



GCSE SCIENCE YEAR 10 SUMMER PREPARATION WORK PHYSICS STUDENT BOOK HIGHER

Please complete all of these questions in this book and store this work in your student revision files.

This will provide a useful resource for revision.

Name	
Class	
Teacher	

**Revision Question Book 1P
GCSE Science**

**This book is suitable for
students currently in Year 9.**



In the following booklet there are several questions based on GCSE Physics Paper One. These questions are additional to the work which you must do on your GCSE course.

To gain the highest grade possible in your GCSE examinations it is recommended that you complete these questions at home or in revision sessions outside of lessons.

This will both familiarise yourself with both the concepts found in the GCSE syllabus and the examination technique found in examinations.

The mark scheme to the questions is integrated in the book for you to use independently.

To improve competency in answering questions on GCSE Science and achieve mastery in this module, answer all of these questions independently.

When you have completed your work in this book, please store this work at home.

Many thanks for all of your hard work in GCSE Science.

Mr. Turnbull



TOPIC 1: ENERGY

1.0 A weightlifter picks up a barbell.



1.1 Which type of energy is stored in the barbell when it is held above the weightlifter's head?

[1 mark]

- Chemical potential
- Elastic potential
- Gravitational potential
- Kinetic

1.2 The weightlifter drops the barbell.

The barbell's store of which type of energy increases as the barbell falls.

[1 mark]

- Chemical potential
- Elastic potential
- Gravitational potential
- Kinetic



1.3 Use the data in **table 1** to draw a line between each calculation and the energy change it is calculating.

Draw **two** lines only.

Table 1

mass of barbell	50 kg
gravitational field strength	9.8 m/s ²
height the barbell drops	2 m
maximum speed the barbell drops	6.2 m/s

[1 mark]

Calculation

Increase / decrease in

$$50 \times 9.8 \times 2$$

Chemical potential energy

Elastic potential energy

$$\frac{1}{2} \times 50 \times 6.2 \times 6.2$$

Gravitational potential energy

Kinetic energy

1.4 Explain why the weightlifter's internal store of energy decreased more when he lifted the bar than the bar's internal store of energy gained.

[2 marks]

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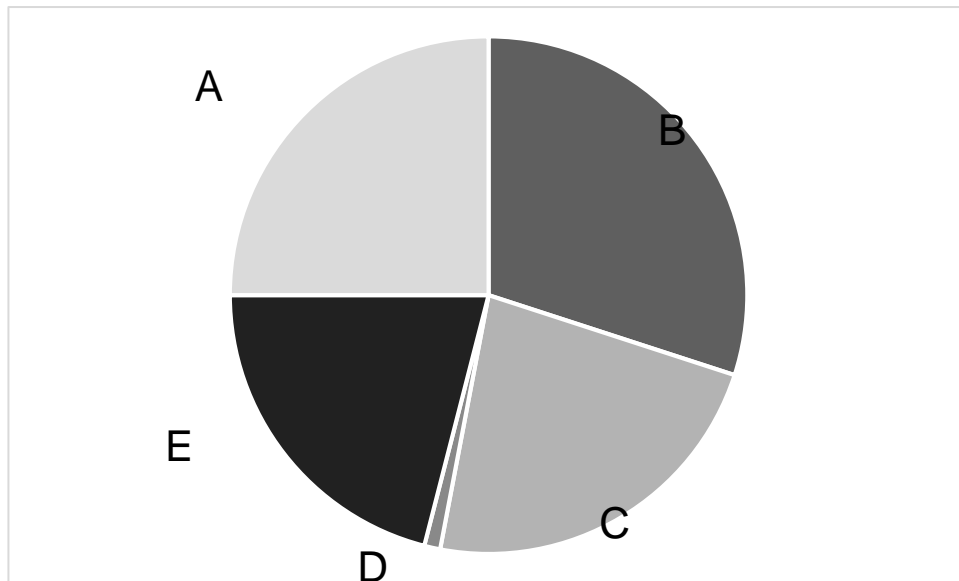
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2.0 Electricity in the UK is produced from a number of energy resources.

Figure 1 below shows the proportion of each energy resource used. The labels have been removed from the pie chart.

Figure 1



2.1 Complete the table.

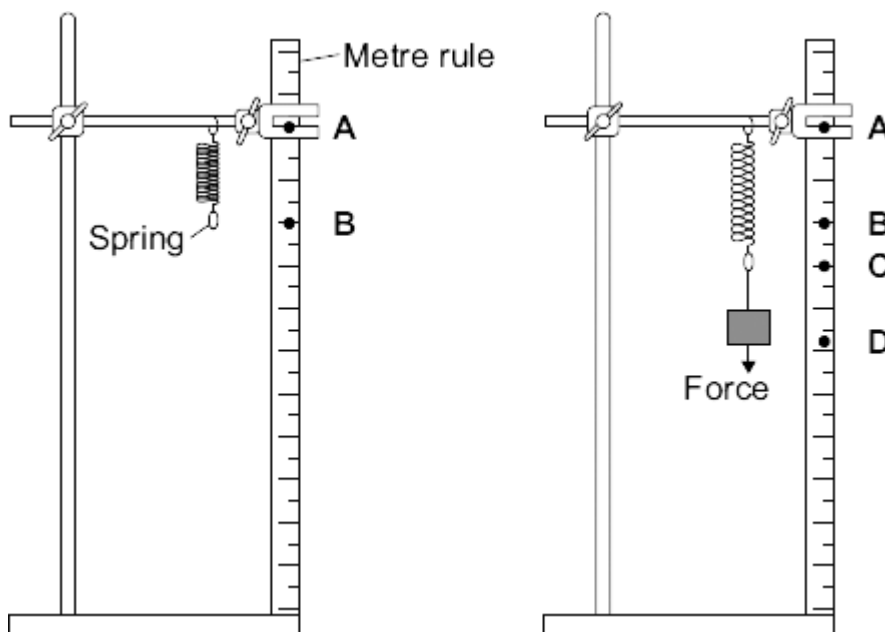
[2 marks]

Energy resource	Percentage of UK electricity production	Segment label
Coal	23	
Natural gas	30	
Nuclear power	21	
Oil	1	
Renewable fuels	25	



3.0 A student investigated how the extension of a spring depends on the force applied to the spring. **Figure 2** shows the spring before and after a force has been applied.

Figure 2



3.1 The distance between each large mark on the rule is 10cm.
Point **A** is on a large mark.

State the length of the spring and the extension after the force is applied.

[1 mark]

Length of spring = _____ cm

Extension = _____ cm

3.2 The stretched spring stores elastic potential energy.

The elastic potential energy stored in a spring can be found by using the equation:

$$\text{Elastic potential energy} = 0.5 \times \text{spring constant} \times (\text{extension})^2$$

A particular spring has a spring constant of 25 N/m.

Calculate the energy stored when the spring is extended by 15 mm.

Give your answer in standard form, to 3 significant figures.

[3 marks]

Energy stored = _____ J



3.3 Another student calculated that the energy stored in her spring was twice the amount of energy for half the extension.

Calculate the spring constant of this spring.

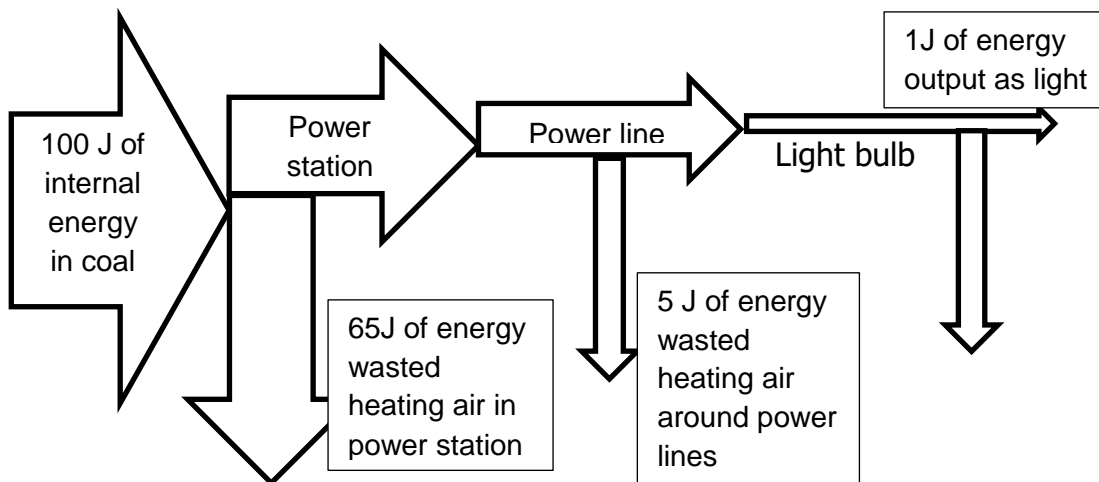
[3 marks]

Spring constant = _____ N/m



4.0 Figure 3 shows the amount of energy lost at various stages in production of electricity to light a light bulb.

Figure 3



Not to scale

4.1 A label is missing from the diagram. What should it say?

[1 mark]

4.2 The electricity company wants to reduce wasted energy.

For the same amount of money, they can either:

- Use 20% of the wasted energy from the power station to heat their offices
- Install new power lines which only waste half the energy as the old ones
- Replace all the bulbs in the town with LED bulbs, which are 99% efficient.

