Please write clearly in block capitals.

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Centre number ☐☐☐☐☐ Candidate number ☐☐☐☐

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE

COMBINED SCIENCE: TRILOGY

Higher Tier Physics Paper 1

Practice Paper Series – Set 2

Time allowed: 1 hour 15 minutes

Materials

For this paper you must have:

- a ruler
- a scientific calculator
- the Physics Equations Sheet (printed at the back of this booklet).

Instructions

- Use black ink or black ball-point pen.
- Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 70.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- When answering question 01.1 you need to make sure that your answer:
  - is clear, logical, sensibly structured
  - fully developed
  - shows how the points that you make are related or follow on from each other where appropriate.

For Examiner's Use

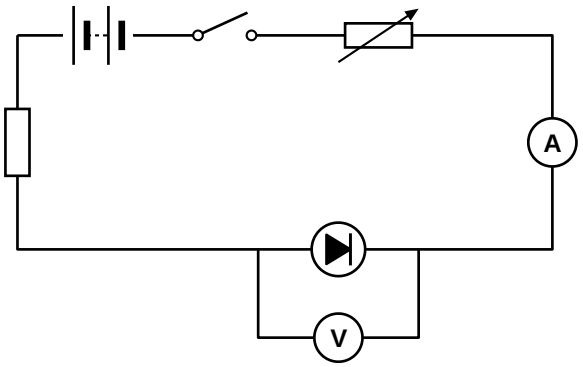
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	

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0 1 A student investigated how the current in a diode depends on the potential difference across the diode.

Figure 1 shows the circuit used.

Figure 1



0 1 . 1 Describe a method the student could use to obtain the current–potential difference characteristic of the diode. [6 marks]

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Question 1 continues on the next page

Table 1 shows some of the student's results.

Table 1

Potential difference in V	0.00	0.20	0.40	0.50	0.60	0.70	0.80
Current in mA	0.0	0.0	0.1	1.2	6.0	20.0	52.0

0 1 . 2 Describe how the current changes as the potential difference increases from 0 V to 0.80 V [2 marks]

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0 1 . 3 Calculate the resistance of the diode when the potential difference across it is 0.70 V [2 marks]

Use **Table 1**.

Resistance = ... Ω

0 1 . 4 Which statement describes a diode? [1 mark]

Tick (✓) **one** box.

- Its resistance is the same in both directions. ☐
- The current in it is directly proportional to the potential difference. ☐
- It has a very high resistance in the reverse direction. ☐
- Its resistance increases as the current increases. ☐

0 1 . 5 The student then reversed the diode in the circuit. [1 mark]

The ammeter reading was 0.0 mA

The resolution of the ammeter was 0.1 mA

The student concluded:

'There is no current at all in the reverse direction.'

Suggest why the student's conclusion may not be correct.

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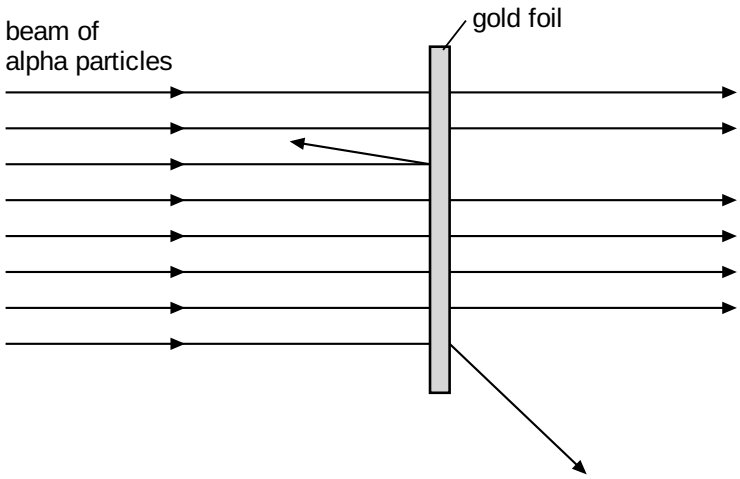
0 2 Scientists have used evidence from experiments to develop models of the atom.

In one experiment, a beam of alpha particles was directed at a very thin sheet of gold foil.

Alpha particles are positively charged.

Figure 2 shows what happened to some of the alpha particles.

