UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2008 question paper

9702 PHYSICS

9702/02 Paper 2 (AS Structured Questions), maximum raw mark 60

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1 **(a)** allow anything in range 20 Hz → 20 kHz B1 [1]

(b) allow anything in range 10 nm → 400 nm B1 [1]

(c) allow anything in range 10 g → 100 g B1 [1]

(d) allow anything in range 0.1 kg m^{-3} → 10 kg m^{-3} B1 [1]

2 **(a)** **(i)** k is the reciprocal of the gradient of the graph C1
k = {32 / (4×10^{-2}) = } 800 N m^{-1} A1 [2]

(ii) *either* energy = average force × extension *or* $\frac{1}{2}kx^2$
or area under graph line C1
energy = $\frac{1}{2} \times 800 \times (3.5 \times 10^{-2})^2$ *or* $\frac{1}{2} \times 28 \times 3.5 \times 10^{-2}$ M1
energy = 0.49 J A0 [2]

(b) **(i)** momentum before cutting thread = momentum after C1
$0 = 2400 \times V - 800 \times v$ M1
$v / V = 3.0$ A0 [2]

(ii) energy stored in spring = kinetic energy of trolleys C1
$0.49 = \frac{1}{2} \times 2.4 \times (\frac{1}{3}v)^2 + \frac{1}{2} \times 0.8 \times v^2$ C1
v = 0.96 m s^{-1} A1 [3]
(if only one trolley considered, or masses combined, allow max 1 mark)

3 **(a)** **(i)** $v^2 = 2as$
$1.2^2 = 2 \times a \times 1.9$ M1
a = 0.38 m s^{-2} A1 [2]

(ii) $F = ma$
= 42 × 0.38 M1
= 16 N A0 [1]

(b) *power* = Fv C1
= 16 × 1.2
= 19 W A1 [2]

(c) **(i)** component = 42 × 9.8 × sin2.8 C1
= 20.1 N A1 [2]

(ii) accelerating force = 20.1 – 16 = 4.1 N C1
acceleration of trolley = 4.1 / 42 = 0.098 m s^{-2} C1
$s = \frac{1}{2}at^2$
$3.5 = \frac{1}{2} \times 0.098 \times t^2$ C1
t = 8.5 s A1 [4]

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(d) *either* allows plenty of time to stop runaway trolley
or speed of trolley increases gradually
or trolley will travel faster B1 [1]
(answer must be unambiguous when read in conjunction with question)

4 (a) (i) 1. stress = force / (cross-sectional) area B1 [1]
2. strain = extension / <u>original</u> length B1 [1]
3. Young modulus = stress / strain B1 [1]
(ratios must be clear in each answer)

(ii) *either* fluids cannot be deformed in one direction / cannot be stretched
or fluids can only have volume change
or no fixed shape B1 [1]

(b) *either* unless Δp is very large *or* 2.2×10^9 is a large number M1
ΔV is very small *or* $\Delta V/V$ is very small, (so 'incompressible') A1 [2]

(c) $\Delta p = h\rho g$
$1.01 \times 10^5 = h \times 1.08 \times 10^3 \times 9.81$ C1
$h = 9.53$ m C1
$\Delta h / h = 0.47 / 10$ *or* $0.47 / 9.53$
error = 4.7% *or* 4.9% *or* 5% A1 [3]

5 (a) (i) frequency: number of oscillations <u>per</u> unit time M1
of the source / of a point on the wave A1 [2]

(ii) speed: speed at which energy is transferred / speed of wave<u>front</u> B1 [1]

(b) (i) does not transfer energy (along the wave) B1 [1]

(ii) position (along wave) where amplitude of vibration is a maximum B1 [1]

(iii) all three positions marked B1 [1]

(c) wavelength = $2 \times 17.8 = 35.6$ cm C1
$v = f\lambda$ C1
$v = 125 \times 0.356$
$= 44.5$ m s^{-1} C1
$44.5^2 = 4.00 / m$ C1
$m = 2.0 \times 10^{-3}$ kg m^{-1} A1 [5]

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6 **(a)** *either* $P = VI$ and $V = IR$ *or* $P = V^2 / R$ C1
resistance = 38.4 Ω A1 [2]

(b) zero B1
1.5 kW B1
3.0 kW B1
0.75 kW B1
2.25 kW B1 [5]

7 **(a)** α-particle: *either* helium nucleus *or* contains 2 protons + 2 neutrons
or $^{4}_{2}\text{He}$ B1

β-particle: *either* electron *or* $^{0}_{-1}\text{e}$ B1

α speed < β speed (1)
α discrete values of speed/energy, β continuous spectrum (1)
either α ionising power >> β ionising power
or α range << β range (1)
α positive, β negative *(only if first two B marks not scored)* (1)
α mass > β mass *(only if first two B marks not scored)* (1)
(any two sensible pairs of statements relevant to differences,
– do not allow statements relevant to only α or β, 1 each, max 2) B2 [4]

(b) **(i)** $^{236}_{92}\text{U} \rightarrow {}^{232}_{90}\text{Th}$ M1
$+ {}^{4}_{2}\text{He}$ A1 [2]

(ii) **1.** correct position for U at $Z = 92$, $N = 145$ B1
2. correct position for Np relative to U i.e. $Z + 1$ and $N - 1$ B1 [2]

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