Name of the Student:_____
Max. Marks : 21 Marks **Time : 21 Minutes**

Mark Schemes

Q1

Question Number	Acceptable Answer		Additional Guidance	Mark
	• μ read from graph	(1)	Accept μ in the range 140 (m^{-1}) - 160 (m^{-1})	3
	• Use of $I = I_0 e^{-\mu x}$	(1)		
	• $I = 1.5$ W m^{-2}	(1)	Accept answers that round to 1.4 W m^{-2} or 1.5 W m^{-2} dependent upon value of μ for MP3 Example of calculation: I=1.8 W m^{-2} $\times e^{-150\ m^{-1} \times 1.4 \times 10^{-3}\ m}$ = 1.46 W m^{-2}	

Q2

Question Number	Answer		Mark
(a)	Photon – quantum/packet of something relevant e.g. light, radiation, any other named e-m radiation, energy	(1)	2
	(quantum/packet) of electromagnetic energy/radiation/waves (dependent mark)	(1)	
(b)	Use of $(20.66 - 18.70) \times 1.6 \times 10^{-19}$	(1)	3
	Use of $E = hf$ (with energy in eV or J)	(1)	
	$f = 4.7 \times 10^{14}$ Hz Example of calculation $f = (20.66 - 18.70) \times 1.6 \times 10^{-19} / 6.63 \times 10^{-34}$ $f = 4.73 \times 10^{14}$ Hz	(1)	

(c)	From kinetic energy of atoms	(1)	1
(d)	Diffraction Light spreads (sideways) as it passes through the slit Narrower slit causes more diffraction/spreading **Or** diffraction increasing as gap width gets closer to wavelength	(1) (1) (1)	3
	Total for question		**9**

Q3

Question Number	Acceptable answers		Additional guidance	Mark
	• Use of $E = hf$ and $c = f\lambda$ • Convert J to eV • 2.1 eV • Arrow drawn on diagram from −3.04 eV to −5.14 eV	(1) (1) (1) (1)	Example of calculation $E = 6.63 \times 10^{-34}$ Js $\times$ 3.00×10^{8} m s^{-1} / 5.89×10^{-7} m $= 3.38 \times 10^{-19}$ J 3.38×10^{-19} J / 1.60×10^{-19} C = 2.11 eV	4

Q4

Question Number	Acceptable answers		Additional guidance	Mark
	• attempt to determine mass difference between radium and radon-plus-alpha • conversion to kg • Use of $\Delta E = c^2\Delta m$ • Use of 1.6×10^{-19} factor • Answer = 4.87 (MeV)	(1) (1) (1) (1) (1)	Δm = 225.97713u – (221.97040u + 4.00151 u) $= 5.22 \times 10^{-3}$ u = $5.22 \times 10^{-3} \times 1.66 \times 10^{-27}$ kg = 8.67×10^{-30} kg $\Delta E = c^2\Delta m = (3 \times 10^{8}$ m s$^{-1})^2 \times 8.67 \times 10^{-30}$ kg = 7.80×10^{-13} J ΔE in MeV = 7.80×10^{-13} J $\div$ 1.6×10^{-19} C = 4.87 MeV	5