Figure 2



0 2 . 1 Describe the structure of an atom according to the nuclear model. [3 marks]

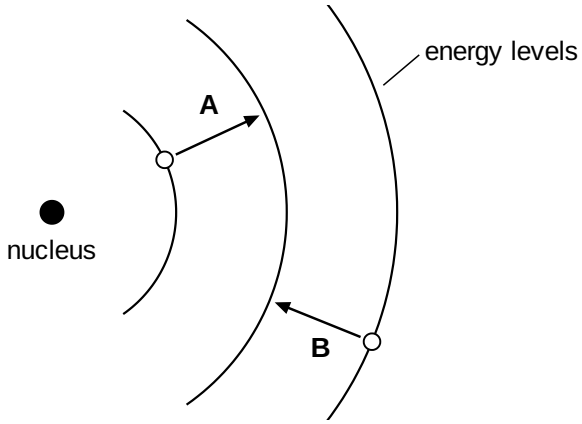
Include the sub-atomic particles and where they are found.

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Question 2 continues on the next page

Figure 3 shows three energy levels in an atom. Arrows **A** and **B** show electrons changing energy level.

Figure 3



0 2 . 2 State whether energy is absorbed or emitted in change **A** and in change **B**. [2 marks]

A .....

B .....

0 2 . 3 A neutral atom becomes a positive ion. [1 mark]

What happens to the electrons of the atom?

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0 2 . 4 The radius of an atom is 1.2×10^{-10} m [2 marks]

The radius of its nucleus is 6.0×10^{-15} m

Calculate how many times as large the radius of the atom is as the radius of its nucleus.

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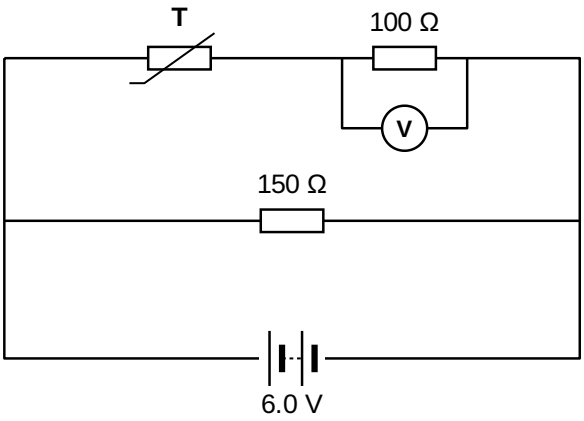
Turn over for the next question

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0 3 **Figure 4** shows a circuit containing a thermistor **T**.

Figure 4



0 3 . 1 At room temperature the reading on the voltmeter is 2.0 V [3 marks]

Calculate the resistance of the thermistor at room temperature.

Resistance = ... Ω

0 3 . 2 The temperature of the thermistor increases. [3 marks]

Explain what happens to the reading on the voltmeter.

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Turn over for the next question

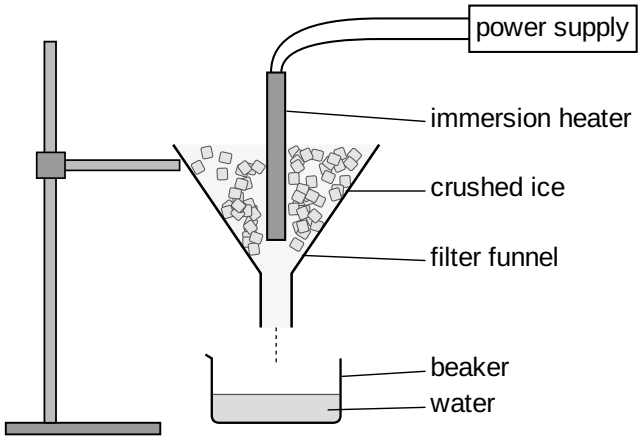
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0 4 A student determined the specific latent heat of fusion of ice.

Figure 5 shows the apparatus used.

Figure 5



0 4 . 1 What is meant by the 'specific latent heat of fusion' of ice? [2 marks]

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0 4 . 2 The ice was already melting at 0 °C before the heater was switched on. [3 marks]

The power of the heater was 40 W

The heater was switched on for 300 s

The mass of ice that melted in this time was 0.040 kg

Calculate the specific latent heat of fusion of ice.

Use the Physics Equations Sheet.

Specific latent heat of fusion = ... J/kg

Question 4 continues on the next page

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0 4 . 3 The student's value was lower than the true value. [2 marks]

The temperature of the room was 20 °C

Explain why the student's value was too low.

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0 4 . 4 Suggest how the student could reduce or correct for the effect of energy transferred from the room. [1 mark]

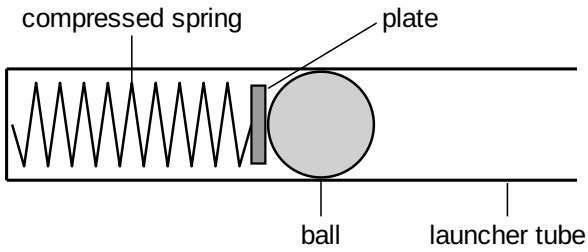
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0 5 **Figure 6** shows a toy launcher.

