OCR

SPECIMEN F

GENERAL CERTIFICATE OF SECONDARY EDUCATION

B762/01

FURTHER ADDITIONAL SCIENCE B

Unit B762/01: modules B6, C6, P6 (Foundation 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 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 **32** pages. Any blank pages are indicated.

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

EQUATIONS

energy = mass × specific heat capacity × temperature change

energy = mass × specific latent heat

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

wave speed = frequency × wavelength

power = voltage × current

energy supplied = power × time

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

distance = average speed × time

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

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

force = mass × acceleration

weight = mass × gravitational field strength

work done = force × distance

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

power = force × speed

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

momentum = mass × velocity

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

GPE = mgh

$$mgh = \tfrac{1}{2}\, mv^2$$

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

$$v = u + at$$

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

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

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

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

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

$$I_e = I_b + I_c$$

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

power loss = (current)^2 × resistance

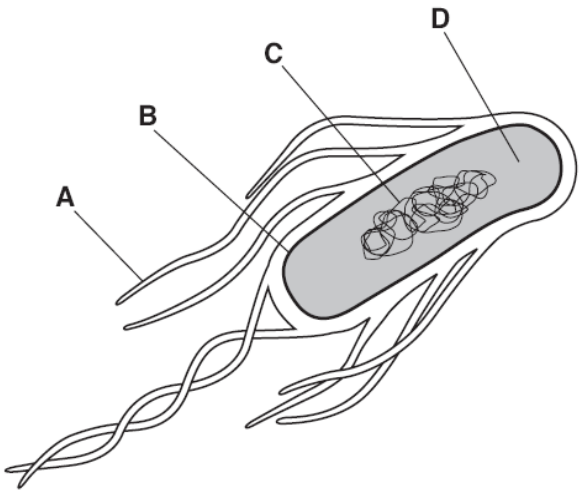
$$V_pI_p = V_sI_s$$

Answer **all** the questions.

Section A – Module B6

1 (a) Sewage can contain bacteria called coliforms.

A coliform is shown in the diagram.



(i) Look at the diagram.

Which labelled part is a flagellum?

Choose **A**, **B**, **C** or **D**.

answer ..... **[1]**

(ii) On the diagram, the coliform is shown 90 mm long.

It is shown on the diagram 30 000 times larger than in real life.

Light microscopes can be used to see things as small as 0.3 microns (0.0003mm).

Use calculations to show that a light microscope can be used to count the number of coliforms in a sample.

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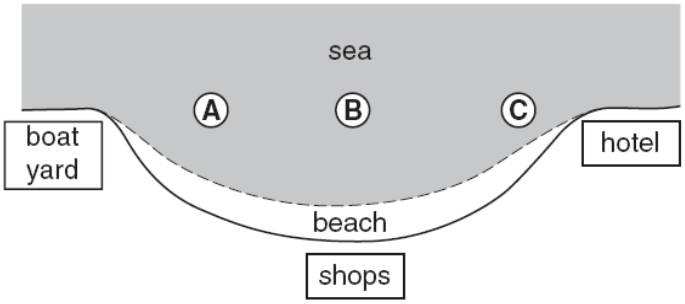
..... **[2]**

(b) Coliforms can be found in sea water if sewage is released into the sea.

The number of coliforms in samples from the sea near beaches is counted.

This tells people whether it is safe to swim.

The drawing shows an area around a beach.



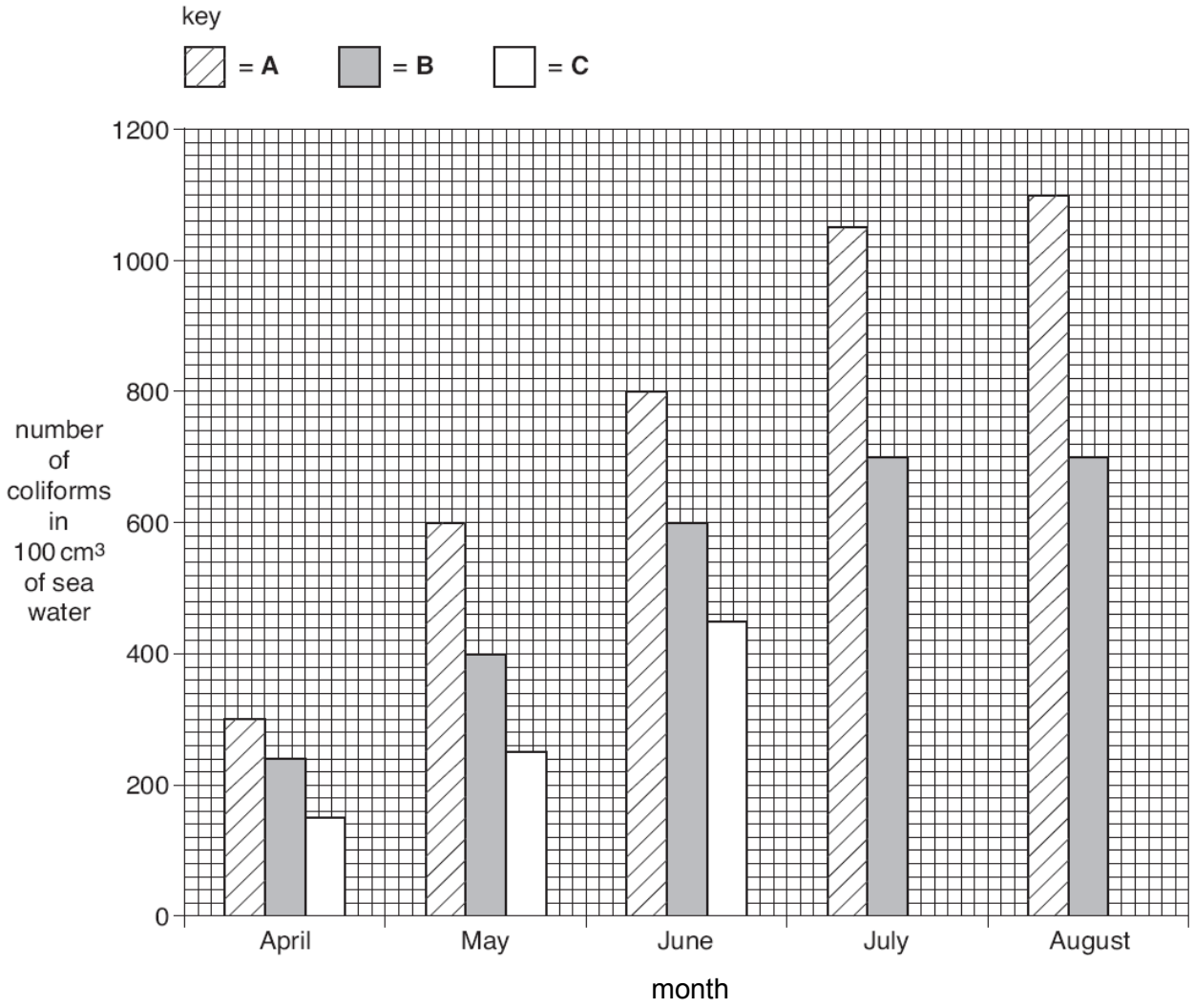
The sea water has been sampled at points A, B and C.

