



I N S P I R I N G E X C E L L E N C E

GCSE Physics

Mock Paper 5 · Higher Tier

C a l c u l a t o r A l l o w e d

T I M E A L L O W E D

1 hour 45 minutes

T O T A L M A R K S

100 marks

E Q U I P M E N T

Calculator · ruler · protractor · pen ·
pencil

S T U D E N T N A M E

Do not turn over this page until instructed to do so.

L E A R N W E L L A C A D E M Y · E X A M I N A T I O N S

I N S T R U C T I O N S T O C A N D I D A T E S

- Answer ALL questions in the spaces provided.
 - You may use a calculator throughout this paper.
 - Write your answers clearly using black or blue ink.
 - You MUST show your working in all calculation questions.
 - Always give the unit with a calculated answer where a unit is required.
 - The marks for each part-question are shown in square brackets, e.g. [3 marks].
 - You are advised to spend about 1 minute per mark, plus checking time.
 - Diagrams are NOT drawn to scale unless otherwise indicated.
 - Take the gravitational field strength $g = 9.8 \text{ N/kg}$ throughout this paper.
-

I N F O R M A T I O N

- The total mark for this paper is 100.
 - There are 12 questions in this paper.
 - The quality of your written communication will be assessed in extended-response questions.
-

G O O D L U C K

QUESTION

01

National and Global Energy Resources

Show all working clearly

MARKS

08

A coastal county currently generates most of its electricity in a gas-fired power station. The council plans to build an offshore wind farm to replace part of this generation.

- (a)** The table lists four energy resources. Complete the table by writing either renewable or non-renewable in each empty box.

Energy resource	Renewable or non-renewable?
Natural gas	
Offshore wind	
Tidal	
Nuclear fuel	

[2 marks]

The wind farm will have 40 turbines. Each turbine has a maximum power output of 3.2 MW.

Because the wind does not always blow at full strength, the turbines produce an average power output of only 38% of their maximum.

$$\text{energy} = \text{power} \times \text{time}$$

- (b)** Calculate the total electrical energy, in GWh, that the wind farm produces in one year. Take one year to be 8760 hours.

[3 marks]

- (c)** The council cannot close the gas-fired power station completely, even after the wind farm is built. Explain why, and suggest one way the county could reduce its reliance on gas still further.

[3 marks]

Total for question: 8 marks

QUESTION

02

Power and Efficiency

Show all working clearly

MARKS

09

An electric hoist on a building site lifts a load of bricks of mass 850 kg vertically through a height of 12 m. The lift takes 25 s.

The hoist draws an electrical power of 5.6 kW from the mains supply while it is lifting.

- (a)** Write down the equation that links gravitational potential energy, mass, gravitational field strength and height.

[1 mark]

- (b)** Calculate the useful work done by the hoist in lifting the bricks. Give the unit.

[2 marks]

- (c)** Calculate the useful output power of the hoist.

$$P = \frac{E}{t}$$

[2 marks]

(d) Calculate the efficiency of the hoist. Give your answer as a percentage.

$$\text{efficiency} = \frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$$

[2 marks]

(e) The hoist is not 100% efficient. Describe what happens to the wasted energy, and suggest one change that would make the hoist more efficient.

[2 marks]

Total for question: 9 marks

QUESTION

03

Mains Electricity and Safety

Show all working clearly

MARKS

07

A student examines the three-core cable inside the plug of an electric kettle.

(a) State the potential difference and the frequency of the UK mains electricity supply.

[2 marks]

(b) The mains supply is alternating current (a.c.), but the current from a cell is direct current (d.c.). Explain the difference between a.c. and d.c.

[2 marks]

(c) The cable contains a live wire, a neutral wire and an earth wire. State the potential difference between the earth wire and the neutral wire when the kettle is working normally.

[1 mark]

- (d) The metal case of the kettle is connected to the earth wire, and there is a fuse in the live wire. Explain how the earth wire and the fuse work together to protect the user if the live wire touches the metal case.

[2 marks]

Total for question: 7 marks

QUESTION

04

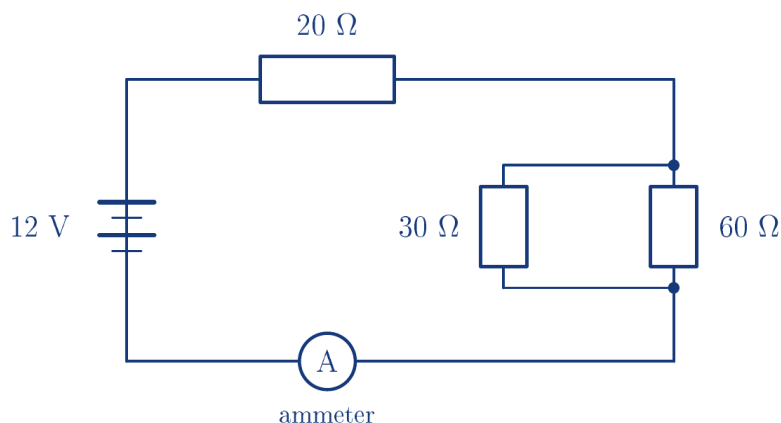
Series and Parallel Circuits

Show all working clearly

MARKS

10

The circuit below contains a $20\ \Omega$ resistor connected in series with two resistors, of resistance $30\ \Omega$ and $60\ \Omega$, which are connected in parallel with each other.



