Unit 2 – Particles & Waves
Section 5 – Wave Particle Duality

2010 **14.** Photons of energy $7{\cdot}0 \times 10^{-19}$ J are incident on a clean metal surface. The work function of the metal is $9{\cdot}0 \times 10^{-19}$ J.

Which of the following is correct?

A No electrons are emitted from the metal.

B Electrons with a maximum kinetic energy of $2{\cdot}0 \times 10^{-19}$ J are emitted from the metal.

C Electrons with a maximum kinetic energy of $7{\cdot}0 \times 10^{-19}$ J are emitted from the metal.

D Electrons with a maximum kinetic energy of $9{\cdot}0 \times 10^{-19}$ J are emitted from the metal.

E Electrons with a maximum kinetic energy of 16×10^{-19} J are emitted from the metal.

2012 **16.** Electromagnetic radiation of frequency $9{\cdot}0 \times 10^{14}$ Hz is incident on a clean metal surface.

The work function of the metal is $5{\cdot}0 \times 10^{-19}$ J.

The maximum kinetic energy of a photoelectron released from the metal surface is

A $1{\cdot}0 \times 10^{-19}$ J

B $4{\cdot}0 \times 10^{-19}$ J

C $5{\cdot}0 \times 10^{-19}$ J

D $6{\cdot}0 \times 10^{-19}$ J

E $9{\cdot}0 \times 10^{-19}$ J.

2013 **17.** Ultraviolet radiation causes the emission of photoelectrons from a zinc plate.

The irradiance of the ultraviolet radiation on the zinc plate is increased.

Which row in the table shows the effect of this change?

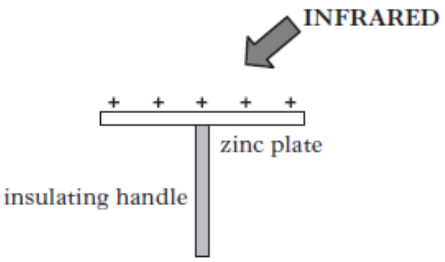
	Maximum kinetic energy of a photoelectron	*Number of photoelectrons emitted per second*
A	increases	no change
B	no change	increases
C	no change	no change
D	increases	increases
E	decreases	increases

2012 **15.** Clean zinc plates are mounted on insulating handles and then charged.

Different types of electromagnetic radiation are now incident on the plates as shown.

Which of the zinc plates is most likely to discharge due to photoelectric emission?

A



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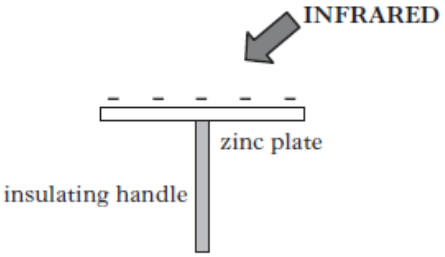

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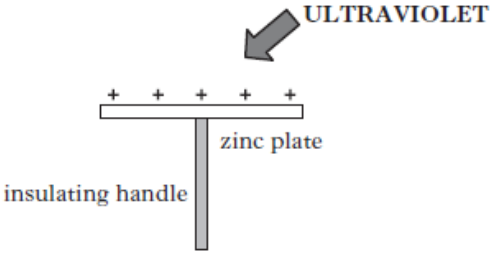

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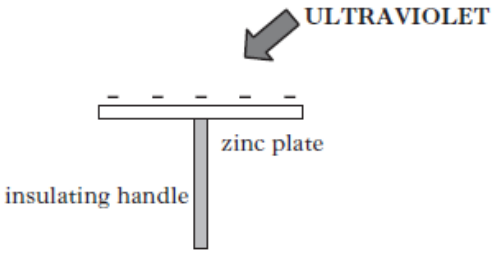
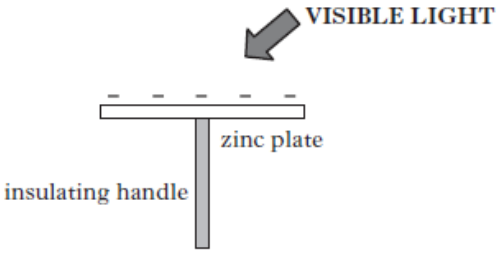


