OCR
RECOGNISING ACHIEVEMENT

SPECIMEN H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

SCIENCE B

B711/02

Unit B711: Science modules B1, C1, P1 (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 15 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 (✎).
- A list of equations can be found on page 2.
- The Periodic Table can be found on the back page.
- 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 **75**.
- This document consists of **28** 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			
Total			

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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

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

momentum = mass × velocity

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

GPE = mgh

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

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

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Answer **all** the questions.

Section A – Module B1

1 Deb is thirteen years old.

Her doctor has told her that she must eat enough protein each day.

(a) She can calculate her estimated average requirement (EAR) for protein in grams using the formula:

EAR in g = 0.6 × body mass in kg

Deb has a mass of 58 kg.

Look at the information about how much protein Deb eats in one day.

food	**protein content in grams**
breakfast cereal	5.0
salad sandwich	8.0
macaroni cheese pasta	13.9
rice pudding	3.0
tinned peaches	0.5

Does Deb meet her EAR for protein and is EAR an accurate measure of her protein requirement?

.....

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

(b) The doctor also tells Deb to make a note of which proteins are animal proteins and which are plant proteins.

He says that animal proteins are **first class proteins**.

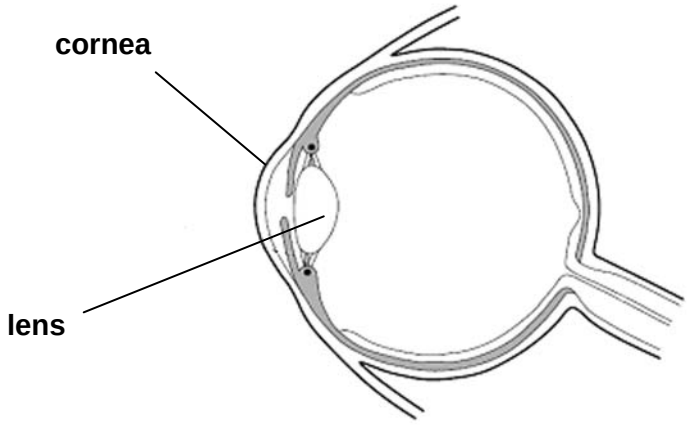
Why are animal proteins called first class proteins?

.....

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

[Total: 4]

2 The diagram shows parts of a human eye.



(a) Describe the job of the cornea and the lens in vision.

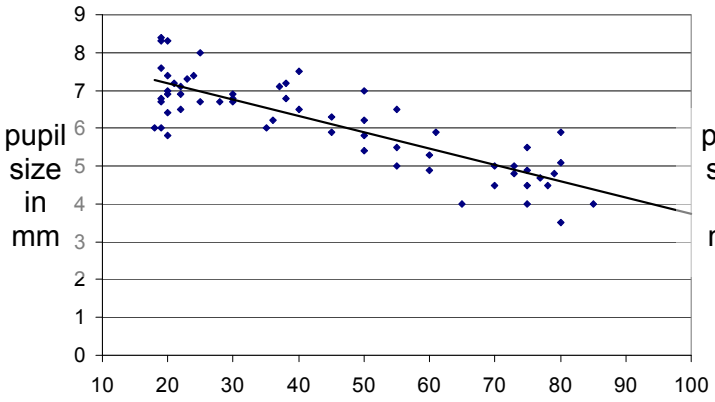
.....

.....

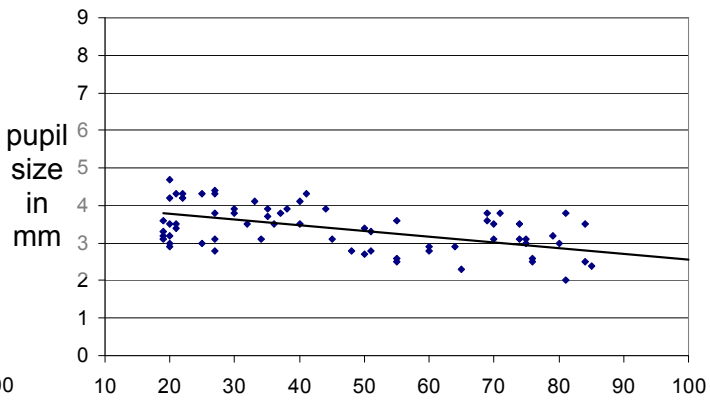
..... **[2]**

(b) Look at the graphs. They show how pupil size (diameter) changes with age for two levels of light.

low light level



high light level



What conclusions can be drawn from these data and what are the implications for elderly people?

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

[Total: 6]

3 Tobacco smoke can affect many systems in the body.

(a) Carbon monoxide in the smoke can cause an increase in blood pressure.

Explain how carbon monoxide can cause an increase in blood pressure.

.....