The table shows the results for point **C**.

month	**number of coliforms in 100 cm^3 of water at point C**
April	150
May	250
June	450
July	500
August	300

(i) The bar chart shows the number of coliforms found in the sea at sample sites **A**, **B** and **C**.

Use the information in the table to draw the **two** bars on the bar chart for point **C** in July and August. **[1]**



(ii) The beach is closed to people if the number of coliforms goes above 1000 in 100 cm^3 of water.

During which **two** months is the beach closed?

..... and ..... **[1]**

(iii) Scientists think that the sewage may be leaking from **one** of the three buildings near the beach.

Look at the graph and the drawing of the beach area.

Write down which building the sewage **probably** comes from.

Explain your answer.

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..... **[2]**

(iv) The scientists are **not certain** about which building the sewage is leaking from.

What could the scientists do to support their conclusion?

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..... **[1]**

[Total: 8]

2 Wine is made from grapes using micro-organisms.

Describe the process by which wine is made.

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

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..... **[6]**

[Total: 6]

3 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 genetically engineered the potato plants so they 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 potato plants used to make the new medicine have been **genetically engineered**.

Describe the process used to genetically engineer the potato plants.

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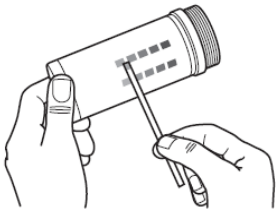
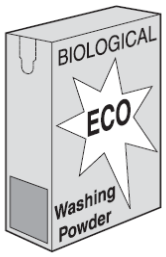
..... **[2]**

[Total: 4]

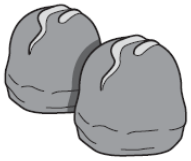
4 The diagrams show some products made using enzymes.



reagent testing strips for people with diabetes



biological washing powder



low sucrose chocolates

(a) Describe how people with diabetes use reagent testing strips.

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..... **[2]**

(b) 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]**

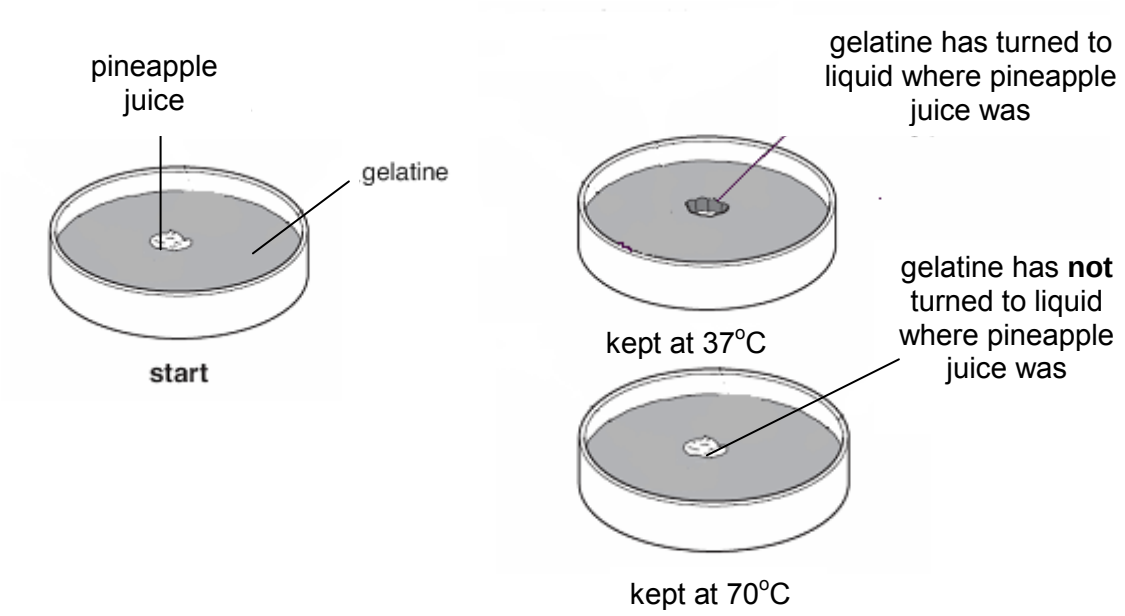
(c) Gerant decides to do an experiment with pineapple juice.

