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

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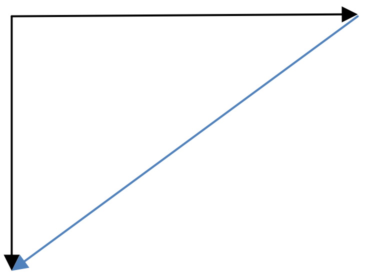
**1** **(a)** (momentum =) mass × velocity **or** mv if defined (1) [1]

**(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)
= $(2.4 / 3.9 \times 10^{-7}) \times (F/e)$ (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 =) $1.17 \times 10^{11}$ (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 = $3.0 \times 10^8$ /1.536 | (1) | |
| | = $1.953 \times 10^8$ 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 $t \approx 7 \times 10^{-14}$ 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 $\alpha$-particles at foil; vacuum; move detector; record counts;
backscattering → +ve/same charge as $\alpha$;
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** $\lambda$ 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: $2.4 \times 10^{15}$ present (1)
$2.4 \times 10^{12}$ 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<br>**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<br>**or** may sometimes be considered as a particle and sometimes as a wave motion | (1) | [3] |
| | **(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** $3.5 \times 10^{5}$ (V) | (1) | |
| | | **(ii)** | ($P =$ ) $VI$ seen **or** implied (in **1.** or **2.**) | (1) | |
| | | | $2.8 \times 10^{8}$ (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 $2.8 \times 10^{8}$ 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 $\Omega$ | (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]**