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

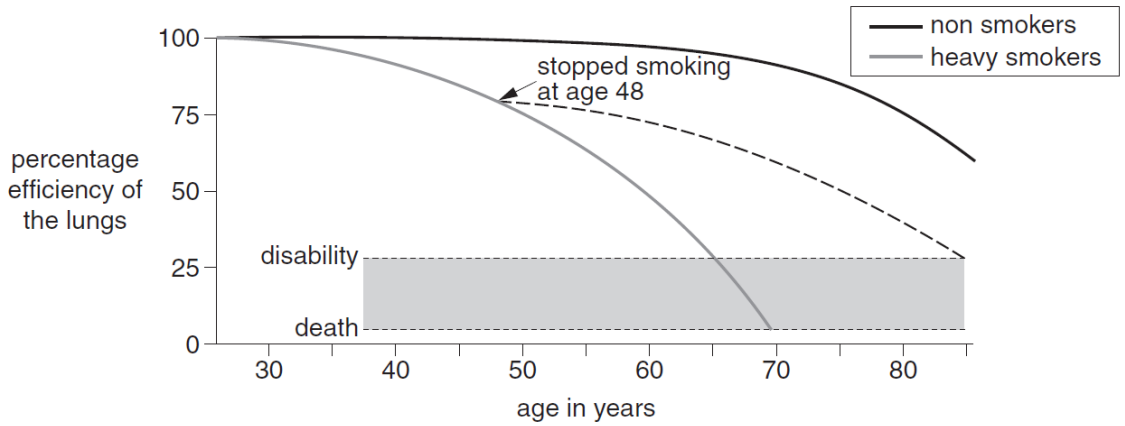
(b) Tobacco smoke can also affect the lungs.

The graph shows how well the lungs work at different ages.

This is shown for two groups of people.

One group is heavy smokers. The other group is non-smokers.

The dotted line shows the possible effect of stopping smoking at age 48.



Doug is a 48 year-old heavy smoker.

If Doug decides to give up smoking, the age at which he is likely to become disabled increases by 20 years.

Explain this difference in the age at which Doug would become disabled.

Use your knowledge of the effect of smoking on the lungs in your answer.

.....

.....

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

(c) Doug continues to smoke because tobacco contains an addictive drug called nicotine.

This drug is also a stimulant.

Explain how nicotine affects synapses in Doug's body.

.....

.....

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

[Total: 4]

4 Fred has cystic fibrosis.

He finds it difficult to breathe because there is too much mucus in his lungs.

Cystic fibrosis is an inherited condition.

It is caused by a recessive allele.

(a) Neither of Fred's parents has cystic fibrosis.

They want to have another child.

What is the probability of their next child having cystic fibrosis?

Draw a genetic diagram to explain your answer.

probability of next child having cystic fibrosis ..... **[2]**

(b) Fred gets a lot of chest infections.

When he gets a bacterial infection, his doctor gives him antibiotics.

Fred's doctor could just give him antibiotics all the time as a precaution.

However, doctors are careful not to use antibiotics more than necessary.

One reason for this is not to waste money.

Write down **one** other reason.

.....

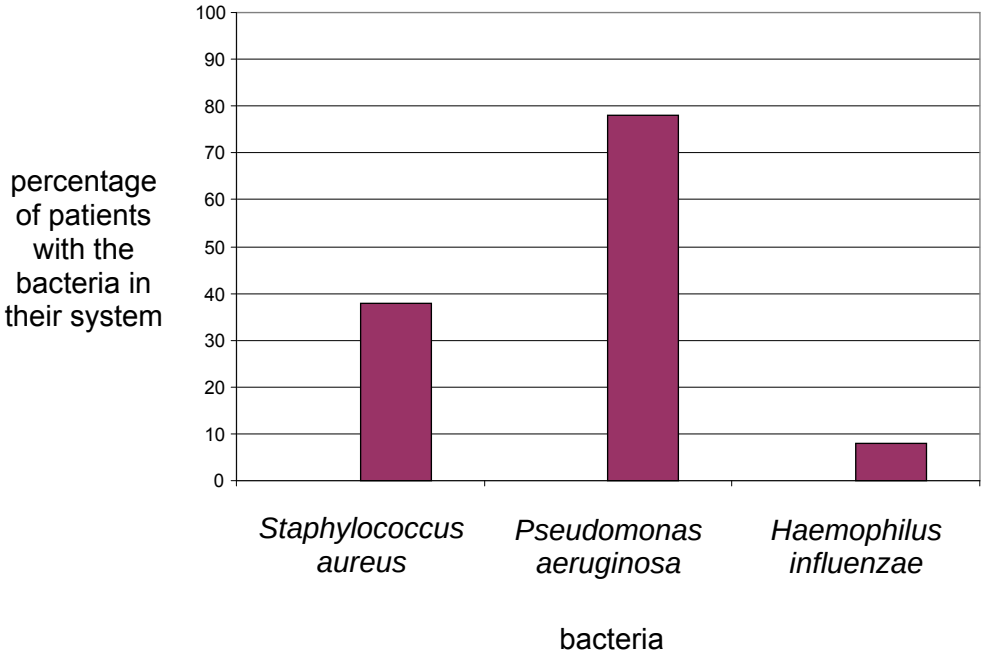
..... **[1]**

(c) Chest infections can be caused by different types of bacteria.

Tests were done on 100 patients with cystic fibrosis.

The tests involved taking a sample from each patient and finding which of three types of bacteria were present in their system.

The bar chart shows the results of the tests.



Can you tell from these data how many patients have more than one of these types of bacteria in their system?

Explain your answer.

.....

