

Past Paper Multiple Choice Questions by Topic – Particles and Waves

1. Three students each make a statement about antiparticles.

- I An antiparticle has the same mass as its equivalent particle.
- II An antiparticle has the same charge as its equivalent particle.
- III Every elementary particle has a corresponding antiparticle.

Which of the statements is/are correct?

- A I only
 - B II only
 - C I and III only
 - D II and III only
 - E I, II and III
2. Ultraviolet radiation causes the emission of photoelectrons from a zinc plate.

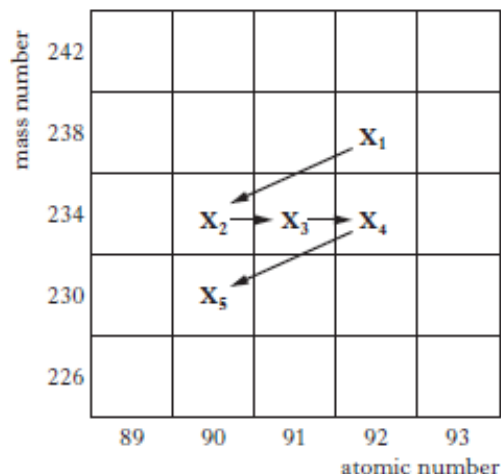
The irradiance of the ultraviolet radiation on the zinc plate is increased.

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

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

3. Part of a radioactive decay series is shown in the diagram.

The symbols X_1 to X_5 represent nuclides in this series.



A student makes the following statements about the decay series.

- I Nuclides X_2 and X_3 contain the same number of protons.
- II Nuclide X_1 decays into nuclide X_2 by emitting an alpha particle.
- III Nuclide X_3 decays into nuclide X_4 by emitting a beta particle.

Which of these statements is/are correct?

- A I only
 - B II only
 - C III only
 - D II and III only
 - E I, II and III
4. A student writes the following statements about electric fields.

- I There is a force on a charge in an electric field.
- II When an electric field is applied to a conductor, the free electric charges in the conductor move.
- III Work is done when a charge is moved in an electric field.

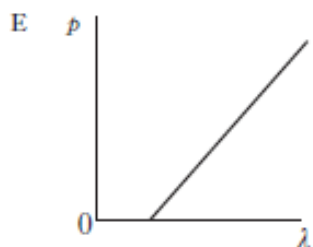
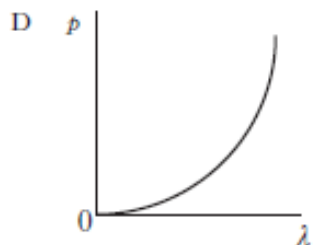
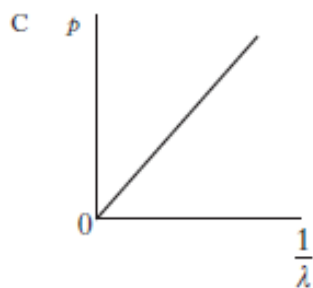
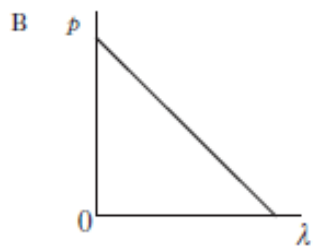
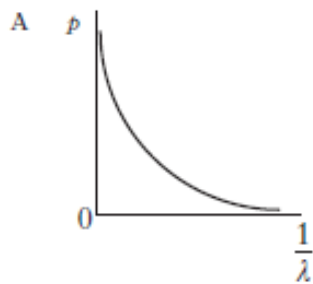
Which of the statements is/are correct?

- A I only
- B II only
- C I and II only
- D I and III only
- E I, II and III

5. 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 ?



