ERUVIO MENTORING · EXTERNAL-STYLE EXAMINATION

Physics

Units 1 and 2 · Thermal, nuclear and electrical physics; linear motion and waves

Paper 2

SHORT RESPONSE · 50 MARKS

STUDENT DETAILS

GIVEN NAME(S) _____ FAMILY NAME _____

SCHOOL _____ DATE _____ BOOK OF _____

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Structure of this examination

PAPER	SECTION	QUESTION TYPE	TIME	MARKS
Paper 1	Section 1	Multiple choice, 20 questions	10 min perusal 90 min working	20
	Section 2	Short response, 5 questions		30
Paper 2	Section 1	Short response, 9 questions	10 min perusal 90 min working	50
Total		**34 questions**	**200 minutes**	**100**

Instructions

- **Perusal time: 10 minutes. Working time: 90 minutes.**
- You may use a QCAA-approved scientific or graphics calculator. The QCAA Physics formula and data book is provided.
- Write using black or blue pen. Planning paper will not be marked.
- All questions are drawn from Unit 1 (thermal, nuclear and electrical physics) and Unit 2 (linear motion and waves).
- **Paper 2 contains 9 short response questions.** Answer all questions in the spaces provided. Show all working.

Show all working. Marks are awarded for method as well as for the final answer, so a response with no working cannot receive full marks.

Section 1

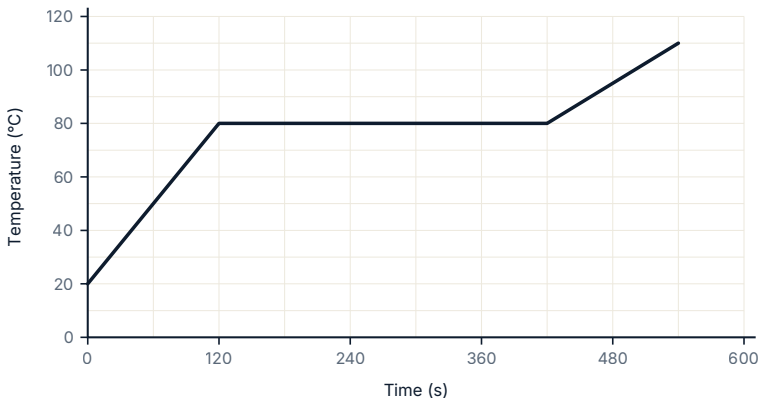
Short response · 9 questions · 50 marks

1 This question is about thermal physics. [3 marks]

(a) Distinguish between heat and temperature. [2]

(b) State the first law of thermodynamics. [1]

2 A heater of constant power 500 W supplies energy to 0.50 kg of a pure solid substance. The graph shows the temperature of the substance against time. Assume all of the energy from the heater is transferred to the substance. [6 marks]



(a) Identify the state of the substance between t = 0 and t = 120 s. [1]

(b) Determine the specific heat capacity of the substance in this state. [2]

WORKING

c = _____ J kg^{-1} K^{-1}

(c) Determine the specific latent heat of fusion of the substance. [2]

WORKING

L_f = _____ J kg^{-1}

(d) Explain why the gradient of the graph after t = 420 s differs from the gradient before t = 120 s. [1]

3 A nuclear fission reaction is represented by the equation below. [5 marks]

$$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{141}_{56}Ba + {}^{92}_{36}Kr + 3\,{}^{1}_{0}n$$

(a) Show that this equation is balanced for both mass number and atomic number. [2]

WORKING

(b) The mass defect of this reaction is 3.10×10^{-28} kg. Calculate the energy released, in MeV. [3]

WORKING

Energy = _____ MeV

4 A student measures the potential difference across an electrical component and the current through it. The results are shown below. [6 marks]

Potential difference (V)	0.0	1.0	2.0	3.0	4.0	5.0
Current (A)	0.00	0.50	0.85	1.10	1.28	1.40

(a) Calculate the resistance of the component when the potential difference across it is 2.0 V and when it is 5.0 V. [2]

WORKING

At 2.0 V = _____ Ω

At 5.0 V = _____ Ω

(b) Justify whether this component is ohmic. [2]

(c) Explain, with reference to the temperature of the component, why its resistance behaves in this way. [2]

5 A student wants a 6.0 V supply to deliver a current of 0.25 A through a lamp of resistance 12 Ω. [5 marks]

(a) Calculate the potential difference across the lamp at this current. [1]

WORKING

V = _____ V

(b) Determine the resistance that must be connected in series with the lamp so that the current is 0.25 A. [2]

WORKING

R = _____ Ω

(c) Calculate the total power delivered by the supply. [2]

WORKING

P = _____ W

6 A skydiver of mass 60 kg falls vertically. At one instant during the fall, the drag force acting on the skydiver is 350 N. Take g = 9.8 m s^{-2}. [7 marks]

(a) Draw a free-body diagram showing the forces acting on the skydiver at this instant. Label each force and its magnitude. [2]

DIAGRAM

(b) Calculate the net force and the acceleration of the skydiver at this instant. [3]

WORKING

F_{net} = _____ N a = _____ m s^{-2}

(c) Explain what happens to the acceleration of the skydiver as the speed increases, and describe what is meant by terminal velocity. [2]

7 A trolley of mass 0.60 kg moving at 3.0 m s^{-1} collides with a stationary trolley of mass 0.40 kg. The two trolleys move off joined together. [6 marks]

(a) Calculate the velocity of the trolleys immediately after the collision. [2]

WORKING

v = _____ m s^{-1}

(b) Calculate the total kinetic energy of the trolleys before and after the collision. [2]

WORKING

Before = _____ J After = _____ J

(c) Determine the energy transformed during the collision and account for it. [2]

WORKING

8 A string of length 1.2 m is fixed at both ends and is made to vibrate in its third harmonic. [6 marks]

(a) Draw the standing wave pattern formed on the string, labelling the nodes (N) and the antinodes (A). [2]

DIAGRAM

(b) Determine the wavelength of the standing wave. [2]

WORKING

λ = _____ m

(c) The speed of the wave on the string is 120 m s^{-1}. Calculate the frequency of the third harmonic. [2]

WORKING

f = _____ Hz

9 Light travelling in air strikes the flat surface of a pool of water at an angle of incidence of 40°. The refractive index of air is 1.00 and the refractive index of water is 1.33. [6 marks]

(a) Calculate the angle of refraction in the water. [3]

WORKING

Angle = _____ °

(b) Calculate the speed of light in the water. [2]

WORKING

v = _____ m s^{-1}

(c) State what happens to the frequency of the light as it enters the water. [1]

END OF PAPER