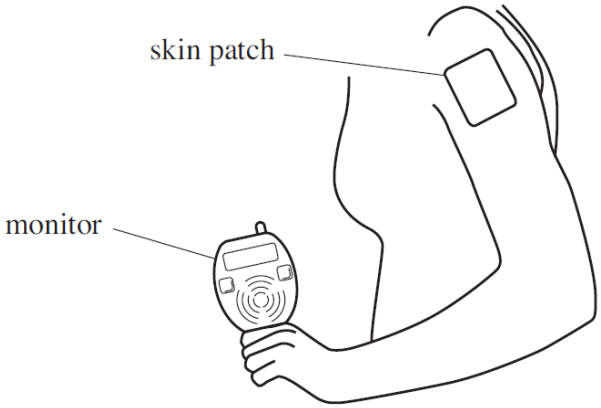
.....

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

[Total: 5]

5 This article appeared in a recent newspaper.

Patch to test for blood glucose levels



A new skin patch is being developed for people who have type 1 diabetes.

It measures the level of glucose in their blood.

The device measures the level every 60 seconds.

The monitor sounds an alarm if the blood sugar level gets too high or too low.

Mary has type 1 diabetes.

She eats a very large meal.

Explain why using the monitor will help her.

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

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

[Total: 6]

Section B – Module C1

6 This question is about esters.

Esters are useful substances. They can be used to make perfumes and solvents.

(a) Look at the list.

alcohol

alkane

polymer

protein

water

Complete the word equation to show how an ester is made.

Use words from the list.

acid + ... ⟶ ester + ... **[1]**

(b) Perfumes and drugs can be tested on animals in some countries.

Write about **one** advantage and **one** disadvantage of testing drugs on animals.

.....

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

[Total: 3]

7 Phil wants to choose a fuel to heat his house.

(a) Two important factors Phil needs to think about when choosing a fuel are the cost of the fuel and the energy released per gram.

Suggest two **other** important factors which Phil needs to think about.

.....

.....

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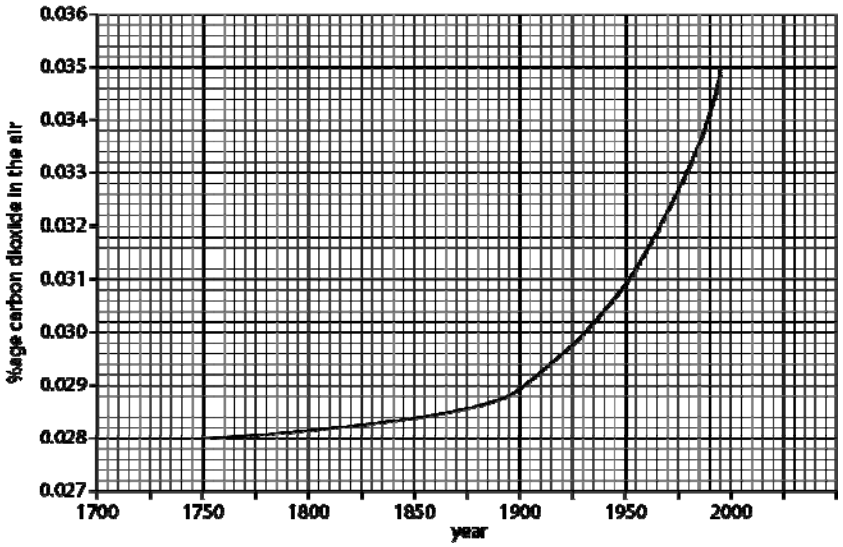
..... **[2]**

(b) Look at the graph. It shows how the percentage of carbon dioxide in the air has increased.



Give **two** reasons why this has happened.

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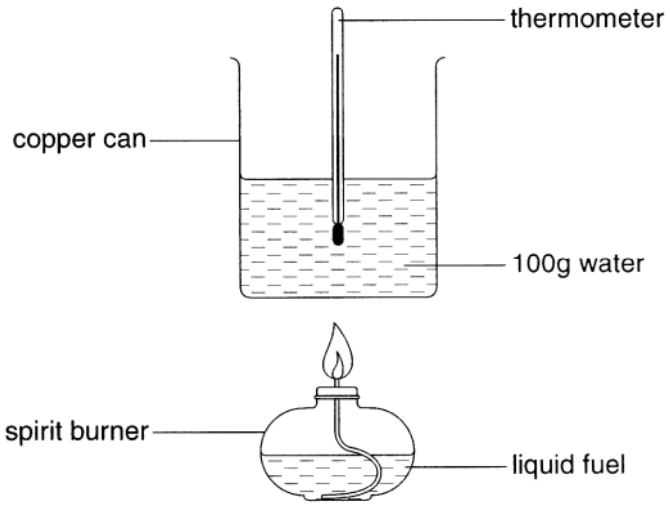
..... **[2]**

(c) Phil wants to heat his greenhouse.

He decides to test four liquid fuels to see which fuel is the best to use.

Look at the diagram.

It shows the apparatus he uses to measure the energy given out by these fuels.



Look at the table. It shows his results.

fuel	temperature of water at start in °C	temperature of water at end in °C	cost of fuel burned in pence
A	15	30	1.0
B	22	42	2.0
C	20	25	0.5
D	20	30	1.5

Phil decides to use fuel **C** to heat his greenhouse.

Evaluate if this is a sensible choice.

