Please write clearly in block capitals.

H

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

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE

PHYSICS

Higher Tier Paper 1

Practice Paper Series – Set 2

Time allowed: 1 hour 45 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 100.
- 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 questions 07.1 and 10.4 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	
9	
10	
TOTAL	

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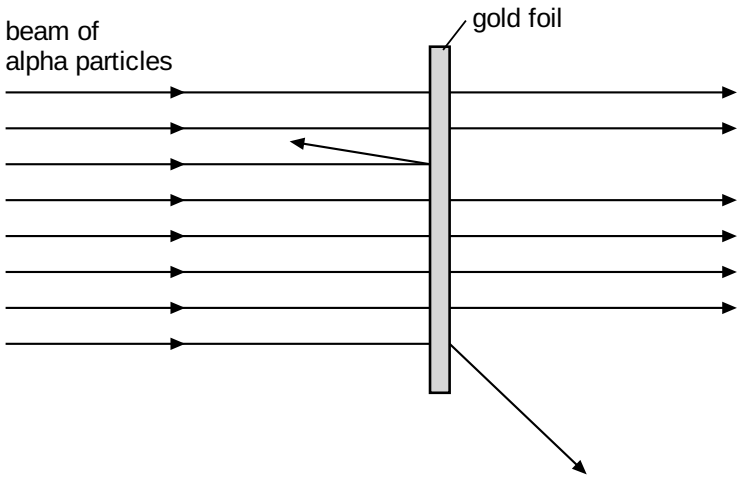
0 1 Scientists have used evidence from experiments to develop models of the atom.

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

Alpha particles are positively charged.

Figure 1 shows what happened to some of the alpha particles.

Figure 1



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

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

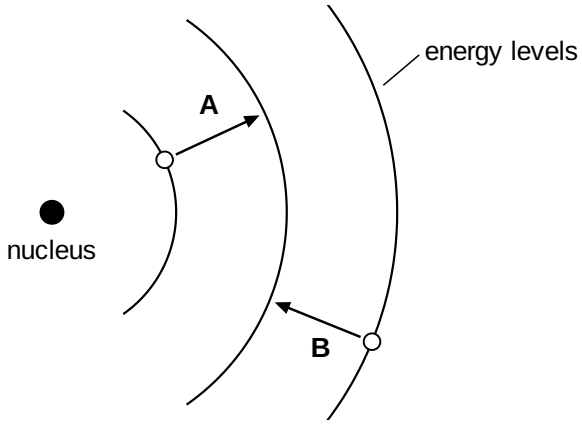
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Question 1 continues on the next page

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Figure 2 shows three energy levels in an atom. Arrows **A** and **B** show electrons changing energy level.

Figure 2



0 1 . 2 State whether energy is absorbed or emitted in change **A** and in change **B**. [2 marks]

A .....

B .....

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

What happens to the electrons of the atom?

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0 1 . 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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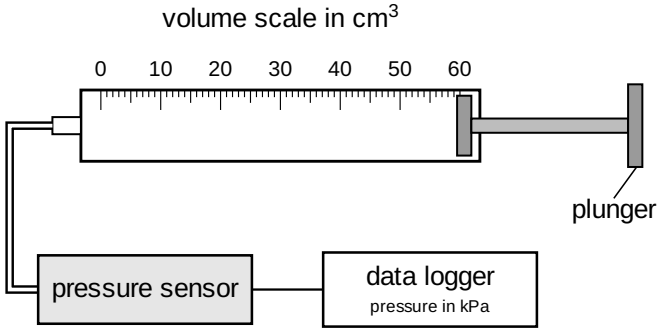
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0 2 A student investigated how the pressure of a fixed mass of air depends on its volume.

Figure 3 shows the equipment.

Figure 3



The student:

- started with 60 cm^3 of air in the syringe
- pushed the plunger in slowly, in steps
- waited for one minute after each step before recording the volume and the pressure.