(a) Show that the total resistance of the whole circuit is $40\ \Omega$.

$$\frac{1}{R_p} = \frac{1}{R_2} + \frac{1}{R_3} \quad (\text{Parallel circuit total resistance equation})$$

$$R_p = R_1 + R_2 \quad (\text{Series circuit resistance})$$

[3 marks]

(b) Calculate the reading on the ammeter.

$$V = IR$$

[2 marks]

(c) Calculate the current in the $60\ \Omega$ resistor.

[3 marks]

(d) Calculate the power dissipated in the $60\ \Omega$ resistor.

$$P = \frac{V^2}{R}$$

[2 marks]

Total for question: 10 marks

QUESTION

05

Changes of State and the Particle Model

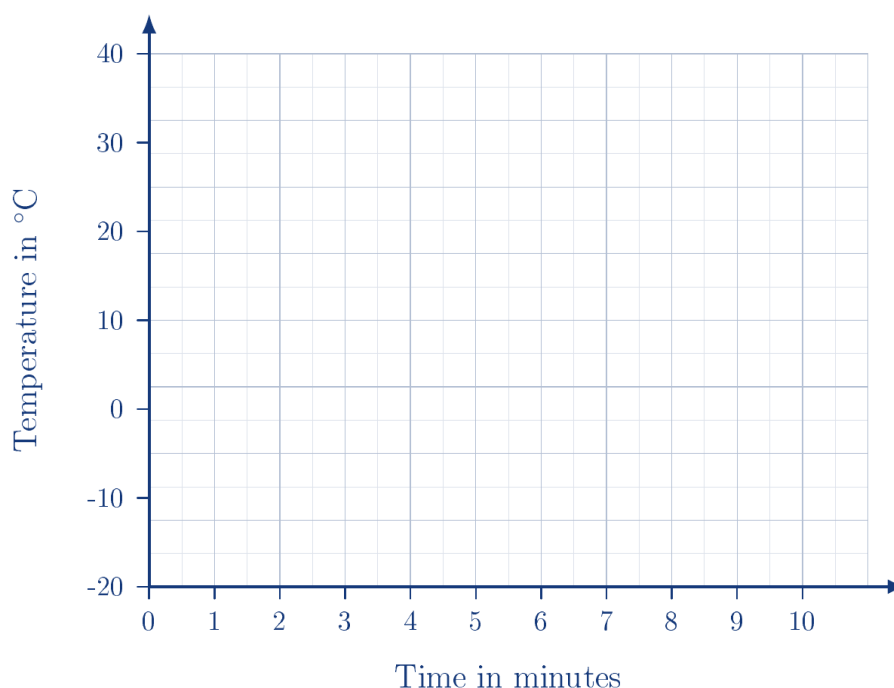
Show all working clearly

MARKS

08

A block of ice of mass 0.50 kg is taken from a freezer at a temperature of -15°C . It is heated steadily until it has all melted and the water has reached a temperature of 20°C .

- (a) On the axes below, sketch a graph to show how the temperature of the ice and then the water changes with time during this heating.



[2 marks]

- (b) Explain, in terms of the particles, why the temperature stays constant while the ice is melting even though energy is still being supplied.

[2 marks]

Use the following data in part (c):

$$c_{\text{ice}} = 2100 \text{ J/kg}^{\circ}\text{C}, \quad c_{\text{water}} = 4200 \text{ J/kg}^{\circ}\text{C}$$

$$L_{\text{fusion}} = 3.34 \times 10^5 \text{ J/kg}$$

(c) Calculate the total energy that must be supplied to take the 0.50 kg of ice from -15°C to water at 20°C .

$$\Delta E = m c \Delta \theta$$

$$E = m L$$

[4 marks]

Total for question: 8 marks

QUESTION

06

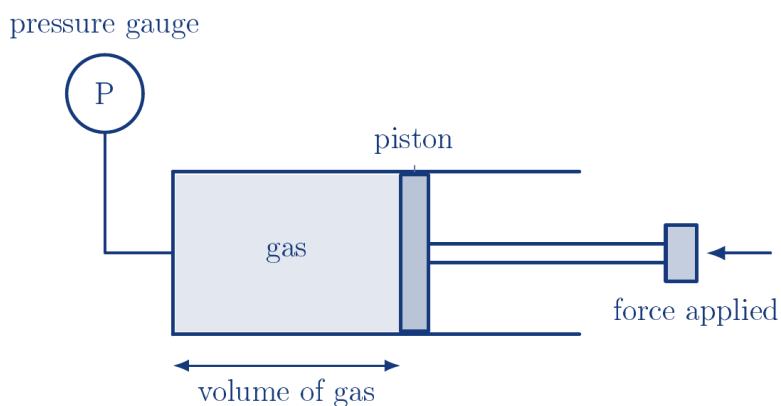
Particle Model and Pressure

Show all working clearly

MARKS

09

A sealed syringe contains a fixed mass of gas. A pressure gauge is attached to the closed end. A student pushes the piston in slowly, so that the temperature of the gas does not change.