Explain which of these things they should do.

[2 marks]



4.3 The lightbulb's manufacturer says that the lightbulb is 5% efficient.
Is this correct?
Use a calculation to justify your answer.

[2 marks]

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4.4 Another lightbulb has a power of 12 W.
It has an efficiency of 80%.
Calculate the amount of time taken in seconds for the bulb to transfer 300 J of energy into light energy.

[3 marks]

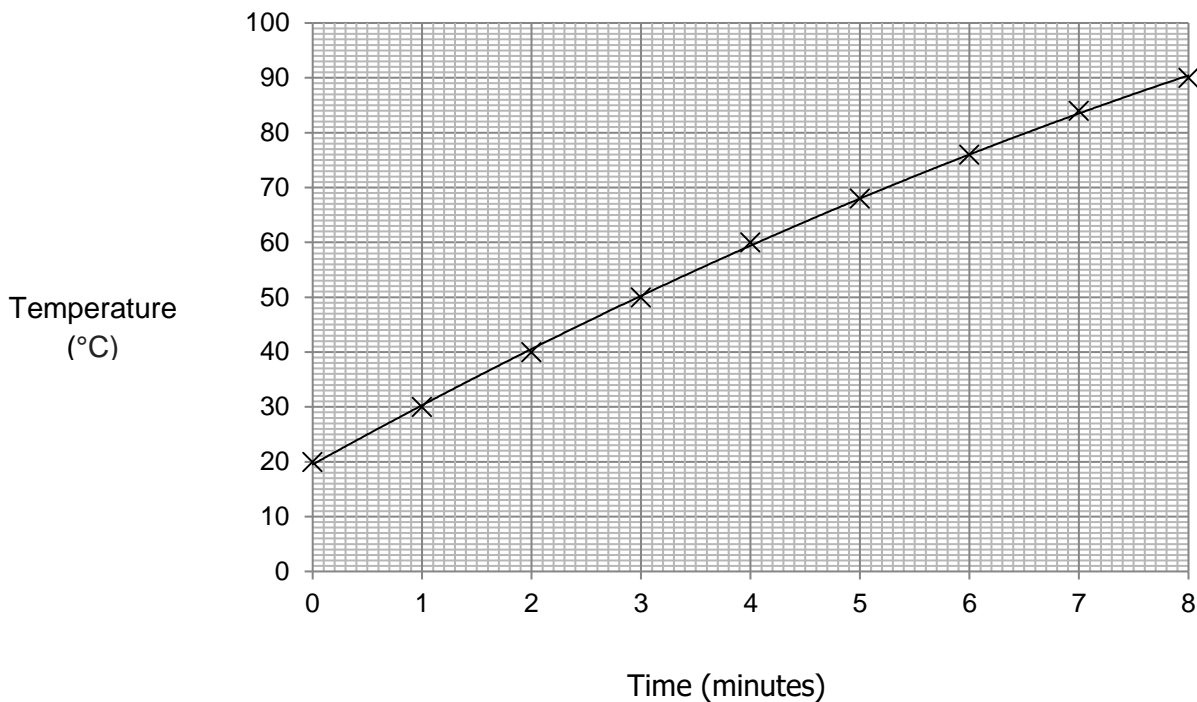
Time taken = _____ s



6.0 A student carried heated a beaker of water and measured the temperature every minute.

Figure 4 shows the results of their experiment.

Figure 4



6.1 The mass of water used was 450 g.
 The power of the heater is 300 W.
 Calculate the specific heat capacity of the water.

[3 marks]

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Specific heat capacity = _____ J/kg°C



6.2 The result of this experiment is higher than the accepted value for water. Suggest **two** reasons why this might be.

[2 marks]

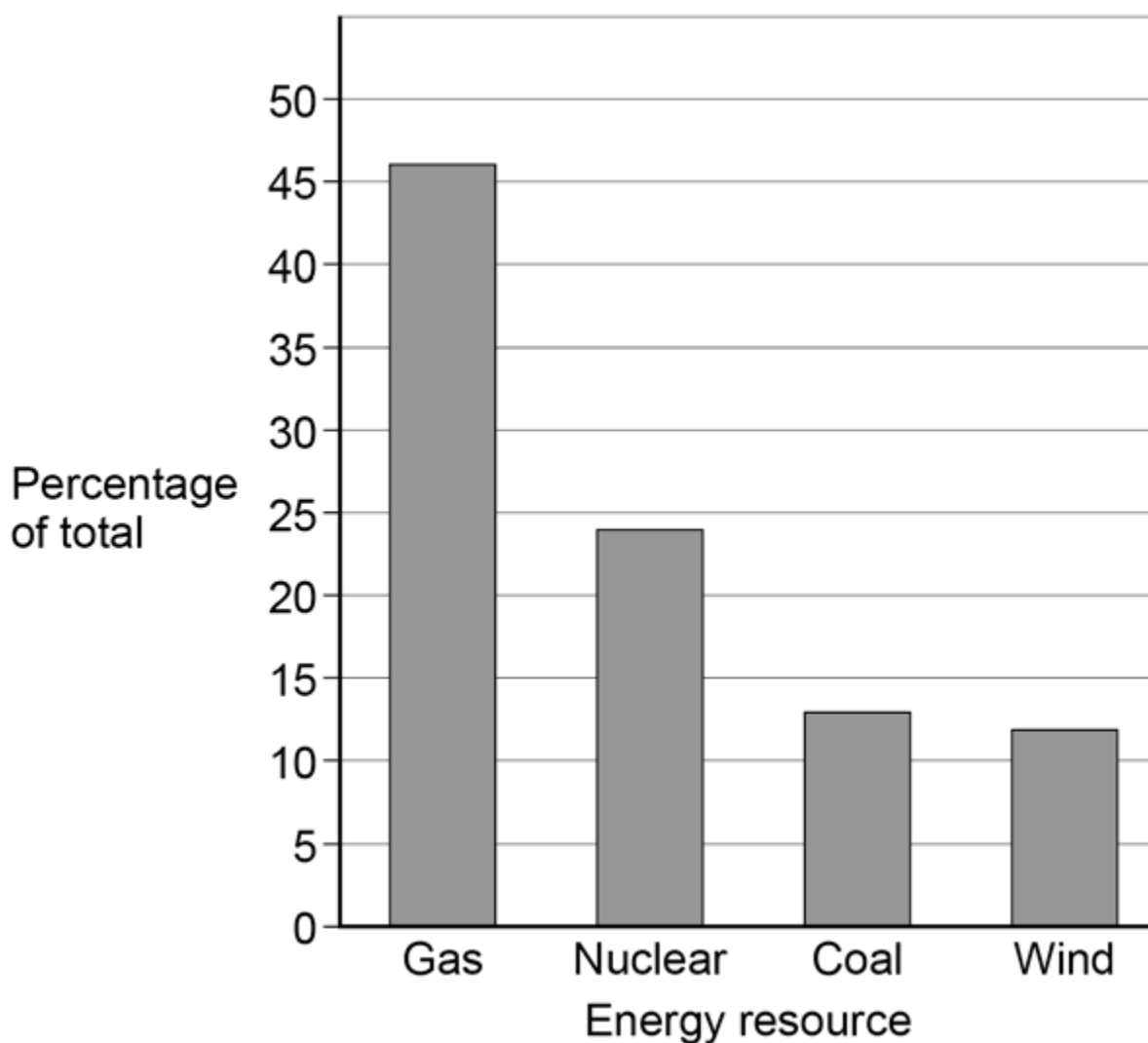
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7.0 Figure 12 gives information about the production of electricity in the UK in 2016.

Figure 12



7.1 The UK government signed the Paris Climate Agreement in April 2016.

The agreement commits the UK to reduce the amount of carbon dioxide released into the atmosphere.



Explain which energy resources in Figure 12 should be used to meet the UK's commitment to the Paris Climate Agreement.

[4 marks]

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7.2 All European countries signed the Paris Climate Agreement in 2016.

In the future, some European countries will only allow electric vehicles.

