ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme June 2003

GCE

Physics A

Unit PHA5/W

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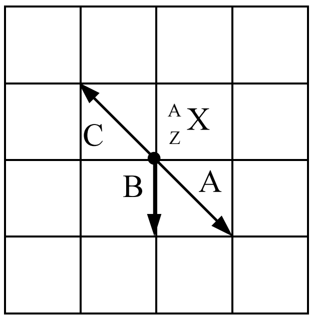
Units 5 - 9 : Section A

1

(a)(i)



correct arrows: A ✓
B ✓
C ✓

(a)(ii) $e^{-1} + {}^{A}_{Z}X \rightarrow {}^{A}_{Z\text{-}1}Y + \nu_e$ ✓ (*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 5 : Section B

2

(a) ray diagram to show:

rays reflected at concave mirror ✓
rays reflected at convex mirror ✓
rays crossing in front of eyepiece ✓ (*3*)

(b) different focal points for rays at different distances from axis ✓
shortest focal length for paraxial rays ✓ (*2*)

(c) light of different wavelengths refracted to different foci ✓
diagram showing refraction with blue focal length closest to lens ✓ max(*2*)
(*7*)

3

(a)(i) $d = \dfrac{50 \times 10^6}{3.26} = 15.3 \times 10^6$ (pc) ✓

(a)(ii) (use of $v = Hd$ gives) $v = 65 \times 10^{-6}$ (km s^{-1} pc^{-1}) $\times 15.3 \times 10^6$ ✓
$\approx$ (1000 km s^{-1})

(a)(iii) (use of $\dfrac{\Delta\lambda}{\lambda} = -\dfrac{v}{c}$ gives) $\Delta\lambda = \dfrac{1000 \times 10^3}{3 \times 10^8} \times 656.3$ (nm) = 2.19 (nm) ✓
(allow C.E. for value of v from (ii)
$\lambda_{galaxy} = 656.3 + 2.19 = 658.5$ nm ✓ (*4*)

(b) for the furthest point of the Universe, $d = \dfrac{c}{H}$ ✓

age of Universe $= \dfrac{d}{c} = \dfrac{1}{H}$ ✓

[or use of $v = Hd$ and $t = \dfrac{d}{v}$ ✓

if all started from same point

t = age of Universe $= \dfrac{1}{H}$ ✓]

assumption: that H remains constant ✓ (*3*)
(*7*)

4

(a) Hertzsprung -Russell diagram to show:

absolute magnitude scale from +15 to −10 ✓
temperature scale from 50 000 to 2500 (K) ✓
main sequence drawn correctly ✓
giants and dwarfs shown in correct areas ✓ (*4*)

(b) Alnitak : helium (absorption)
Sirius : hydrogen Balmer (absorption) lines 4 correct ✓✓
Sun : metals (absorption) 2 correct ✓
Antares : molecular bands (*2*)

(c) reference to $P = \sigma AT^4$ ✓
class M (Antares) cooler than class O (Alnitak) ✓
but same brightness, therefor cooler star bigger ✓
so Antares has larger surface area ✓ max(*3*)

(*9*)

5

(a)(i) supernova: star whose luminosity increase enormously due to it exploding ✓

(a)(ii) neutron star: star with the density of nuclear matter ✓

(a)(iii) black hole: an object whose escape velocity is greater than speed of light ✓ (*3*)

(b) $\left(\text{use of } R = \dfrac{2GM}{c^2} \text{ gives}\right) \quad R = \dfrac{2 \times 6.67 \times 10^{-11} \times 10 \times 2 \times 10^{30}}{\left(3 \times 10^{8}\right)^2}$ ✓

$= 2.96 \times 10^4$ m ✓ (*2*)

(*5*)

Quality of Written Communication (Q1(c)(i) and Q4(c)) ✓✓ (*2*)

(*2*)