

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2007 question paper

9702 PHYSICS

9702/04

Paper 4 (A2 Structures Questions), maximum raw mark 100

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.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

- CIE will not enter into discussions or correspondence in connection with these mark schemes.

CIE is publishing the mark schemes for the May/June 2007 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.



Page 2	Mark Scheme	Syllabus	Paper
	GCE A/AS LEVEL – May/June 2007	9702	04

- 1 (a) (region of space) where a mass experiences a force B1 [1]
- (b) (i) potential energy = $(-)\frac{GMm}{x}$
 $\Delta E_p = \frac{GMm}{2R} - \frac{GMm}{3R}$
 $= \frac{GMm}{6R}$ C1
M1
A0 [2]
- (ii) $E_k = \frac{1}{2}m(7600^2 - 7320^2)$
 $= (2.09 \times 10^6)m$ M1
A0 [1]
- (c) (i) $2.09 \times 10^6 = \frac{(6.67 \times 10^{-11} M)(6 \times 3.4 \times 10^6)}{}$
 $M = 6.39 \times 10^{23} \text{ kg}$ C1
A1 [2]
- (ii) e.g. no energy dissipated due to friction with atmosphere/air
rocket is outside atmosphere
not influenced by another planet etc. B1 [1]
- 2 (a) (on melting,) bonds between molecules are broken/weakened
or molecules further apart/are able to slide over one another
kinetic energy unchanged so no temperature change
potential energy increased/changed so energy required B1
B1
B1 [3]
- (b) thermal energy/heat required to convert unit mass of solid to liquid
with no change in temperature/ at its normal boiling point M1
A1 [2]
- (c) (i) thermal energy lost by water = $0.16 \times 4.2 \times 100$
 $= 67.2 \text{ kJ}$ C1
 $67.2 = 0.205 \times L$ C1
 $L = 328 \text{ kJ kg}^{-1}$ A1 [3]
- (ii) more energy (than calculated) melts ice
so, (calculated) L is lower than the accepted value M1
A1 [2]
- 3 (a) field strength = potential gradient
correct sign OR directions discussed M1
A1 [2]
- (b) area is $21.2 \text{ cm}^2 \pm 0.4 \text{ cm}^2$
(if outside $\pm 0.4 \text{ cm}^2$ but within $\pm 0.8 \text{ cm}^2$, allow 1 mark)
 1.0 cm^2 represents $(1.0 \times 10^{-2} \times 2.5 \times 10^3 =) 25 \text{ V}$
potential difference = 530 V C1
A1 [4]
- (c) $\frac{1}{2}mv^2 = qV$
 $\frac{1}{2} \times 9.1 \times 10^{-31} \times v^2 = 1.6 \times 10^{-19} \times 530$ C1
 $v = 1.37 \times 10^7 \text{ ms}^{-1}$ A1 [2]
- (d) (i) $d = 0$ B1 [1]
- (ii) acceleration decreases then increases
some quantitative analysis (e.g. minimum at 4.0 cm)
(any suggestion that acceleration becomes zero or that there is a deceleration scores 0/2) B1
B1 [2]

