

PHYSICS 2

Two hours

Answer ALL Questions

You are reminded of the necessity for good English and orderly presentation in your answers. In calculations you must show all the steps in your working, giving your answer at each stage.

Calculators may be used.

- 1 (a) The mass M of a gas escaping in a short time, t , through a small hole of area, A , in the wall of a gas cylinder is given by $M/t = k p^\alpha \rho^\beta A^\gamma$ where k is a constant and p and ρ are pressure and density respectively. Give the dimensions of p and determine the values of the constants, α , β and γ (6 marks)
- (b) A man falls into a deep well. A rope is wrapped around his body and pulled out.
(i) State and explain how the force applied on his body varies until the body is taken out of water and on to the surface. Show on a sketch graph how this force varied during the taking out of the body. (4 marks)
(ii) Sketch another graph to show how the man's speed varied with time as he was falling into the well until he finally came to rest. (5 marks)
- (c) (i) State the law of the conservation of momentum.
(ii) Describe an experiment to verify the law of the conservation of linear momentum. (10 marks)
2. (a) (i) When do you say an object has undergone circular motion?
(ii) Which speed(s) may be associated with circular motion?
(iii) A certain disc makes 66 revolutions per minute. Calculate the angular speed of the disc.
(iv) When does circular motion come into play on a moving vehicle? What consequences may this have? How can this be taken care of even for increasing speeds? (9 marks)
- (b) (i) Derive an expression for Kepler's third law.
(ii) Explain how and why the acceleration of free-fall varies on the earth's surface. (6 marks)
- (c) The period of the moon in orbit round the earth is 27.3 days. The earth has radius 6.37×10^3 km and the value of the acceleration of free fall on its surface is 9.81 m s^{-2} . Calculate
(i) the distance from the earth centre to the moon.
(ii) the linear (tangential) acceleration of the moon in orbit. (5 marks)
3. (a) A copper wire of length 0.5 m carries a current of 1.5 A.
(i) Find the drift velocity assuming that there are 9.0×10^{22} electrons in the wire.
(ii) What will be the drift velocity, if the wire above is replaced by another copper wire three times thicker?
(iii) Show graphically the relationship between drift velocity and area of cross-section. (8 marks)
- (b) (i) How long does it take for a current of 0.80 A to transfer 67 C?
(ii) How many electrons flow per second? (3 marks)
- (c) (i) Distinguish between emf and terminal potential difference. A battery of emf

5.4 V, drives a current of 0.30 A through a lamp. A voltmeter connected across bulb reads 4.8 V.

- (ii) Draw a circuit diagram to show the arrangement of the above components.
- (iii) Explain why the voltmeter reading is less than the emf of the cell. Calculate:
- (iv) the internal resistance of the battery (v) the electrical energy transformed per second in the lamp. (v) State two assumptions you made in order to complete these calculations. Electronic charge = 1.6×10^{-19} C.

(10 marks)

4. (a) You are given two bulbs rated 0.30 A, 5 W and 0.50 A, 20 V. Which of these bulbs is more

(i) economical to use

(ii) powerful ?

(iii) Explain your answers.

(3 marks)

- (b) State ohm's law and sketch the current- voltage relationships for a filament bulb, copper wire and semiconductor.

(4 marks)

- (c) (i) Define temperature coefficient of resistance. In an experiment to determine the temperature coefficient of resistance of a material, the following data were obtained.

R/ Ω	1.52	1.58	1.70	1.80	1.88	1.96
$\theta/^\circ\text{C}$	6	17	38	56	70	84

(ii) Plot a graph of resistance versus temperature.

(5 marks)

(iii) Determine the temperature coefficient of resistance for the material and its resistance at 0°C .

(7 marks)

- (e) What are the readings of the meters x, y and z?

(9 marks)

