Q1.

Monochromatic radiation from light source **P** is incident on a metal surface and photoelectrons are emitted.

When monochromatic radiation from light source **Q** is used, no photoelectrons are emitted.

Which property of the radiation from **P** must be greater than that from **Q**?

A frequency ⬭

B intensity ⬭

C speed ⬭

D wavelength ⬭

(Total 1 mark)

Q2.

What is the de Broglie wavelength of a positron travelling at 5% of the speed of light?

A 2.7×10^{-16} m ⬭

B 2.7×10^{-14} m ⬭

C 4.9×10^{-13} m ⬭

D 4.9×10^{-11} m ⬭

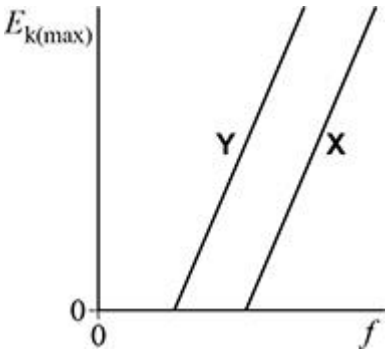
(Total 1 mark)

Q3.

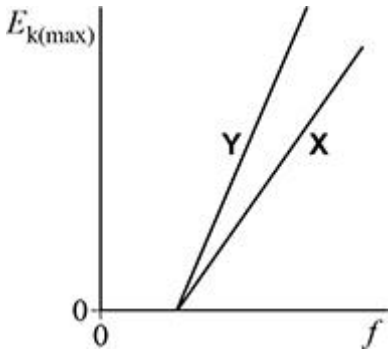
In two separate experiments, electromagnetic radiation of variable frequency f is incident on the surfaces of plates made from metals **X** and **Y**.
The work function of **X** is greater than the work function of **Y**.

Which graph shows how the maximum kinetic energy $E_{k(max)}$ of photoelectrons emitted from the surfaces of the plates varies with f?

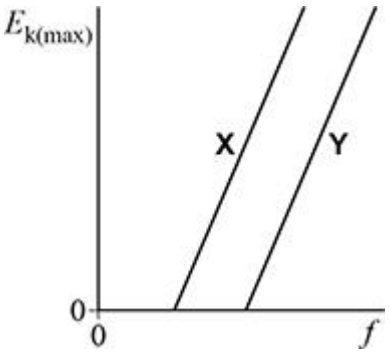
A



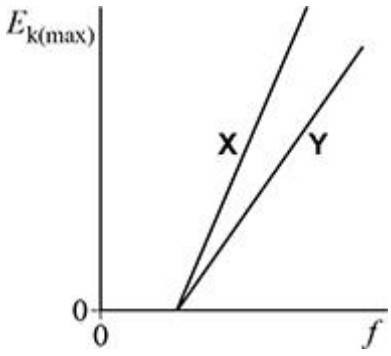
B



C



D



A ⬭

B ⬭

C ⬭

D ⬭

(Total 1 mark)

Q4.

Monochromatic light is incident on a metal surface in a vacuum and photoelectrons are emitted from the surface. The photoelectric current I is the rate of flow of charge from the surface.
The maximum kinetic energy of the photoelectrons is $E_{k(max)}$.
$E_{k(max)}$ and I are measured.

The frequency of the light is then increased. There is no change to the rate at which energy is incident on the surface.

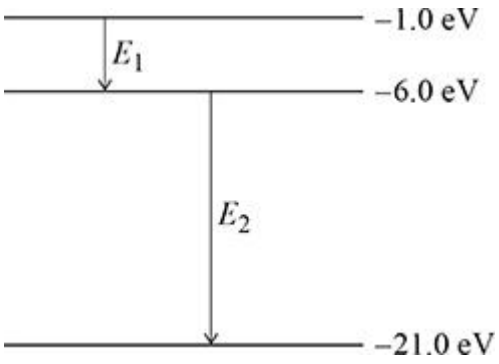
What happens to $E_{k(max)}$ and I when the frequency is increased?

	$E_{k(max)}$	I	
A	increases	decreases	⬭
B	increases	no change	⬭
C	no change	no change	⬭
D	no change	decreases	⬭

(Total 1 mark)

Q5.

Three energy levels for an atom are shown.



Energy change E_1 leads to the emission of a photon of wavelength λ_1.

Energy change E_2 leads to the emission of a photon of wavelength λ_2.

What is $\frac{\lambda_1}{\lambda_2}$?

A $\frac{1}{4}$ ○

B $\frac{1}{3}$ ○

C 3 ○

D 4 ○

(Total 1 mark)

Q6.

An electron and a proton move with the same speed.

What is $\frac{\text{de Broglie wavelength of electron}}{\text{de Broglie wavelength of proton}}$?

A 5.5×10^{-4} ○

B 2.3×10^{-2} ○

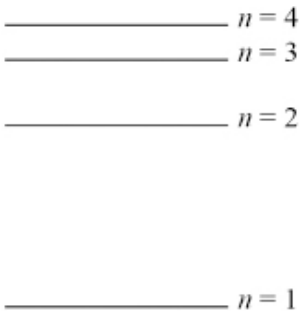
C 42 ○

D 1800 ○

(Total 1 mark)

Q7.

