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

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.

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)** allow anything in range 20 Hz → 20 kHz

(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* ½kx^2
or area under graph line C1
energy = ½ × 800 × (3.5 × 10^{-2})^2 *or* ½ × 28 × 3.5 × 10^{-2} M1
energy = 0.49 J A0 [2]

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

(ii) energy stored in spring = kinetic energy of trolleys C1
0.49 = ½ × 2.4 × ($\frac{1}{3}v$)^2 + ½ × 0.8 × 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 = ½at^2
3.5 = ½ × 0.098 × t^2 C1
t = 8.5 s A1 [4]

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

4 **(a)** **(i)** **1.** stress = force / (cross-sectional) area B1 [1]
2. strain = extension / original 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 per unit time M1
of the source / of a point on the wave A1 [2]

(ii) speed: speed at which energy is transferred / speed of wavefront 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]

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

(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]