KEY

First Name:_____ Last Name:_____

L13 – Formative Quiz – Photons

Use the following diagram to answer Q1:

Types of Photons			
1 – Gamma	2 – Infrared	3 – Microwave	4 – X-Ray

Q1: The photons listed above, when ordered from ***least energy*** to ***highest energy***, are ____, ____, ____, and ____. *(1 mark)*

*(Record you **four-digit** answer in the numerical response boxes below.)*

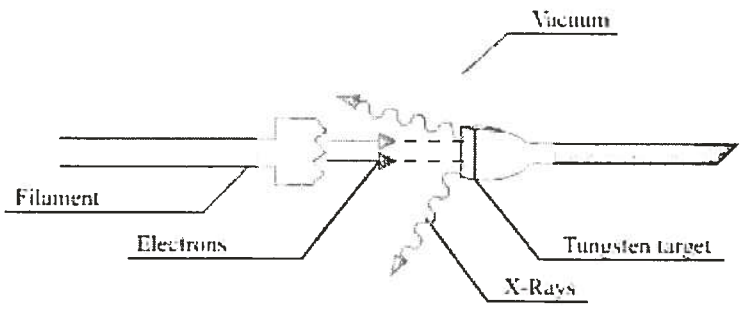
RMIVUXG

Low E, Low f — High E, High f — E = hf

3	2	4	1

Use the following diagram to answer Q2 and Q3:

X-Ray Production



In the above diagram, X-Rays of frequency 5.2×10^{16} Hz are produced by high-energy electrons

Q2: The high-energy electrons have a velocity ***a.bc*** x 10^{d} m/s. The values of ***a, b, c,*** and ***d*** are ____, ____, ____, and ____. *(1 mark)*

*(Record you **four-digit** answer in the numerical response boxes below.)*

$E_{electron} \rightarrow E_{photon}$

$\frac{1}{2}mv^2 \rightarrow hf$

$\frac{1}{2}(9.11\times10^{-31}\,kg)v^2 = (6.63\times10^{-34}\,J\cdot s)(5.2\times10^{16}\,Hz)$

$v^2 = 7.5688\ldots\times10^{13}$

$v = 8.699899\ldots\times10^{6}\ m/s$

$v \approx 8.70\times10^{6}$

8	7	0	6

KEY

Q3: Which two ***Physics Principals*** are required to solve Q2? *(1 mark)*

*(Record you **two-digit** answer in the numerical response boxes below.)*

5	9		

or 9 5

5- Conservation of Energy ($E_{electron} \rightarrow E_{photon}$)
9- Wave-particle duality ($E = hf$)

Q4: An electron is accelerated from rest using an accelerating voltage of ***a.bc*** x 10^{d} Volts and collides with a tungsten target to generate an X-Ray of energy 4.8 x 10^{-17} J. The values of ***a, b, c,*** and ***d*** are ____, ____, ____, and ____. *(1 mark)*

*(Record you **four-digit** answer in the numerical response boxes below.)*

3	0	0	2

$E_p \rightarrow E_{K_{electron}} \rightarrow E_{photon}$

$$\Delta V = \frac{\Delta E_p}{q}$$

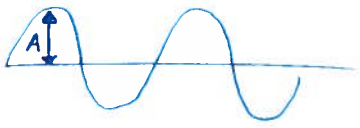
$$\Delta V = \frac{4.8 \times 10^{-17}\ J}{1.60 \times 10^{-19}\ C}$$

$$\Delta V = 300\ V$$
$$= 3.00 \times 10^{2}\ V$$

Q5: SHORT ANSWER – Explain the biggest change between the classical wave theory of light and the quantum theory of light. *(1 marks)*

Classical

Energy determined by Amplitude



Quantum

Energy determined by frequency.
$E = hf$

MARKING:

Beginning	0-2
Progressing	3
Competent	4
Exemplary	5