The initial pressure and volume, and the final volume, are:

$$p_1 = 250 \text{ kPa}, \quad V_1 = 0.080 \text{ m}^3, \quad V_2 = 0.030 \text{ m}^3$$

- (a)** For a fixed mass of gas held at constant temperature, write down the relationship between pressure and volume.

$$pV = \text{constant}$$

[1 mark]

- (b)** Calculate the final pressure of the gas. Give your answer in kPa.

[3 marks]

(c) Explain, in terms of the motion of the gas particles, why the pressure of the gas increases when the piston is pushed in.

[3 marks]

(d) The student now pushes the piston in very quickly instead of slowly. Explain why the temperature of the gas rises.

[2 marks]

Total for question: 9 marks

QUESTION

07

Nuclear Fission and Fusion

Show all working clearly

MARKS

07

In a nuclear reactor, a uranium-235 nucleus absorbs a slow-moving neutron and splits into two smaller nuclei, releasing further neutrons.



- (a)** Determine the values of A and Z in the equation above. Explain how you worked out each value.

[2 marks]

- (b)** The neutrons released can go on to cause further fission. Explain what is meant by a chain reaction, and describe how the control rods in a reactor are used to keep the rate of fission steady.

[3 marks]

- (c)** Nuclear fusion releases far more energy per kilogram of fuel than fission, but no fusion power station is yet in commercial use. Give two reasons why fusion is difficult to achieve on Earth.

[2 marks]

Total for question: 7 marks

QUESTION

08

Hazards and Uses of Radiation

Show all working clearly

MARKS

08

(a) Complete the table below to compare the three types of nuclear radiation.

Radiation	Ionising power	Stopped by
Alpha		
Beta		
Gamma		

[3 marks]

A doctor injects a patient with a radioactive tracer so that the blood flow through the kidneys can be imaged by a detector held outside the body.

(b) The tracer chosen is a gamma emitter with a half-life of about 6 hours. Explain why a gamma emitter is used rather than an alpha emitter, and why a half-life of about 6 hours is more suitable than one of several years.

[3 marks]

- (c) Explain the difference between irradiation and contamination, and state which of the two the radiographer standing beside the patient is at greater risk from.

[2 marks]

Total for question: 8 marks

QUESTION

09

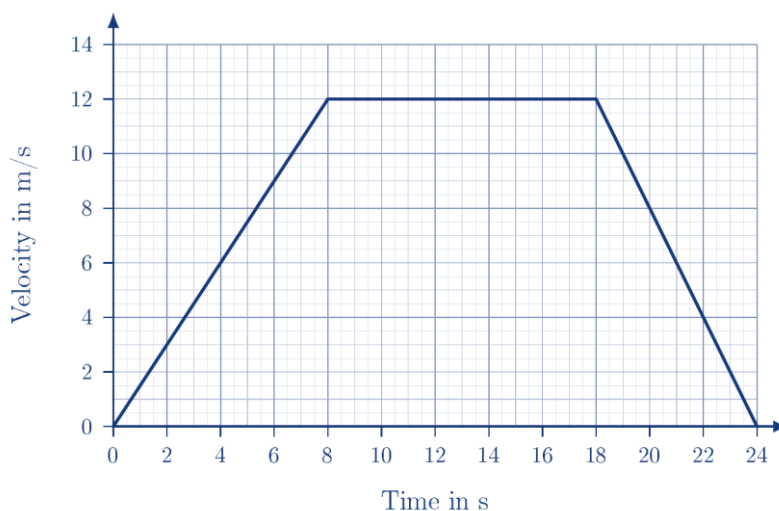
Motion Along a Line

Show all working clearly

MARKS

10

A cyclist rides in a straight line along a level road. The velocity-time graph for the journey is shown below.



(a) Calculate the acceleration of the cyclist during the first 8 seconds. Give the unit.

$$a = \frac{\Delta v}{t}$$

[2 marks]

(b) Calculate the total distance travelled by the cyclist during the 24 seconds shown.

[4 marks]

(c) Calculate the average speed of the cyclist over the whole 24 seconds.

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

[2 marks]

- (d) Without further calculation, explain how the graph shows that the cyclist slows down at a greater rate than she speeds up.

[2 marks]

Total for question: 10 marks