CAMBRIDGE
INTERNATIONAL EXAMINATIONS

November 2003

GCE ADVANCED SUBSIDIARY LEVEL AND ADVANCED LEVEL

MARK SCHEME

MAXIMUM MARK: 60

SYLLABUS/COMPONENT: 9702/02

PHYSICS
Paper 2 (Structured Questions (AS))

UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate

Categorisation of marks

The marking scheme categorises marks on the *MACB* scheme.

B marks: These are awarded as independent marks, which do not depend on other marks. For a B-mark to be scored, the point to which it refers must be seen specifically in the candidate's answer.

M marks: These are method marks upon which A-marks (accuracy marks) later depend. For an M-mark to be scored, the point to which it refers must be seen in the candidate's answer. If a candidate fails to score a particular M-mark, then none of the dependent A-marks can be scored.

C marks: These are compensatory method marks which can be scored even if the points to which they refer are not written down by the candidate, providing subsequent working gives evidence that they must have known it. For example, if an equation carries a C-mark and the candidate does not write down the actual equation but does correct working which shows he/she knew the equation, then the C-mark is awarded.

A marks: These are accuracy or answer marks which either depend on an M-mark, or allow a C-mark to be scored.

Conventions within the marking scheme

BRACKETS
Where brackets are shown in the marking scheme, the candidate is not required to give the bracketed information in order to earn the available marks.

UNDERLINING
In the marking scheme, underlining indicates information that is essential for marks to be awarded.

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1 (a) (i) acceleration (allow a definition of acceleration) B1

(ii) the velocity is decreasing or force/acceleration is in negative direction – accept 'body is decelerating'/'slowing down' ..... B1 [2]

(b) (i) e.g. separation of dots becomes constant/does not continue to increase (must make a reference to the diagram) B1

(ii)1 distance = 132 cm B1

(ii)2 at constant speed, distance travelled in 0.1 s = 25 cm (allow ± 1 cm) C1
distance = 132 + (4 x 25)
= 232 cm ..... A1 [4]

(c) $s = ut + \frac{1}{2}at^2$
$1.6 = \frac{1}{2} \times 9.8 \times t^2$ (allow $g = 10$ m s^{-2} C1
$t = 0.57$ s C1
hence 6 photographs ('bald' answer scores 2 marks only) ..... A1 [3]

2 (a) mass: measure of body's resistance/inertia to changes in velocity/motion B1
weight: effect of gravitational field on mass or force of gravity B1
any further comment e.g. mass constant, weight varies/ weight = mg/scalar and vector ..... B1 [3]

(b) e.g. where gravitational field strength changes (change) in fluid surrounding body…. *1 each, max 2* ..... B2 [2]

3 (a) force x perpendicular distance M1
(of the force) from the pivot ..... A1 [2]

(b) no resultant force (in any direction) B1
no resultant moment (about any point) ..... B1 [2]

(c) (i) correct direction in both ..... B1 [1]

(ii)1 moment = 150 x 0.3 = 45 N m (1 sig. fig. -1) A1

(ii)2 torque = 45 N m i.e. same is (i) A1

(ii)3 $45 = 0.12 \times T$ C1
$T = 375$ N ..... A1 [4]

4 (a) (i)1 amplitude = 0.4(0) mm A1

(i)2 wavelength = 7.5×10^{-2} m
(1 sig. fig. -1 unless already penalised) A1

(i)3 period = 0.225 ms C1
frequency = $1/T = 4400$ Hz A1

(i)4 $v = f\lambda$
$= 4400 \times 7.5 \times 10^{-2}$ C1
= 330 m s^{-1} ..... A1 [6]

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(a) (ii) reasonable shape, same amplitude and wavelength doubled ..... B1 [1]

(b) (i) 1.7(2) μm A1

(ii) d sinθ = $n\lambda$ (double slit formula scores 0/2)
$1.72 \times 10^{-6} \times \sin\theta = 590 \times 10^{-9}$ C1
$\theta = 20.1°$ (allow 20°) A1

(iii) ½L = 1.5 tan20.1 ..... C1
L = 1.1 m ..... A1 [5]

5 (a) (i) arrow from B towards A B1

(ii) $E = V/d$
$= 450/(9.0 \times 10^{-2})$ C1
$= 5.0 \times 10^{3}$ N C^{-1} (accept 1 sig. fig) ..... A1 [3]

(b) (i) energy = qV or Eqd C1
$= 1.6 \times 10^{-19} \times 450$ A1
$= 7.2 \times 10^{-17}$ J A0

(ii) Ek = ½mv^2
$7.2 \times 10^{-17} = ½ \times 9.1 \times 10^{-31} \times v^2$ C1
$v = 1.26 \times 10^{7}$ m s^{-1} ..... A1 [4]

(c) line from origin, curved in correct direction but not 'level out' ..... B1 [1]

6 (a) (i) 26 protons B1

(ii) 30 neutrons ..... B1 [2]

(b) (i) mass = $56 \times 1.66 \times 10^{-27}$ C1
(allow $\times 1.67 \times 10^{-27}$ but 0/2 for use of 26 or 30)
$= 9.3 \times 10^{-26}$ kg A1

(ii) density = mass/volume where volume = $4/3 \times \pi \times r^3$ C1
$= (9.3 \times 10^{-26})/(4/3 \times \pi \times \{5.7 \times 10^{-15}\}^3)$
$= 1.2 \times 10^{17}$ kg m^{-3} ..... A1 [4]

(c) nucleus occupies only very small fraction of <u>volume of atom</u>
or 'lot of empty space inside atom' B1
(do not allow spacing between atoms)
any further good physics e.g. nuclear material is very dense ..... B1 [2]

7 (a) (i) $P = Vi$ C1
$1200 = 240 \times i$ M1
$i = 5.0$ A A0

(ii) $V = iR$
$240 = 5.0 \times R$ C1
R = 48Ω ..... A1 [4]

(b) (i) p.d. = (5.0 x 4.0 =) 20 V A1

(ii) mains voltage = (240 + 20 =) 260 V A1

(iii) P = (20 x 5.0 =) 100 W ..... A1 [3]

(c) power input = 1200 + 100 = 1300 W C1
efficiency = 1200/1300 = 0.92 ..... A1 [2]

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