Suggest how this is likely to affect methods of electricity generation in these countries.

[3 marks]

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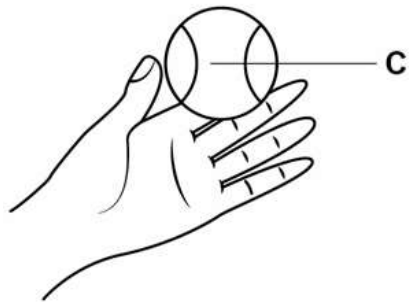
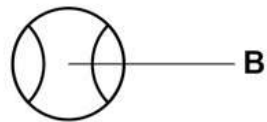
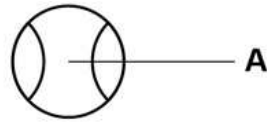
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Q8.

Figure 1 shows a tennis ball thrown vertically into the air.

Figure 1



At position C, the ball has just left the tennis player's hand at a speed of 5.0 m/s

The tennis ball has a mass of 0.058 kg

1.1 Write down the equation that links kinetic energy, mass and speed.

[1 mark]

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8.2 Calculate the kinetic energy of the tennis ball at position C.

[2 marks]

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Kinetic energy = _____ J

8.3 At position A the tennis ball is at maximum height.

What is the gravitational potential energy of the tennis ball at position A?

Ignore the effect of air resistance.

[1 mark]

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At position B the tennis ball has 0.38 J of gravitational potential energy.

8.4 Write down the equation that links gravitational field strength, gravitational potential energy, height and mass.

[1 mark]

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8.5 Calculate the height of the tennis ball above the tennis player's hand when at position B.

gravitational field strength = 9.8 N/kg

[3 marks]

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MARK SCHEME

Qu No.		Extra Information	Marks
1.1	Gravitational potential		1
1.2	Kinetic		1
1.3	$50 \times 9.8 \times 2$ – Gravitational potential $\frac{1}{2} \times 50 \times 6.2 \times 6.2$ - Kinetic	Both required for the mark	1
1.4	Energy lost to the surroundings		1
	Named example (eg air gained internal energy)	Accept heat / air got warmer / sound	1

Qu No.		Extra Information	Marks										
2.1	<table border="1"> <tr> <td>Coal</td> <td>C</td> </tr> <tr> <td>Natural gas</td> <td>B</td> </tr> <tr> <td>Nuclear power</td> <td>E</td> </tr> <tr> <td>Oil</td> <td>D</td> </tr> <tr> <td>Renewable fuels</td> <td>A</td> </tr> </table>	Coal	C	Natural gas	B	Nuclear power	E	Oil	D	Renewable fuels	A	<p>1 mark for B, E and D correct</p> <p>1 mark for C and A correct</p>	<p>1</p> <p>1</p>
Coal	C												
Natural gas	B												
Nuclear power	E												
Oil	D												
Renewable fuels	A												
2.2													
Level 3	<p>Clear, coherently organised answer.</p> <p>Clear understanding of the overall energy needs of the country.</p> <p>Understands the need for a range of resources.</p> <p>Discusses both renewable and non-renewable energy resources, making clear points about each.</p>		4-6										
Level 2	<p>Some structure to answer.</p> <p>Some discussion of the overall energy needs of the country.</p> <p>Discusses a range of resources, giving advantages and disadvantages, although these may not be coherently linked.</p>		3-4										
Level 1	<p>Limited structure to answer.</p> <p>Some discussion of a number of sources with limited link to the overall energy needs of the country.</p>		1-2										
Level 0	No relevant content		0										
Indicative content													
<p>Same or greater overall energy required and/or efficiency savings mean potentially less energy required</p> <ul style="list-style-type: none"> Fossil fuels plentiful in supply Fossil fuels contribute to global warming Unlikely to be time to set up new nuclear fuel plants Renewable energy resources expensive to set up Renewable energy resources can be inefficient Wave, hydro and/or wind likely to be useful for the UK Solar power less likely to be useful Biomass has negatives in land use and fertilisers etc <p>Ignore discussion of nuclear waste etc.</p>													



Qu No.		Extra Information	Marks
3.1	Length = 20cm Extension = 10cm	Both required for the mark	1
3.2	$0.5 \times 25 \times (15 \times 10^{-3})^2$ 0.0028125 2.81×10^{-3} (J)	If extension of 15 used, do not allow first mark. ECF allowed: 2812.5 2.81×10^3 (J)	1 1 1
3.3	Either: Attempt to use value from 3.2: Rearrange $k = E/(0.5 \times x^2)$ Substitute $k = \frac{(2 \times 2.81 \times 10^{-3})}{(0.5 \times (15 \times 10^{-3}/2)^2)}$ K = 200 N/m Or: Algebraic manipulation: Rearrange $k = E/(0.5 \times x^2)$ Substitute multiple values $k = 2E/(0.5 \times (x/2)^2)$ Compare or cancel with original $k = 8k$ = 200 N/m	Allow ECF Allow rounding errors	1 1 1 (1) (1) (1)

Qu No.		Extra Information	Marks
4.1	<u>29 J</u> of energy wasted (from light bulb, heating the air)	OWTTE	1
4.2	Heating schools saves <u>13 J</u> of energy New powerlines save <u>2.5 J</u> of energy LED bulbs save <u>29.7 J</u> of energy So replace lightbulbs	All three calculations for 1 mark	1 1
4.3	Use of: $\text{efficiency} = \frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$ $1 / 30 = 0.034$ (So not correct)	No mark for conclusion.	1 1
4.4	$12 \times 0.8 = 9.6$ Time = energy / power $300 / 9.6 = 31.25$ s	Allow 0 or 1 dp	1 1 1



Qu No.	Extra Information	Marks
5.1		
Level 3	Clear, coherently organised answer. Method complete with clear understanding of the experimental requirements and how the data would be analysed.	4-6
Level 2	Some structure to answer. Main steps in method covered, with some errors or omissions. Limited expression of data analysis.	3-4
Level 1	Limited structure to answer. Some steps described, with little or no control variables. No data analysis.	1-2
Level 0	No relevant content	0
Indicative content		
<ul style="list-style-type: none"> Heat a known mass of water To a known temperature. Transfer the water to a beaker lagged with the first material. Cover the beaker with a lid of the same material. Record the temperature and start a clock. Record the temperature drop after a fixed time. Repeat using the same mass of water with the other materials Determine which material has the smallest temperature drop in a given time/ longest time for a given temperature drop This will be the most effective material 		

Qu No.	Extra Information	Marks
6.1	Energy supplied, = power \times time $= 300 \times 8 \times 60$ $= 144 \times 10^3 \text{ J}$ Temperature rise = 70°C Mass = 0.45 kg Specific heat capacity = $E/(m \cdot \Delta T)$ $= 144 \times 10^3 / (0.45 \times 70)$ $= 4.6 \times 10^3 \text{ J/kg } ^\circ\text{C}$	1 1 1
6.2	Any two from: <ul style="list-style-type: none"> Loss of heat to surroundings Heat absorbed by the beaker Evaporation Inaccurate thermometer/clock/balance 	2



Question	Answers	Extra information	Mark	AO / Spec. Ref. / Demand
7.1	Level 2: Relevant reasons are identified, given in detail and logically linked to form a clear account.		3-4	AO3 AO1 4.1.3 Std./High
	Level 1: Relevant reasons are identified, and there are attempts at logically linking. The resulting account is not fully clear.		1-2	
	No relevant content		0	
	Indicative content nuclear <ul style="list-style-type: none"> • no carbon dioxide released (when generating electricity) or doesn't release greenhouse gases • reliable • high energy density • power stations already built • other power stations being built wind <ul style="list-style-type: none"> • no carbon dioxide released (when generating electricity) or doesn't release greenhouse gases • renewable energy resource • no fuel cost 			
7.2	wind power is unreliable		1	AO1 4.1.3 Std./High
	(so) will be unable to meet demand when wind speed is low or when there is no wind or unable to maintain base load at all times		1	
7.3	electricity generation will need to increase (to meet higher demand)		1	AO3 AO2 AO1 4.1.3 Std./High
	(using) nuclear power or wind power or other renewables		1	
	so that carbon dioxide emissions don't increase or reference to Paris Climate agreement		1	
Total			9	



Question	Answers	Extra information	Mark	AO / Spec. Ref. / Demand
8.1	kinetic energy = $0.5 \times \text{mass} \times \text{speed}^2$	allow $E_k = 1/2 mv^2$	1	AO1 4.1.1.2 Standard
8.2	$E_k = 0.5 \times 0.058 \times 5^2$ $E_k = 0.725 \text{ (J)}$	an answer of 0.725 (J) scores 2 marks	1 1	AO2 4.1.1.2 Standard
8.3	0.725 (J)	allow ecf from 01.2 allow the same amount of E_k as at A	1	AO1 4.1.1.2 Standard
8.4	gravitational potential energy = mass \times gravitational field strength \times height	allow $E_p = mgh$	1	AO1 4.1.1.2 Standard
8.5	$0.38 = 0.058 \times 9.8 \times h$ $h = \frac{0.38}{(0.058 \times 9.8)}$ $h = 0.67 \text{ (m)}$	an answer that rounds to 0.67 scores 3 marks	1 1 1	AO2 4.1.1.2 Standard
Total			8	



TOPIC 2: ELECTRICITY

1.0 Most domestic appliances are connected to the mains electricity.

1.1 What is the frequency of mains electricity?

Tick **one** box

[1 mark]

1.05 A

50 Hz

230 V

1.2 What is the potential difference of mains electricity?

Tick **one** box

[1 mark]

1.05 A

50 Hz

230 V

1.3 Most domestic appliances are connected to the mains electricity with a plug.

Explain why a plug needs a live **and** a neutral wire.

