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
$W = 95 \times 9.81$ (= 932) — C1
$F = (95 \times 15) + 932 = 2400$ (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

$\%R = \%V + \%I$
$= (0.1 / 6.8) \times 100 + (0.01 / 0.64) \times 100$ — C1
$= 1.47\% + 1.56\%$
$\Delta R = 0.0303 \times 10.625 = 0.32\,\Omega$
$R = 10.6 \pm 0.3\,\Omega$ — 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° / 2π 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
$n / t = 4.7 \times 10^{6}\,s^{-1}$ A1 [3]