0 2 . 1 Suggest why the student waited for one minute before recording each pressure. [1 mark]

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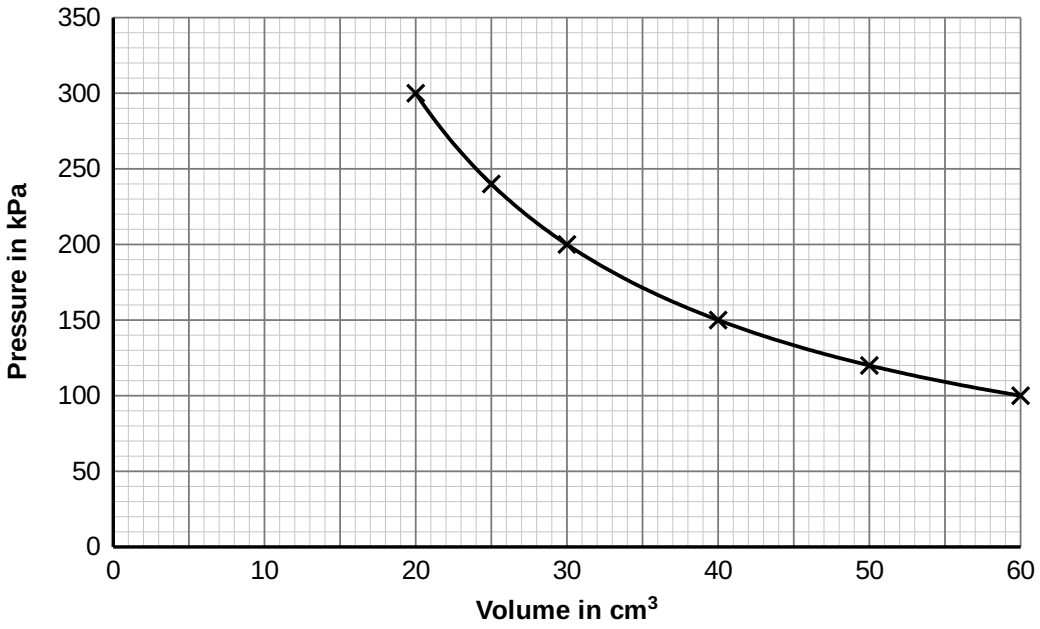
Question 2 continues on the next page

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0 2 . 2 **Figure 4** shows the student's results. [3 marks]

Use **Figure 4** to show that the pressure of the air is inversely proportional to its volume.

Figure 4



0 2 . 3 Calculate the pressure of the air when its volume is 15 cm^3 [2 marks]

Pressure = ... kPa

Question 2 continues on the next page

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0 2 . 4 The student repeated the experiment but pushed the plunger in quickly from 60 cm^3 to 30 cm^3 [3 marks]

Immediately afterwards the pressure was 230 kPa

One minute later the pressure was 200 kPa

Explain these observations.

0 2 . 5 Another student repeated the experiment using a different syringe. [3 marks]

- At the start, the volume of the air was 60 cm^3 and its pressure was 100 kPa
- The student pushed the plunger in slowly until the volume was 30 cm^3
  The pressure was then 190 kPa
- The student then pulled the plunger out slowly until the volume was 60 cm^3 again
  The pressure was then 92 kPa

The student concluded that some air had leaked out of the syringe.

Evaluate the student's conclusion.

Turn over for the next question

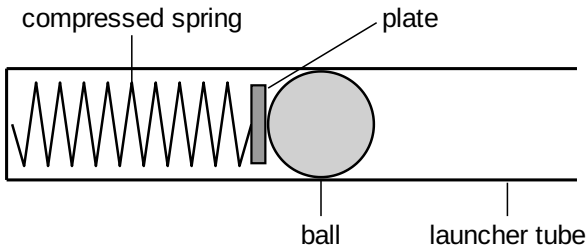
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0 3 **Figure 5** shows a toy launcher.