[2 marks]

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1.4 The law specifies the colour that mains wires should be for all domestic electrical circuits.

It is important that the live wire is easy to identify to reduce the risk of an electric shock.

Explain how an electric shock can be caused by a person touching the live wire.

[2 marks]

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1.5 Most houses are supplied with mains electricity even though it is dangerous. Suggest why houses are supplied with dangerous mains electricity.

[2 marks]

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1.6 An iron is supplied with a current of 3 A from the mains. The resistance of the iron is 100 Ω . Calculate the power of the iron.

[2 marks]

Power = _____ W

2.0 A student wants to investigate how the current through a filament lamp affects its resistance.

2.1 Use the circuit symbols in **Figure 1** to draw a circuit diagram that he could use.

Figure 1

12 V battery	variable resistor	filament lamp	voltmeter	ammeter

[2 marks]



2.2 Describe how the student could use her circuit to investigate how the current through a filament lamp affects its resistance.

[4 marks]

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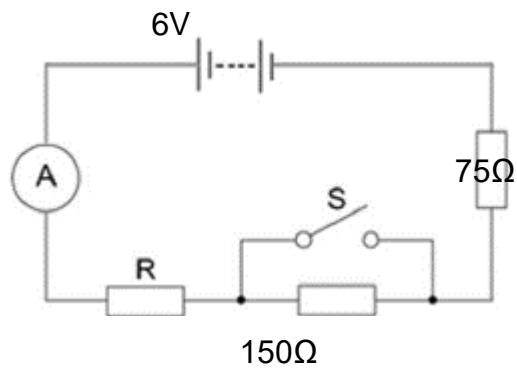
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3.0 A student sets up the electrical circuit shown in **Figure 5** below.

Figure 5



3.1 The ammeter displays a reading of 0.025 A.
 Calculate the potential difference across the 75 Ω resistor.
 Give your answer to 2 significant figures.

[2 marks]

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Potential difference = _____ V

3.2 Calculate the resistance of the resistor labelled **R**.

[3 marks]

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Resistance = _____ Ω

3.3 State what happens to the total resistance of the circuit and the current through the circuit when switch **S** is closed.

[2 marks]

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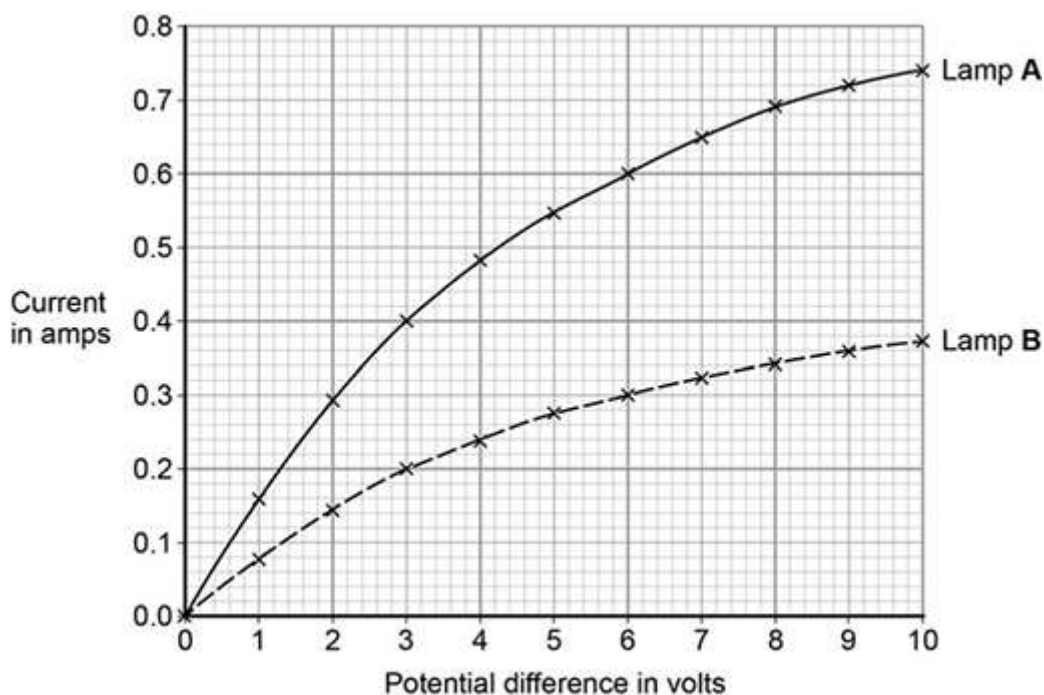
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4.0 A student investigated how current varies with potential difference for two different lamps of the same type.

Her results are shown in the **Figure 6** below.

Figure 6



4.1 Draw the circuit diagram for the circuit that the student could have used to obtain the results shown in the figure above.

[3 marks]

4.2 The student make the following conclusion

'Lamp A is twice a bright as lamp B'

Use data from **Figure 2** to explain why the student's conclusion is correct.

[3 marks]

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5.0 **Figure 13** shows a battery-powered drone.

Figure 13



5.1 The battery in the drone can store 97.5 kJ of energy.

When the drone is hovering, the power output of the battery is 65.0 W

Calculate the time for which the drone can hover.

[3 marks]

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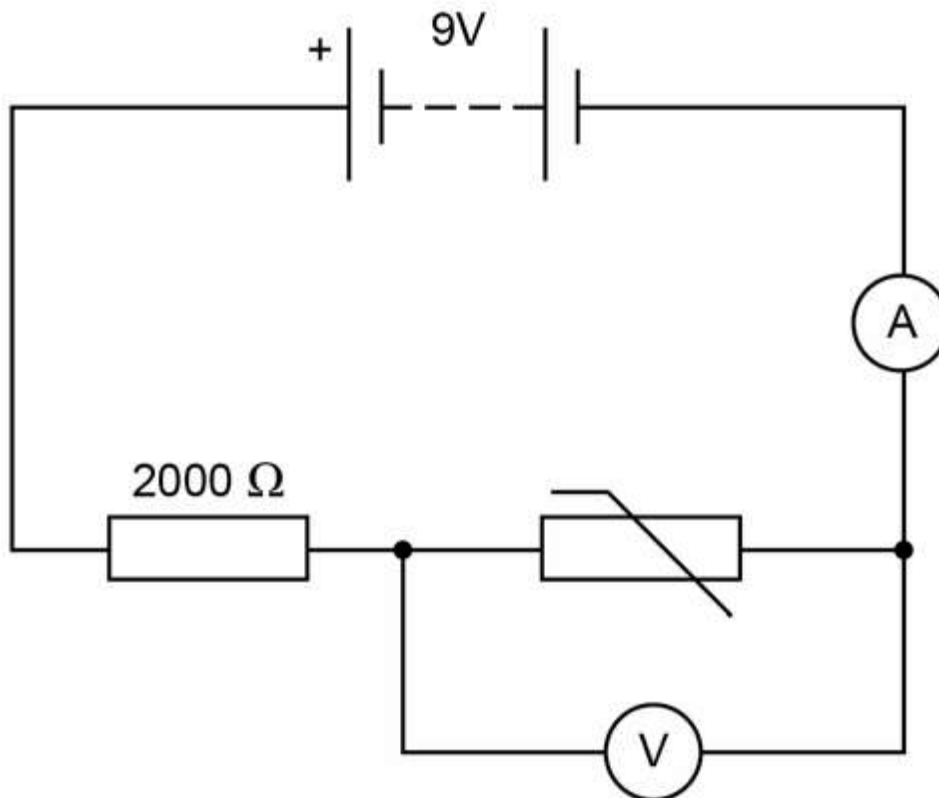
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Time = seconds



Q6. Figure 3 shows a temperature sensing circuit used to control a heating system in a house.