6. Light travels from air into glass.

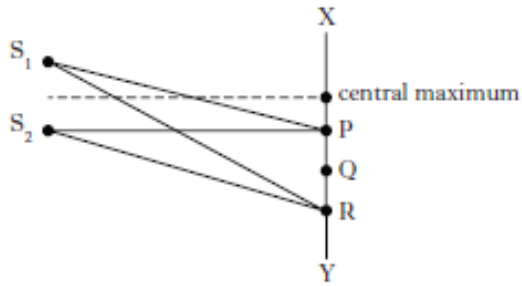
Which row in the table describes what happens to the speed, frequency and wavelength of the light?

	<i>Speed</i>	<i>Frequency</i>	<i>Wavelength</i>
A	increases	decreases	stays constant
B	decreases	stays constant	decreases
C	stays constant	decreases	decreases
D	increases	stays constant	increases
E	decreases	decreases	stays constant

7. The irradiance of light can be measured in

- A W
- B W m^{-1}
- C W m
- D W m^{-2}
- E W m^2 .

8. S_1 and S_2 are sources of coherent waves. An interference pattern is obtained between X and Y.



The first order maximum occurs at P, where $S_1P = 200\text{ mm}$ and $S_2P = 180\text{ mm}$.

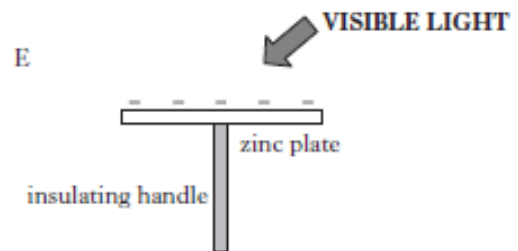
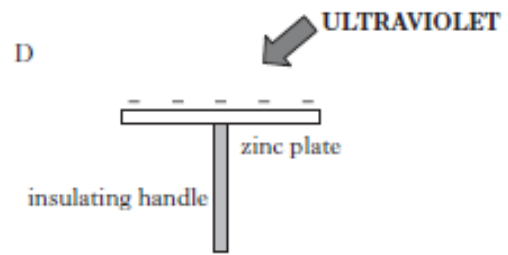
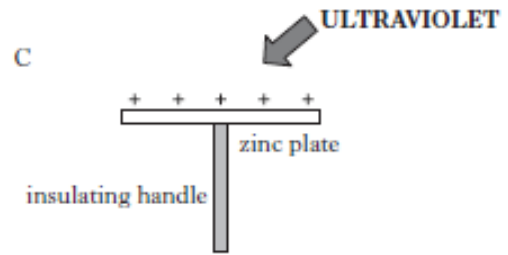
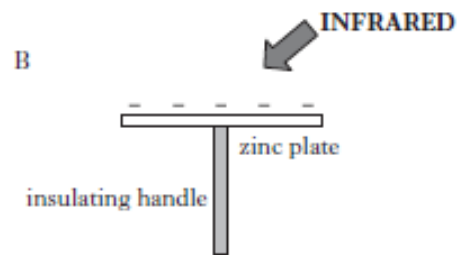
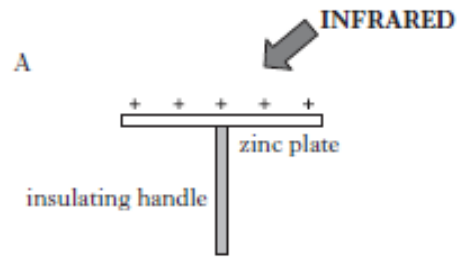
For the third order maximum, at R, the path difference ($S_1R - S_2R$) is

- A 20 mm
- B 30 mm
- C 40 mm
- D 50 mm
- E 60 mm.

9. 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?



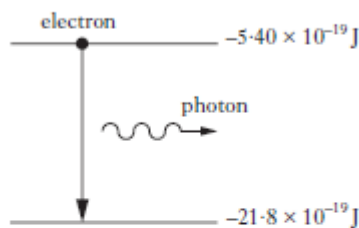
10. Electromagnetic radiation of frequency 9.0×10^{14} Hz is incident on a clean metal surface.

The work function of the metal is 5.0×10^{-19} J.

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

- A 1.0×10^{-19} J
- B 4.0×10^{-19} J
- C 5.0×10^{-19} J
- D 6.0×10^{-19} J
- E 9.0×10^{-19} J.