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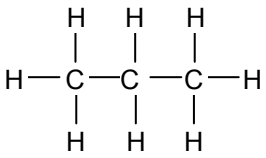
..... **[3]**

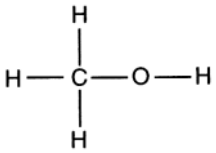
[Total: 7]

8 This question is about carbon compounds.

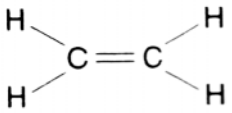
Look at the displayed formulas.



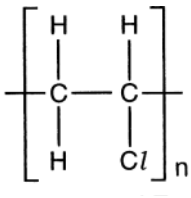
propane



methanol



ethene



poly(chloroethene)

carbon dioxide

(a) Which compound is a **saturated** hydrocarbon?

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

(b) Which compound will decolourise bromine water?

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

(c) Write down the molecular formula of methanol.

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

(d) Poly(chloroethene) is a polymer.

Look at the displayed formula of poly(chloroethene).

Poly(chloroethene) is made from a monomer called chloroethene.

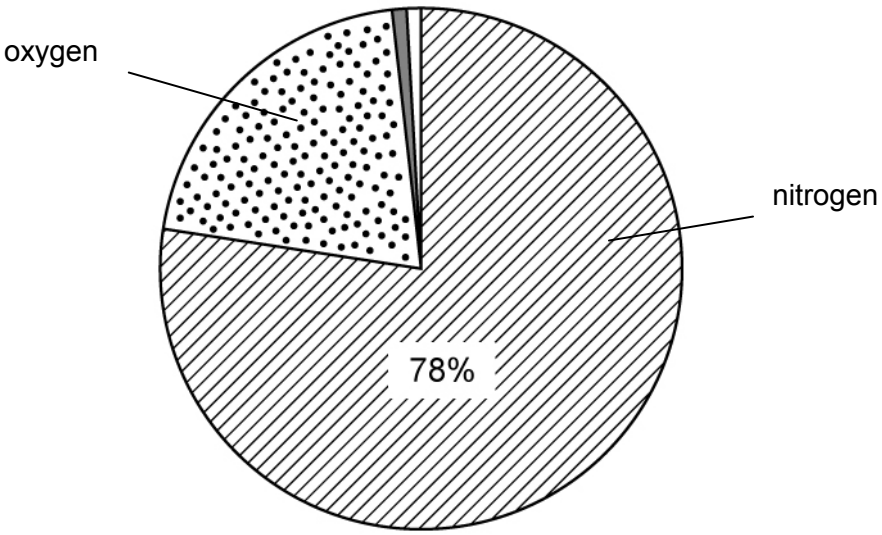
Draw the displayed formula of chloroethene.

[1]

[Total: 4]

9 This question is about gases in the air.

Look at the pie chart. It shows the composition of the air.



(a) What percentage of the air is oxygen?

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

(b) Carbon monoxide is a pollutant in the air made when petrol burns in car engines.

A catalytic converter removes carbon monoxide from the exhaust gases of a car.

Describe, with the aid of a **balanced symbol** equation, how a catalytic converter removes carbon monoxide.

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

(c) Nitrogen and oxygen do not normally react with each other.

However within a car engine nitrogen and oxygen do react to make nitrogen monoxide.

Explain, with the aid of a **balanced symbol** equation, why nitrogen and oxygen react within a car engine.

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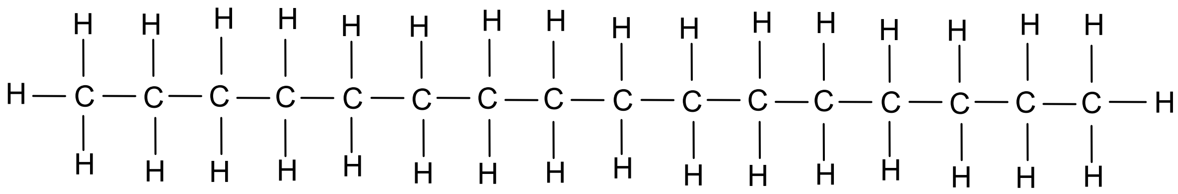
..... **[2]**

[Total: 5]

10 Cracking is an important reaction that takes place within an oil refinery.

Cracking converts large hydrocarbon molecules into more useful smaller hydrocarbon molecules.

Look at the displayed formula for hexadecane.



The cracking of hydrocarbons, such as hexadecane, produces many different products and is a very important reaction in an oil refinery.

Explain why using chemical equations.

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

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....**[6]**

[Total: 6]

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Section C – Module P1

11 Asif has an old gas fire that heats the living room of his house.

(a) The label on the gas fire states that it is 60% efficient.

The energy in a year's gas supply for the fire is 1500 MJ.

Draw a Sankey diagram for Asif's gas fire.

Add labels to show how the energy is used.

[3]

(b) Asif changes his old gas fire for a new one because he thinks a more efficient fire will save him money.

Look at the data in the table about new gas fires.

model of gas fire	efficiency (%)	cost to buy gas fire in £	1 year saving on fuel costs compared to old gas fire in £
aspect	76	900	80
concept	74	600	70
firewell	70	750	50
moment	69	475	45
tinder	74	850	70

Asif plans to keep the new gas fire for **10 years**.

The salesman recommends that Asif buys the model with the highest efficiency.

Asif considers the payback time for each gas fire and the saving on fuel cost.

Which model of gas fire should Asif choose?

answer .....

Explain your answer.

.....

.....