Figure 3



6.1 What quantity does the ammeter measure?

[1 mark]

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6.2 The current in the circuit is 3.5 mA when the potential difference across the thermistor is 4.2 V

Calculate the resistance of the thermistor.

[3 marks]

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Resistance = _____ Ω



6.3 Calculate the charge that flows through the thermistor in 5 minutes when the current is 3.5 mA

[3 marks]

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Charge = _____ C

6.4 Explain why the potential difference across the thermistor changes as the temperature in the house decreases.

[2 marks]

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6.5 The circuit shown in **Figure 3** can be modified to turn lights on and off by replacing the thermistor with a Light Dependent Resistor (LDR).

Draw the circuit symbol for an LDR in the space below.

[1 mark]



MARK SCHEME

Qu No.		Extra Information	Marks
1.1	50 Hz		1
1.2	230 V		1
1.3	Live wire carries the (alternating) potential difference/voltage (from the supply)		1
	Neutral wire completes the circuit		1
1.4	connection is made to earth	Accept answer in terms of a complete circuit or establishing a path (for charge to flow)	1
	charge can flow through the body. or large potential difference across the body		1
1.5	domestic appliances need a supply with a high power	Allow idea that houses need lots of energy	1
	the supply/appliance has features to reduce the risk.	allow other sensible suggestion	1
1.6	$P = (3)^2 \times 100$	Allow one mark for $P=I^2V$ if substitution incorrect.	1
	900 (W)	Allow 900 (W) with no working for 2 marks	1

Qu No.		Extra Information	Marks
2.1	battery, lamp and ammeter connected in series with variable resistor		1
	voltmeter in parallel with (filament) lamp		1
2.2			
Level 2:	A detailed and coherent description of the experiment. The response provides a logical sequence.		3-4
Level 1:	: Simple description of the experiment with some steps missing. The response may not be in a logical sequence and may not lead to the collection of valid results.		1-2
Level 0:	No relevant content		0
Indicative content			
ammeter used to measure current			
voltmeter used to measure potential difference			
resistance of variable resistor altered to change current in circuit or change potential difference (across filament lamp)			
resistance (of filament lamp) calculated or $R=V / I$ statement resistance calculated for a large enough range of different currents that would allow a valid conclusion about the relationship to be made			

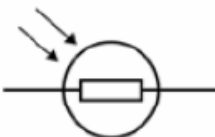


Qu No.		Extra Information	Marks
3.1	$V = 0.025 \times 75$ 1.9 (V)	Allow 1.9 (V) with no working for 2 marks	1 1
3.2	total resistance = $6 / 0.025$ $R = 240 - 225$ 15 (Ω)		1 1 1
3.3	resistance decreases current increases		1 1
Qu No.		Extra Information	Marks
4.1		battery in series with bulb and ammeter voltmeter in parallel with the bulb variable resistor or variable power supply	1 1 1
4.2	correct pair of current readings at the same pd therefore current in lamp A is twice the current in lamp B so lamp A is twice as powerful and lamp B (hence is twice as bright)	eg at 10 V, $I_A = 0.74A$ and $I_B = 0.37A$ must refer to power/ rate of energy transfer	1 1 1
4.3	$R = V / I$ <u>lowest</u> $R = 0.6 / 0.1$ $R = 6 \Omega$ <u>Highest</u> $R = 10 / 0.74$ $R = 13.5 \Omega$ difference = $13.5 - 6 = 7.5 \Omega$	allow $R = 1.0 / 1.6$ $R = 6.25 \Omega$ (other values may be acceptable but the values from the graph must be when $V \leq 1V$ and the lamp can reasonably be assumed to be ohmic)	1 1 1 1
		allow 7.25Ω if consistent	



Question	Answers	Extra information	Mark	AO / Spec. Ref. / Demand
5.1	$97\,500 = 65.0 \times t$ $t = \frac{97\,500}{65.0}$ $t = 1500 \text{ (s)}$	<p>an answer of 1500 (s) scores 3 marks</p> <p>an answer of 1.5 scores 2 marks</p>	<p>1</p> <p>1</p> <p>1</p>	AO2 4.2.4.2 Std./High
5.2	$19.6 = I^2 \times 1.60$ $I^2 = \frac{19.6}{1.60}$ $I = 3.5 \text{ (A)}$ <p>current through battery = 14 (A)</p>	<p>an answer of 14 (A) scores 4 marks</p> <p>allow 1 mark for a correct value for I correctly multiplied by 4</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p>	AO2 4.2.4.1 4.2.2 High
Total			7	

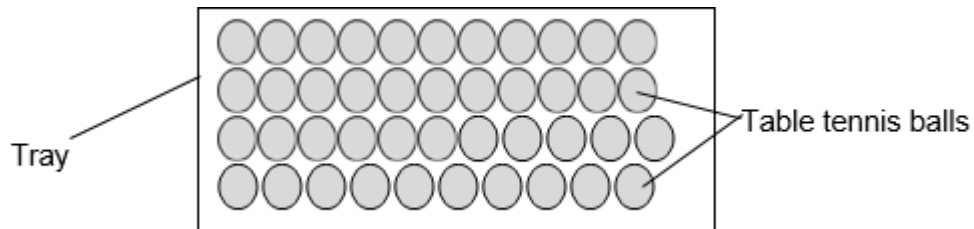


Question	Answers	Extra information	Mark	AO / Spec. Ref. / Demand
6.1	current		1	AO1 4.2.1.2 Standard
6.2	$4.2 = 3.5 \times 10^{-3} \times R$ $R = 4.2 / 3.5 \times 10^{-3}$ $R = 1200 (\Omega)$	an answer of 1200 (Ω) scores 3 marks an answer of 1.2 scores 2 marks	1 1 1	AO2 4.2.1.3 Std./High
6.3	conversion from minutes to seconds (300 s) $Q = 0.0035 \times (5 \times 60)$ $Q = 1.05 \text{ C}$	an answer of 1.05 (C) scores 3 marks an answer of 17.5 scores 1 mark an answer of 1050 or 0.0175 scores 2 marks	1 1 1	AO2 4.2.1.2 Std./High
6.4	(potential difference) increases (because thermistor) resistance increases	2nd mark dependent on scoring 1st mark	1 1	AO1 4.2.1.4 Std./High
6.5			1	AO1 4.2.1.1 Standard
Total			10	

**TOPIC 3: PARTICLE MODEL OF MATTER****Note**

This topic has yet to be covered in class.

1.0 A teacher uses a tray filled with table tennis balls to model how particles are arranged in materials, as shown in **Figure 1**

Figure 1

1.1 Initially the balls are arranged in regular pattern as shown in **Figure 1**.

Which state of matter is best represented by the balls in **Figure 1**?

[1 mark]

Tick **one** box.

Solid

Liquid

Gas

1.2 The teacher then moves the tray from side to side so that the table tennis balls are no longer in a regular pattern.

Which state of matter is now best represented by the balls?

[1 mark]

Tick **one** box

Solid

Liquid

Gas



1.3 The teacher next performs another demonstration by moving the tray more vigorously so that some of the balls jump out of the tray.

The teacher tells the students that the balls that have left the tray represent gas particles.

Which **two** processes could this demonstration represent?

[2 marks]

Tick **two** box

Boiling

condensing

evaporation

freezing

melting

1.4 Gases can be at different temperatures.

The temperature of a gas is related to

[1 mark]

The average size of the particles

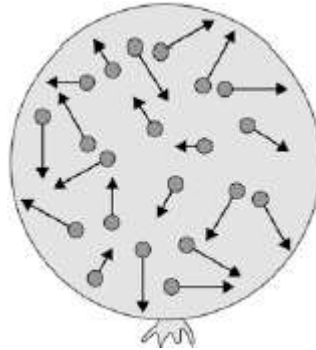
The average mass of the particles

The average kinetic energy of the particles



2.1 Figure 2 shows some of the gas particles in a balloon.

Figure 2



Describe the movement of the gas particles inside the balloon.

[2 marks]

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2.2 The gas in the balloon has a mass of 0.032 kg.

The balloon has a volume of 0.025 m³.

Calculate the density of the gas in the balloon.