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 5



0 3 . 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

0 3 . 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

Question 3 continues on the next page

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0 3 . 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:

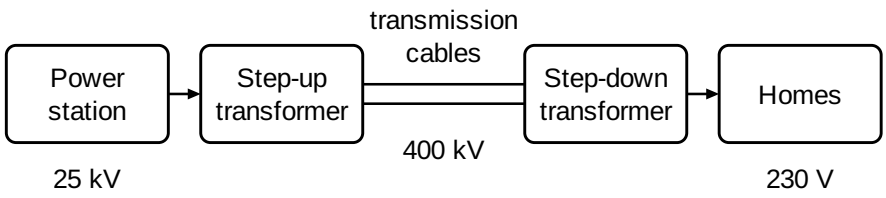
- 75% of the elastic potential energy is still transferred to the kinetic energy store of the ball
- the limit of proportionality of the spring is not exceeded.

0 3 . 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]

0 4 Electricity is transferred from power stations to homes using the National Grid.

Figure 6 shows part of the National Grid.

Figure 6



0 4 . 1 The output power of the power station is 100 MW [2 marks]

The potential difference at the output of the power station is 25 kV

Calculate the current from the power station.

Current = ... A

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0 4 . 2 The total resistance of the transmission cables is 2.0 Ω [2 marks]

Calculate the power that would be wasted in the cables if the current from the power station passed through them without using a step-up transformer.

Power = ... W

0 4 . 3 The step-up transformer increases the potential difference to 400 kV [5 marks]

Assume that the transformer is 100% efficient.

Calculate the percentage of the output power of the power station that is wasted in the transmission cables.

Percentage = ... %

0 4 . 4 Give the reason why step-down transformers are used before electricity is supplied to homes. [1 mark]

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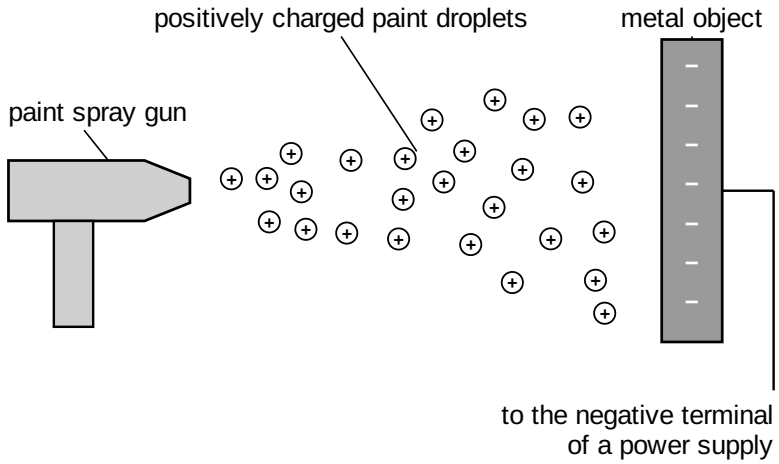
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0 5 Electrostatic paint spraying is used to paint metal objects such as bicycle frames.

Figure 7 shows how the paint is sprayed.

Figure 7



0 5 . 1 The paint droplets become positively charged as they leave the spray gun. [1 mark]

What happens to the paint droplets to make them positively charged?

Tick (✓) **one** box.

- They gain electrons. ☐
- They gain protons. ☐
- They lose electrons. ☐
- They lose protons. ☐

0 5 . 2 Explain why the paint droplets spread out as they move away from the spray gun. [2 marks]

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Question 5 continues on the next page

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0 5 . 3 The metal object is connected to the negative terminal of a power supply. [3 marks]

Explain why paint droplets also reach the side of the metal object facing away from the spray gun.

Use ideas about electric fields in your answer.

0 5 . 4 An isolated, positively charged paint droplet can be modelled as a positively charged sphere. [2 marks]

Describe the pattern and direction of its electric field lines.

0 5 . 5 The paint does not conduct electricity. [3 marks]

Parts of the metal object that are already covered with paint attract fewer paint droplets than parts that are not covered.

Explain why.

