage water supplies / sewage systems / AW (1) this means water supplies mix with sewage allowing transmission of cholera (1)	2	**answers must link damaged sewage / water systems to transmission of cholera to gain full credit** **ignore** other methods of transmission
	(b)		**Level 3** Describes process in detail including explanation of the roles of restriction enzymes and ligase enzyme. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Quality of written communication does not impede communication of the science at this level. (5–6 marks) **Level 2** Limited description of the process including correct explanation of role of either restriction enzymes **or** ligase enzyme. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. Quality of written communication partly impedes communication of the science at this level. (3–4 marks) **Level 1** Limited description of the process without reference to the type and role of enzymes. Answer may be simplistic. There may be limited use of specialist terms. Quality of written communication impedes communication of the science at this level. (1–2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include:** • identification of a desired gene in another species • removal of gene from DNA • cutting open the DNA in the potato • restriction enzymes used to cut out the gene and cut open potato DNA • sticky ends produced at the end of the DNA strands • inserting the new gene into the DNA • ligase enzyme used to join DNA together so potato contains new gene • gene works in the potato to produce the medicine
			Total	**8**	

Question			Expected answers	Marks	Additional guidance
2	(a)		(low sucrose) will be sweeter (1)	1	
	(b)	(i)	because acidic conditions change the shape of enzyme / active site (1) causing enzymes to be denatured (1)	2	**answer must link change to enzyme to denaturing in acidic conditions to gain full credit** **allow** reference to irreversible changes (1) **ignore** enzymes don't work as well / are damaged **ignore** powder is denatured **not** enzymes killed
		(ii)	because pineapple juice contains enzyme / protease (1) so the (enzyme / protease) breaks down / digests gelatine (1) this (breakdown / digestion) only occurs at low temperatures (37°C) / does not occur at high temperatures (70°C) / AW (1) because the enzyme denatures / changes shape at high temperature (70°C) / ORA (1)	4	**answers must be linked and in order to gain full credit** **allow** enzymes cannot react with substrate / protein at high temperatures (1)
			Total	**7**	

Question			Expected answers	Marks	Additional guidance
3	**(a)**		(in all concentrations) the amoeba absorbs water (by osmosis) (1) in the more concentrated salt solution the amoeba takes up water more slowly (so less to empty) (1) (because) in the more concentrated salt solution there is less difference in concentration between the amoeba and the solution (1)	3	**allow** in the more concentrated salt solution the amoeba takes up less water
	(b)		(contractile) vacuoles might not all be same size / AW (1)	1	
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
4	(a)		15.6 (%) (1) evidence of total sugar equalling 3kg which equals 0.3kg per litre (1)	2	
	(b)	(i)	(no – mark) Initially / from 0.1 to 0.2 as concentration of sugar doubles alcohol concentration doubles so is directly proportional; however, at higher sugar concentrations when the sugar concentration increases by 50% the alcohol concentration increases by 39.3% or less than 50% / AW (2) OR from sugar concentration of 0.1 to 0.3 the alcohol concentration does not triple (1)	2	'yes' scores 0 **allow** answers in terms of other equivalent correct calculations answers which do not identify change in proportionality with increasing sugar concentration limited to 1 mark, i.e. do not identify the initial proportional relationship
		(ii)	(no – no mark) not all sugar had fermented to alcohol (1) because high concentration of alcohol (starts to) kill the yeast (1)	2	
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
5	(a)		oxygen (1)	1	**allow** O_2
	(b)		$2H^{+} + 2e^{-} \rightarrow H_2$	1	**allow** any correct multiple including fractions **allow** = for arrow **not** and or & for +
	(c)		prediction of 20 (seconds) (1) because temperature not relevant and time inversely proportional to the current used / temperature not important factor and current x 3 from 1 so time ÷ 3 (1)	2	
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
6	(a)		glucose → ethanol + carbon dioxide (1)	1	**not** sugar **not** alcohol
	(b)		because the reaction is catalysed by enzymes (1) if the temperature is too low the yeast is inactive and if too high the enzymes are denatured / and at these temperatures the enzyme is most effective (1)	2	answers must link change in temperature to the presence of enzymes to gain full credit just optimum temperature is not sufficient **allow** enzyme molecule loses shape **allow** if temperature is below 20°C yeast inactive and if above 50°C the yeast will die (1) **not** enzyme is killed
	(c)		C_2H_5OH / C_2H_6O (1)	1	**allow** any order of atoms **not** C^2H^5OH / C^2H^6O / C2H5OH / C2H6O
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
7	(a)		iron + oxygen + water → hydrated iron (III) oxide (1)	1	**allow** mix of formulae and names $Fe + O_2 + H_2O \rightarrow Fe_2O_3.H_2O$ **allow** = sign for arrow **not** and / & for +
	(b)		Fe loses electrons and O_2 or H_2O gains electrons / electrons are transferred from iron to oxygen or water (1)	1	**not** electrons are lost and electrons are gained / electrons are transferred **but** 'electrons are lost from the first equation and gained in the second equation' is sufficient
			Total	**2**	

