UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

Pre-U Certificate

MARK SCHEME for the May/June 2011 question paper

for the guidance of teachers

9792 PHYSICS

9792/02 Paper 2 (Part A Written), maximum raw mark 100

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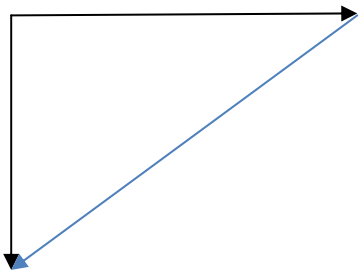
1 **(a)** (momentum =) mass × velocity **or** mv if defined (1) [1]

(b) force is proportional (equal) to the rate of change of momentum (1)
OR force is proportional (equal) to the mass × the acceleration (**not** just formula)
(impulse =) force × time (undefined symbols fine here)
(= mass × acceleration × t) = mass × v (1) [2]

(c) **(i)**



new velocity added **on left** (1)
change in velocity (i.e. **correct** diagonal) (1) [2]

(ii) $v^2 = 16^2 + 12^2$ (1)
$v = 20$ (m s^{-1}) (1)
in direction S 53° W (or as shown on diagram) (1) [3]

(iii) change in momentum = 1460 (1)
Ns **or** kg m s^{-1} (1) [2]

[Total: 10]

2 **(a)** **(i)** E (1)

(ii) B (1)

(iii) A (1) [3]

(b) ductile (**or** tough) (1) [1]

(c) The area **under**/**beneath** the graph (1) [1]

(d) A straight line to the x-axis (1)
parallel to OA (1) [2]

(e) (Y =) stress / strain **or** *Fl*/*Ae* (1)
= (2.4 /3.9 × 10^{-7}) × (*F*/*e*) (1)
evidence of using graph to find *F* and *e*
e.g. = 89/0.0046 (between O and A but **condone** 10^n factor) (1)
(Y =) 1.17 × 10^{11} (Pa) (1) [4]

[Total: 11]

3 **(a)** (resistance) = potential difference **or** voltage / current (1) [1]

(b) (12 V / 4 Ω =) 3.0 (A) (1) [1]

(c) **(i)** 2 (V) (1) [1]

(ii) 2 / 1.6 **or** candidate's (i) / 1.6 (1)
= 1.25 (A) (1) [2]

(iii) (3.0 A – 1.25 A =) 1.75 (A) (1) [1]

(d) **(i)** For 9.6 Ω and p.d. of 12 V I_n = 1.25 A (**ignore** subscript) (1)
$I_1 = I_2$ **or** is current from generator (no current to/from battery (1) [2]

(ii) some of the 1.25 A from the generator will flow in the opposite direction to I_3 and will charge up the battery (1) [1]

[Total: 9]

4 **(a)** diagram showing **only** reflection **and** $i = r$ (by eye) (1)
light in direction dense to rare (1)
light striking surface at an angle greater than the critical angle (1) [3]

(b) sin 90 / sin $c = n$ (1)
$1/\sin c = n$ (1) [2]

(c) **(i)** refractive index **or** speed in medium is dependent on wavelength /frequency/colour (1) [1]

(ii) **1.** speed = 3.0×10^8 /1.536 (1)
= 1.953×10^8 m s^{-1} (**at least** 3 sig.fig.) (1) [2]
2. sin 90 / sin c = n = 1.536 / 1.517 (1)
sin c = 1.517/ 1.536 giving c = 81° (1) [2]

(iii) diagram **or** 4/sin 81° **or** 4 × candidate's n (1)
4050 – 4000 (1)
(x = 0.050 km) (=) 50 (m)
(other possible values from earlier roundings) (1) [3]

[Total: 13]

5. **(a)** **(i)** (f =)$3.0 \times 10^8 / 589 \times 10^{-9}$ (**ignore** 10^n) (1)
$5.09\ (5.1) \times 10^{14}$ (Hz) (1) [2]

(ii) 32 → 42 waves in t (1)
$T = 1.96 \times 10^{-15}$ s so t ≈ 7×10^{-14} s **according to candidate's value** (1) [2]

(iii) from two different sources/not a **constant** phase difference (1) [1]

(iv) any coherence between one set of waves and another cannot last/changes of phase/position of fringes varies so any pattern only lasts for a very short time (2) [2]

(b) signal (wave) (1)
carrier (wave) (1)
amplitude modulated (wave) (1) [3]

