UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2006 question paper

9702 PHYSICS

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

This mark scheme is published as an aid to teachers and students, 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.

The grade thresholds for various grades are published in the report on the examination for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses.

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1 (a) (i) product of force and distance moved — M1
(by force) in the direction of the force — A1 [2]

(ii) work (done) per unit time (*idea of ratio needed*) — B1 [1]

(b) *either* work/time *or* power = (force × distance)/time — M1
to give power = force × velocity — A1 [2]

(c) (i) kinetic energy (= $\frac{1}{2}mv^2$) = $\frac{1}{2} \times 1900 \times 27^2$ — C1
power = 692550 / 8.1 = 8.55×10^4 W — A1 [2]

(ii) *either* for equal increments of speed, increments of E_K are different — M1
so longer time (to increase speed) at high speeds — A1 [2]
or air resistance increases with speed (M1)
so driving force (and acceleration) reduced (A1)
or P (= Fv) = mav (M1)
(P and m constant) so when v increases, a decreases (A1)

2 (a) uses a tangent (anywhere), not a single point — C1
draws tangent at correct position — B1
acceleration = 1.7 ± 0.1 — A2 [4]
(*outside 1.6 → 1.8 but within 1.5 → 1.9, allow 1 mark*)

(b) (i) because slope (of tangent of graph) is decreasing — M1
acceleration is decreasing — A1 [2]

(ii) e.g. air resistance increases (with speed)
(angle of) slope of ramp decreases — B1 [1]

(c) (i) scatter of points about line — B1 [1]

(ii) intercept / line does not go through origin — B1 [1]

3 (a) helium nucleus OR contains two protons and two neutrons — B1 [1]

(b) kinetic energy = $\frac{1}{2}mv^2$ — C1
$\frac{1}{2} \times 4 \times 1.66 \times 10^{-27} \times v^2 = 1.07 \times 10^{-12}$ — A1
$v = 1.8 \times 10^7$ m s^{-1} — A0 [2]

(c) (i) sum of momenta (in any direction) is constant
/ total momemtum is constant — M1
in a closed system / no external force — A1 [2]

(ii) momentum of francium (= 0) = momentum of α + momentum of astatine — C1
$204 \times V = 4 \times 1.8 \times 10^7$ — C1
$V = 3.5 \times 10^5$ m s^{-1} — A1 [3]
(*nuclei incorrectly identified, 0/3*
nuclei correctly identified but incorrect masses, -1 each error)

(d) another particle / photon is emitted — M1
at an angle to the direction of the α-particle — A1 [2]
(allow 1 mark for 'Francium nucleus is not stationary')

4 (a) (i) when two (or more) waves meet (at a point) M1
there is a change in overall intensity / displacement A1
(ii) constant phase difference (between waves) B1 [3]

(b) (i) $d\sin\theta = n\lambda$ B1
$(10^{-3} / 550) \sin 90 = n \times 644 \times 10^{-9}$ C1
$n = 2.8$ C1
so two orders A1 [4]
(*power-of-ten error giving 2800 orders, allow 1/3 only for calculation of n*)

(ii) **1.** $d\sin\theta = n\lambda$ (*either here or in* ***(i)*** *– not both*)
θ is greater so λ is greater B1 [1]
2. when n is larger, $\Delta\theta$ is larger M1
so greater in second order A1 [2]

5 (a) metal: crystalline / lattice / atoms in regular pattern B1
(atoms in regular) pattern that repeats itself (within crystal) B1 [2]
polymer: long chains of atoms / molecules B1
chain consists of 'units' that repeat themselves B1 [2]

(b) (i) e.g. latex is soft / not strong / flows / ductile B1
elastic limit easily exceeded B1 [2]
(*allow any two sensible comments, 1 each*)

(ii) more solid / does not flow / stronger / higher ultimate tensile stress
more brittle
elastic limit much higher
increased toughness
(*any two, 1 each*) B2 [2]

6 (a) (i) $R = \rho L / A$ B1
(ii) strain = $\Delta L / L$ B1
either $\Delta R = \rho \Delta L / A$ *or* $R \propto L$ with ρ and A constant B1
dividing, $\Delta R / R = \Delta L / L$ A0 [3]

(b) Young modulus = stress / strain C1
strain $= 72.0 / (1.20 \times 10^{-7} \times 2.10 \times 10^{11})$ C1
$= 2.86 \times 10^{-3}$ (*allow 1/350* A1
$\Delta R = 2.86 \times 10^{-3} \times 4.17 = 1.19 \times 10^{-2}\ \Omega$ A1
answer given to 3 sig. fig B1 [5]

7 (a) both measure (energy / work) / charge B1
for e.m.f., transfer of chemical energy to electrical energy B1
for p.d., transfer of electrical energy to thermal energy / other forms B1 [3]

(b) (i) $I_1 + I_2 = I_3$ B1 [1]
(ii) **1.** $E_2 = I_2R_2 + I_3R_3$ B1 [1]
2. $E_1 - E_2 = I_1R_1 - I_2R_2$ B1 [1]