Question			Expected answers	Marks	Additional guidance
8			because boiled tap water needs less soap than un-boiled tap water it must contain temporary hardness (1) however, because boiled tap water still needs more soap than distilled water it still has hardness in it, so also contains permanent hardness (1)	2	both marking points needed, in either order, for 2 marks; however, either of the marking points alone scores 1 mark
			Total	**2**	

Question			Expected answers	Marks	Additional guidance
9	(a)	(i)	any year between 1988 and 1993 (1)	1	
		(ii)	**any two from:** there was not enough evidence to make the theory convincing (1) there were other alternative theories to consider (1) scientists had to have their work peer reviewed (1)	2	**allow** there were social or economic pressures on the government to oppose the ban
		(iii)	level in 2010 is in range 12.3–12.7 so it will take 91 to 94 years (1) so by 2101 to 2104 it should be zero (1)	2	**allow** starting from any value from 1990 onwards and so will have to apply appropriate ecf – read off graph, then divide by 0.135 to get number of years (1) and then add this to the original year (1) **allow** ecf from wrong number of years
	(b)	(i)	$O_3 \rightarrow O + O_2$ (1)	1	**allow** any correct multiple
		(ii)	the breakdown of a CFC needs UV light and at ground level most UV light has been removed (by the ozone layer) (1)	1	CFCs are inert is **not sufficient**
			Total	**7**	

Question			Expected answers	Marks	Additional guidance
10			**Level 3** Accurate electrode equations included for both electrodes and a detailed explanation of the advantages and disadvantages focusing on at least two different areas, e.g. energy transfer, pollution, availability etc. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Quality of written communication does not impede communication of the science at this level. (5–6 marks) **Level 2** An attempt at electrode equations for both electrodes and a limited explanation of the advantages and advantages of fuel cells focusing on at least one area, e.g. energy transfer or pollution etc. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. Quality of written communication partly impedes communication of the science at this level. (3–4 marks) **Level 1** Some relevant equations included and gives only a simplistic explanation of the advantages and disadvantages. Answer may be simplistic. There may be limited use of specialist terms. Quality of written communication impedes communication of the science at this level. (1–2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include:** **electrode equations**: • positive (+ve) electrode: $O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$ • negative (-ve) electrode: $H_2 + 2OH^- \rightarrow 2H_2O + 2e^-$ • $2H_2 + O_2 \rightarrow 2H_2O$ **advantages** • energy released as electricity rather than as heat • fuel cell produces electricity more efficiently / more direct energy transfer • uses hydrogen, a renewable resource • does not produce carbon dioxide, a greenhouse gas when generating electricity • produces water which is not polluting **disadvantages** • construction involves use of poisonous or toxic materials • disposal problems when fuel cells are finished in terms of the poisonous nature of some chemicals used • need to use energy to make hydrogen • potential difficulties of storing hydrogen • overcoming the general public concern over the use of hydrogen **allow** less polluting as a low level response / has a lower carbon footprint **ignore** fuel cell is environmentally friendly / is greener / references to cost unless qualified / can run for ever
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
11	(a)	(i)	the brightness increases because there is less resistance / there is more current (1)	1	
		(ii)	9 (V) /✓ in second to last box (1)	1	if end column is blank **allow** correct answer ticked circled or underlined
		(iii)	because increased current increases collisions between charge carriers/electrons and atoms (1) this causes more atomic vibration / increased temperature / AW (1) more atomic vibration/higher temperature further increases number of collisions which means there is more resistance (1)	3	**marking points must be linked and in order to gain full credit** **allow** references to ions in place of atoms
	(b)		1Ω (2) but if answer **incorrect** used $\frac{1}{R} = \frac{1}{2} + \frac{1}{4} + \frac{1}{4}$ (or $\frac{1}{R} = \frac{1}{2} + \frac{1}{2}$) (1)	2	**allow** 2 x 4Ω resistors in parallel is equivalent to a 2Ω resistor in series (1)
			Total	**7**	

<table>
<tr><th colspan="3">Question</th><th>Expected answers</th><th>Marks</th><th>Additional guidance</th></tr>
<tr><td>12</td><td>✎</td><td></td><td>Level 3
Comprehensive explanation of the action of forces and of a broad range of methods for increasing speed. Application of knowledge about current and field to bring about a change in direction. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Quality of written communication does not impede communication of the science at this level.
(5–6 marks)