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

[Total: 5]

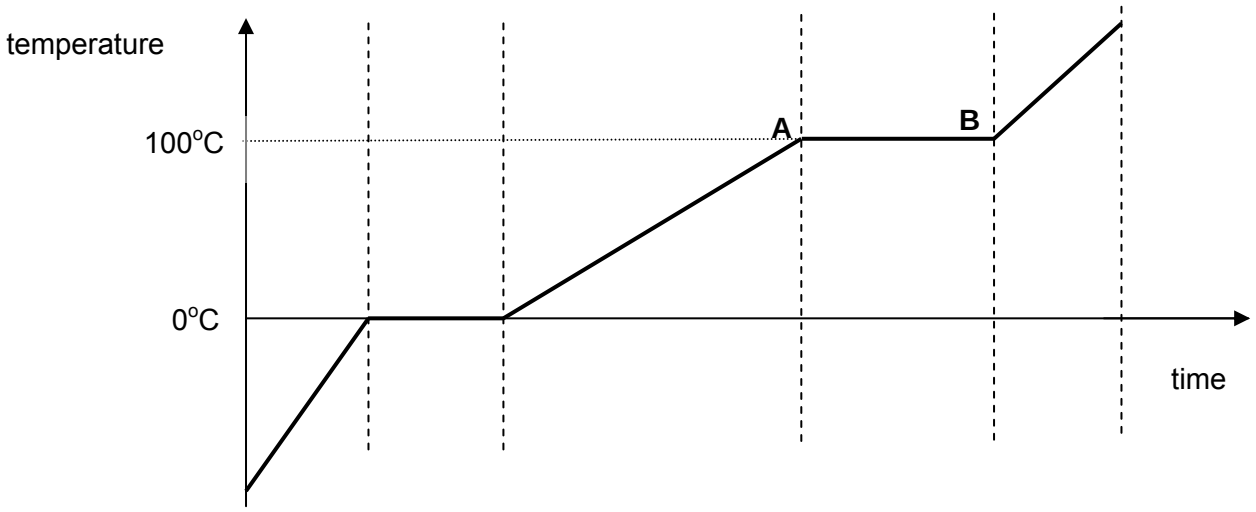
12 Sue looks up some information about the specific latent heat of water.

change of state	specific latent heat in kJ/kg
melting	334
vaporisation	2260

Sue is heating 100g of ice.

Look at the graph.

It shows Sue's results.



(a) Calculate the energy which is supplied to the water between points **A** and **B** on the graph.

.....

.....

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

(b) Energy is supplied between **A** and **B**.

Explain why the temperature of the water does not change.

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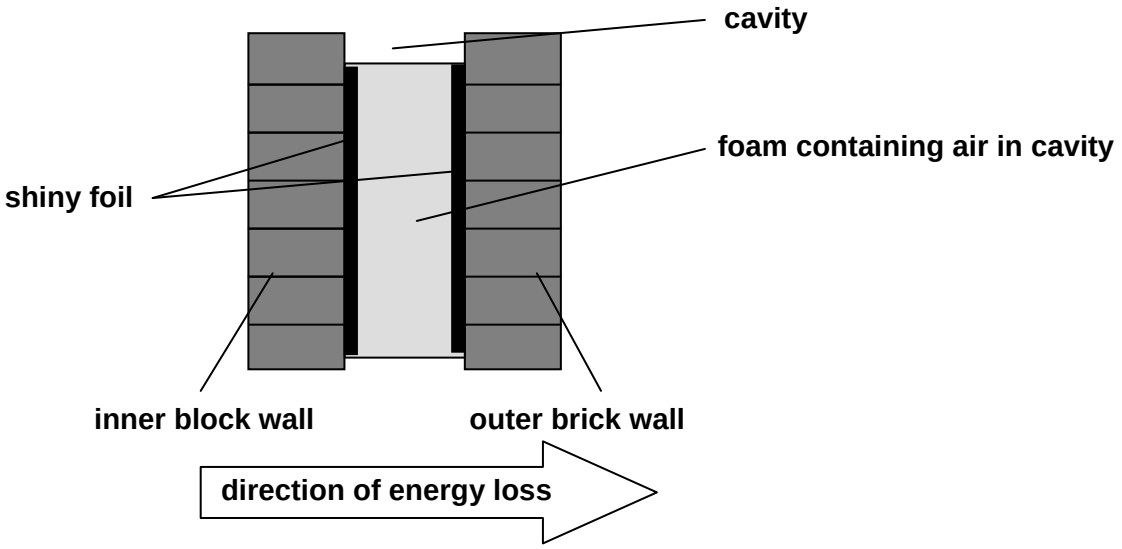
..... **[2]**

[Total: 4]

13 Energy losses in the home can be reduced by energy saving measures.

One measure is to put foam covered with shiny foil as insulation in the cavity.



Describe how energy is lost through the wall from the inside to the outside **and** how the insulation reduces the different types of energy loss.

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

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

[Total: 6]

14 This question is about electromagnetic waves.

Look at the information about **three** types of electromagnetic waves.

type	wavelength range in m	energy range in J
A ……	7×10^{-7} to 1×10^{-3}	2×10^{-22} to 3×10^{-19}
microwave	1×10^{-3} to 1×10^{-1}	3×10^{-24} to 2×10^{-22}
B ……	$> 1 \times 10^{-1}$	$< 3 \times 10^{-24}$

(a) Fill in the two gaps in the table labelled **A** and **B**. **[1]**

(b) Microwaves are part of the electromagnetic spectrum.