[2 marks]

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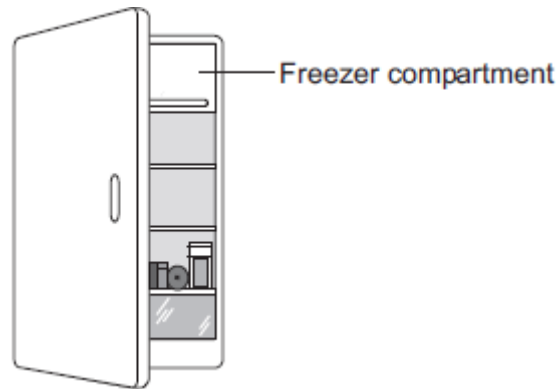
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Density of gas = _____ kg/m³



3.0 Figure 3 shows a fridge with a freezer compartment.

Figure 3



3.1 Energy is transferred to cool food when it is placed in the fridge.

Complete the sentence to describe how energy is transferred to cool the food.

[2 marks]

food	fridge	surroundings
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Energy is transferred from the _____ to the _____,

this energy is then transferred to the _____.



3.3 The temperature of the air inside the freezer compartment is $-5\text{ }^{\circ}\text{C}$.

The temperature of the air inside the fridge is $5\text{ }^{\circ}\text{C}$

Explain why the particles in the freezer compartment move at a different speed than those in the main part of the fridge.

[2 marks]

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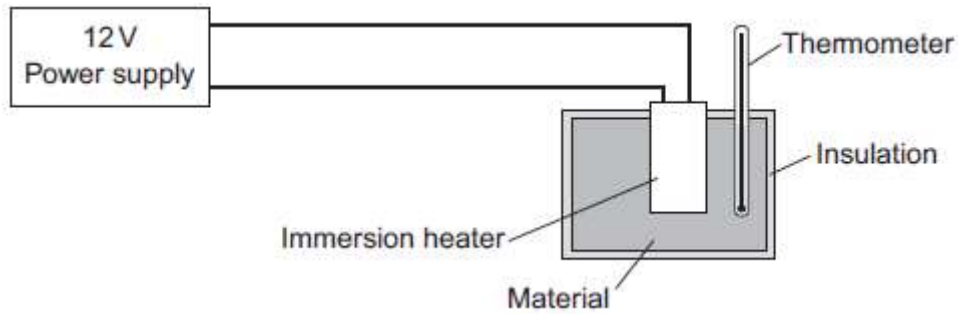
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4.0 A student used the apparatus in **Figure 4** to compare the specific heat capacities of different metals.

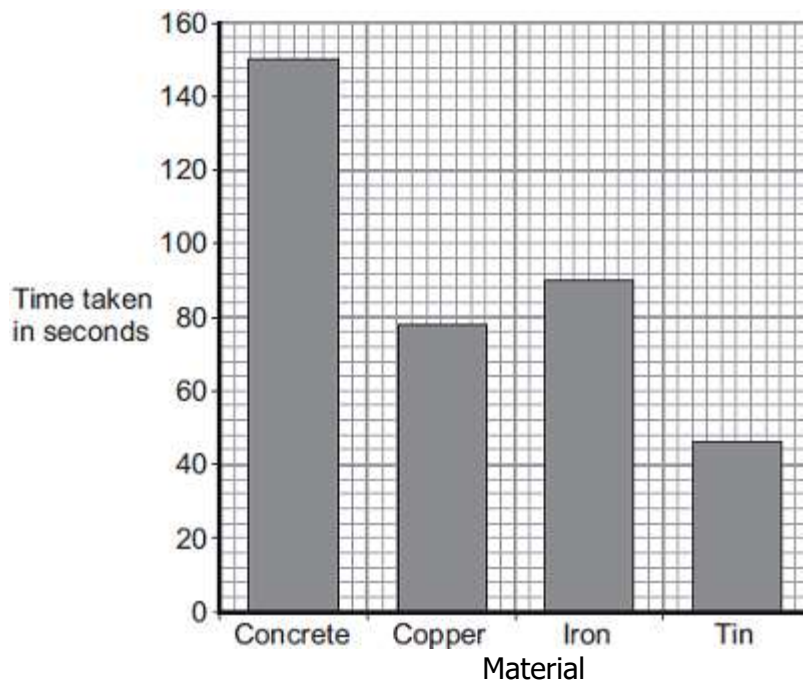
Figure 4



The student measured the time taken to increase the temperature of each material by 10 °C.

Figure 5 shows the student's results.

Figure 5



4.1 The student makes the following conclusion;

'The specific heat capacity of concrete is five times greater than tin.'

Use data from the bar chart to decide if the student's conclusion is correct.

[2 marks]

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4.2 The iron block had a mass of 1.023 kg.

The specific heat capacity of iron is 450 J / kg °C.

Calculate the energy transferred by the heater to increase the temperature of the iron block by 10 °C.

Use the correct equation from the physics equation sheet.

Give your answer to two significant figures.

[3 marks]

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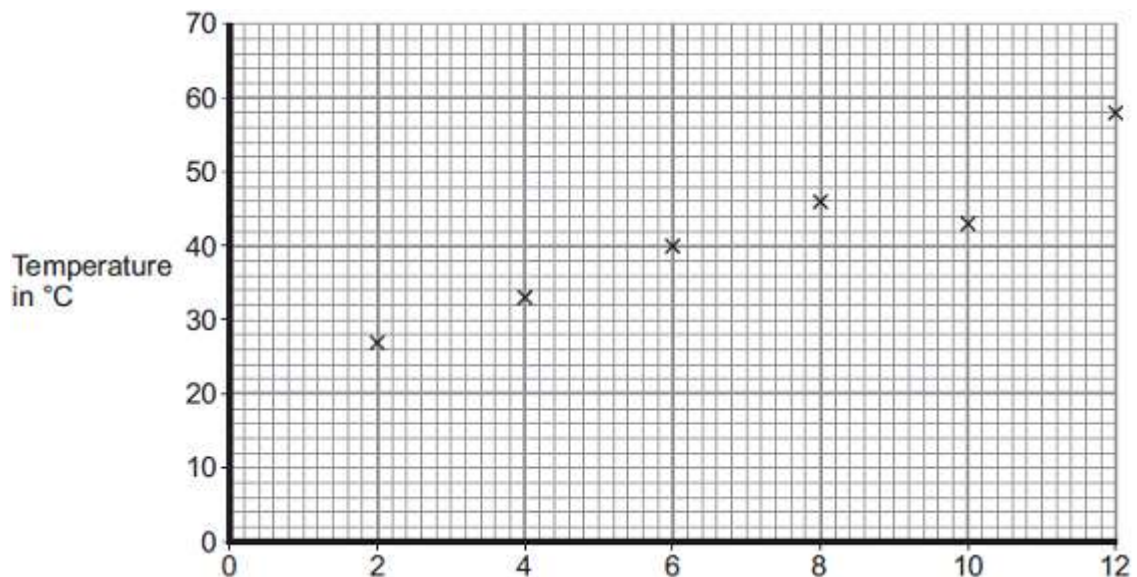
Energy transferred = _____ J

The student used the same apparatus to heat a 1 kg block of aluminium.

He recorded the temperature of the block as it was heated from room temperature.

The results are shown in **Figure 6**.

Figure 6



Time the immersion heater is switched on for in minutes



4.3 After how many minutes did the student record the incorrect temperature?

[1 mark]

Time = _____ minutes

4.4 Draw the line of best fit for the points plotted in **Figure 6**.

[1 mark]

4.5 What was the temperature of the room?

[1 mark]

Temperature _____ °C

4.6 Another student suggested repeating the experiment using a heater with a greater power.

Explain what effect this would have on the gradient of the graph the student drew.

[3 marks]

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**MARK SCHEME**

Qu No.		Extra Information	Marks
1.1	solid		1
1.2	liquid		1
1.3	boiling		1
	evaporation		1
1.4	the average kinetic energy of the particles		1
1.5	motion is random		1
	range of speeds or range of directions		1
1.6	$\rho = 0.032 / 0.026$		1
	$\rho = 1.3 \text{ (kg/m}^3\text{)}$	allow 1.28 (kg/m ³)	1
		allow 1.3 (kg/m ³) with no working for 2 marks	

Qu No.		Extra Information	Marks
2.1	motion is random		1
	range of speeds or range of directions		1
2.2	$\rho = 0.032 / 0.026$		1
	$\rho = 1.3 \text{ (kg/m}^3\text{)}$	allow 1.28 (kg/m ³)	1
		allow 1.3 (kg/m ³) with no working for 2 marks	



Qu No.		Extra Information	Marks
3.1	food fridge surroundings		2
		2 marks for all three in the correct place 1 mark for 2 or 1 in the correct place	
3.2			
Level 3:	A detailed and coherent description of both the arrangement and motion of the particles in the different states of matter		5-5
Level 2:	A coherent description of both the arrangement and motion of the particles in the different states of matter.		3-4
Level 1:	Simple description of the arrangement and/or motion of the particles in the different states of matter		1-2
	No relevant content		0
Indicative content			
Solid Particles closely packed in a regular pattern Particles vibrate about a fixed position			
Liquid Particles closely packed in an irregular pattern Particles are able to move relative to each other			
Liquid Particles are widely spread in no pattern Particles move randomly and rapidly.			
3.3	Air molecules in fridge will have a greater speed.		1
	because the air is at a greater temperature so greater kinetic energy		1
		allow 2 marks for the converse.	