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]

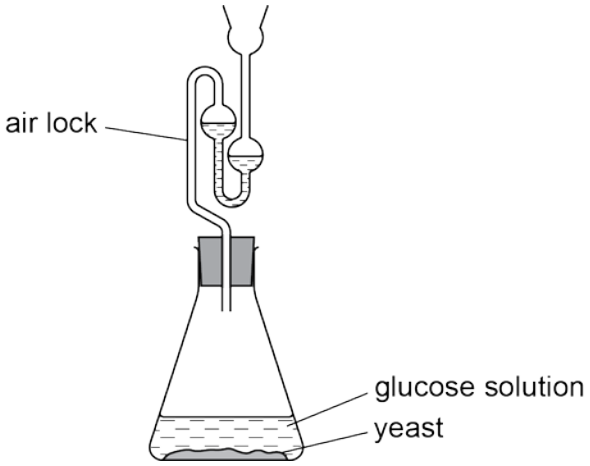
Section B – Module C6

5 Fermentation is used to make ethanol.

Sarah and Daniel investigate fermentation.

Look at the diagram.

It shows the apparatus they use.



(a) What are the optimum conditions for fermentation?

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..... **[2]**

(b) Fermentation is one way to make ethanol.

Write down one **other** way to make ethanol.

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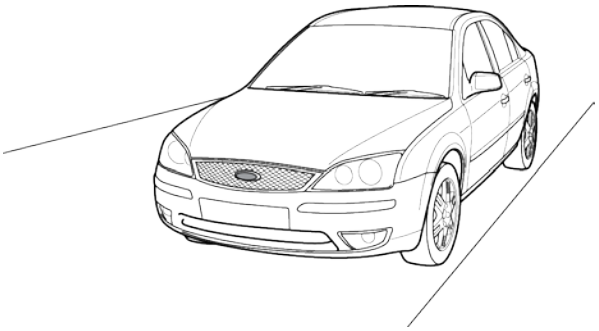
..... **[1]**

[Total: 3]

6 Look at the picture of a car.



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

One disadvantage of using iron is that it rusts.

Two substances react with iron to make rust.

Write down the names of these **two** substances.

Choose from

chlorine

hydrogen

nitrogen

oxygen

water

trichlorofluoromethane

answer .....and..... **[1]**

(b) Write down **two** methods of preventing rusting.

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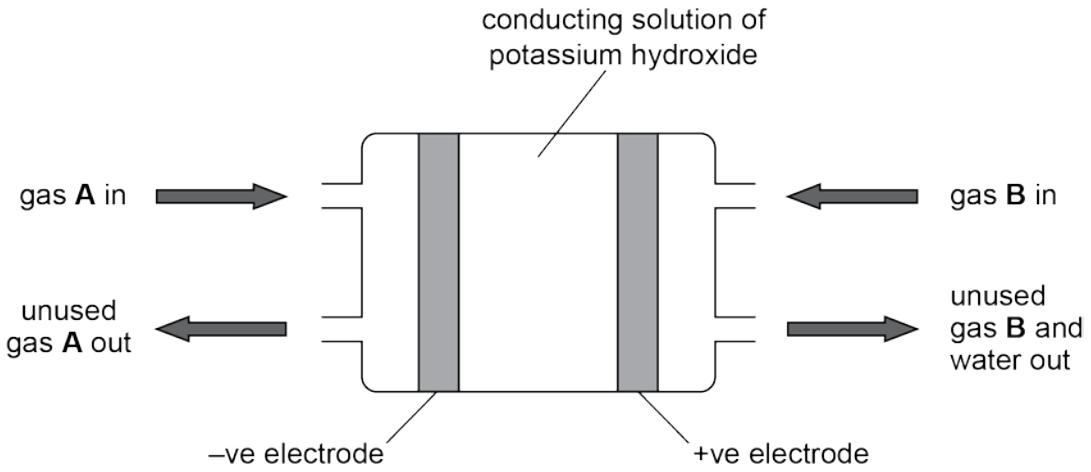
..... **[2]**

[Total: 3]

7 Look at the diagram of a fuel cell.



A fuel cell produces electrical energy.

(a) This fuel cell uses two gases to produce an electric current.

What is the fuel in this fuel cell?

..... **[1]**

(b) Most cars are powered by an engine that burns petrol.

Using a fuel cell to power a car instead of a petrol engine means the car's emissions are less polluting.

Explain why.

