UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2006 question paper

9702 PHYSICS

9702/04 Paper 4 (Core), maximum raw mark 60

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1 (a) *either* ratio of work done to mass/charge
or work done moving unit mass/charge from infinity
or both have zero potential at infinity — B1 [1]

(b) gravitational forces are (always attractive) — B1
electric forces can be attractive or repulsive — B1
for gravitational, work got out as masses come together /mass moves from infinity — B1
for electric, work done on charges if same sign, work got out if opposite sign as charges come together — B1 [4]

2 (a) (i) idea of heat lost (by oil) = heat gained (by thermometer) — C1
$32 \times 1.4 \times (54 - t) = 12 \times 0.18 \times (t - 19)$ — C1
$t = 52.4°C$ — A1 [3]

(ii) *either* ratio (= 1.6/54) = 0.030 *or* (=1.6/327) = 0.0049 — A1 [1]

(b) thermistor thermometer (allow 'resistance thermometer') — B1
because small mass/thermal capacity — B1 [2]

(c) boiling point temperature is constant — M1
further comment
e.g. heating of bulb would affect only rate of boiling — A1 [2]

3 (a) use of $a = -\omega^2 x$ clear — C1
either $\omega = \sqrt{(2k/m)}$ *or* $\omega^2 = (2k/m)$ — B1
$\omega = 2\pi f$ — C1
$f = (1/2\pi)\sqrt{(2 \times 300)/0.240)}$ — B1
$= 7.96 \approx 8$ Hz — A0 [4]

(b) (i) resonance — B1 [1]

(ii) 8 Hz — B1 [1]

(c) (increase amount of) damping — B1
without altering (*k* or) *m* …(some indirect reference is acceptable) — B1
sensible suggestion — B1 [3]

4 (a) (i) $GMm\{(R + h_1)^{-1} - (R + h_2)^{-1}\}$ — B1
$\frac{1}{2}m\{v_1^2 - v_2^2\}$ — B1 [2]

(b) $2M \times 6.67 \times 10^{-11}\{(26.28 \times 10^6)^{-1} - (29.08 \times 10^6)^{-1}\} = 5370^2 - 5090^2$ — B1
$M \times 4.888 \times 10^{-19} = 2.929 \times 10^6$ — C1
$M = 6.00 \times 10^{24}$ kg — A1 [3]
(If equation in **(a)** *is dimensionally unsound, then 0/3 marks in* **(b)***, if dimensionally sound but incorrect, treat as e.c.f.)*

5 (a) (i) (induced) e.m.f proportional/equal to rate of change of flux (linkage) — B1
(allow 'induced voltage, induced p.d.)
flux is cust as the disc moves — M1
hence inducing an e.m.f — A0 [2]

(ii) field in disc is not uniform/rate of cutting not same/speed of disc not same (over whole disc) — B1
so different e.m.f.'s in different parts of disc — M1
lead to eddy currents — A0 [2]

(b) eddy currents dissipate thermal energy in disc — B1
energy derived from oscillation of disc — B1
energy of disc depends on amplitude of oscillations — B1 [3]

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6 (a) (i) peak voltage = $6\sqrt{2}$ C1
peak voltage = 8.48 V A1 [2]

(ii) zero because *either* no current in circuit (and $V = IR$)
or all p.d. across diode B1 [1]

(b) waveform: half-wave rectification B1
peak height at about 4.25 cm B1
half-period spacing of 2.0 cm B1 [3]
(allow ±¼ square for height and half-period)

(c) (i) *capacitor shown in parallel with resistor* B1 [1]

(ii) *either* energy = $\frac{1}{2}CV^2$ or = $\frac{1}{2}QV$ and $Q = CV$ C1
$= \frac{1}{2} \times 180 \times 10^{-6} \times (6\sqrt{2})^2$ C1
$= 6.48 \times 10^{-3}$ J A1 [3]

(iii) *either* fraction = 0.43^2 or final energy = 1.2 mJ C1
fraction = 0.18 A1 [2]

7 (a) (i) quantum/packet/discrete amount of energy M1
electromagnetic mentioned A1 [2]

(ii) max. k.e. corresponds to electron emitted from surface B1
energy is required to bring electron to surface B1 [2]

(b) at higher frequency, fewer photons (per second) for same intensity M1
so rate of emission decreases A1 [2]
(allow argument based on photoelectric efficiency)

8 (a) (i) *either* number = $6.02 \times 10^{23} \times (\{2.65 \times 10^{-6}\}/234)$
or number = $(2.65 \times 10^{-9})/(234 \times 1.66 \times 10^{-27})$ C1
$= 6.82 \times 10^{15}$ A1 [2]

(ii) $A = \lambda N$ C1
$604 = \lambda \times 6.82 \times 10^{15}$
$\lambda = 8.86 \times 10^{-14}\ s^{-1}$ A1 [2]

(iii) $T_{\frac{1}{2}} = \ln 2/\lambda$
$= 7.82 \times 10^{12}$ s C1
$= 2.48 \times 10^{5}$ years A1 [2]

(b) half-life is (very) long (compared with time of counting) B1 [1]

(c) there would be appreciable decay of source during the taking of measurements B1 [1]

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