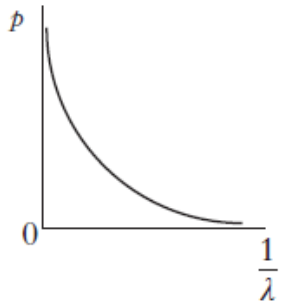
E



2013 Revised **14.** All particles exhibit wave properties.

The momentum p of a particle is inversely proportional to its wavelength λ.

Which of the following graphs shows the relationship between p and λ?

A


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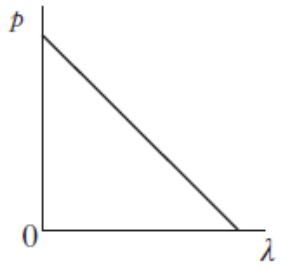

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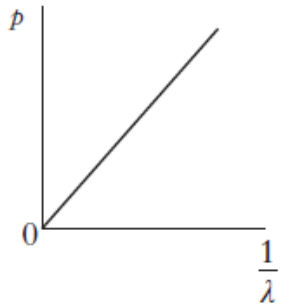
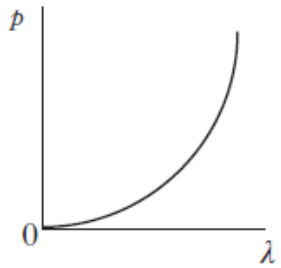
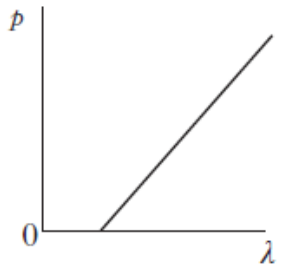


D


E


2015 **14.** A student makes the following statements about waves.

I The energy of a wave depends on its amplitude.

II The period of a wave is the number of complete waves passing any point each second.

III The amplitude of a wave is the distance between the crest and the trough.

Which of these statements is/are correct?

A I only

B III only

C I and II only

D I and III only

E II and III only

2015 Revised **11.** Radiation of frequency $9{\cdot}40 \times 10^{14}$ Hz is incident on a clean metal surface.

The work function of the metal is $3{\cdot}78 \times 10^{-19}$ J.

The maximum kinetic energy of an emitted photoelectron is

A $2{\cdot}45 \times 10^{-19}$ J

B $3{\cdot}78 \times 10^{-19}$ J

C $6{\cdot}23 \times 10^{-19}$ J

D $1{\cdot}00 \times 10^{-18}$ J

E $2{\cdot}49 \times 10^{33}$ J.

2016 11. The table below shows the threshold frequency of radiation for photoelectric emission for some metals.

Metal	*Threshold frequency* (Hz)
sodium	$4{\cdot}4 \times 10^{14}$
potassium	$5{\cdot}4 \times 10^{14}$
zinc	$6{\cdot}9 \times 10^{14}$

Radiation of frequency $6{\cdot}3 \times 10^{14}$ Hz is incident on the surface of each of the metals.

Photoelectric emission occurs from

A sodium only

B zinc only

C potassium only

D sodium and potassium only

E zinc and potassium only.

2016 12. Radiation of frequency $9{\cdot}00 \times 10^{15}$ Hz is incident on a clean metal surface.

The maximum kinetic energy of a photoelectron ejected from this surface is $5{\cdot}70 \times 10^{-18}$ J.

The work function of the metal is

A $2{\cdot}67 \times 10^{-19}$ J

B $5{\cdot}97 \times 10^{-18}$ J

C $1{\cdot}17 \times 10^{-17}$ J

D $2{\cdot}07 \times 10^{-2}$ J

E $9{\cdot}60 \times 10^{-1}$ J.