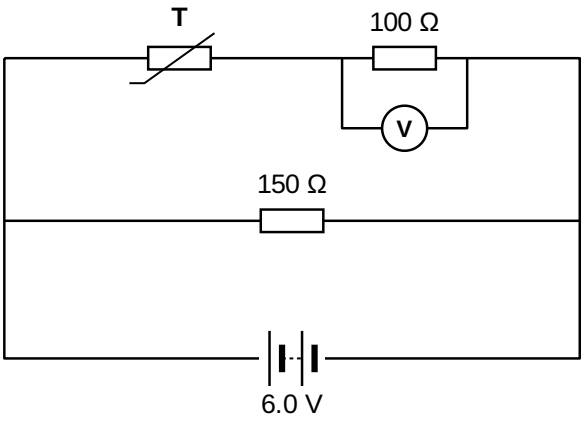
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0 6 **Figure 8** shows a circuit containing a thermistor **T**.

Figure 8



0 6 . 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 6 . 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 7 A student wants to determine the density of the material used to make some small pebbles.

The pebbles have irregular shapes.

0 7 . 1 Describe a method the student could use to determine the density of the material. [6 marks]

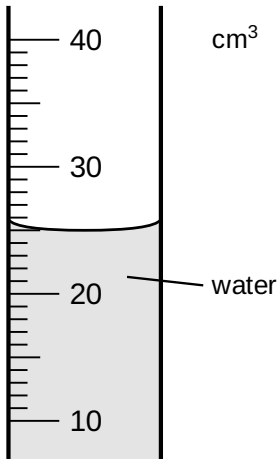
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The student filled a displacement can with water up to the spout.

The student added 65.0 g of pebbles to the can and collected the water that was displaced in a measuring cylinder.

Figure 9 shows part of the measuring cylinder.

Figure 9



0 7 . 2 Determine the volume of the pebbles. [1 mark]

Volume = ... cm^3

0 7 . 3 Calculate the density of the material. [3 marks]

Give your answer in kg/m^3

Density = ... kg/m^3

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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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

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 1 shows the results.

Table 1

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.

Turn over for the next question

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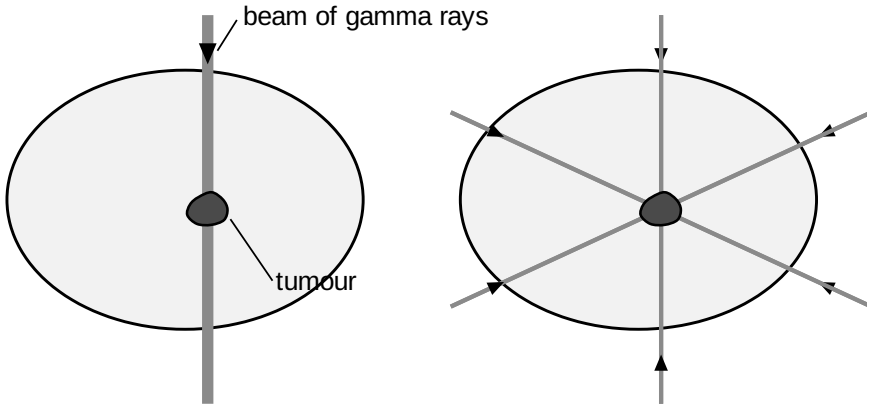
0 9 Gamma radiation is used to treat some cancers.

Figure 10 shows two plans for treating a tumour. Each diagram is a cross-section through the patient's body.

- In Plan **A**, one beam of gamma rays is directed at the tumour.
- In Plan **B**, six weaker beams of gamma rays are directed at the tumour from different directions.

The tumour receives the same dose of radiation in both plans.

Figure 10



Plan A **Plan B**

0 9 . 1 Explain why gamma radiation can be used to treat a tumour deep inside the body. [2 marks]

0 9 . 2 Explain why Plan **B** is better for the patient than Plan **A**. [3 marks]

Question 9 continues on the next page

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0 9 . 3 Some tumours are treated by injecting a substance that emits alpha particles into the tumour. [3 marks]

Explain why the alpha particles can destroy the tumour without causing much damage to healthy tissue.

