

Chapter 7

Multiple choice and quick questions

- Which one of the following phenomena **A** to **E** provides evidence that electromagnetic radiation can behave as particles?
 - X-rays are diffracted by a graphite film
 - Light is diffracted as it passes through a narrow slit
 - Light can eject electrons from a metal surface
 - The speed of light reduces when it is refracted by glass
 - Light and radio waves can be polarised

- In which of the following calculations listed is it necessary to use the Planck constant h ?
 - finding the wavelength of a free electron from its momentum
 - finding the momentum of an electron from its kinetic energy
 - finding the maximum energy of photoelectrons from the wavelength of incident light

A 1 only **B** 2 only **C** 1 and 3 only **D** 2 and 3 only **E** 1, 2 and 3

- Which of the following statements about the photoelectric effect is/are correct?
 - When electron emission occurs, the rate of emission is proportional to the intensity of the radiation used.
 - Electrons are only emitted if the incident electromagnetic radiation has a wavelength greater than some threshold value.
 - Electrons are only emitted if the incident electromagnetic radiation has an intensity greater than some threshold value.

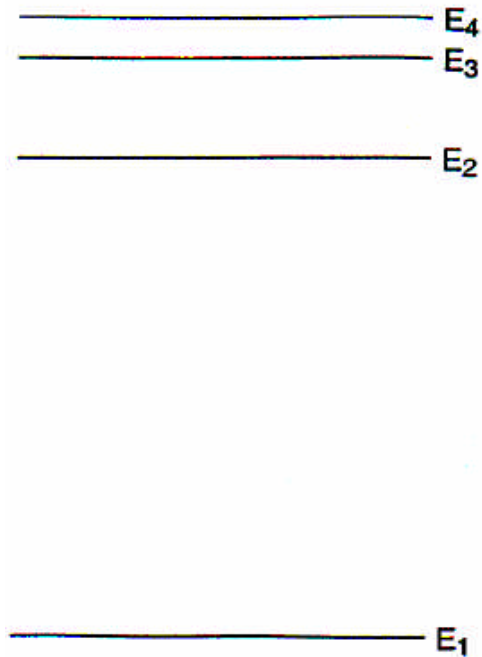
A 1 only **B** 2 only **C** 1 and 3 only **D** 2 and 3 only **E** 1, 2 and 3

- An electron gun accelerates electrons through a voltage V .

Assuming that the mass of the electrons remains constant, which one of the expressions **A** to **E** gives the relationship between wavelength λ associated with the electrons and the accelerating voltage?

A $\lambda \propto V^2$ **B** $\lambda \propto V$ **C** $\lambda \propto 1/V$ **D** $\lambda \propto 1/V^2$ **E** $\lambda \propto 1/\sqrt{V}$

5. The diagram below shows a series of electron energy levels for a particular atom. The energy intervals are drawn to scale vertically.



When an electron makes the transition E_3 to E_2 , a green line is produced in the visible spectrum. Which one of the transitions A to D below would produce a visible blue line?

- A E_2 to E_1 B E_3 to E_1 C E_4 to E_2 D E_4 to E_3

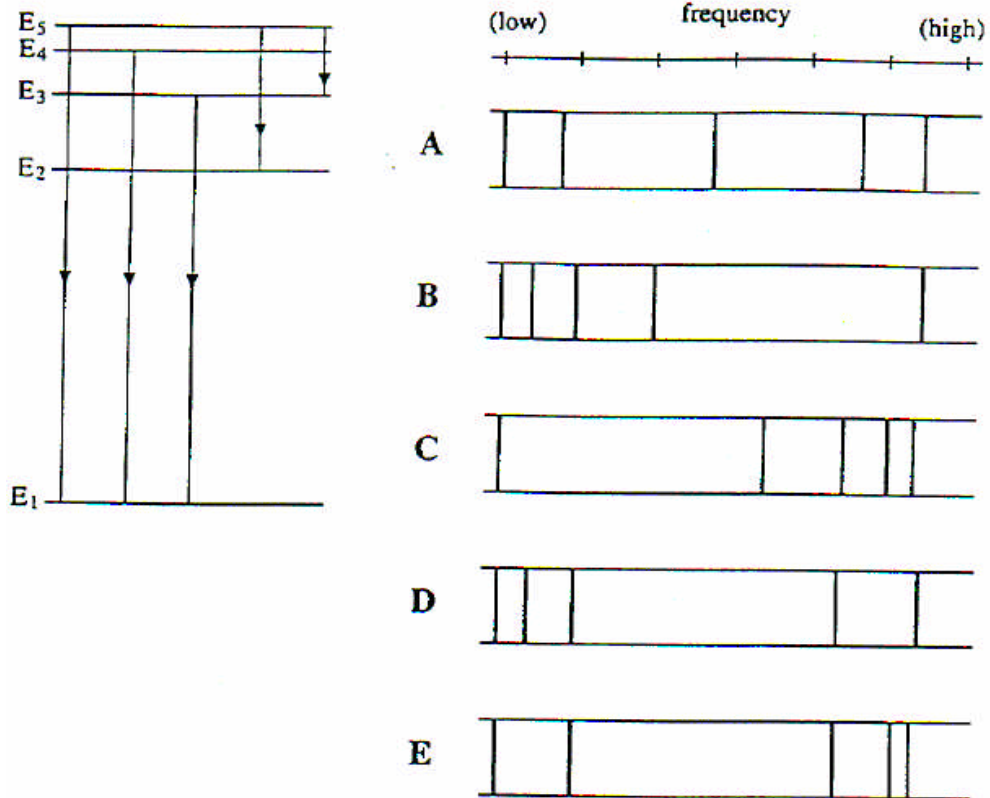
6. When electrons are fired at a thin piece of graphite in an evacuated tube a pattern of rings is seen on a fluorescent screen at the end of the tube. Which of the following statements is/are true?