Qu No.		Extra Information	Marks
4.1	conclusion is no correct because $45 / 150 = 3.3$ 3.3 is less than 5	allow 40-50 for TIn	1 1
4.2	$E = 1.023 \times 450 \times 10$ $E = 4\,600 \text{ (J)}$ Answer to 2 sig. figs.	allow 2 marks for a correct answer to an incorrect number of sig figs e.g. 4 604 (J) allow 1 mark for an incorrect answer to an incorrect number of sig figs e.g. 4 603 (J) if substitution is correct	1 1 1
4.3	10 (minutes)		1
4.4	Correct line of best fit drawn		1
4.5	20 (°C)		1
4.6	gradient would be greater because energy supplied per second would be greater. so rate of increase of temperature would be greater. or more energy supplied (in 12 minutes) so greater final temperature (so greater temperature difference)		1 1 1



Qu No.	Extra Information	Marks
5.1		
Level 3:	Clear and coherent description of both methods including equation needed to calculate density. Steps are logically ordered and could be followed by someone else to obtain valid results.	5-5
Level 2:	Clear description of one method to measure density or partial description of both methods. Steps may not be logically ordered.	3-4
Level 1:	Basic description of measurements needed with no indication of how to use them.	1-2
	No relevant content	0
Indicative content		
<p>For both measure mass using a balance calculate density using $\rho = m / V$</p> <p>Metal cube measure length of cube's sides using a ruler calculate volume</p> <p>Small statue immerse in water measure volume / mass of water displaced volume of water displaced = volume of small statue</p>		

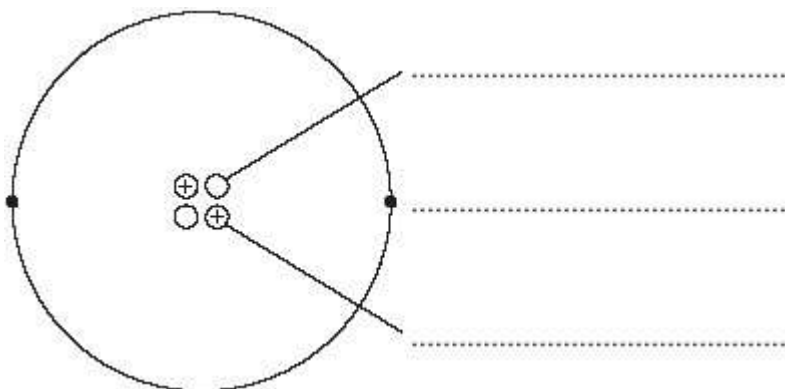


TOPIC 4: ATOMIC STRUCTURE

Note
This topic has yet to be covered in class.

1.0 Figure 1 shows a helium atom.

Figure 1



1.1 Use the words in the box to label the diagram.

electron neutron proton

[2 marks]

1.2 An alpha particle is the same as the nucleus of a helium atom.

How is an alpha particle different from a helium atom?

[1 mark]

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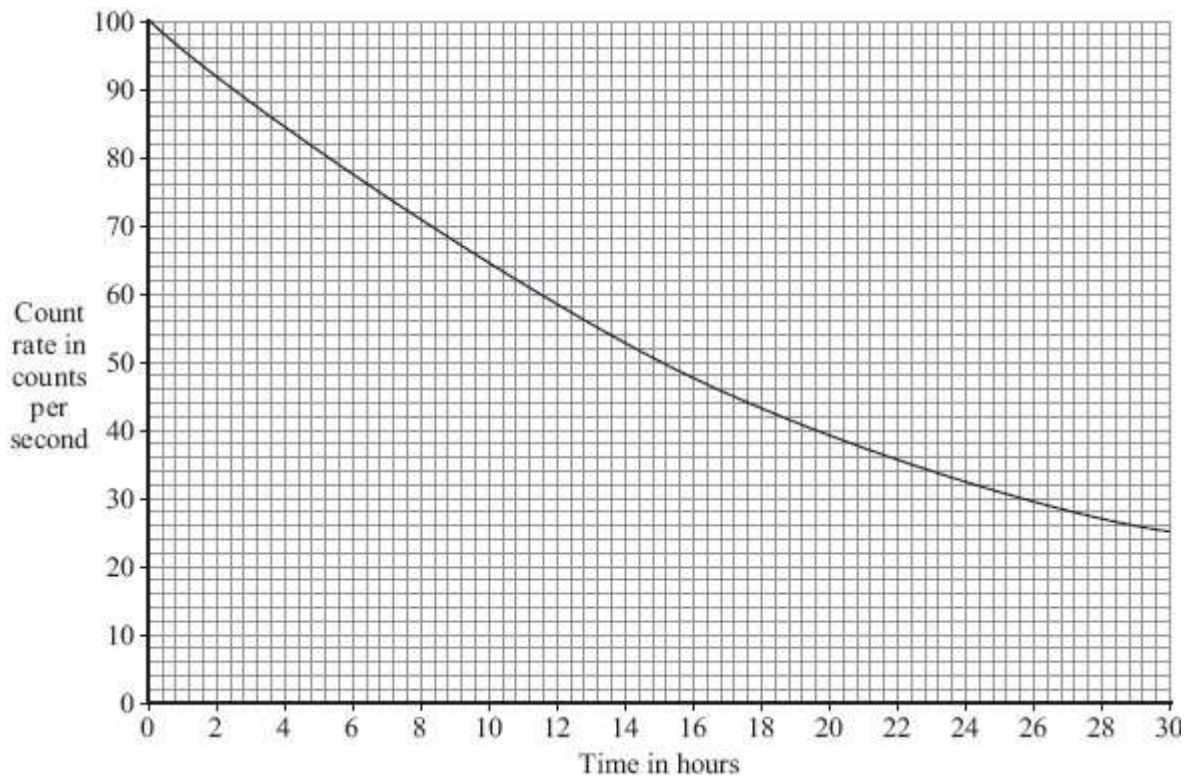
1.3 Complete the atomic symbol for helium to show helium's atomic number and mass number

[2 marks]

He



The graph shows how the count rate from a sample of radioactive sodium-24 changes with time.



1.4 What time, in hours, does it take for the count rate to fall from 60 counts per second to 40 counts per second?

[2 marks]

.....

.....

time = _____ hours

1.5 What is the half-life of sodium-24?

[1 mark]

half-life = _____ hours



2.1 The names of three types of radiation are given in **List A**. Some properties of these three types of radiation are given in **List B**.

Draw **one** line from each type of radiation in **List A** to its correct property in **List B**

List A Type of radiation	List B Property of radiation
alpha	will pass through paper but is stopped by thin metal
beta	has the shortest range in air
gamma	will not harm human cells
_____	is very weakly ionising

2 Complete the following sentences using the words from the box.

[4 marks]

alpha	beta	gamma	proton	neutron
-------	------	-------	--------	---------

The most penetrating type of radiation is _____.

The type of radiation with the greatest charge is _____.

The type of radiation with the greatest range in air is _____.

The two types of radiation that have no charge are _____ and _____.



3.0 The table shows the average background radiation dose from various sources that a person living in the UK receives in one year.

Source of background radiation	Average radiation dose received each year in mSv
Cosmic rays (from space)	0.40
Food and drink	0.30
Medical treatments (including X-rays)	0.55
Radon gas	1.25
Rocks	0.50
TOTAL	3.00

3.1 A student looked at the data in the table and then wrote down four statements.

Which of the following statements are true?

[2 marks]

Tick **two** boxes.

More than half of the average radiation dose comes from radon gas.

On average, cosmic rays produce less background radiation than rocks.

Everyone living in the UK receives the same background radiation dose.

Having no X-rays reduces a person's radiation dose.

3.2 Each time a chest X-ray is taken, the patient receives about 0.12 mSv of radiation.

How many chest X-rays would just exceed the yearly average dose for medical treatments?