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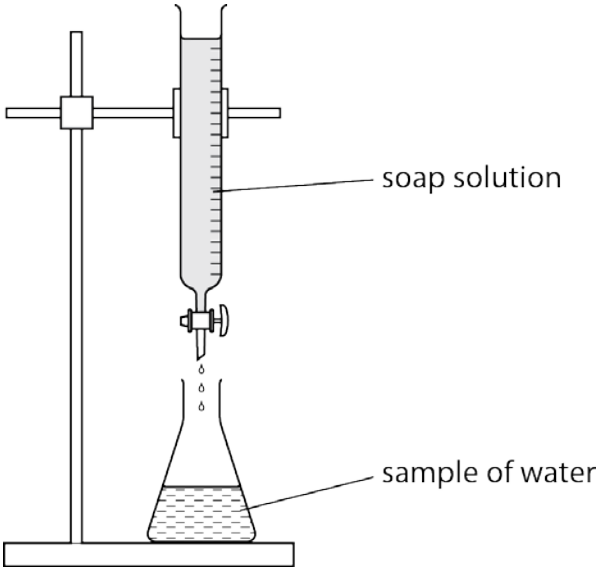
..... **[2]**

[Total: 3]

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 solution until a lather remains on the surface after shaking.

Look at their table of results.

sample of water	**volume of soap solution added in cm^3**
boiled tap water	15
spring water	18
river water	28
tap water	30
distilled water	5

(a) Luke and Henry tested distilled water as well as the four other water samples.

Suggest why.

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..... **[1]**

(b) Which sample of water is the softest?

Choose from

boiled tap water

river water

spring water

tap water

answer ..... **[1]**

(c) Tap water contains **both** temporary hardness and permanent hardness.

Explain how you can tell from the results.

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..... **[2]**

(d) Hardness is caused by dissolved ions in the water.

Put a (ring) around the name of **one** ion which causes hardness.

calcium

carbonate

chloride

hydrogen

magnesium

[1]

[Total: 5]

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

CFCs have been used as aerosol propellants and refrigerants.

This is because they have useful properties such as being non-poisonous.

(a) Explain, in terms of their properties, why CFCs were used as propellants and refrigerants.

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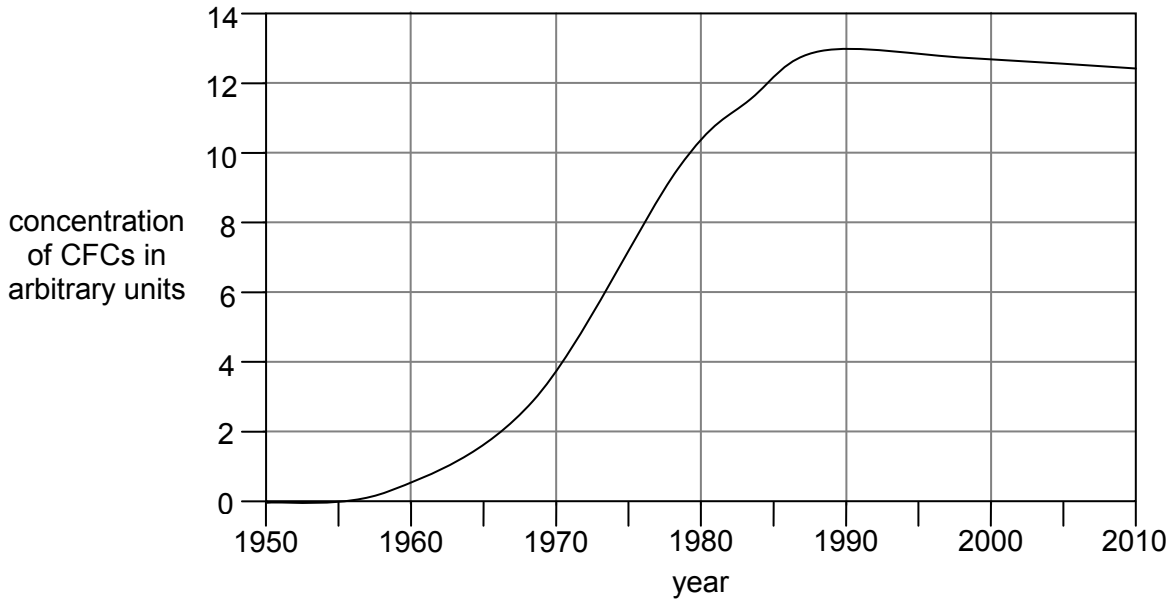
..... **[3]**

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

Look at the graph.

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



(i) Why has the UK government banned the use of CFCs?

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..... **[1]**

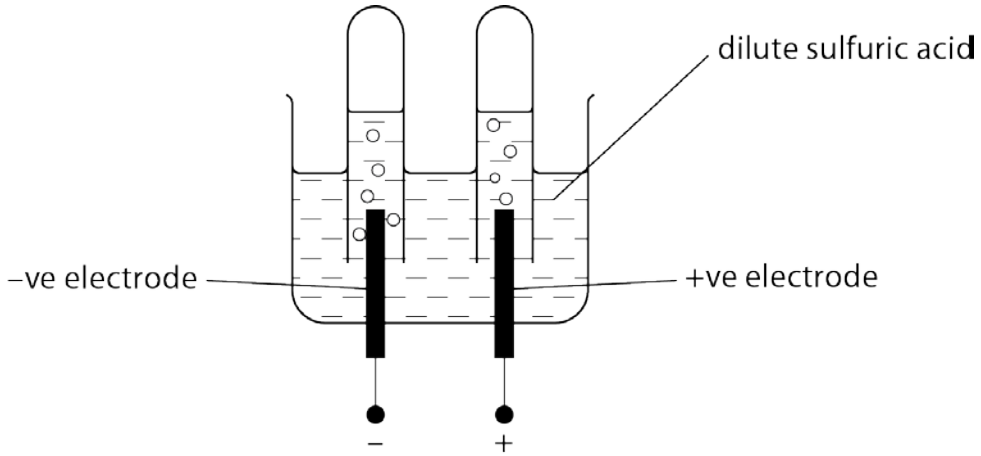
(ii) Use the graph to estimate in which year the UK ban on the use of CFCs started.

