**UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**GCE Advanced Subsidiary Level and GCE Advanced Level**

# MARK SCHEME for the May/June 2007 question paper

## 9702 PHYSICS

**9702/02** 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.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

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**1** **(a)** **(i)** all positions (accept 20, 40, 60, 80) marked to within ±5° B2
positions are 40°, 70°, 90° and 102°
*(-1 for each error or omission)*

**(ii)** allow 107° → 113° B1 [3]

**(b)** e.g. more sensitive at low volumes B1 [1]
*(do not allow reference to 'accuracy')*

**2** **(a)** force per unit positive charge (on a small test charge) B1 [1]

**(b)** field strength = (210/{$1.5 \times 10^{-2}$} =) $1.4 \times 10^{4}$ N $C^{-1}$ A1 [1]

**(c)** **(i)** acceleration = $Eq / m$ C1
= $(1.4 \times 10^{4} \times 1.6 \times 10^{-19}) / (9.1 \times 10^{-31})$ C1
= $2.5 \times 10^{15}$ m $s^{-2}$ ($2.46 \times 10^{15}$) A1
towards positive plate / upwards (and normal to plate) B1 [4]

**(ii)** time = $2.4 \times 10^{-9}$ s A1 [1]

**(d)** *either* vertical displacement after acceleration for $2.4 \times 10^{-9}$ s
= ½ × $2.46 \times 10^{15} \times (2.4 \times 10^{-9})^2$ C1
= $7.1 \times 10^{-3}$ m A1
(0.71 cm < 0.75 cm and) so will pass between plates A1 [3]
*i.e. valid conclusion based on a numerical value*

*or* $0.75 \times 10^{-2} = ½ \times 2.46 \times 10^{15} \times t^2$ (C1)
$t$ is time to travel 'half-way across' plates = $2.47 \times 10^{-9}$ s (A1)
(2.4 ns < 2.47 ns) so will pass between plates (A1)
*i.e. valid conclusion based on a numerical value*

**3** **(a)** mass / volume (ratio idea essential) B1 [1]

**(b)** **(i)** mass = $Ah\rho$ B1 [1]

**(ii)** pressure = force/area B1
weight (of liquid)/force (on base) = $Ah\rho g$ B1
pressure = $h\rho g$ A0 [2]

**(c)** **(i)** ratio = 1600 or 1600:1 A1 [1]

**(ii)** ratio = $\sqrt[3]{1600}$ C1
= 11.7 (*allow 12*) A1 [2]

**(d) (i)** density of solids and liquids are (about) equal B1 [1]

**(ii)** strong forces: fixed volume B1
rigid forces: retains shape / does not flow / little deformation B1 [2]
*(allow 1 mark for fixed volume, fixed shape)*

**4 (a) (i)** (change in) potential energy = $mgh$ C1
$= 0.056 \times 9.8 \times 16$
$= 8.78$ J (*allow 8.8*) A1 [2]

**(ii)** (initial) kinetic energy = $\frac{1}{2}mv^2$ C1
$= \frac{1}{2} \times 0.056 \times 18^2$
$= 9.07$ J (*allow 9.1*) C1
total kinetic energy = 8.78 + 9.07 = 17.9 J A1 [3]

**(b)** kinetic energy = $\frac{1}{2}mv^2$
$17.9 = \frac{1}{2} \times 0.056 \times v^2$ and $v = 25(.3)$ m s$^{-1}$ B1 [1]

**(c)** horizontal velocity = 18 m s$^{-1}$ B1 [1]

**(d) (i)** correct shape of diagram
(two sides of right-angled triangle with correct orientation) B1

**(ii)** angle = 41° → 48° (allow trig. solution based on diagram) A2 [3]
(*for angle 38° → 41° or 48° → 51°, allow 1 mark*)

**5 (a) (i)** vibrations (in plane) normal to direction of energy propagation B1 [1]

**(ii)** vibrations in one direction (normal to direction of propagation) B1 [1]

**(b) (i)** at (displacement) antinodes / where there are no heaps, wave has maximum amplitude (of vibration) B1
at (displacement) nodes/where there are heaps, amplitude of vibration is zero/minimum B1
dust is pushed to / settles at (displacement) nodes B1 [3]

**(ii)** $2.5\lambda = 39$ cm C1
$v = f\lambda$ C1
$v = 2.14 \times 10^3 \times 15.6 \times 10^{-2}$
$= 334$ m s$^{-1}$ (*allow 330, not 340*) A1 [3]

**(c)** Stationary wave formed by interference / superposition / overlap of B1
*either* wave travelling down tube and its reflection
*or* two waves of same (type and) frequency travelling in opposite directions B1
speed is the speed of the incident / reflected waves B1 [3]

**6** **(a)** **(i)** **1** total resistance = 0.16 Ω A1

**2** e.m.f. = *either* $(14 - E)$ *or* $(E - 14)$ A1 [2]

**(ii)** *either* $14 - E = 42 \times 0.16$ *or* $(E - 14) = -42 \times 0.16$ C1

$E = 7.3$ V A1 [2]

**(b)** **(i)** charge = $It$ C1

$= 12.5 \times 4 \times 60 \times 60$

$= 1.8 \times 10^5$ C A1 [2]

**(ii)** *either* energy = $EQ$ *or* energy = $Eit$ C1

*either* energy = $14 \times 1.8 \times 10^5$ *or* energy = $14 \times 12.5 \times 4 \times 3600$

$= 2.52 \times 10^6$ J A1 [2]

**(iii)** energy = $I^2Rt$ *or* $Vit$ and $V = IR$ C1

$= 12.5^2 \times 0.16 \times 4 \times 3600$

$= 3.6 \times 10^5$ J A1 [2]

**(c)** efficiency = $(2.52 \times 10^6 - 3.6 \times 10^5)/(2.52 \times 10^6)$ C1

= 86% A1 [2]

**7** **(a)** β(-decay) B1 [1]

**(b)** γ(-decay) B1

*either* any two of $Z$, $N$ and $A$ do not change

*or* it is loss of energy only

*or* it is an electromagnetic wave B1 [2]

Allow 'α(-decay) as change of 4 in the nucleon number cannot be shown on the diagram' (B2)

Do not give credit for a 'bald' α(-decay)