Microwave radiation is used in cooking and also in communications.

David reads the label on the back of his microwave oven.

Stainless Steel Microwave Oven
Model MMSO8
230-240V
Input power 1200W
Microwave frequency 3.44 X 10^9 Hz
Made in China

The speed of microwaves is 3.00×10^8 m/s.

(i) Use the information on the label to calculate the **wavelength** of these microwaves.

.....

.....

answer ..... m **[2]**

(ii) Use the data in the table to estimate the energy of microwaves with this wavelength.

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

(c) Lucy's father is deciding whether or not to buy her a mobile phone.

He is concerned that there may be health risks associated with using a mobile phone.

Give an example of a potential health risk and describe how Lucy's father should evaluate the risks when making his decision.

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

[Total: 7]

15 The Montreal protocol in 1987 set up an international agreement to phase out the use of CFCs.

Explain why this ban on the use of CFCs is necessary and why it had to be internationally agreed.

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

[Total: 3]

[Paper Total: 75]

END OF QUESTION PAPER

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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 H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

SCIENCE B

B711/02

Unit B711: Science modules B1, C1, P1 (Higher Tier)

MARK SCHEME

Duration: 1 hour 15 minutes

MAXIMUM MARK 75

This document consists of 16 pages

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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, eg 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

   eg 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.

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Question			Expected answers	Marks	Additional guidance
1	(a)		Deb's EAR is 34.8 (1) total protein intake is 32.4g which is less than EAR (1) **any one from:** not accurate because it is only an estimate for an 'average' person (1) not accurate because it will vary with age / Deb is a teenager/growing so will have a higher than average requirement (1)	3	
	(b)		contain essential amino acids / contain amino acids that cannot be made by the body (1)	1	**ignore** references to essential proteins
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
2	(a)		they both bend light / refract (light) / focus light (1) idea that it is the lens that (fine) focuses the light on the retina (1)	2	**allow** lens helps to form an image on the retina
	(b)		increasing age decreases the size of the pupil for **both levels of brightness** (1) in dark conditions there is a greater difference between the old and the young (1) which means that for older people it is difficult for enough light to enter the eye in dark conditions which makes it difficult to see / read / AW (1) older people have smaller changes in pupil diameter in response to changes in light (1) which means that older people will not be able to see very well when going from bright to dark conditions (1)	4	**answers must link conclusions from graphs to implications in order to gain full credit** **allow** more variation for individuals of a given age in dark conditions (1) **allow** specific examples of going from light to dark conditions eg which means that older people will not be able to see very well when going from outside to inside on a sunny day (1)
			Total	**6**	

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Question			Expected answers	Marks	Additional guidance
3	(a)		carbon monoxide makes the blood carry less oxygen so heart rate increases (1)	1	
	(b)		because smoking causes damage to cilia which means chemicals build up and cause cancer / emphysema (1) but giving up prevents further damage to cilia / less build-up of chemicals so reducing risk of cancer / emphysema (1)	2	**answers must link giving up cancer to limiting lung damage and subsequent risk of disease in order to gain full credit**
	(c)		causes more neurotransmitter to cross the synapse / increases the chance of nerve impulse being passed (1)	1	**allow** increases the rate at which a nerve impulse passes **allow** or mimic (neuro)transmitter **ignore** references to signals / messages
			Total	**4**	

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Question			Expected answers	Marks	Additional guidance
4	(a)		probability = 0.25 / 25% / ¼ / 1 in 4 / 1 to 3 (1) genetic diagram showing two heterozygotes crossing to produce four correct offspring (1)	2	
	(b)		to prevent resistant strains spreading / being selected for / AW (1)	1	**allow** bacteria can develop resistance **not** reference to the person becoming resistant / the disease becoming resistant **not** to stop bacteria mutating
	(c)		no (no mark) because some patients have more than one type of bacteria since the percentages for the three types of bacteria add up to more than 100% / the data doesn't show if the 80% who had *Pseudomonas aeruginosa* also had *Staphylococcus aureus* / *Haemophilus influenzae* or if they were different patients (1) don't know how many patients have more than one type of bacteria because data doesn't show the percentage with no bacteria (1)	2	**allow** for each type of bacteria, the data shows the percentage of patients with that type of bacteria in their system but it does not show if these same patients have any of the other two types of bacteria in the system (1)
			Total	**5**	

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Question			Expected answers	Marks	Additional guidance
5			**Level 3** Answer comprehensively explains the effects of diabetes on Mary and applies understanding of diabetes to clearly explain why the monitor will help in the context of a very large meal. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5-6 marks) **Level 2** Answer explains some of the effects of diabetes on Mary and applies understanding of diabetes to explain the need to inject insulin but the importance of regulating the dose is not explained. 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. There are occasional errors in grammar, punctuation and spelling. (3-4 marks) **Level 1** Answer identifies the effects of diabetes in terms of being unable to regulate blood glucose. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1-2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include:** • Mary cannot produce enough insulin • she cannot therefore regulate her blood glucose level • idea of homeostasis • after the meal blood glucose level is too high • reference to problems caused by hyperglycaemia • alarm will sound to tell her so that she can inject herself with insulin • she needs this insulin injection to regulate blood glucose • important to match the dose to the blood glucose level • device measures very regularly so will give more frequent measurements so she knows almost immediately if the level is too high • she doesn't have to cut herself or use blood to detect her blood glucose level reducing risk of infection/improving quality of life • automatically tests without her having to remember • once she has injected insulin it will convert glucose to glycogen for storage in the liver • reducing blood glucose level **allow** blood sugar instead of blood glucose
			Total	**6**	

