Name of the Student:_____
Max. Marks : 17 Marks **Time : 17 Minutes**

Q1.

An isolated metal plate is given a negative charge. Electromagnetic radiation is incident on the plate. The plate loses its charge due to the photoelectric effect.

(a) Discuss how the rate of loss of charge from the plate depends on the frequency and intensity of the incident radiation.

In your answer you should explain why:

- the plate loses its charge
- the photoelectric effect occurs only for frequencies greater than a particular value
- the rate of loss of charge increases with intensity for radiation above that particular value of frequency.

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(6)

(b) Charged particles are emitted from the metal plate with a maximum kinetic energy of $1.1\ \text{eV}$ when radiation of frequency $1.2 \times 10^{15}\ \text{Hz}$ is incident on the plate.

Calculate, in eV, the work function of the metal.

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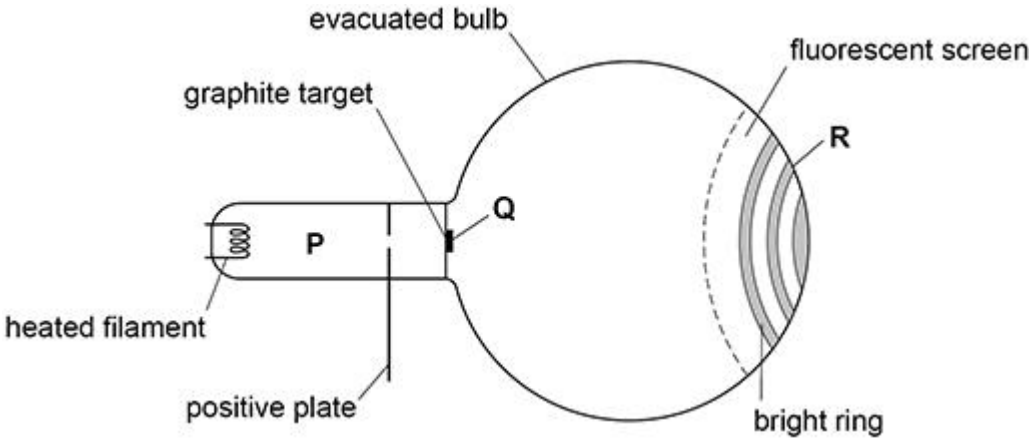
work function = _____ eV

(3)

(Total 9 marks)

Q2.

The figure below shows apparatus used to demonstrate the wave–particle duality of electrons.



The heated filament emits slow-moving electrons.

In region **P**, the electrons are accelerated to a high speed.
At **Q**, the fast-moving electrons are incident on the graphite target.
R is a point on one of the bright rings that are formed where the electrons strike the fluorescent screen.

(a) The electrons demonstrate wave-like and particle-like behaviour as they travel from the filament to the screen.

State and explain at which of **P**, **Q** or **R** the electrons are demonstrating wave-like behaviour.

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(2)

(b) The apparatus is adjusted so that the electrons are incident on the graphite target with a greater speed.

Explain why the bright rings formed on the screen now have a smaller diameter.

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(3)

(Total 5 marks)

Q3.

(a) Identify the number of neutrons in a nucleus of polonium-210 $\left({}^{210}_{84}\mathrm{Po}\right)$.

Tick (✓) **one** box.

84 ☐

126 ☐

210 ☐

294 ☐

(1)

(b) A polonium-210 nucleus is formed when a stationary nucleus of bismuth-210 decays. A beta-minus (β^-) particle is emitted in this decay.

Outline, with reference to β^- decay, why bismuth-210 and polonium-210 have different proton numbers.

_____

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(2)

(Total 3 marks)

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