A ball is held against a plate on the end of a compressed spring. When the spring is released, the ball is pushed out of the tube.

Figure 6



0 5 . 1 The spring is compressed by 150 mm [2 marks]

The spring constant of the spring is 320 N/m

Calculate the elastic potential energy stored in the compressed spring.

Assume that the limit of proportionality of the spring has not been exceeded.

Use the Physics Equations Sheet.

Elastic potential energy = ... J

Question 5 continues on the next page

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0 5 . 2 When the spring is released, 75% of the elastic potential energy is transferred to the kinetic energy store of the ball. [3 marks]

The mass of the ball is 0.060 kg

Calculate the speed of the ball as it leaves the launcher.

Speed = _____ m/s

0 5 . 3 A student said: [3 marks]

'If the spring is compressed twice as far, the ball will leave the launcher twice as fast.'

Explain whether the student is correct.

Assume that:

- 75% of the elastic potential energy is still transferred to the kinetic energy store of the ball
- the limit of proportionality of the spring is not exceeded.

0 5 . 4 Give **one** reason why less than 100% of the elastic potential energy is transferred to the kinetic energy store of the ball. [1 mark]

Turn over for the next question

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0 6 Cobalt-60 is a radioactive isotope. It emits beta particles and gamma rays.

Radiation from cobalt-60 is used to kill bacteria in food. This is called food irradiation.

0 6 . 1 A nucleus of cobalt-60 decays by emitting a beta particle. [2 marks]

Complete the nuclear equation for this decay.

$$^{60}_{27}\text{Co} \longrightarrow {}^{60}_{28}\text{Ni} + \square$$

0 6 . 2 The food is irradiated after it has been packed into large boxes. [2 marks]

Explain why gamma radiation is used to irradiate the food, rather than beta radiation.

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0 6 . 3 Food that has been irradiated does not become radioactive. [2 marks]

Explain why.

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0 6 . 4 The activity of a new cobalt-60 source is 6.4×10^{13} Bq [3 marks]

The source is replaced when its activity has decreased to 4.0×10^{12} Bq

The half-life of cobalt-60 is 5.3 years

Calculate the time before the source needs to be replaced.

Time = ... years

Turn over for the next question

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0 7 A student determined the density of a cooking oil.

The student:

- put an empty measuring cylinder on a balance
- poured 10 cm^3 of oil into the measuring cylinder
- recorded the total mass of the measuring cylinder and the oil
- repeated, adding 10 cm^3 of oil each time.

Table 2 shows the results.

Table 2

Volume of oil in cm^3	10	20	30	40	50
Total mass in g	187.2	196.6	205.6	214.6	224.0

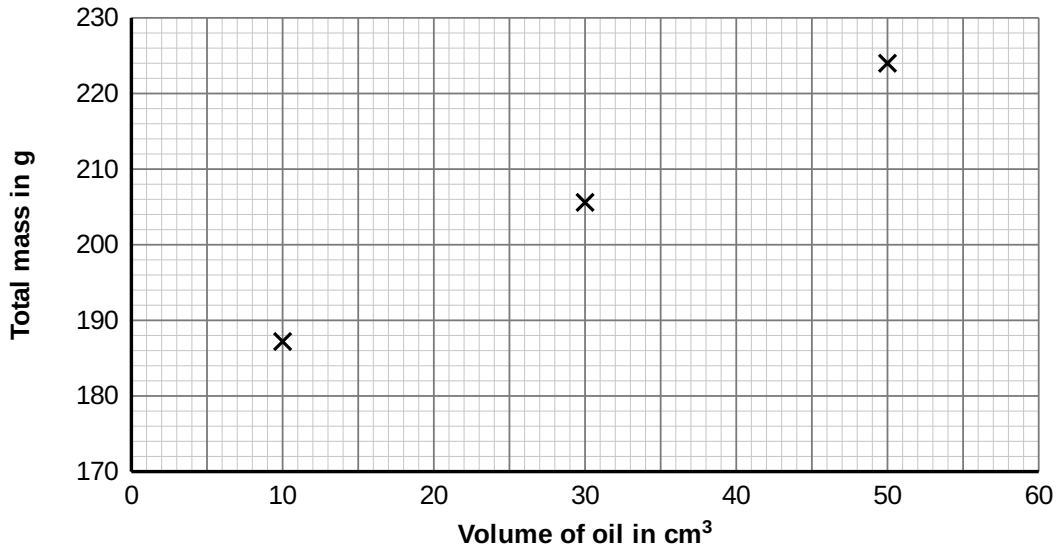
0 7 . 1 **Figure 7** shows some of the results. [2 marks]

Complete **Figure 7**.