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Question			Expected answers	Marks	Additional guidance
6	(a)		acid + **alcohol** → ester + **water** (1)	1	
	(b)		**advantage** idea that test more realistic as animals are alive (1) **disadvantage** cruel to animals / ethical objection / may work differently in different species / animals are not the same as humans (1)	2	**allow** it could hurt / harm / kill animals / inhumane **allow** references to animal rights eg animal can't speak for itself eg some people think animals have the same rights as humans eg animals have no control over what happens to them
			Total	**3**	

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Question			Expected answers	Marks	Additional guidance
7	(a)		idea of availability / is it easy to get hold of / how long will it last (1) idea of flammability / is it easy to light the fuel / does it have a clean flame (1) how much space is needed to store the fuel / can the fuel be stored or it provided by pipeline (1) can the fuel be used safely / is the fuel toxic / are there any harmful effects when in contact with humans / will it produce poisonous carbon monoxide when it burns (1)	2	**allow** can it run out / is it nearby **ignore** references to pay back time, efficiency or solar panels
	(b)		**any two from** because population has increased (1) because there is more demand for or consumption of energy / increased burning of fossil fuels / increased industry (1) because of increased deforestation / AW (1)	2	**allow** more demand for fuel **allow** idea of demand for fuel from emerging economies eg China is having an industrial revolution or more countries are becoming developed **allow** more transport eg cars / more electrical (appliances) / more consumables / more technology **ignore** references to renewable energy
	(c)		fuel **C** is a sensible choice because it is cheaper than all the others (1) evidence of calculation of temperature differences to conclude that fuel **C** is not a sensible choice because fuel **B** gives the largest temperature rise / ora (1) **OR** evidence of calculation of temperature rise per penny to conclude that fuel **C** is not a sensible choice because fuel **A** has the highest temperature rise for 1 pence of fuel burned / ora (2)	3	**answers must link choice of fuel with evidence to gain credit** **allow** answers in terms of fuel **B** being a better choice if linked to evidence **allow** answers in terms of fuel **C** being a better choice if linked to evidence
			Total	**7**	

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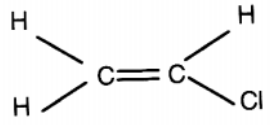
Question			Expected answers	Marks	Additional guidance
8	(a)		propane (1)	1	**allow** correct formula C_3H_8 **not** propene
	(b)		ethene (1)	1	**allow** correct formula C_2H_4
	(c)		CH_4O (1)	1	**allow** CH_3OH / COH_4 / H_4CO / OH_4C / H_4OC **not** CH3OH / CH^3OH **not** CH4O / CH^4O **allow** $C_1H_4O_1$
	(d)		 (1)	1	bonds can be in any direction
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
9	(a)		20 - 21 (%) (1)	1	
	(b)		Carbon monoxide removed by being converted to carbon dioxide (1) $2CO + 2NO \rightarrow N_2 + 2CO_2$ (1)	2	
	(c)		$N_2 + O_2 \rightarrow 2NO$ (1) because the temperature is high enough to provide enough energy to break the covalent bonds within a nitrogen molecule / the temperature is high enough to supply the activation energy to make nitrogen atoms (1)	2	
			Total	**5**	

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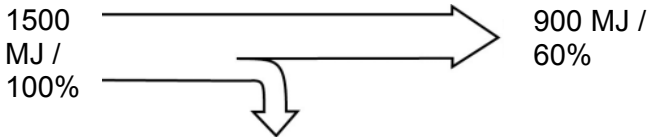
Question			Expected answers	Marks	Additional guidance
10			**Level 3** Applies understanding of cracking to explain, using symbol equations, the possible products made during cracking of hexadecane including a clear indication as to why cracking can make many products. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5-6 marks) **Level 2** Limited application of understanding of cracking to explain, using word or symbol equations, the importance of some of the products formed. 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. There are occasional errors in grammar, punctuation and spelling. (3-4 marks) **Level 1** Answer attempts an explanation to include at least one reason for cracking and an idea of possible products. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1-2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include:** • Cracking produces smaller alkene and alkane molecules • Cracking produces hydrogen • The alkenes made are a source of polymers • The alkanes made can be used as petrol • Cracking enables oil refinery to balance supply with demand • Equations can be word or symbol equations e.g. hexadecane → octane + octene $C_{16}H_{34} \rightarrow C_8H_{18} + C_8H_{16}$ • Equations can use molecular, structural or displayed formulae • Get many products because any of the carbon-carbon bonds in hexadecane can break
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
11	(a)		correct energy values on diagram  (2) energy input, (useful) output/heating living room and wasted energy labels correctly positioned / AW (1)	3	Sankey diagram drawn with all correct energy values / percentages (2) OR **allow** correctly positioned 600 MJ (1) **allow** correctly positioned 900 MJ (1)
	(b)		concept (no mark) because concept is the only model where payback time is less than 10 years and this means that Asif saves the most money (£100) over 10 years with the concept (2) **OR** because concept is the only model where payback time is less than 10 years / over 10 years Asif saves the most money with the concept (1)	2	concept not chosen or incorrect model chosen answer scores (0) **allow** correct use of figures eg paid £600 and get £700 back in savings at end of 10 years (1) **allow** although aspect is more efficient / saves more on fuel each year, aspect costs more than the concept (1)
			Total	**5**	

