First variant Mark Scheme

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2009 question paper

for the guidance of teachers

9702 PHYSICS

9702/21 Paper 2 (AS Structured Questions), maximum raw mark 60

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

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UNIVERSITY of CAMBRIDGE
International Examinations

1 (a) (i) micrometer (screw gauge) / travelling microscope ..... B1 [1]

(ii) *either* ohm-meter *or* voltmeter and ammeter
or multimeter/avo on ohm setting ..... B1 [1]

(iii) *either* (calibrated) c.r.o. *or* a.c. voltmeter and × $\sqrt{2}$ ..... B1 [1]

(b) density = mass / volume C1
= 580 / 6^3 = 2.685 g cm^{-3} …(*allow 2.68, 2.69, 2.7*) A1

% uncertainty in mass = (10 / 580) × 100 = 1.7% C1
% uncertainty in volume = 3 × (0.1 / 6) × 100 = 5.0% C1
uncertainty in density = 0.18 g cm^{-3}
density = 2.7 ± 0.2 g cm^{-3} ..... A1 [5]
(*answer 2.69 ± 0.09 g cm^{-3} scores 4 marks*)

2 (a) ball moving in <u>opposite</u> direction (after collision) ..... B1 [1]

(b) (i) change in momentum = 1.2 (4.0 + 0.8) C2
(*correct values, 1 mark; correct sign {values added}, 1 mark*)
= 5.76 N s …(*allow 5.8*) ..... A1 [3]

(ii) force = $\Delta p / \Delta t$ or $m\Delta v / \Delta t$ C1
= 5.76 / 0.08 or 1.2 × 4.8 / 0.08 ..... C1
= 72 N ..... A1 [3]

(c) 5.76 = 3.6 × V C1
V = 1.6 m s^{-1} ..... A1 [2]

(d) *either* speed of approach = 4.0 m s^{-1} and
speed of separation = 2.4 m s^{-1} M1
not equal and so inelastic A1

or kinetic energy before = 9.6 J and
kinetic energy after collision = 4.99 J M1
kinetic energy after is less / not conserved so inelastic ..... A1 [2]

3 (a) product of (magnitude of one) force and distance between forces M1
reference to *either* perpendicular distance between forces
or line of action of forces and perpendicular distance .... A1 [2]

(b) (i) 90° ..... B1 [1]

(ii) 130 = F × 0.45 (*allow e.c.f. for angle in **(i)***) C1
F = 290 N ..... A1 [2]
(*allow 1 mark only if angle stated in **(i)** is not used in **(ii)***)

4 **(a)** **(i)** change of shape / size / length / dimension C1
when (deforming) force is removed, returns to original shape / size A1 [2]

(ii) $L = ke$ ..... B1 [1]

(b) $2e$ B1
$\frac{1}{2}k$ …(*allow e.c.f. from extension*) B1

$\frac{1}{2}e$ and $2k$ B1

$\frac{3}{2}e$ …(*allow e.c.f. from extension in part 2*) B1
$\frac{2}{3}k$ …(*allow e.c.f. from extension*) ..... B1 [5]

5 **(a)** *either* phase difference is π rad / 180°
or path difference (between waves from S_1 and S_2) is $\frac{1}{2}\lambda$ / $(n + \frac{1}{2})\lambda$. B1
either same amplitude / intensity at M
or ratio of amplitudes is 1.28 / ratio of intensities is 1.28^2 ..... B1 [2]

(b) path difference between waves from S_1 and S_2 = 28 cm B1
wavelength changes from 33 cm to 8.25 cm B1
minimum when λ = (56 cm,) 18.7 cm, 11.2 cm, (8.0 cm) B1
so two minima ..... B1 [4]

6 **(a)** **(i)** $E = V / d$ C1
$= 350 / (2.5 \times 10^{-2})$
$= 1.4 \times 10^4$ N C^{-1} ..... A1 [2]

(ii) force = Eq C1
$= 1.4 \times 10^4 \times 1.6 \times 10^{-19}$ M1
$= 2.24 \times 10^{-15}$ ..... A0 [2]

(b) **(i)** $F = ma$ C1
$a = (2.24 \times 10^{-15}) / (9.1 \times 10^{-31})$
$= 2.46 \times 10^{15}$ m s^{-2} …(*allow* 2.5×10^5) ..... A1 [2]

(ii) $s = \frac{1}{2}at^2$ C1
$2.5 \times 10^{-2} = \frac{1}{2} \times 2.46 \times 10^{15} \times t^2$
$t = 4.5 \times 10^{-9}$ s ..... A1 [2]

(c) *either* gravitational force is normal to electric force
or electric force horizontal, gravitational force vertical ..... B2 [2]
special case: force/acceleration due to electric field >> force/acceleration due to gravitational field, allow 1 mark

7 **(a)** **(i)** R ..... B1 [1]

(ii) $0.5R$ ..... B1 [1]

(iii) $2.5R$ …(*allow e.c.f. from* ***(ii)***) ..... B1 [1]

(b) **(i)** $I_1 + I_2 = I_3$ ..... B1 [1]

(ii) $E_2 = I_3R + I_2R$ ..... B1 [1]

(iii) $E_1 - E_2 = 2I_1R - I_2R$ ..... B1 [1]

8 **(a)** rate of decay / activity / decay (of nucleus) is not affected by external factors / environment / surroundings ..... B2 [2]
(*If states specific factor(s), rather than giving general statement above, then give 2 marks for two stated factors, but 1 mark only if one factor stated*)

(b) **(i)** gamma / γ ..... B1 [1]

(ii) alpha / α ..... B1 [1]

(iii) gamma / γ ..... B1 [1]

(iv) beta / β ..... B1 [1]