CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2015 series
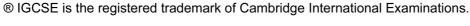
9702 PHYSICS

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.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2015 series for most Cambridge IGCSE®, Cambridge International A and AS Level components and some Cambridge O Level components.

1 (a) temperature   B1

      current   B1   [2]

      (allow amount of substance, luminous intensity)

(b) (i) 1. E = (stress / strain =) [force / area] / [extension / original length]

                  units of stress: $kg\,m\,s^{-2}/m^2$ and no units for strain   B1

                  units of E: $kg\,m^{-1}\,s^{-2}$ A0   [1]

            2. units for T: s, l: m and M: kg

               K^2 = $T^2 E / M l^3$ hence units: $s^2 kg\,m^{-1}\,s^{-2}/kg^3$ ($= m^{-4}$)   C1

               units of K: m^{-2} A1   [2]

(ii) % uncertainty in E = 4% (for T^2) + 0.6% (for l^3) + 0.1% (for M) + 3% (for K^2)

                                = 7.7%   B1

      E = $[(1.48 \times 10^5)^2 \times 0.2068 \times (0.892)^3]/(0.45)^2$

        = 1.588×10^{10} C1

      7.7% of E = 1.22×10^9 C1

      E = $(1.6 \pm 0.1) \times 10^{10}\,kg\,m^{-1}\,s^{-2}$ A1   [4]

2 (a) ps = 10^{-12} (s) **or** $T = 4 \times 50 \times 10^{-12}$ (s)   B1

      $v = f\lambda$ **or** $v = \lambda / T$ C1

      λ = $3.0 \times 10^8 \times 4 \times 50 \times 10^{-12}$ C1

        = 0.06(0) m   A1   [4]

(b) $1500 = 3.0 \times 10^8 \times 4 \times$ time-base setting **or** $T = 5 \times 10^{-6}$ s   C1

      time-base setting = 1.3 (1.25) $\mu s\,cm^{-1}$ A1   [2]

3 (a) work done is force $\times$ distance moved in direction of force
      or
      no work done along PQ as no displacement/distance moved in direction of force   B1

      work done is same in vertical direction as same distance moved in direction of
      force   B1   [2]

www.dynamicpapers.com

Page 3	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9702	21

(b) (i) at maximum height $t = 1.5$ (s)   **or** $s = ½(u + v)t$, $s = 11$ m and $t = 1.5$ s   C1

$V_v = 0 + 9.81 \times 1.5$ $V_v = (11 \times 2) / 1.5$

$\qquad = 15\ (14.7)\,\text{m s}^{-1}$ A1   [2]

(ii) straight line from (0,0) to (3.00, 25.5)   B1   [1]

(iii) at maximum height $V_h = 25.5 / 3$ (= $8.5\,\text{m s}^{-1}$)   B1

ratio $= mgh / ½mv^2$ C1

$\qquad = (2 \times 9.81 \times 11.0) / (8.5)^2$

$\qquad = 3.0\ (2.99)$ A1   [3]

(iv) deceleration is greater/resultant force (weight and friction force) is greater   M1

time is less   A1   [2]

4 (a) density = mass / volume   C1

mass $= 7900 \times 4.5 \times 24 \times 10^{-6} = 0.85\ (0.853)\,\text{kg}$ M1   [2]

(b) pressure $=$ force / area   C1

force $= W\cos 40°$ C1

pressure $= (0.85 \times 9.81 \cos 40°) / 24 \times 10^{-4}$

$\qquad = 2.7\ (2.66) \times 10^3\,\text{Pa}$ A1   [3]

(c) $F = ma$ C1

$W \sin 40° - f = ma$ C1

$0.85 \times 9.81 \times \sin 40° - f = 0.85 \times 3.8$

$f\ (= 5.36 - 3.23) = 2.1\,\text{N}$ [$5.38 - 3.242$ if $0.8532\,\text{kg}$ is used for the mass]   A1   [3]

www.dynamicpapers.com

Page 4	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9702	21

5 **(a)** progressive: all particles have same amplitude
stationary: no nodes or antinodes or maximum to minimum/zero amplitude   B1

progressive: adjacent particles are not in phase
stationary: waves particles are in phase (between adjacent nodes)   B1 [2]

   (b) **(i)** wavelength 1.2 m (zero displacement at 0.0, 0.60 m, 1.2 m, 1.8 m, 2.4 m)

either peaks at 0.30 m and 1.5 m and troughs at 0.90 m and 2.1 m
or vice versa (but not both)   B1

maximum amplitude 5.0 mm   B1 [2]

   (ii) 180° or π rad   A1 [1]

   (iii) at $t = 0$ particle has kinetic energy as particle is moving   B1

at $t = 5.0$ ms no kinetic energy as particle is stationary
so decrease in kinetic energy (between $t = 0$ and $t = 5.0$ ms)   B1 [2]

6 **(a)** energy converted from chemical to electrical per unit charge   B1 [1]

   (b) **(i)** current $= E/(R + r)$ C1

$= 6.0/(16 + 0.5)$
$= 0.36\ (0.364)$ A   A1 [2]

   (ii) terminal p.d. $= (0.36 \times 16) = 5.8$ V **or** $(6 - 0.36 \times 0.5)$
$= 5.8$ V   A1 [1]

   (c) **(i)** use of $R = \rho l/A$ or proportionality with length and inverse
proportionality with area or d^2 C1

$d/2$ and $l/2$ gives resistance of $Z = 2R_Y = 24\ (\Omega)$ C1

R = resistance of parallel combination $= [1/24 + 1/12]^{-1}$
$= 8(.0)\ (\Omega)$ A1 [3]

   (ii) resistance of circuit less therefore current larger   B1

lost volts greater therefore terminal p.d. less   B1 [2]

   (d) power $= I^2R$ **or** VI **or** V^2/R C1

current in second circuit $(= 6.0/12.5) = 0.48$ (A)   B1

ratio $= [(0.36)^2 \times 16]/[(0.48)^2 \times 12] = 0.75$ [0.77 if full s.f. used]   B1 [3]

7 (a) (i) curved path towards negative (–) plate (right-hand side) B1 [1]

(ii) range of α-particle is only few cm in air/loss of energy of the α-particles due to collision with air molecules/ionisation of the air molecules B1 [1]

(iii) $V = E \times d$ C1

$= 140 \times 10^6 \times 12 \times 10^{-3} = 1.7\ (1.68)\,\text{MV}$ A1 [2]

(b) β have opposite charge to α therefore deflection in opposite direction B1

β has a range of velocities/energies hence number of different deflections B1

β have less mass or q/m is larger hence deflection is greater
or
β with (very) high speed (may) have less deflection B1 [3]

(c)

emitted particle	change in Z	change in A
α-particle	–2	–4
β-particle	+1	0

A1 [1]