..... **[1]**

[Total: 5]

10 Harry investigates the electrolysis of dilute sulfuric acid.

Look at the apparatus he uses.



Hydrogen is made at the negative electrode.

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

He does five experiments.

He investigates three factors:

- the concentration of the dilute sulfuric acid
- the temperature of the dilute sulfuric acid
- the current used.

He keeps everything else the same.

Look at his table of results.

experiment number	concentration of acid in mol/dm^3	temperature of dilute sulfuric acid in ^{o}C	current used in amps	time taken to fill the test tube with hydrogen in seconds
1	1.0	10	1.0	60
2	1.0	15	1.0	60
3	1.0	15	2.0	30
4	1.0	15	4.0	15
5	2.0	15	4.0	15

What conclusions can be drawn from these results?

Explain how each conclusion is supported by the data.

✎ *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

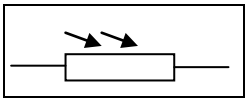
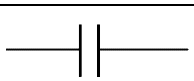
11 (a) Sally does some experiments about electricity in a physics lesson.

Sally's teacher gives her some cards to help her understand what some electrical components are used for. There are three sets of cards:

name of component	**component symbol**	**description of what the component does**

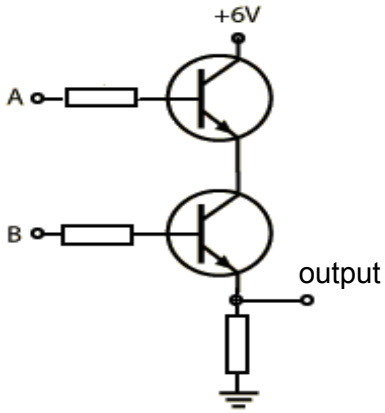
Draw straight lines to join each **name** to the correct **symbol**.

Draw straight lines from each **symbol** to the correct **description**.

name	**symbol**	**description**
capacitor		stores charge
thermistor		responds to a change in light
LDR		responds to a change in temperature

[2]

(b) (i) Look at the diagram of a logic gate.



What type of logic gate is shown in the diagram?

..... **[1]**

(ii) Describe how the inputs at **A** and **B** affect the behaviour of the two transistors, and the output of the logic gate.

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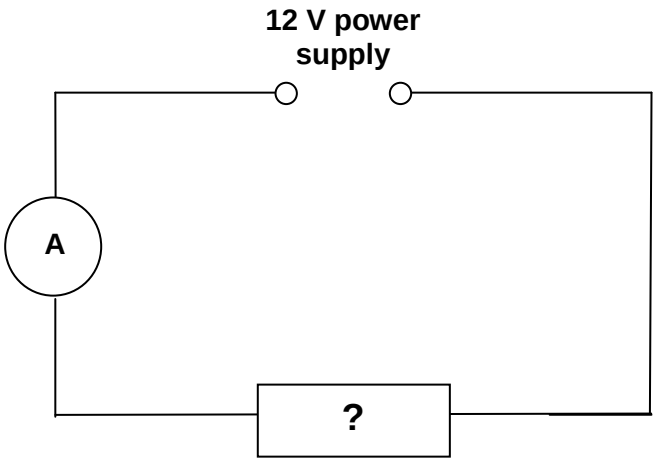
..... **[3]**

[Total: 6]

12 (a) Sally is investigating an unknown electrical component.

She builds a circuit and measures the current.

Look at the diagram.



She exposes the component to different temperature and light levels.

She records the current each time. Here are her results.

temperature in ^{o}C	light level	current in amps
0	normal	0.08
20	normal	0.12
75	normal	0.36
0	high	0.08
20	high	0.12

Use the data in the table to suggest what the unknown component could be.

Explain your answer.

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..... **[4]**

(b) (i) Sally replaces the unknown component with a bulb.

She switches the circuit on for a short time.

A current of 3.0 A passes through the bulb.

Calculate the **resistance** of the bulb.

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answer …….. unit..... **[2]**

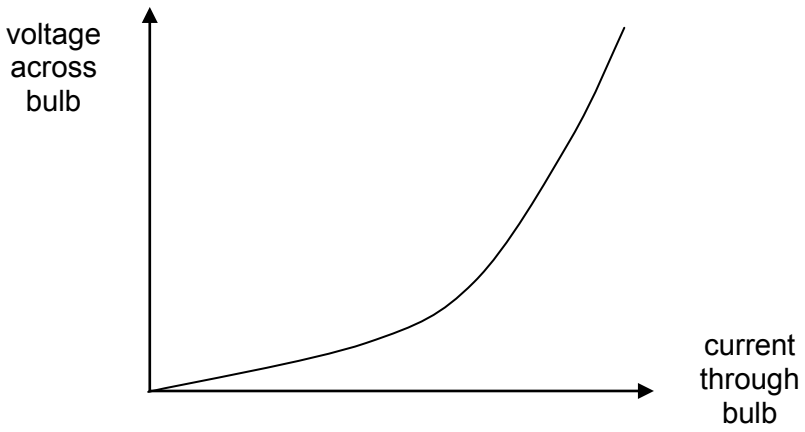
(ii) Sally switches the circuit back on.