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Question			Expected answers	Marks	Additional guidance
12	(a)		226 kJ (2) **BUT** 0.1 x 2260 (1)	2	**allow** 226 000 J (2)
	(b)		because the average kinetic energy of the particles does not change as energy supplied is used to break intermolecular bonds (2) **OR** average kinetic energy of the particles does not change / energy used to break intermolecular bonds (1)	2	**answers must link breaking intermolecular bonds with kinetic energy of particles to gain full credit** **allow** 'water molecules' instead of 'particles' **allow** answers in terms of 'overcome forces of attraction between molecules' instead of breaking intermolecular bonds
			Total	**4**	

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Question			Expected answers	Marks	Additional guidance
13			**Level 3** A detailed description of the three processes by which energy is transferred from inside to outside and how energy losses are reduced using cavity wall insulation. Applies knowledge of how inclusion of shiny foil reduces energy loss in the context of a cavity wall. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5-6 marks) **Level 2** Limited description of some processes by which energy is transferred, order from inside to outside may be confused, some reductions by cavity walls described but not linked to different forms of transfer. 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. There are occasional errors in grammar, punctuation and spelling. (3-4 marks) **Level 1** An incomplete description, naming some processes by which energy is transferred. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1-2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include:** • cavity wall insulation slows down the process of heat transfer • cavity wall insulation retains more heat inside the home • energy moves by **conduction** through the internal blocks • foam or air is a poor **conductor** / foam or air is a good **insulator** so energy transfer is reduced • air/bubbles trapped (in foam) reduces **convection** • reduces heat or energy **radiated** into cavity • inner silver foil surface reflects heat or IR back • outer silver foil surface emits less heat • energy moves by conduction through the external bricks **accept** cavity wall insulation reduces energy losses mainly by conduction and convection **ignore** heat escapes **reject** heat particles
			Total	**6**	

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Question			Expected answers	Marks	Additional guidance
14	(a)		(**A**) infrared and (**B**) radio waves (1)	1	**both correct for one mark**
	(b)	(i)	0.09(m) (2) **but if answer is incorrect** $\frac{3.00 \times 10^{8}}{3.44 \times 10^{9}}$ (1)	2	**allow** 0.087(m) (1) **allow** 8.72 cm if unit is clear (2) **but** 8.72 on its own scores 0
		(ii)	in the range 1×10^{-23} to 3×10^{-24} (J) (1)	1	**ignore** lower level answers below target level for this question eg in the radio range / $< 3 \times 10^{-24}$
	(c)		**risks** **any one from:** cell damage to brain from heating effects of microwaves (1) which could lead to <u>possible</u> increased risk of brain tumours (1) **ways of limiting risk** risks can be reduced by using speakerphone or headset / reduce risk by using for only short conversations (1) risks may be offset against benefits of using mobile phones (1)	3	**to gain full credit candidates must identify a risk, consider possible ways to limit the risks, and weigh the residual risks against the benefits** **ignore** more likely to become a victim of crime **allow** view that there is not enough evidence to support risks
			Total	**7**	

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Question			Expected answers	Marks	Additional guidance
15			CFCs have depleted the ozone layer / CFCs caused a hole in the ozone layer (over Antarctica) (1) this depletion of the ozone layer allows more ultraviolet radiation to reach Earth / ozone needed to protect Earth from ultraviolet so if there is a hole Earth will not be protected (1) idea of needs to be an international ban to have an effect because all countries must stop / it is a worldwide problem that cannot be solved by individual countries (1)	3	**answers must link depletion of the ozone layer to more ultraviolet reaching Earth to gain second marking point** **allow** idea that even though no new CFCs have been produced (since 1985 in developed nations) previously produced CFC are persistent and remain in the environment for a long time (1)
			Total	**3**	

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Assessment Objectives (AO) Grid

(includes quality of written communication ✎)

Question	AO1	AO2	AO3	Total
1(a)	1	2		**3**
1(b)	1			**1**
2(a)	2			**2**
2(b)		2	2	**4**
3(a)	1			**1**
3(b)	1	1		**2**
3(c)	1			**1**
4(a)		1	1	**2**
4(b)	1			**1**
4(c)		2		**2**
5✎	4	2		**6**
6(a)	1			**1**
6(b)	2			**2**
7(a)		2		**2**
7(b)		2		**2**
7(c)		1	2	**3**
8(a)		1		**1**
8(b)	1			**1**
8(c)		1		**1**
8(d)		1		**1**
9(a)	1			**1**
9(b)	2			**2**
9(c)	1	1		**2**
10✎	2	4		**6**
11(a)	1	2		**3**
11(b)			2	**2**
12(a)		2		**2**
12(b)	2			**2**
13✎	4	2		**6**
14(a)	1			**1**
14(b)(i)	1	1		**2**
14(b)(ii)		1		**1**
14(c)	1	2		**3**
15	2	1		**3**
Totals	**34**	**34**	**7**	**75**

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