The four lowest energy levels of an atom are shown.



A gas contains atoms in the n = 4 level.
The atoms de-excite to the n = 1 level.

How many photon frequencies are observed?

A 3 ⬭

B 4 ⬭

C 5 ⬭

D 6 ⬭

(Total 1 mark)

Q8.

Monochromatic light of frequency f is incident on a metal surface in a vacuum.
Photoelectrons are emitted from the surface.

The photoelectric current I is measured.
The magnitude of the stopping potential V_s is then measured.
f is increased without changing the rate at which photons arrive at the metal surface.
What are the new measurements of the photoelectric current and the magnitude of the stopping potential?

	Photoelectric current	Magnitude of the stopping potential	
A	I	V_s	⬭
B	I	$> V_s$	⬭
C	$> I$	V_s	⬭
D	$> I$	$> V_s$	⬭

(Total 1 mark)

Q9.

Photoelectrons are released when monochromatic light with a photon energy of 4.2×10^{-19} J is incident on a metal surface.
The work function of the surface is 2.4 eV.

What is the maximum speed of the photoelectrons as they leave the surface?

A 1.3×10^{6} m s^{-1} ○

B 6.3×10^{5} m s^{-1} ○

C 2.8×10^{5} m s^{-1} ○

D 2.0×10^{5} m s^{-1} ○

(Total 1 mark)

Q10.

Electrons with a certain kinetic energy pass through a powdered crystalline sample and are incident on a fluorescent screen.
The diagram shows a sketch of the diffraction pattern produced.

A change is made and this second pattern is produced.

Which change could produce the second pattern?

A decreasing the kinetic energy of the electrons ⬭

B replacing the electrons with protons with the same kinetic energy ⬭

C using a crystalline sample with a wider spacing between its atoms ⬭

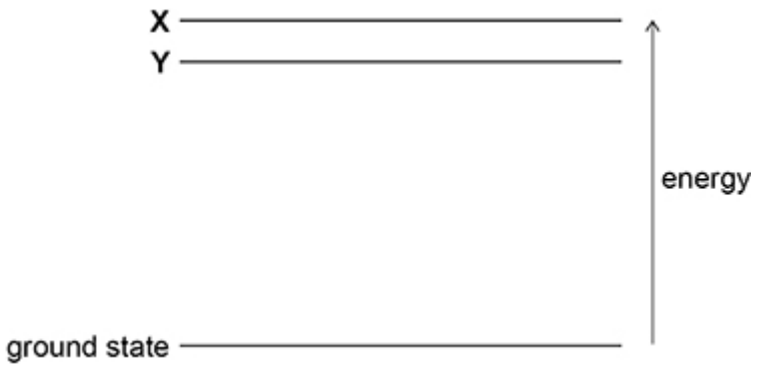
D moving the screen closer to the crystalline sample ⬭

(Total 1 mark)

Q11.

The diagram shows the ground state and two higher-energy states **X** and **Y** of an atom.

A transition from **X** to the ground state produces a photon of wavelength 147 nm.
A transition from **Y** to the ground state produces a photon of wavelength 160 nm.



What is the energy difference between **X** and **Y**?

A 1.5×10^{-17} J ⬭

B 1.4×10^{-18} J ⬭

C 1.2×10^{-18} ⬭

D 1.1×10^{-19} J ⬭

(Total 1 mark)

Q12.

Which provides evidence for discrete atomic energy levels?

A β^+ decay ⬭

B electron diffraction ⬭

C line spectra ⬭

D the photoelectric effect ⬭

(Total 1 mark)

Q13.

In photoelectricity, V_s is the stopping potential.

What quantity is eV_s?

A energy of an incident photon ⬭

B maximum kinetic energy of a photoelectron ⬭

C threshold frequency × the Planck constant ⬭

D work function ⬭

(Total 1 mark)

Q14.

A fluorescent tube contains a gas.

The coating of the tube

A becomes ionised by the gas and emits photons of ultraviolet light. ⬭

B absorbs photons of ultraviolet light from the gas and emits visible light. ⬭

C absorbs photons of ultraviolet light from the gas and emits photoelectrons. ⬭

D absorbs several photons of visible light from the gas and then emits one photon of ultraviolet light. ⬭

(Total 1 mark)

Q15.

Which row gives evidence for the wave nature of electrons and evidence for the particulate nature of light?

	Wave nature of electrons	Particulate nature of light	
A	electron diffraction	photoelectric effect	⬭
B	electron diffraction	single-slit diffraction	⬭
C	photoelectric effect	single-slit diffraction	⬭
D	photoelectric effect	electron diffraction	⬭

(Total 1 mark)

Q16.

Which particle has the smallest de Broglie wavelength?

A an electron moving at 4×10^3 m s^{-1} ⬭

B a proton moving at 4×10^3 m s^{-1} ⬭

C an electron moving at 8×10^5 m s^{-1} ⬭

D a proton moving at 8×10^5 m s^{-1} ⬭

(Total 1 mark)