She varies the voltage of the power supply.

She records the values of voltage and current for the bulb.

For each result she leaves the circuit switched on for a long time.

Look at the graph of her results.



What is happening to the resistance of the bulb and how is this shown by the graph?

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..... **[2]**

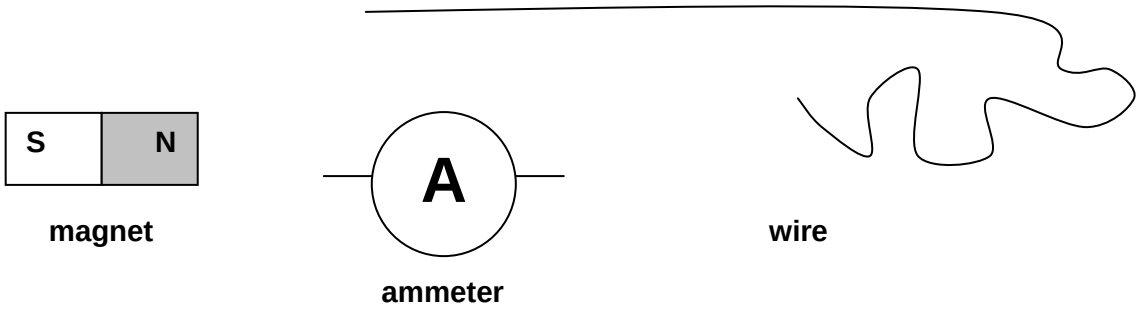
[Total: 8]

13 This question is about generating electricity.

(a) Dave has some scientific equipment.

He wants to **generate** electricity.

Look at the equipment.



Explain how he uses this equipment to generate a current and how he would know that a current is generated.

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..... **[2]**

(b) Electricity is generated in power stations.

It is supplied to homes through cables and transformers in the National Grid.

Before it can be used in houses the voltage must be reduced.

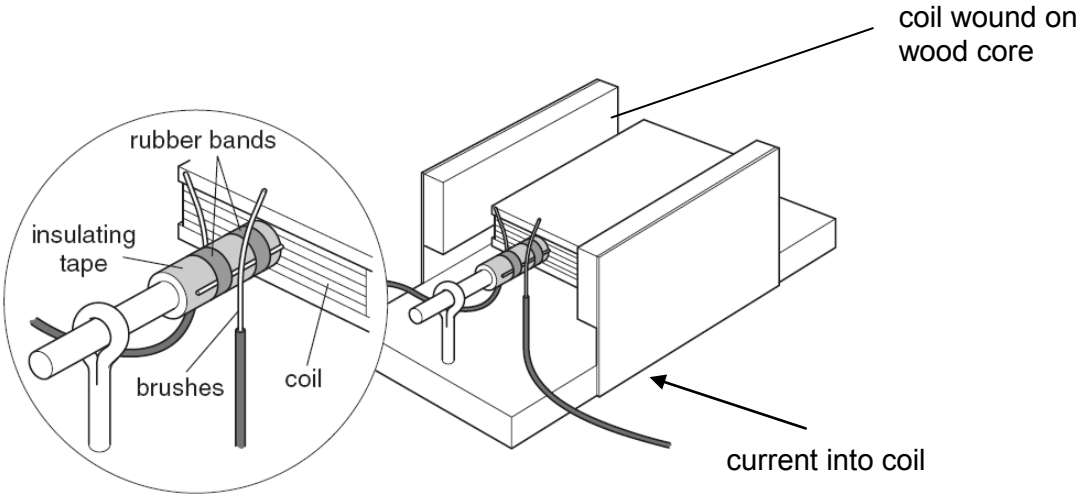
What is used to **reduce** the voltage?

..... **[1]**

[Total: 3]

14 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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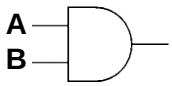
..... **[6]**

[Total: 6]

15 Gates are used to control electronic devices.

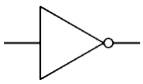
Here are the logic tables for two types of logic gate.

AND gate logic table



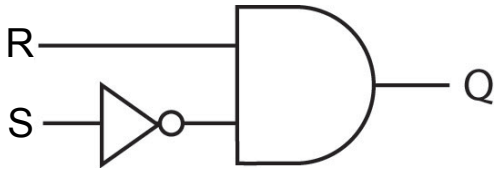
Input A	Input B	Output
0	0	0
0	1	0
1	0	0
1	1	1

NOT gate logic table



Input	Output
0	1
1	0

Logic gates can be combined to create new logic tables. For example, a **NOT** gate and an **AND** gate can be combined like this.



Complete the logic table for this combination. The first two rows have been done for you.

Input R	Input S	Output Q
0	0	0
0	1	0
1	0	
1	1	

[2]

[Total: 2]

Section D

16 This question is about measuring fitness levels.

(a) One way of measuring fitness is to calculate someone's **recovery rate.**

Recovery rate is a measure of how quickly after exercise the pulse rate returns to a resting level.

