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

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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.

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

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

(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 <u>mercury</u>
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]

5 **(a)** no hysteresis loop/no permanent deformation M1
(*do not allow 'force proportional to extension')*
so elastic change A0 **[1]**

(b) work done = area under graph line OR average force × distance B1
$= \frac{1}{2}Fx$ $\frac{1}{2}(F_2 + F_1)(x_2 - x_1)$ A1
$F = kx$, so work done = $= \frac{1}{2}kx^2$ $\frac{1}{2}k(x_2 + x_1)(x_2 - x_1)$ A1
work done = $\frac{1}{2}k(x_2^2 - x_1^2)$ A0 **[3]**

(c) gain in energy of trolley $= \frac{1}{2}k(0.060^2 - 0.045^2) + \frac{1}{2}k(0.030^2 - 0.045^2)$ C1
$= 0.36$ J C1
kinetic energy $= \frac{1}{2} \times 0.85 \times v^2 = 0.36$ C1
$v = 0.92$ m s^{-1} A1 **[4]**

6 **(a)** **(i)** correct shape drawn B1 **[1]**

(ii) two nodes marked correctly B1 **[1]**

(b) $\frac{1}{2}\lambda = 0.324$ m C1
$v = f\lambda$ C1
$= 512 \times 2 \times 0.324$
$= 332$ m s^{-1} A1 **[3]**

(c) $\frac{1}{4}\lambda = 16.2$ cm C1
either antinode is 0.5 cm above top of tube
or antinode is 16.2 cm above water surface A1 **[2]**

7 **(a)** lamp C M1
lamp is shorted 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)** $V = I R$ C1
$R = 30\ \Omega$ A1 **[2]**

(ii) $P = VI$ *or* I^2R *or* V^2 / R C1
$P = 1.2$ W A1 **[2]**

(e) filament is cold when measuring with ohm-meter in (b) B1
resistance of filament rises as temperature rises B1 **[2]**

8 **(a)** nucleus emits M1
α- or β- particles and/or γ-rays A1 **[2]**

(b) decay unaffected by environmental changes M1
such as temperature, pressure etc. (*one e.g. is sufficient)* A1 **[2]**

(c) constant probability of decay (per unit time) of a nucleus B1
cannot predict which particular nucleus will decay next B1 **[2]**