You should:

- plot the results for 20 cm^3 and 40 cm^3
- draw a line of best fit.

Figure 7



0 7 . 2 Determine the mass of the empty measuring cylinder. [1 mark]

Use **Figure 7**.

Mass = ... g

Question 7 continues on the next page

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0 7 . 3 Determine the density of the oil. [3 marks]

Use **Figure 7**.

Give your answer in kg/m^3

Density = ... kg/m^3

0 7 . 4 The balance had a zero error. It read 2.0 g when there was nothing on it. [2 marks]

Explain why this zero error did not affect the student's value for the density of the oil.

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0 8 A family wants to reduce the rate of energy transfer from their house.

0 8 . 1 The family decides to fit loft insulation. [2 marks]

Describe how the thickness and the thermal conductivity of loft insulation affect the rate of energy transfer through the roof.

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Question 8 continues on the next page

0 8 . 2 Before the loft insulation was fitted, the electric heaters in the house needed a mean power of 1.6 kW to keep the house warm. [3 marks]

After the loft insulation was fitted, the heaters needed a mean power of 1.3 kW

The heaters are switched on for 8.0 hours each day.

Electricity costs 27p for each kilowatt-hour (kWh) of energy.

Use the equation:

energy transferred (kWh) = power (kW) × time (h)

Calculate how much money the family saves each day.

Money saved each day = £ .....

0 8 . 3 The family could replace the electric heaters with a stove that burns wood pellets. [2 marks]

Wood pellets are a renewable energy resource. Coal is a non-renewable energy resource.

Explain the difference between a renewable energy resource and a non-renewable energy resource.

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Question 8 continues on the next page

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The family tested two insulating jackets, **A** and **B**, on their hot water tank.

Each jacket was tested on a different day. The water heater was switched off for 8 hours during each test.

Table 3 shows the results.

Table 3

Jacket	Temperature of the water at the start in °C	Temperature of the water after 8 hours in °C
A	80	60
B	60	46

0 8 . 4 The family concluded that jacket **B** is the better insulator because the temperature of the water decreased by less. [3 marks]

Evaluate the family's conclusion.

END OF QUESTIONS

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Additional page, if required.

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There are no more questions in this paper. Original practice paper © sciencegcse.co.uk – free to use for non-commercial education. Not an AQA paper.

Physics Equations Sheet

GCSE Combined Science: Trilogy – Practice Paper Series, Set 2

You may use these equations in your answers. HT = Higher Tier only equations. The equations are those listed in the AQA specification; this sheet is provided by sciencegcse.co.uk and is not an AQA document.

		Word equation	Symbol equation
1		kinetic energy = 0.5 × mass × (speed)^2	$E_k = ½ m v^2$
2		elastic potential energy = 0.5 × spring constant × (extension)^2	$E_e = ½ k e^2$
3		gravitational potential energy = mass × gravitational field strength × height	$E_p = m g h$
4		change in thermal energy = mass × specific heat capacity × temperature change	$\Delta E = m c \Delta\theta$
5		power = energy transferred ÷ time	$P = E / t$
6		power = work done ÷ time	$P = W / t$
7		efficiency = useful output energy transfer ÷ total input energy transfer	
		efficiency = useful power output ÷ total power input	
8		charge flow = current × time	$Q = I t$
9		potential difference = current × resistance	$V = I R$
10		power = potential difference × current	$P = V I$
11		power = (current)^2 × resistance	$P = I^2 R$
12		energy transferred = power × time	$E = P t$
13		energy transferred = charge flow × potential difference	$E = Q V$
14	**HT**	potential difference across primary coil × current in primary coil = potential difference across secondary coil × current in secondary coil	$V_p I_p = V_s I_s$
15		density = mass ÷ volume	$\rho = m / V$
16		thermal energy for a change of state = mass × specific latent heat	$E = m L$
17		weight = mass × gravitational field strength	$W = m g$
18		work done = force × distance (along the line of action of the force)	$W = F s$
19		force applied to a spring = spring constant × extension	$F = k e$
20		distance travelled = speed × time	$s = v t$
21		acceleration = change in velocity ÷ time taken	$a = \Delta v / t$
22		(final velocity)^2 − (initial velocity)^2 = 2 × acceleration × distance	$v^2 - u^2 = 2 a s$
23		resultant force = mass × acceleration	$F = m a$
24	**HT**	momentum = mass × velocity	$p = m v$
25		period = 1 ÷ frequency	$T = 1 / f$
26		wave speed = frequency × wavelength	$v = f \lambda$
27	**HT**	force on a conductor (at right angles to a magnetic field) carrying a current = magnetic flux density × current × length	$F = B I l$