Recovery rate can be calculated using the formula:

$$\text{recovery rate} = \frac{\text{pulse rate during exercise} - \text{pulse rate after 1 minute}}{10}$$

The table shows how recovery rate relates to fitness level.

recovery rate	fitness level
less than 2	poor
2 to 2.9	fair
3 to 3.9	good
4 to 5.9	excellent
above 6	outstanding

Pulse rate is measured in beats per minute (bpm).

(i) Amy measures her pulse rate whilst running on a treadmill.

It is 120 bpm.

She stops running and measures her pulse rate one minute later.

Now it is 91 bpm.

Show that Amy's **fitness level** is 'fair'.

Show all your working clearly.

[1]

(ii) When Neil does the test, his recovery rate is 3.1, so his fitness level is 'good'.

Is Neil really fitter than Amy?

Explain your answer.

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..... **[2]**

(b) 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]**

(c) Neil and Amy want to measure their fitness levels in a different way.

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]**

(d) Amy and Neil have now measured their fitness levels using two different methods.

Evaluate these methods and the results they produce.

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..... **[3]**

[Total: 10]

[Paper Total: 85]

END OF QUESTION PAPER

PERIODIC TABLE

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						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

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

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SPECIMEN F

GENERAL CERTIFICATE OF SECONDARY EDUCATION

B762/01

FURTHER ADDITIONAL SCIENCE B

Unit B762/01: modules B6, C6, P6 (Foundation Tier)

MARK SCHEME

Duration: 1 hour 30 minutes

MAXIMUM MARK 85

This document consists of 20 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
   words = 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)	(i)	A (1)	1	**allow** ringed / underlined answer
		(ii)	(90/30000) = 0.003mm (1) therefore size of coliform > 0.0003mm (1)	2	
	(b)	(i)	both bars correctly drawn (1) (July = 500, August =300)	1	**allow** bars of any width drawn to correct height (+/- half square)
		(ii)	July and August (1)	1	**allow** answers either way round
		(iii)	boat yard (1) because most coliforms / bacteria are found in A / nearby (1)	2	**answers must link high number of coliforms to proximity to boatyard to gain full credit**
		(iv)	take more samples / collect samples over longer period of time / take samples from sewage pipes of buildings to compare with samples from sewage (1)	1	**allow** collect more evidence (1) if no other mark awarded **ignore** repeat the same / identical experiment again
			Total	**8**	

Question			Expected answers	Marks	Additional guidance
2	✎		**Level 3** Describes process of fermentation in detail in terms of anaerobic respiration and the need for keeping air and other micro-organisms out. 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** Describes reactants and products of fermentation and need for yeast and absence of oxygen. 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** Names fermentation and identifies that alcohol is made and yeast is used. 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:** • process is fermentation • yeast is used • alcohol is made • extracting sugar from source material • sugar / glucose is broken down • in the absence of oxygen • by anaerobic respiration • production of carbon dioxide • entry of air and other micro-organisms must be prevented **allow** higher level answers: • keeping fermentation warm • clarifying/clearing/drawing off the wine **ignore** any references to distillation or drinks produced by distillation unless linked to toxic effects of alcohol on yeast at high concentrations
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
3	(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)		removing a gene from one organism (1) and inserting it into the potato plant so the gene works in the potato plant (1)	2	
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
4	(a)		test their urine / blood (by dipping strip in) (1) **any one from:** for sugar / glucose against chart / by colour change (1) so that they know how much insulin to inject (1)	2	
	(b)		(low sucrose) will be sweeter (1)	1	
	(c)		pineapple juice contains enzyme / protease (1) so the (enzyme / protease) breaks down / digests gelatine (1) this (breakdown / digestion) only occurs at low temperatures (37^{o}C) / does not occur at high temperatures (70^{o}C) / AW (1) **because the enzyme** denatures / changes shape at high temperature (70^{o}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
5	(a)		20 – 50 ^{o}C (1) no oxygen (1)	2	**allow** must have water present
	(b)		hydration of ethene (1)	1	**allow** reacting ethene with steam **allow** hydrolysis of ethyl ethanoate
			Total	**3**	

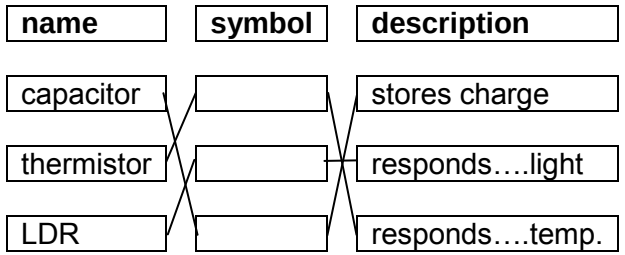
Question			Expected answers	Marks	Additional guidance
6	(a)		oxygen and water (1)	1	**allow** O_2 and H_2O **both** needed
	(b)		**any two from** use a layer of oil / grease the iron (1) paint over the iron (1) galvanising the iron / coating with zinc / coating with chromium (1) sacrificial protection / attach magnesium to iron (1) alloying / make stainless steel (1) tin plate / tinning (1)	2	**allow** chrome plating **ignore** keep iron away from water or oxygen / keep it dry
			Total	**3**	

Question			Expected answers	Marks	Additional guidance
7	(a)		hydrogen (1)	1	**allow** H_2
	(b)		because petrol engines make carbon dioxide / produce greenhouse gases / ora, but in a fuel cell water is the only waste product made which is not a pollutant (2) **OR** petrol engines make carbon dioxide/greenhouse gases / fuel cells make water (1)	2	**to gain 2 marks answers must include comparison of products from petrol engine and fuel cell** assume answer refers to a fuel cell unless specified otherwise **allow** produce oxides of nitrogen for petrol engines **ignore** environmentally friendly / less damaging to environment / greener
			Total	**3**	