1. Increasing the voltage across the electron gun decreases the diameter of the rings.
2. The formation of the rings can be explained by the wave properties of electrons.
3. The momentum of the electrons affects the diameter of the rings.

- A 1 only B 2 only C 1 and 3 only D 2 and 3 only

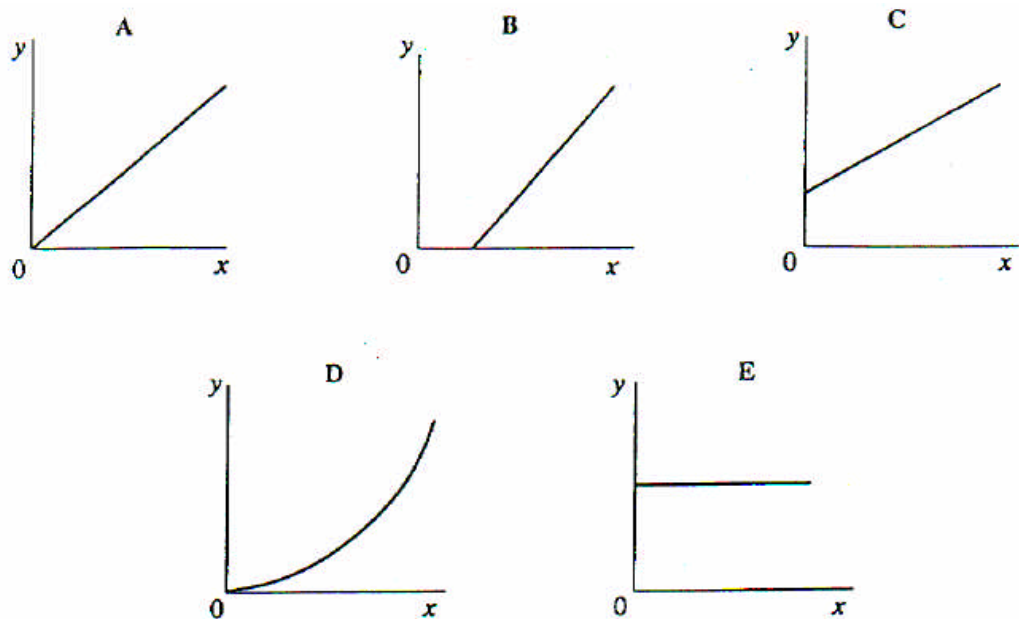
E 1, 2 and 3

7. The diagram below on the left shows five energy levels of an atom, one being much lower than the other four. Five transitions between the levels are indicated, each of which will produce a photon of definite energy and frequency. On the right are shown five spectra **A** to **E**. Which one best corresponds to the transitions between levels which are indicated?



8. Which one of the following physical quantities could be measured in electronvolts (eV)?
- A electronic charge
 - B kinetic energy
 - C electrical potential
 - D potential difference
 - E momentum
9. In which of the calculations listed below is it necessary to use the Planck constant h ?
1. the wavelength of a free electron from its momentum
 2. the momentum of an electron from its kinetic energy
 3. the energy of photoelectrons from the wavelength of incident light
- A 1 only B 2 only C 1 and 3 only D 2 and 3 only
- E 1, 2, 3

10.



Which of the above graphs best illustrates the relationships described below when monochromatic light is shone on a metal surface causing photo emission?

- (a) the variation of the maximum kinetic energy y of electrons emitted, with the frequency x of the incident monochromatic light
- (b) the variation of the maximum kinetic energy y of electrons emitted, with the intensity x of the incident light of a single frequency

11. In the photoelectric effect, light falling on a metal surface causes electrons to be ejected from the surface. Which one of the following statements is true?

- 1. The maximum energy of the ejected electrons is independent of the type of metal.
- 2. The waves associated with the ejected electrons have the same wavelength as the incident light.
- 3. Electrons are only ejected if the wavelength of the incident light is greater than some minimum 'threshold' value.
- 4. The maximum energy of the ejected electrons is independent of the intensity of the incident light.
- 5. The number of electrons ejected per second increases linearly with the frequency of the incident light.