[Total: 10]

6. **(a)** diagram showing alpha source, gold foil, detector (2)
(1 mark off for any omission)
four of these points:
fire α-particles at foil; vacuum; move detector; record counts;
backscattering → +ve/same charge as α;
few deflected → nucleus small**/**most pass through so empty space (4) [6]

(b) **spontaneous:** not affected by anything (associated with the atom) (1)
such as pressure/temperature/chemical combination (1) [2]
or does not require an external mechanism to cause it (2) [2]
random: impossible to predict when/which nucleus will decay
or direction of emission (1) [1]

(c) at the start the rate of decay is fixed **or** dN/dt is –ve **or** λ const. (1)
but subsequently the number of nuclei falls/halves (1)
number decaying each hour falls **or** dN/dt falls **or** dN/dt N (1) [3]

(d) **(i)** 1 in 1000 decay: 2.4×10^{15} present (1)
2.4×10^{12} decay in an hour at the start (1) [2]

(ii) 10 half lives means $2.4 \times 10^{15} / 2^{10}$ (1)
$= 2.4 \times 10^{15} / 1024 = 2.34 \times 10^{12}$ (1) [2]

[Total: 16]

7. **(a)** looks like diffraction/interference/superposition
and destructive/constructive pattern (1)
this implies that electrons can be considered as a wave (function) (1)
so they have dual properties/wave-particle duality (1) [3]
or may sometimes be considered as a particle and sometimes as a wave motion

(b) ($\lambda = h/p =$) h/mv seen or used (1)
$= 6.63 \times 10^{-34} / (9.11 \times 10^{-31} \times 2.8 \times 10^{7})$ (1)
$= 2.60 \times 10^{-11}$ m (1) [3]

[Total: 6]

Section B

8 **(a)** **(i)** **1.** 800 (A) (1)
2. 350 000 **or** 3.5×10^{5} (V) (1)

(ii) ($P =$) VI seen **or** implied (in **1.** or **2.**) (1)
2.8×10^{8} (W) **and** 0 (1)

(iii) up and down graph – e.g. sawtooth, triangular wave – **and** number on axis (1)
decent $\sin^2$ graph with correct curvature at bottom (1)
time period of bumps = 0.010 s (1)

(iv) horizontal line (1)
horizontal line at 2.8×10^{8} W / candidate's value (1)

(v) reference to area under the graph (1)
area under the graph is greater (1) [11]

(b) **(i)** 0.0107 m **or** 1.07 cm **or** 10.7 mm (1)

(ii) $\pi(r_1^2 - r_2^2)$ **or** $\pi(1.50^2 - 0.43^2)$ **or** $\pi(0.0150^2 - 0.0043^2)$ (1)
6.49/6.50 cm^2 **or** $6.49/6.50 \times 10^{-4}$ m^2 (1)

(iii) $R = \rho l/A$ **or** $1.72 \times 10^{n} \times 5.8 \times 10^{n} / 6.49 \times 10^{n}$ (1)
$1.72 \times 10^{-8} \times 580\,000 / 6.49 \times 10^{-4}$ **or** 15.3/15.4 Ω (1)

(iv) ($P =$) I^2R **or** $800^2 \times 15.3/15.4$ (1)
9.79 – 9.86 MW (1) [7]

(c) financial consequences:

high voltage transmission is cheapest/most efficient (1)
d.c. voltage transformation expensive (1)
transformation costs not cancelled by reduced transmission costs (1)
d.c. transformation is less efficient (1)

practicality:

d.c. transformation complicated (1)
intermediate tapping off difficult (1)
spare parts less readily available/more expensive (1)
circuit breakers less straightforward/expensive/straightforward (1)
d.c. supply dangerous (1)
less reliable (reduced availability) (1)
domestic transformers (in chargers etc.) use a.c. (1)
good communications (for multi-terminal systems) (1)

reduced advantages:

short distances (1)
skin effect/resistive losses unimportant over short distances (1)
more cables not a problem (1)
not in sea (1)
different applications require different voltages **or** specific example (1)
second specific example such as: electronics require ~10 V (1)
small scale rectification to d.c. easy (1)
thicker cables not a problem (1)
capacitance/reactive/power loss small in air (1)
dielectric losses small in air (1)

other appropriate suggestions each (1)

maximum for question = 7 [7]

[Total: 25]