Level 2
Limited explanation of the action of forces and of a range of methods for increasing speed. Application of knowledge about current or field to bring about a change in direction. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. Quality of written communication partly impedes communication of the science at this level.
(3–4 marks)

Level 1
Explanation incomplete including factors that affect speed or direction. Answer may be simplistic. There may be limited use of specialist terms. Quality of written communication impedes communication of the science at this level. (1–2 marks)

Level 0
Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</td><td>6</td><td>relevant points include:

forces on the coil
• forces in opposite directions on opposite sides of coil
• produce rotation
• sides at right angles to (magnetic) field for maximum force

speed of rotation increased by stronger (magnetic) field
• stronger magnets
• higher current
• more turns on coil/more turns/m
• adding a (soft) iron core

allow more powerful magnets
higher voltage
more coils
bigger coil area

ignore bigger magnets
stronger current
more wire

direction of rotation
• reverse direction of magnetic field
• reverse current direction
• interaction of current and field direction determines the direction of rotation

allow swap magnets around
reverse connections to electricity or voltage supply
higher level answers making correct reference to Fleming's Left Hand Rule.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>6</td><td></td></tr>
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Question			Expected answers	Marks	Additional guidance
13	(a)		resistance of LDR goes down / current goes up (1) motor speeds up (1)	2	**allow** motor starts for second marking point
	(b)		3.75 (V) scores (2) but if answer is **incorrect** 5 x 36/(12 + 36) / 5 x 3/4 (1)	2	
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
14			because the logic gates will be damaged due to exposure to high voltage/mains power (1) because a relay isolates the logic gates and uses a low voltage from the logic gates to switch the high voltage to the motor (1)	2	answers must link use of relay to isolating logic gates from mains power to gain full credit
			Total	**2**	

Question			Expected answers	Marks	Additional guidance
15	(a)		200 (2) but if answer is **incorrect** 4000 x (11 ÷ 220) (1)	2	
	(b)		idea of higher output voltage from transformer produces a lower current from I_s = IpVp / Vs / ORA / current at higher voltage less by a factor of 20 (1) **then** at higher voltage or lower current there is less heat / power / energy loss in cables because loss depends on I^2 / power loss less by a factor of $400/20^2$ (1) **then** idea that therefore low current decreases losses which increases efficiency (1)	3	answers must be in correct order to gain full credit
			Total	**5**	

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</td><td>1</td><td>all values need to be correct</td></tr>
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Question			Expected answers	Marks	Additional guidance
17	(a)		the first method is quicker / ora (1) the first method has less chance of miscounting / less accurate / ora (1) the first method is less precise / will only get final values that are multiples of 4 / ora (1)	2	
	(b)		Neil (no mark) Neil returned to resting value after 2 / 3 min (1) but Amy still had not returned to resting after 5 min / AW (1) Neil's pulse rate returned to resting level quicker than Amy's (1)	2	answers must support conclusion to gain full credit **ignore** simply 'Neil increased by less'
	(c)	(i)	correct description of a trend / pattern from the table (1) idea that different tests give different trends (1) idea that there may be other factors involved (1) idea that conflicting evidence leads to different conclusions / there is a level of uncertainty in the conclusion (1)	3	
		(ii)	unlikely / AW (no mark) 30.1 is an average for a group (1) a person can not do 30.1 sit-ups / AW (1) she is close to the top of the BMI range so should expect to be below average for that range (1) Amy may be good or poor at sit-ups / not an average performer (1) Amy may be older or younger than the girls tested (1)	3	
			Total	**10**	

Assessment Objectives (AO) Grid

(includes quality of written communication ✐)

Question	AO1	AO2	AO3	Total
1(a)	1	1		2
1(b) ✐	6			6
2(a)		1		1
2(b)(i)	2			2
2(b)(ii)		4		4
3(a)		3		3
3(b)		1		1
4(a)		2		2
4(b)(i)			2	2
4(b)(ii)	1	1		2
5(a)	1			1
5(b)	1			1
5(c)		2		2
6(a)	1			1
6(b)	2			2
6(c)	1			1
7(a)	1			1
7(b)	1			1
8			2	2
9(a)(i)		1		1
9(a)(ii)		2		2
9(a)(iii)		2		2
9(b)(i)		1		1
9(b)(ii)		1		1
10✐	5	1		6
11(a)(i)	1			1
11(a)(ii)		1		1
11(a)(iii)	2	1		3
11(b)		2		2
12✐	4	2		6
13(a)	1	1		2
13(b)		2		2
14	1	1		2
15(a)	1	1		2
15(b)	1		2	3
16		1		1
17(a)			2	2
17(b)			2	2
17(c)(i)			3	3
17(c)(ii)			3	3
Totals	**34**	**35**	**16**	**85**