2017 9. Radiation is incident on a clean zinc plate causing photoelectrons to be emitted.

The source of radiation is replaced with one emitting radiation of a higher frequency.

The irradiance of the radiation incident on the plate remains unchanged.

Which row in the table shows the effect of this change on the maximum kinetic energy of a photoelectron and the number of photoelectrons emitted per second?

	Maximum kinetic energy of a photoelectron	*Number of photoelectrons emitted per second*
A	no change	no change
B	no change	increases
C	increases	no change
D	increases	decreases
E	decreases	increases

2017 10. Ultraviolet radiation of frequency $7{\cdot}70 \times 10^{14}$ Hz is incident on the surface of a metal.

Photoelectrons are emitted from the surface of the metal.

The maximum kinetic energy of an emitted photoelectron is $2{\cdot}67 \times 10^{-19}$ J.

The work function of the metal is

A $1{\cdot}07 \times 10^{-19}$ J

B $2{\cdot}44 \times 10^{-19}$ J

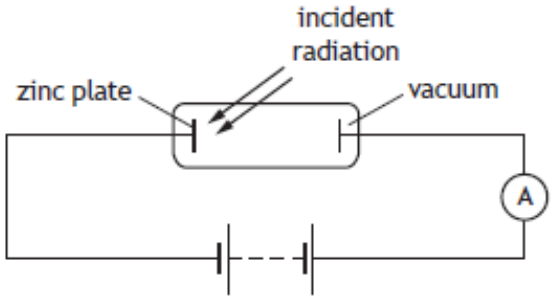
C $2{\cdot}67 \times 10^{-19}$ J

D $5{\cdot}11 \times 10^{-19}$ J

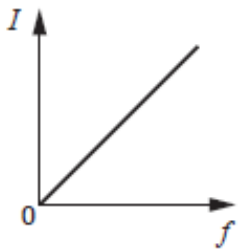
E $7{\cdot}78 \times 10^{-19}$ J.

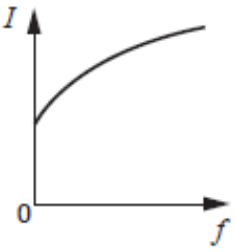
2019 15. The diagram shows an experiment set up to investigate the photoelectric effect.

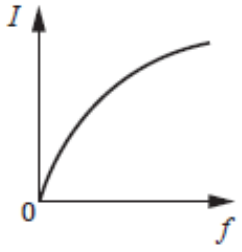
The frequency of the incident radiation is varied and the current in the circuit is measured.

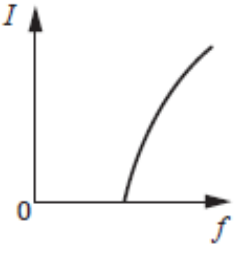


Which graph shows the relationship between the current I in the circuit and the frequency f of the incident radiation?

A


D


B


E


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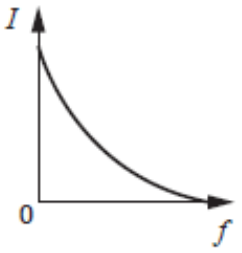

2019 16. A photon of energy $6{\cdot}40 \times 10^{-19}$ J is incident on a metal plate.
This causes photoemission to take place.
The work function of the metal is $4{\cdot}20 \times 10^{-19}$ J.
The maximum speed of the photoelectron is

A $1{\cdot}19 \times 10^{6}\ \text{m s}^{-1}$
B $9{\cdot}60 \times 10^{5}\ \text{m s}^{-1}$
C $6{\cdot}95 \times 10^{5}\ \text{m s}^{-1}$
D $6{\cdot}79 \times 10^{5}\ \text{m s}^{-1}$
E $4{\cdot}91 \times 10^{5}\ \text{m s}^{-1}$.