0 9 . 4 The radioactive isotope in the injected substance has a half-life of 11 days [2 marks]

Suggest why an isotope with a half-life of a few days is used, rather than one with a half-life of a few minutes or one with a half-life of many years.

0 9 . 5 The activity of the injected substance is 6.0 MBq when it is injected. [2 marks]

Calculate the activity of the substance 33 days after it is injected.

Activity = _____ MBq

1 0 Electricity can be generated in nuclear power stations or by tidal barrages.

1 0 . 1 In a nuclear reactor, uranium-235 nuclei undergo fission. [1 mark]

The equation shows one possible fission reaction.

$$^{235}_{92}U + {}^{1}_{0}n \longrightarrow {}^{141}_{56}Ba + {}^{92}_{36}Kr + x\,{}^{1}_{0}n$$

Determine the value of x.

x = _____

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1 0 . 2 Explain the difference between the chain reaction in a nuclear reactor and the chain reaction in a nuclear weapon. [2 marks]

1 0 . 3 Scientists are developing power stations that use nuclear fusion. [3 marks]

Compare nuclear fission with nuclear fusion.

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Question 10 continues on the next page

A country needs a new power station. It could build a tidal barrage or a nuclear power station.

Table 2 gives information about the two options.

Table 2

	Tidal barrage	Nuclear power station
Maximum power output in MW	400	1200
Mean power output in MW	84	1100
Cost to build in £ billion	1.6	12
Expected working life in years	120	60
Fuel	none needed	uranium, which must be mined
Waste	none	radioactive waste that must be stored safely for thousands of years
Effect on the local area	floods mudflats where birds feed; changes the habitats in the estuary	uses a small area of land
When electricity is generated	only when the tide flows through the turbines (about 8 hours each day)	all the time, except when shut down for maintenance

1 0 . 4 Evaluate building a tidal barrage compared with building a nuclear power station. [6 marks]

Use information from **Table 2** and your own knowledge.

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END OF QUESTIONS

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Additional page, if required.

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Physics Equations Sheet

GCSE Physics – 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	$E_k = \frac{1}{2} m v^2$
2		elastic potential energy = 0.5 × spring constant × (extension)^2	$E_e = \frac{1}{2} k e^2$
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		density = mass ÷ volume	$\rho = m / V$
15		thermal energy for a change of state = mass × specific latent heat	$E = m L$
16		pressure × volume = constant (for gases)	$p V$ = constant
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 = spring constant × extension	$F = k e$
20		moment of a force = force × distance (normal to direction of force)	$M = F d$
21		pressure = force normal to a surface ÷ area of that surface	$p = F / A$
22	**HT**	pressure due to a column of liquid = height of column × density of liquid × gravitational field strength	$p = h \rho g$
23		distance travelled = speed × time	$s = v t$
24		acceleration = change in velocity ÷ time taken	$a = \Delta v / t$
25		(final velocity)^2 − (initial velocity)^2 = 2 × acceleration × distance	$v^2 - u^2 = 2 a s$
26		resultant force = mass × acceleration	$F = m a$
27	**HT**	momentum = mass × velocity	$p = m v$
28	**HT**	force = change in momentum ÷ time taken	$F = m \Delta v / \Delta t$
29		period = 1 ÷ frequency	$T = 1 / f$
30		wave speed = frequency × wavelength	$v = f \lambda$
31		magnification = image height ÷ object height	
32	**HT**	force on a conductor (at right angles to a magnetic field) carrying a current = magnetic flux density × current × length	$F = B I l$
33	**HT**	potential difference across primary coil ÷ potential difference across secondary coil = number of turns in primary coil ÷ number of turns in secondary coil	$V_p / V_s = n_p / n_s$
34	**HT**	potential difference across primary coil × current in primary coil = potential difference across secondary coil × current in secondary coil	$V_p I_p = V_s I_s$