ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme June 2003

GCE

Physics A

Unit PHA8/W

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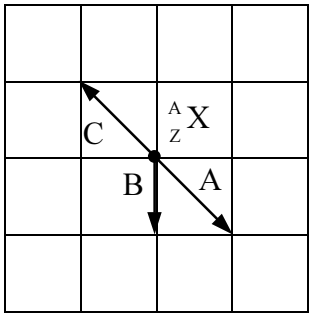
Units 5 - 9 : Section A

1

(a)(i)



correct arrows: A ✓
B ✓
C ✓

(a)(ii) $e^{-1} + {}^{A}_{Z}X \rightarrow {}^{A}_{Z-1}Y + \nu_e$ ✓ (*4*)

(b)(i) $((4.18 - 1.33) \times 10^{-13}) = 2.85 \times 10^{-13}$ (J) ✓

(b)(ii) 1.33×10^{-13} (J)
0.30×10^{-13} (J) for 3 correct values ✓
1.63×10^{-13} (J)

(b)(iii) (use of $\Delta E = hf$ gives) $f\left(= \frac{1.63 \times 10^{-13}}{6.63 \times 10^{-34}}\right) = 2.46 \times 10^{20}$ Hz ✓

(allow C.E. from (b)(ii) if largest value taken) (*3*)

(c)(i) (✓ for each precaution <u>with</u> reason to $_{max}2$)

handle with (long) (30 cm) tweezers
because the radiation intensity decreases with distance

store in a lead box (immediately) when not in use
to avoid unnecessary exposure to radiation

[or any sensible precaution with reason]

(b)(ii) γ rays are more penetrating and are therefore more hazardous
(to the internal organs of the body)

β^- particles are more hazardous because they are more ionising ✓
(✓ for any argued case for either radiation) <u>(*3*)</u>

<u>(*10*)</u>

Unit 8 : Section B

2

(a)(i) (vertically) upwards ✓

(a)(ii) $mg = qE, \therefore \frac{q}{m} = \frac{g}{E}$ ✓

$= \frac{9.8}{4.9 \times 10^5}$ ✓ $(= 2.0 \times 10^{-5}\ \text{C kg}^{-1})$ (*3*)

(b) initial downwards acceleration due to weight (or gravity) ✓
viscous force/drag/friction (or resistance) due to air increases with increase in speed ✓
speed increases until drag become equal to (and opposite to) weight ✓
(no resultant force) hence no acceleration ✓ max(*3*)
(*6*)

3

(a)(i) two beams (or rays) reach the observer ✓
interference takes place between the two beams ✓
bright fringe formed if/where (optical) path difference = whole number of wavelengths
(or two beams in phase)
[or dark fringe formed if/where (optical) path difference = whole number + 0.5 wavelengths]
(or two beams out of phase by 180 °C/ π/2 /½ cycle) ✓

(a)(ii) rotation by 90° realigns beams relative to direction of Earth's motion ✓
no shift means no change in optical path difference between the two beams ✓
(∴) time taken by light to travel to each mirror unchanged by rotation ✓
distance to mirrors is unchanged by rotation ✓
(∴) no shift means that the speed of light is unaffected
[or disproves other theory] ✓ max(*5*)

(b) the speed of light does not depend on the motion of the light source ✓
or that of the observer ✓ (*2*)
(*7*)

4

(a)(i) suitable description and outline detail ✓
for an appropriate named particle ✓
(e.g. electron diffraction of a beam of electrons by a thin metal sample
or tunnelling in the STM across a gap by electrons)

(a)(ii) suitable description and outline detail ✓
for an appropriate named particle ✓
(e.g. a beam of electrons deflected by an electric or magnetic field
or collision/impact on a screen of electrons/ions) $_{\max}(3)$

(b)(i) $E_k = 5.0 \times 10^6 \times 1.6 \times 10^{-19}$ (J) ✓

(use of $E_k = \frac{1}{2}mv^2$ gives) $v \left(= \left(\frac{2E_k}{m}\right)^{1/2}\right) = \frac{(2 \times 5.0 \times 1.6 \times 10^{-13})^{1/2}}{1.67 \times 10^{-27}}$ ✓

$(= 3.1 \times 10^7 \text{ m s}^{-1})$

(b)(ii) (use of $\lambda = \frac{h}{mv}$ gives) $\lambda = \frac{6.63 \times 10^{-34}}{1.67 \times 10^{-27} \times 3.1 \times 10^7}$ ✓

$= 1.3 \times 10^{-14}$ m

[or alternatively

$\lambda \left(= \frac{h}{\sqrt{2meV}}\right) = \frac{6.63 \times 10^{-34}}{\sqrt{2 \times 1.67 \times 10^{-27} \times 1.6 \times 10^{-19} \times 5 \times 10^6}}$

$= 1.3 \times 10^{-14}$ m] ✓ (4)

(7)

5

(a) magnetic force perpendicular to (direction of) motion (or velocity) ✓
force does not change speed (or force does no work) ✓
force causes direction of motion to change ✓
force (or acceleration) is centripetal/ acts towards centre of curvature ✓
velocity is tangential ✓ $_{\max}(3)$

(b)(i) magnetic force = Bev ✓

centripetal acceleration = $\frac{v^2}{r}$, $\therefore Bev = \frac{mv^2}{r}$ ✓ (gives $v = \frac{Ber}{m}$)

(b)(ii) $\frac{mv^2}{r} = Bev$ gives $\frac{e}{m} = \frac{v}{Br}$ ✓

$$= \frac{3.2 \times 10^{7}}{7.3 \times 10^{-3} \times 25 \times 10^{-3}} \quad \checkmark$$

$$= 1.75 \times 10^{11}\ \text{C kg}^{-1} \quad \checkmark$$

(5)

(8)

Quality of Written Communication (Q1(c)(i) and Q5(a)) ✓✓

(2)

(2)