Question			Expected answers	Marks	Additional guidance
8	(a)		as a control / to see how much soap is needed to make a lather with pure water / water can only be hard if it needs more soap than distilled water (1)	1	
	(b)		boiled tap water (1)	1	**allow** other ways of indicating boiled tap water but answer on answer line takes precedence
	(c)		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**
	(d)		calcium / magnesium (1)	1	**allow** correct response ticked or underlined
			Total	**5**	

Question			Expected answers	Marks	Additional guidance
9	(a)		**any three from** used as a refrigerant: because it is inert (1) because it has a low boiling point / easily compressed into a liquid (1) used as a propellant: because it does not burn / it is inert (1) because it is insoluble in water (1) because it is volatile (1)	3	**properties must be linked to uses to gain credit**
	(b)	**(i)**	(they agreed with scientists who told them) it causes ozone depletion (1)	1	**allow** scientists made them aware of the risks of ozone depletion
		(ii)	any year between 1988 and1993 (1)	1	
			Total	**5**	

Question			Expected answers	Marks	Additional guidance
10	✎		**Level 3** A comprehensive explanation which correctly recognises all the factors that change the time to collect the gas and link that to the evidence. Relationship between current and time quantified. 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** A detailed explanation which recognises some factors that change the time to collect the gas and link that to the evidence. 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** An attempt at an explanation which recognises some factors that change the time to collect the gas. No attempt to link to the evidence. 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:** • concentration does not change time because no change in time with experiments 3 and 4 • temperature does not change time because no change in time with experiments 1 and 2 • current does change time because of the change of time in experiments 2, 3 and 4 • as current increases the time decreases from experiments 2, 3 and 4 • as the current doubles the time halves **allow** higher level answer that current is inversely proportional to the time from experiments 2, 3 and 4 **allow** higher reference in terms of explanations, e.g. as current increases more charge is passed, temperature and concentration do not change the charge passed **allow** reference to the rate of electrolysis, e.g. electrolysis is quicker as current increases, temperature and concentration do not change the speed of electrolysis **ignore** reference to collision theory
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
11	(a)			2	name symbol and description all linked correctly all three correct 2 marks one or two correct 1 mark
	(b)	(i)	AND gate (1)	1	
		(ii)	refers to (small) current from **A** (or **B**) to base of (each) transistor (1) this causes (a greater) current from collector to emitter (1) need input from both **A** and **B** to get an output current (1)	3	**ignore** truth table, answers must describe behaviour of each transistor to gain full credit **allow** reference to current vertically / down through the transistor
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
12	(a)		thermistor (1) because changing the temperature changes the current / AW (1) and the change in current shows that the resistance must have changed (1) changing light level has no effect / AW (1)	4	**answers must link temperature, resistance and current to gain full credit for this question** **allow** 'changing the temperature, will change the resistance of a thermistor, and this change in resistance will cause a change in the current in the circuit' (2) as an alternative to 2nd and 3rd marking points **allow** cannot be LDR as an LDR does not respond to temperature (change) (1)
	(b)	(i)	4 (1) ohms/Ω (1)	2	
		(ii)	resistance is not constant / increases (at higher currents) / ora (1) the graph is a curve / not a straight line / gradient of graph is changing / AW (1)	2	**allow** higher level answers above target level, e.g. because V is not directly proportional to I, R must be changing (1)
			Total	**8**	

Question			Expected answers	Marks	Additional guidance
13	(a)		by placing the wire in complete circuit with the ammeter and moving the magnet/wire (1) this will show a current because there will be a reading on the ammeter (1)	2	magnet must **not** be in the circuit for the complete circuit mark **allow** higher level answers, e.g. move the wire so it cuts the magnetic field (1)
	(b)		step-down transformer (1)	1	step-down needed for the mark
			Total	**3**	

Question			Expected answers	Marks	Additional guidance
14	✎		**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 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)	6	**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/per 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.
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
15			1 (row 3) (1) 0 (row 4) (1)	2	
			Total	**2**	

Question			Expected answers	Marks	Additional guidance
16	(a)	(i)	((120 – 95)÷10 =) 2.9 so fitness level is 'fair'	1	
		(ii)	Yes or no or possibly (no mark) because recovery rate is above that of Amy / Amy's recovery rate is 2.9 but Neil's rate is 3.1 / fitness level for Amy is only 'fair' but fitness level of Neil is 'good' (1) because recovery rates are close to each other so within limits of uncertainty (1) no repeats taken so not average figures (1) there are different ways of measuring fitness and this is only one way (1)	2	**reasoning must be linked to answer to gain full credit**
	(b)		the first method is quicker / ora (1) the first method 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	
	(c)		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'
	(d)		first method only two values / limited amount of data used to assess fitness (1)	3	

			second method idea of more evidence / data (1) number of press-ups not counted so perhaps not a fair test (1) although two methods are used, they both indicate that Neil is fitter than Amy (1) do not take into account age or mass etc. (1)		**allow** idea of one being heavier / doing more work **allow** different exercises could be done for each method therefore results may not be conclusive (1) **allow** there is evidence from two different methods to support a conclusion / AW (1)
			Total	**10**	

Assessment Objectives (AO) Grid
(includes quality of written communication ✎)

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

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