ERUVIO MENTORING · EXTERNAL-STYLE EXAMINATION

Physics

Units 3 and 4 · Gravity and electromagnetism; revolutions in modern physics

Paper 1 · Section 2

SHORT RESPONSE · 30 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 3 (gravity and electromagnetism) and Unit 4 (revolutions in modern physics).
- **Section 2 contains 5 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 2

Short response · 5 questions · 30 marks

1 A ball is kicked from level ground with a speed of 20 m s^{-1} at an angle of 35° above the horizontal. Air resistance is negligible. Take g = 9.8 m s^{-2}. [6 marks]

(a) Calculate the horizontal and vertical components of the initial velocity. [2]

WORKING

u_x = _____ m s^{-1} u_y = _____ m s^{-1}

(b) Calculate the maximum height reached by the ball above the ground. [2]

WORKING

h = _____ m

(c) Determine the horizontal range of the ball. [2]

WORKING

Range = _____ m

2 A satellite of mass 850 kg travels in a stable circular orbit at an altitude of 400 km above the surface of the Earth. The mass of the Earth is 5.97×10^{24} kg and the radius of the Earth is 6.37×10^{6} m. [6 marks]

(a) Show that the orbital speed of a satellite in a circular orbit of radius r about a body of mass M is given by $v = \sqrt{(GM/r)}$. [2]

WORKING

(b) Calculate the orbital speed of the satellite. [2]

WORKING

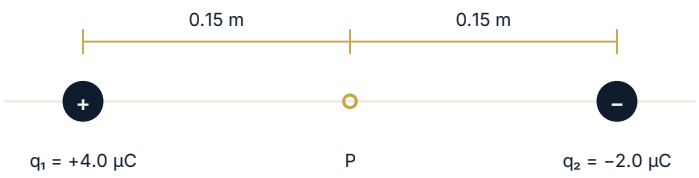
v = _____ m s^{-1}

(c) Determine the period of the orbit, in minutes. [2]

WORKING

T = _____ min

3 Two point charges are held 0.30 m apart in air, as shown. Point P lies midway between them. [6 marks]



(a) Calculate the magnitude of the electrostatic force between the two charges. [2]

WORKING

F = _____ N

(b) Determine the magnitude and the direction of the resultant electric field at P. [3]

WORKING

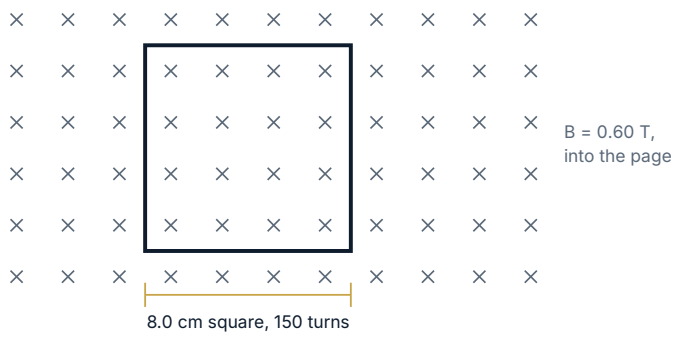
E = _____ N C^{-1} Direction

(c) Calculate the magnitude of the force that would act on an electron placed at P. [1]

WORKING

F = _____ N

4 A square coil of 150 turns and side 8.0 cm lies at right angles to a uniform magnetic field, as shown. The magnetic flux density falls uniformly from 0.60 T to 0.20 T in 0.050 s. [6 marks]



(a) Calculate the change in magnetic flux through one turn of the coil. [2]

WORKING

$\Delta\Phi$ = _____ Wb

(b) Calculate the magnitude of the average emf induced in the coil. [2]

WORKING

emf = _____ V

(c) State Lenz's law, and use it to determine the direction of the induced current in the coil as seen by the reader. [2]

5 Muons produced high in the atmosphere travel towards the surface of the Earth at 0.98c. In the frame of reference of the muon, the average lifetime of a muon is 2.2 μs. [6 marks]

(a) Calculate the Lorentz factor for a muon travelling at 0.98c. [1]

WORKING

γ = _____

(b) Determine the average lifetime of a muon as measured by an observer on the Earth. [2]

WORKING

t = _____ s

(c) Calculate the average distance a muon travels through the atmosphere, as measured by an observer on the Earth. [2]

WORKING

d = _____ m

(d) Explain, from the frame of reference of the muon, why the muon is able to reach the surface of the Earth. [1]

END OF PAPER