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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Level

MARK SCHEME for the May/June 2006 question paper

9702 PHYSICS

9702/02 **Paper 2**

Maximum raw mark 60

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which Examiners were initially instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began. Any substantial changes to the mark scheme that arose from these discussions will be recorded in the published *Report on the Examination*.

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.

Mark schemes must be read in conjunction with the question papers and the *Report on the Examination*.

The minimum marks in these components needed for various grades were previously published with these mark schemes, but are now instead included in the Report on the Examination for this session.

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1 **(a)** kg m s^{-2} B1

(b) kg m^{-1} s^{-1} B1

(c) **(i)** $v^2 = 2gs$
$= 2 \times 9.8 \times 4.5$ C1
$v = 9.4$ m s^{-1} A1 **[2]**

(ii) *either*
F $(= 3.2 \times 10^{-4} \times 1.2 \times 10^{-2} \times 9.4) = 3.6 \times 10^{-5}$ N M1
weight of sphere $(= mg = 15 \times 10^{-3} \times 9.8) = 0.15$ N M1
$3.6 \times 10^{-5} << 0.15$, so justified A1 **[3]**
or
$mg = crv_T$ (M1)
terminal speed $= 3.8 \times 10^4$ m s^{-1} (M1)
$9.4 << 3.8 \times 10^4$, so justified (A1)

2 **(a)** **(i)** point at which whole weight of body M1
may be considered to act A1 **[2]**

(ii) sum of forces in any direction is zero B1
sum of moments about any point is zero B1 **[2]**

(b) *either*:
T and W have zero moment about P M1
so F must have zero moment, i.e. pass through P A1 **[2]**
or:
if all pass through P, distance from P is zero for all forces (M1)
so sum of moments about P is zero (A1)

(c) **(i)** $F\cos\alpha = T\cos\beta$ B1 **[1]**

(ii) $W = F\sin\alpha + T\sin\beta$ B1 **[1]**

(iii) $2W = 3T\sin\beta$ B1 **[1]**

3 **(a)** sum of (random) kinetic and potential energies M1
of the atoms/molecules of the substance A1 **[2]**

(b) **(i)** potential energy unchanged as atoms remain in same positions M1
allow 'reduced because atoms slightly closer together'
vibrational kinetic energy reduced because temperature lower M1
so internal energy less A1 **[3]**

(ii) potential energy increases because separation increases M1
kinetic energy unchanged because temperature unchanged M1
so internal energy increases A1 **[3]**

4 **(a)** mass per unit volume (*ratio idea must be clear, not units*) B1 **[1]**

(b) **(i)** pressure is same at the surface of mercury
because at same horizontal level B1 **[1]**

(ii) $h\rho g$ is same for both B1
$53 \times 10^{-2} \times 1.0 \times 10^3 \times g = 71 \times 10^{-2} \times \rho \times g$ C1
$\rho = 7.5 \times 10^2$ kg m^{-3} A1 [3]

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5	**(a)**	no hysteresis loop/no permanent deformation (*do not allow 'force proportional to extension'*) so elastic change	M1 A0	
	(b)	work done = area under graph line OR average force × distance = ½Fx ½$(F_2 + F_1)(x_2 - x_1)$ $F = kx$, so work done = = ½kx^2 ½$k(x_2 + x_1)(x_2 - x_1)$ work done = ½$k(x_2^2 - x_1^2)$	B1 A1 A1 A0	**[3]**
	(c)	gain in energy of trolley = ½$k(0.060^2 - 0.045^2)$ + ½$k(0.030^2 - 0.045^2)$ = 0.36 J kinetic energy = ½ × 0.85 × v^2 = 0.36 v = 0.92 m s^{-1}	C1 C1 C1 A1	**[4]**
6	**(a)**	**(i)** correct shape drawn	B1	**[1]**
		(ii) two nodes marked correctly	B1	**[1]**
	(b)	½λ = 0.324 m v = $f\lambda$ = 512 × 2 × 0.324 = 332 m s^{-1}	C1 C1 A1	**[3]**
	(c)	¼λ = 16.2 cm *either* antinode is 0.5 cm above top of tube *or* antinode is 16.2 cm above water surface	C1 A1	**[2]**
7	**(a)**	lamp C lamp is shorted	M1 A1	**[2]**
	(b)	shorted <u>lamp A</u> would cause damage to the supply/lamps /blow fuse in supply	B1	**[1]**
	(c)	15 Ω	B1	**[1]**
	(d)	**(i)** $V = I R$ R = 30 Ω	C1 A1	**[2]**
		(ii) $P = VI$ *or* I^2R *or* V^2 / R P = 1.2 W	C1 A1	**[2]**
	(e)	filament is cold when measuring with ohm-meter in (b) resistance of filament rises as temperature rises	B1 B1	**[2]**
8	**(a)**	nucleus emits α- or β- particles and/or γ-rays	M1 A1	**[2]**
	(b)	decay unaffected by environmental changes such as temperature, pressure etc. (*one e.g. is sufficient)*	M1 A1	**[2]**
	(c)	constant probability of decay (per unit time) of a nucleus cannot predict which particular nucleus will decay next	B1 B1	**[2]**