CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2012 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.

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1 (a) (i) acceleration = change in velocity / time (taken)
or acceleration = rate of change of velocity   B1   [1]

(ii) a body continues at constant velocity unless acted on by a resultant force   B1   [1]

(b) (i) distance is represented by the area under graph   C1
distance = ½ × 29.5 × 3 = 44.3 m (accept 43.5 m for 29 to 45 m for 30)   A1   [2]

(ii) resultant force = weight – frictional force   B1
frictional force increases with speed   B1
at start frictional force = 0 / at end weight = frictional force   B1   [3]

(iii) 1. frictional force increases   B1   [1]

2. frictional force (constant) and then decreases   B1   [1]

(iv) 1. acceleration = $(v_2 - v_1) / t$ = (20 – 50) / (17 – 15)   C1
= (–) 15 m s^{-2} A1   [2]

2. $W - F = ma$ C1
W = 95 × 9.81 (= 932)   C1
F = (95 × 15) + 932 = 2400 (2360) (2357) N   A1   [3]

2 (a) resistance = potential difference / current   B1   [1]

(b) (i) metal wire in series with power supply and ammeter   B1
voltmeter in parallel with metal wire   B1
rheostat in series with power supply or potential divider arrangement
or variable power supply   B1   [3]

(ii) 1. intercept on graph   B1   [1]

2. scatter of readings about the best fit line   B1   [1]

(iii) correction for zero error explained   B1
use of V and corrected I values from graph   C1
resistance = V / I = 22.(2) Ω [e.g. 4.0 / 0.18]   A1   [3]

(c) R = 6.8 / 0.64 = 10.625   C1

$\%R$ = $\%V + \%I$
= (0.1 / 6.8) × 100 + (0.01 / 0.64) × 100   C1
= 1.47% + 1.56%
ΔR = 0.0303 × 10.625 = 0.32 Ω
R = 10.6 ± 0.3 Ω   A1   [3]

3 (a) pressure = force / area   B1 [1]

(b) molecules collide with object / surface and rebound   B1

molecules have change in momentum hence force acts   B1

fewer molecules per unit volume on top of mountain / temperature is less

hence lower speed of molecules   B1

hence less pressure   A0 [3]

(c) (i) $\rho = m / V$ C1

$W = V\rho g = 0.25 \times 0.45 \times 9.81 \times 13600$ C1

$= 15000\ (15009)\,\text{N}$ A1 [3]

(ii) $p = W / A$ (or using $p = \rho gh$) $= 15009 / 0.45$

$= 3.3 \times 10^4\,\text{Pa}$ A1 [1]

(iii) pressure will be greater due to the air pressure (acting on the surface of the liquid)

   B1 [1]

4 (a) waves pass through the elements / gaps / slits in the grating   M1

spread into geometric shadow   A1 [2]

(b) (i) 1. displacements add to give resultant displacement   B1

each wavelength travels the same path difference or are in phase   B1

hence produce a maximum   A0 [2]

2. to obtain a maximum the path difference must be λ or phase difference

$360° / 2\pi$ rad   B1

λ of red and blue are different   B1

hence maxima at different angles / positions   A0 [2]

(ii) $n\lambda = d \sin\theta$ C1

$N = \sin 61° / (2 \times 625 \times 10^{-9}) = 7.0 \times 10^5$ A1 [2]

(iii) $n\lambda = 2 \times 625$ is a constant (1250)   C1

$n = 1 \rightarrow \lambda = 1250$ outside visible

$n = 3 \rightarrow \lambda = 417$ in visible

$n = 4 \rightarrow \lambda = 312.5$ outside visible

$\lambda = 420\,\text{nm}$ A1 [2]

5 (a) when the load is removed then the wire / body object does not return to its original shape /

length   B1 [1]

(b) (i) stress = force / area   C1

$F = 220 \times 10^6 \times 1.54 \times 10^{-6} = 340\ (338.8)\,\text{N}$ A1 [2]

(ii) $E = (F \times l) / (A \times e)$ C1

$e = (90 \times 10^6) \times 1.75 / (1.2 \times 10^{11}) = 1.31 \times 10^{-3}\,\text{m}$ A1 [2]

(c) the stress is no longer proportional to the extension   B1 [1]

6 (a) 92 protons in the nucleus and 92 electrons around nucleus   B1
     143 neutrons (in the nucleus)   B1   [2]

(b) (i) α-particle travels short distance in air   B1   [1]

     (ii) very small proportion in backwards direction / large angles   B1
        majority pass through with no /small deflections   B1
        either most of mass is in very small volume (nucleus) and is charged or most of atom is
        empty space   B1   [3]

(c) $I = Q / t$ C1
     $n/t = (1.5 \times 10^{-12}) / (2 \times 1.6 \times 10^{-19})$ C1
     $n/t = 4.7 \times 10^6 \, \text{s}^{-1}$ A1   [3]