UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2010 question paper

for the guidance of teachers

9702 PHYSICS

9702/22 Paper 2 (AS Structured Questions)

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, which would have considered the acceptability of alternative answers.

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International Examinations

1 **(a)** micrometer/screw gauge/digital callipers ……. B1 [1]

(b) **(i)** look/check for zero error ……. B1 [1]

(ii) take several readings …….. M1
around the circumference/along the wire ……. A1 [2]

2 **(a)** e.g. initial speed is zero
constant acceleration
straight line motion
(*any two, one mark each*) ……B2 [2]

(b) **(i)** $s = ½at^2$
$0.79 = ½ \times 9.8 \times t^2$ …….. C1
$t = 0.40$ s allow 1 SF or greater ……. A1
2 or 3 SF answer …….. A1 [3]

(ii) distance travelled by end of time interval = 90 cm ……. C1
$0.90 = ½ \times 9.8 \times t^2$
$t = 0.43$ s allow 2 SF or greater ……. C1
time interval = 0.03 s ……... A1 [3]

(c) (air resistance) means ball's speed/acceleration is less …… M1
length of image is shorter …… A1 [2]

3 **(a)** **(i)** force is rate of change of momentum …… B1 [1]

(ii) force on body A is equal in magnitude to force on body B (from A) ……M1
forces are in opposite directions …… A1
forces are of the same kind ……A1 [3]

(b) **(i)** 1 $F_A = -F_B$ ……. B1 [1]
2 $t_A = t_B$ …… B1 [1]

(ii) $\Delta p = F_A t_A = -F_B t_B$ …….. B1 [1]

(c) graph: momentum change occurs at same times for both spheres ……. B1
final momentum of sphere B is to the right …….. M1
and of magnitude 5 N s …… A1 [3]

4 **(a)** e.g. no energy transfer
amplitude varies along its length/nodes and antinodes
neighbouring points (in inter-nodal loop) vibrate in phase, etc.
(*any two, 1 mark each to max 2* ……..B2 [2]

(b) **(i)** $\lambda = (330 \times 10^2)/550$ …….. M1
$\lambda = 60\,\text{cm}$ …… A0 [1]

(ii) node labelled at piston …… B1
antinode labelled at open end of tube …… B1
additional node and antinode in correct positions along tube …… B1 [3]

(c) at lowest frequency, length = $\lambda/4$ ……... C1
$\lambda = 1.8$ m
frequency = 330/1.8 …… C1
= 180 Hz ……... A1 [3]

5 **(a)** **(i)** Young modulus = stress/strain …… C1
data chosen using point in linear region of graph …… M1
Young modulus = $(2.1 \times 10^8)/(1.9 \times 10^{-3})$
$= 1.1 \times 10^{11}$ Pa …….. A1 [3]

(ii) This mark was removed from the assessment, owing to a power-of-ten inconsistency in the printed question paper.

(b) area between lines represents energy/area under curve represents energy .. M1
when rubber is stretched and then released/two areas are different ……..... A1
this energy seen as thermal energy/heating/difference represents energy released as heat …… A1 [3]

6 **(a)** *either* $P \propto V^2$ *or* $P = V^2/R$ …… C1
reduction = $(230^2 - 220^2)/230^2$
= 8.5 % …….. A1 [2]

(b) **(i)** zero …… A1 [1]

(ii) 0.3(0) A …….. A1 [1]

(c) **(i)** correct plots to within ± 1 mm …… B1 [1]

(ii) reasonable line/curve through points giving current as 0.12 A
allow ± 0.005A) …… B1 [1]

(iii) $V = IR$ …… C1
$V = 0.12 \times 5.0$
= 0.6(0) V ……... A1 [2]

(d) circuit acts as a potential divider/current divides/current in AC not the same as current in BC …… B1
resistance between A and C not equal to resistance between C and B …….
or current in wire AC × R is not equal to current in wire BC × R
any 2 statements

7 (a) (i) *either* helium nucleus
or contains 2 protons and 2 neutrons …… B1 [1]

(ii) e.g. range is a few cm in air/sheet of thin paper
speed up to 0.1 *c*
causes dense ionisation in air
positively charged or deflected in magnetic or electric fields
(*any two, 1 each to max 2*) …….. B2 [2]

(b) (i) $^{4}_{2}\alpha$ …… B1
either $^{1}_{1}p$ *or* $^{1}_{1}H$…….. B1 [2]

(ii) 1 initially, α-particle must have some kinetic energy …….. B1 [1]

(ii) 2 1.1 MeV = $1.1 \times 1.6 \times 10^{-13} = 1.76 \times 10^{-13}$ J ……. C1
$E_K = \frac{1}{2}mv^2$ …….. C1
$1.76 \times 10^{-13} = \frac{1}{2} \times 4 \times 1.66 \times 10^{-27} \times v^2$ …… C1
$v = 7.3 \times 10^{6}$ m s^{-1} ……..... A1 [4]
use of 1.67×10^{-27} kg for mass is a maximum of 3/4