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.

® IGCSE is the registered trademark of Cambridge International Examinations.

CAMBRIDGE
International Examinations

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

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

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

$K^2 = T^2E/Ml^3$ hence units: $\text{s}^2\text{ kg m}^{-1}\text{s}^{-2}/\text{kg}^3$ (= 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

$E = [(1.48 \times 10^5)^2 \times 0.2068 \times (0.892)^3]/(0.45)^2$
$= 1.588 \times 10^{10}$ C1

7.7% of $E = 1.22 \times 10^9$ C1

$E = (1.6 \pm 0.1) \times 10^{10}\text{ kg m}^{-1}\text{ s}^{-2}$ 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

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

$= 0.06(0)\text{ m}$ A1 [4]

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

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

3 **(a)** work done is force × 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]

© Cambridge International Examinations 2015

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

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

$= 15\ (14.7)\,\text{m s}^{-1}$ 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

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

$= 3.0\ (2.99)$ 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 $= (0.85 \times 9.81 \cos 40°) / 24 \times 10^{-4}$

$= 2.7\ (2.66) \times 10^3\,\text{Pa}$ 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 kg is used for the mass] A1 [3]

© Cambridge International Examinations 2015

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 × 16) = 5.8 V **or** (6 – 0.36 × 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 (Ω) C1

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

© Cambridge International Examinations 2015

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]

© Cambridge International Examinations 2015