ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme June 2003

GCE

Physics A

Unit PHA9/W

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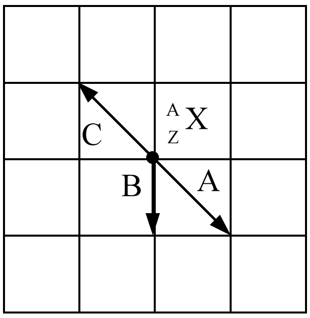
Units 5 - 9 : Section A

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) $f\left(= \dfrac{1.63 \times 10^{-13}}{6.63 \times 10^{-34}}\right) = 2.46 \times 10^{20}$ 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) (*3*)

(*10*)

Unit 9 : PHA9/W : Section B

2

(a)(i) suitable scales ✓
correctly plotted points ✓
straight line ✓

(a)(ii) (use of $X_C = \frac{1}{2\pi fC}$ gives) $V = \frac{I}{2\pi fC}$ ✓

$C = \frac{I}{f} \times \frac{1}{2\pi V} = \text{gradient} \times \frac{1}{2\pi V}$ ✓

[gradient $\left(= \frac{I}{f}\right) = 20\pi C$]

$C = \frac{18.2 \times 10^{-3}}{1600} \times \frac{1}{2\pi 10} = 0.18\ \mu\text{F}$ ✓ $_{\text{max}}$(*5*)

(b)(i) at high f, reactance, X_C, has a low value (compared to R) ✓
most of voltage dropped across R making V_{out} small ✓

(b)(ii) when $X_C = R$, $f = \frac{1}{2\pi RC}$ ✓

$f = \frac{1}{2\pi 2 \times 10^3 \times 0.18 \times 10^{-6}} = 442\ \text{Hz}$ ✓
(allow C.E. for value of C from (a)(ii))

(b)(iii) for $f << 440$ Hz, $V_{out} \approx V_{in}$ ✓

$\frac{V_{out}}{V_{in}} \to 1$ ✓

$\left[\text{or } \frac{V_{out}}{V_{in}} = \frac{1}{\sqrt{1 + f^2 / f_0^2}}\right]$ $_{\text{max}}$(*5*)

(*10*)

3

(a)(i) potential at P is very low ≈ 0.2 V (or 0 V) ✓

(a)(ii) TR is off ✓
∴ no current through relays (alarm off) ✓ (*3*)

(b) potential at P goes high (12 V) ✓ [or > 0.7 V]
TR conducts ✓
current through relays and alarm switches on ✓ $_{\text{max}}$(*2*)

(c) TR off
[or transistor by-passed] ✓
still a current through relay ✓ (2)

(d) protects the transistor ✓ (1)
(8)

4

(a) $V_{-} = 12 \times \frac{30}{46}$ ✓
$= 7.8$ V ✓ (2)

(b)(i) between V_{out} and 0 V ✓
(or from +12 V to V_{out})
correct direction and resistor ✓

(b)(ii) (since V_{in} < switching voltage) $V_{out} = -12$ V (12 V across LED) ✓
(or alternative)

(b)(iii) voltage across R = (12 – 2) = 10 (V) ✓
$10 = 25 \times 10^{-3} \times R$ gives $R = 400\ \Omega$ ✓ (5)
(or alternatively $22 = 25 \times 10^{-3}$ to give $R = 880\ \Omega$)

(c) to switch LED voltage at B = 7.8 (V) ✓
R_{LDR} given by $7.8 = \frac{12 \times 47}{(47 + R)}$ or ✓
$R_{LDR} = 25.(3)$ kΩ ✓
light level = 30 lux ✓ max(3)
(10)

QWC marks given for Q1(c)(i) and Q2(b) (2)
(2)