[2 marks]

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.....

number of chest X-rays = _____



3.2 What percentage of the total dose comes from natural sources?

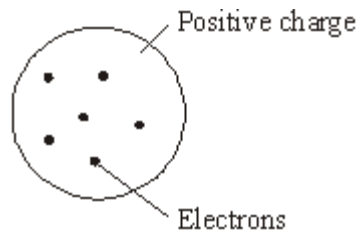
[3 marks]

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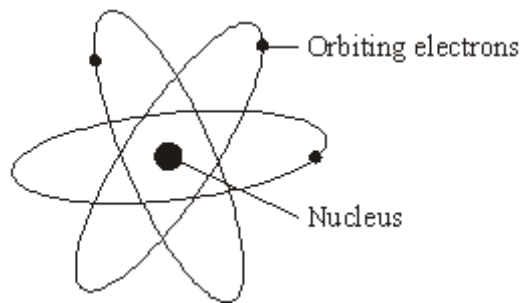
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Percentage = _____

4.0 The discovery of the electron led to the plum pudding model to explain the structure of the atom.



The results from the alpha particle scattering experiment led to the plum pudding model being replaced by the nuclear model.



4.1 Describe the differences between the two models of the atom.

[6 marks]

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Give a reason for your answer.

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5.3 Technetium-99 has a short half-life and emits gamma radiation.

What is meant by the term 'half-life'?

[1 mark]

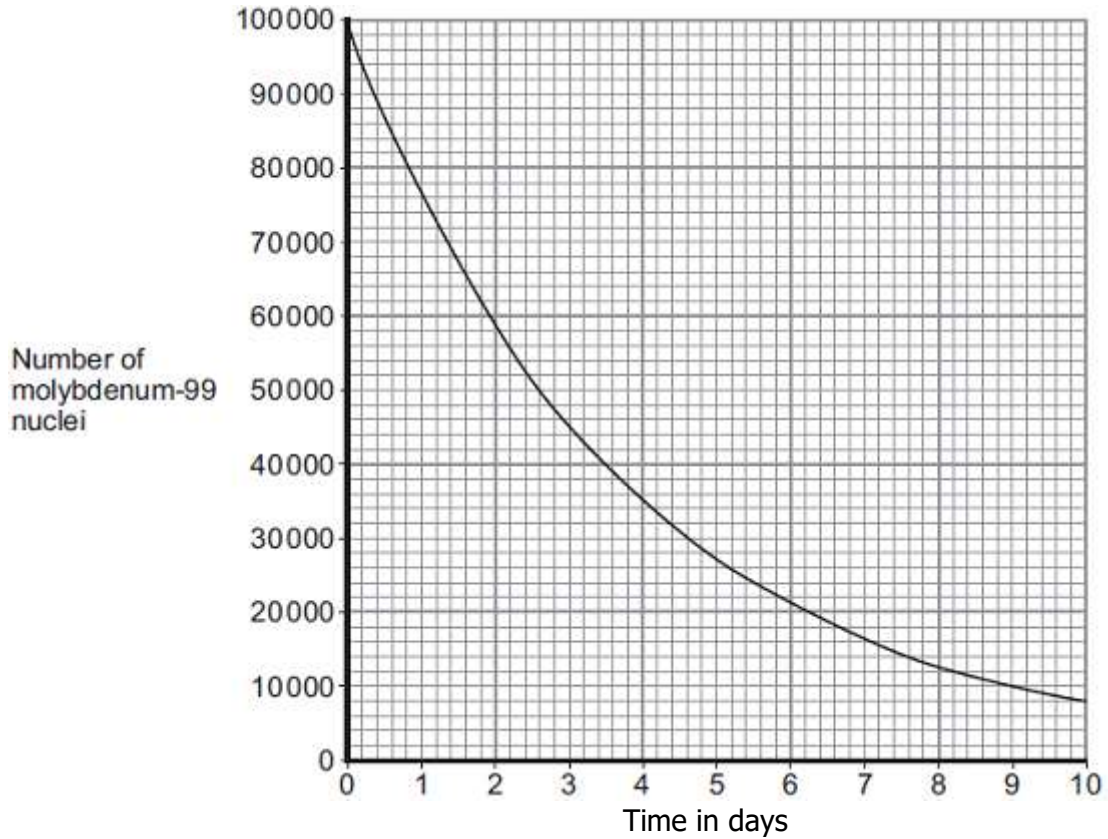
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5.4 Technetium-99 is used by doctors as a medical tracer. In hospitals it is produced inside a technetium generator by the decay of molybdenum-99 nuclei.

The graph below shows how the number of nuclei in a sample of molybdenum-99 changes with time as the nuclei decay.



A technetium generator will continue to produce sufficient technetium-99 until three half-lives have passed. After how many days should the technetium generator be replaced?

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Number of days = _____



5.5 A doctor claims that after 4 weeks the technetium generator will be safe to dispose of.
Calculate the number of molybdenum nuclei remaining after 4 weeks, and comment on whether it would be safe to dispose of.

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number of molybdenum nuclei remaining = _____

Safety

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MARK SCHEME

Qu No.		Extra Information	Marks
1.1		all three labels correct allow 1 mark for 1 or 2 correct labels	2
1.2	has no electrons	allow alpha has a positive(charge) allow a helium (atom) has no (charge)	1
1.3	4		1
	2		1
1.4	19.6 - 11.6	allow ± 0.2 for each reading	1
	8 (hours)	allow ± 0.4 if consistent with values read from the graph	1
1.5	15.2 (hours)	allow ± 0.2	1

Qu No.		Extra Information	Marks
2.1		allow 1 mark for each correct line if more than one line is drawn from any type of radiation box then all of those lines are wrong	3
2.2	gamma		1
	alpha		1
	alpha		1
	gamma and neutron	both required for 1 mark	1



Qu No.		Extra Information	Marks
3.1	on average, cosmic rays produce less background radiation than rocks		1
	having no X-rays reduces a person's radiation dose		1
3.2	0.55/0.12	do not allow 4.583	1
	number of chest X-rays = 5		1
3.3	Sum = 2.55		1
	Percentage of total dose = $(2.55 / 3.00) \times 100$		1
	85 %	allow 2 marks for 0.85	1



Qu No.	Extra Information	Marks
4		
Level 3:	A detailed and coherent comparison of the arrangement of the particles in the different models.	5-5
Level 2:	A detailed and coherent description of the arrangement of the particles in the different models.	3-4
Level 1:	A simple description of the arrangement and/or a simple comparison of the arrangement of the particles in the different models	1-2
	No relevant content	0
Indicative content		
	nuclear model mass is concentrated at the centre / nucleus plum pudding model mass is evenly distributed nuclear model positive charge occupies only a small part of the atom plum pudding model positive charge spread throughout the atom nuclear model electrons orbit some distance from the centre / nucleus plum pudding electrons embedded in the (mass) of positive (charge) nuclear model the atom mainly empty space plum pudding model is a 'solid' mass	



Qu No.		Extra Information	Marks
5.1	(same) number of protons		1
5.2	beta atomic / proton number increases (by 1) or number of neutrons decreases / changes by 1		1 1
5.3	time taken for number of radioactive nuclei to halve or (average) time taken for count-rate / activity to halve		1
5.4	1 half-life = 5.6 days number of days = 16.8 days		1 1
5.5	Number of half-lives = $28/5.6$ fraction = $(\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2})$ or $(\frac{1}{2})^5$ 100 000 / 32 313 safe number is comparatively low, so low activity unlikely to be substantial risk of contamination/irradiation. or unsafe There are still some atoms of molybdenum left so some radiation emitted therefore still a small risk.	312.5 no mark for safe/unsafe	1 1 1 1 1 1



DATA



GCSE Physics Equation Sheet

1	pressure due to a column of liquid = height of column \times density of liquid \times gravitational field strength (g)	$p = h \rho g$
2	(final velocity) ² - (initial velocity) ² = 2 \times acceleration \times distance	$v^2 - u^2 = 2 a s$
3	force = $\frac{\text{change in momentum}}{\text{time taken}}$	$F = \frac{m \Delta v}{\Delta t}$
4	elastic potential energy = 0.5 \times spring constant \times (extension) ²	$E_e = \frac{1}{2} k e^2$
5	change in thermal energy = mass \times specific heat capacity \times temperature change	$\Delta E = m c \Delta \theta$
6	period = $\frac{1}{\text{frequency}}$	
7	magnification = $\frac{\text{image height}}{\text{object height}}$	
8	force on a conductor (at right angles to a magnetic field) carrying a current = magnetic flux density \times current \times length	$F = B I l$
9	thermal energy for a change of state = mass \times specific latent heat	$E = m L$
10	$\frac{\text{potential difference across primary coil}}{\text{potential difference across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$	$\frac{V_p}{V_s} = \frac{n_p}{n_s}$
11	potential difference across primary coil \times current in primary coil = potential difference across secondary coil \times current in secondary coil	$V_s I_s = V_p I_p$
12	For gases: pressure \times volume = constant	$p V = \text{constant}$



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