Page 3	Mark Scheme	Syllabus	Paper
	GCE A/AS LEVEL – May/June 2007	9702	04

- 4 (a) r.m.s. output = $9/\sqrt{2}$ or peak input = $230\sqrt{2}$ C1
 $N_S/N_P = V_S/V_P$ C1
 $N_S = 138 \rightarrow 140$ turns A1 [3]
- (b) (i) four diodes correctly positioned regardless of output polarity M1
giving correct output polarity (*all 'point to left'*) A1 [2]
- (ii) capacitor shown in parallel with R B1 [1]
- (c) (i) time t_1 to time t_2 B1 [1]
- (ii) sketch: same peak values M1
ripple reduced and reasonable shape A1 [2]
- 5 (a) (i) packet/discrete quantity/quantum (of energy) of e.m. radiation B1 [1]
- (ii) either $E = (6.63 \times 10^{-34} \times 3 \times 10^8)/(350 \times 10^{-9})$
or $E = (6.63 \times 10^{-34} \times 8.57 \times 10^{14})$ M1
 $E = 5.68 \times 10^{-19}$ J A0 [1]
- (iii) 0.5 B1 [1]
- (b) (i) energy of photon M1
to cause emission of electron from surface
either with zero k.e or photon energy is minimum A1 [2]
- (ii) correct conversion eV \rightarrow J or J \rightarrow eV seen once B1
photon energy must be greater than work function C1
350 nm wavelength and potassium metal A1 [3]
- 6 (a) probability of decay M1
of a nucleus per unit time A1 [2]
(*allow 1 mark for $A = \lambda N$, with symbols explained*)
- (b) (i) $\lambda = \ln 2 / (28 \times 365 \times 24 \times 3600)$ C1
 $= 7.85 \times 10^{-10} \text{ s}^{-1}$ A1 [2]
- (ii) $A = (-)\lambda N$
 $N = (6.4 \times 10^9) / (7.85 \times 10^{-10})$ C1
 $= 8.15 \times 10^{18}$ C1
mass = $(8.15 \times 10^{18} \times 90) / (6.02 \times 10^{23})$ (e.c.f. for value of N) C1
 $= 1.22 \times 10^{-3}$ g A1 [4]
- (iii) volume = $(1.22 \times 10^{-3} / 2.54) = 4.8 \times 10^{-4} \text{ cm}^3$ A1 [1]
- (c) *either* very small volume of Strontium-90 has high activity B1
or dust can be highly radioactive B1 [2]
breathing in dust presents health hazard

Page 4	Mark Scheme	Syllabus	Paper
	GCE A/AS LEVEL – May/June 2007	9702	04

- 7 (a) (i) oscillations are damped/amplitude decreases
as magnet moves, flux is cut by coil
e.m.f./current is induced in the coil
causing energy loss in load OR force on magnet
energy is derived from oscillations of magnet
OR force opposes motion of magnet
- (ii) $T = 0.60 \text{ s}$
 $\omega_0 (= 2\pi/T) = 10.5 \text{ rad s}^{-1}$
- (b) sketch: sinusoidal wave with period unchanged or slightly smaller
same initial displacement, less damping
- (c) (i) sketch: general shape – peaked curve
peak at ω_0 and amplitude never zero
- (ii) resonance
- (iii) useful: e.g. child on swing, microwave oven heating
avoid: e.g. vibrating panels, vibrating bridges
(for credit, stated example must be put in context)

Section B

- 8 (a) e.g. infinite (voltage) gain
infinite input impedance
zero output impedance
infinite bandwidth
infinite slew rate
(any three, 1 each)
- (b) (i) negative (feedback)
- (ii) 1 gain $(= 5.8/0.069) = 84$
- (ii) 2 gain $= 1 + 120/X$
 $84 = 1 + 120/X$
 $X = 1.45 \text{ k}\Omega$
- (iii) gain increases OR bandwidth reduced OR output increases

Page 5	Mark Scheme	Syllabus	Paper
	GCE A/AS LEVEL – May/June 2007	9702	04

- 9 (a) X-ray beam directed through body onto detector (plate) B1
different tissues absorb/attenuate beam by different amounts B1
giving 'shadow' image of structures B1
any other detail e.g. comment re sharpness or contrast B1 [4]
- (b) X-ray image is flat OR 2-dimensional (1)
CT scan takes many images of a slice at different angles (1)
these build up an image of a slice through the body (1)
series of images of slices is made (1)
so that 3D image can be built up (1)
image can then be rotated (1)
1 mark for each point, max 5 B5 [5]
- 10 (a) correct values of 2, 5, 10, 15 and 4 (–1 each error) B2
graph drawn as a series of steps M1
steps occurring at correct times A1 [4]
- (b) sample more frequently B1
greater number of bits B1 [2]
- 11 (a) modulator and oscillator identified B1
both amplifiers identified correctly B1
ADC and parallel-to serial converter identified B1 [3]
- (b) computer at cellular exchange B1
monitors signal strength B1
switches call from one base station to another B1
to maintain maximum signal strength B1 [4]