11. In an atom, a photon of radiation is emitted when an electron makes a transition from a higher energy level to a lower energy level as shown.



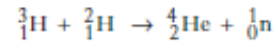
The wavelength of the radiation emitted due to an electron transition between the two energy levels shown is

- A 1.2×10^{-7} m
- B 7.3×10^{-8} m
- C 8.2×10^0 m
- D 1.4×10^7 m
- E 2.5×10^{15} m.

12. Which of the following statements describes a spontaneous nuclear fission reaction?

- A ${}_{92}^{235}\text{U} + {}_0^1\text{n} \rightarrow {}_{56}^{144}\text{Ba} + {}_{36}^{90}\text{Kr} + 2{}_0^1\text{n}$
- B ${}_{3}^7\text{Li} + {}_1^1\text{H} \rightarrow {}_2^4\text{He} + {}_2^4\text{He}$
- C ${}_{1}^3\text{H} + {}_{1}^2\text{H} \rightarrow {}_{2}^4\text{He} + {}_{0}^1\text{n}$
- D ${}_{88}^{226}\text{Ra} \rightarrow {}_{86}^{222}\text{Rn} + {}_{2}^4\text{He}$
- E ${}_{84}^{216}\text{Po} \rightarrow {}_{84}^{216}\text{Po} + \gamma$

13. The statement below represents a nuclear reaction.



The total mass on the left hand side is 8.347×10^{-27} kg.

The total mass on the right hand side is 8.316×10^{-27} kg.

The energy released during one nuclear reaction of this type is

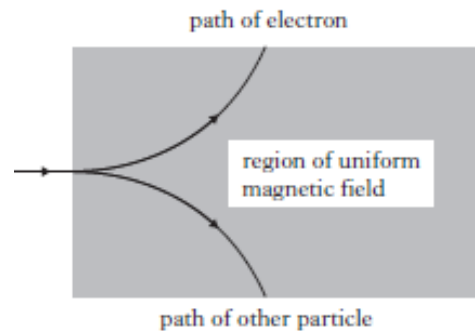
- A 9.30×10^{-21} J
- B 2.79×10^{-12} J
- C 7.51×10^{-10} J
- D 1.50×10^{-9} J
- E 2.79×10^{13} J.

14. Which of the following lists the particles in order of size from smallest to largest?

- A helium nucleus; electron; proton
- B helium nucleus; proton; electron
- C proton; helium nucleus, electron
- D electron; helium nucleus, proton
- E electron; proton; helium nucleus

15. An electron and another particle of identical mass pass through a uniform magnetic field.

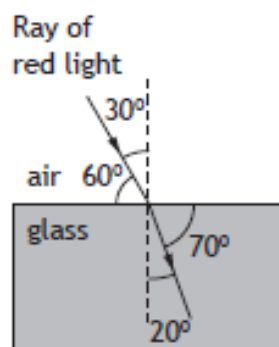
Their paths are shown in the diagram.



This observation provides evidence for the existence of

- A neutrinos
- B antimatter
- C quarks
- D protons
- E force mediating particles.

16. The photoelectric effect
- A is evidence for the wave nature of light
 - B can be observed using a diffraction grating
 - C can only be observed with ultra-violet light
 - D can only be observed with infra-red light
 - E is evidence for the particulate nature of light.
17. A ray of red light is incident on a glass block as shown.



The refractive index of the glass for this light is

- A 0.53
 - B 0.68
 - C 1.46
 - D 1.50
 - E 2.53.
18. A ray of red light travels from air into water.
Which row in the table describes the change, if any, in speed and frequency of a ray of red light as it travels from air into water?

	<i>Speed</i>	<i>Frequency</i>
A	increases	increases
B	increases	stays constant
C	decreases	stays constant
D	decreases	decreases
E	stays constant	decreases

19. Light from a point source is incident on a screen. The screen is 3.0 m from the source. The irradiance at the screen is 8.0 W m^{-2} . The light source is now moved to a distance of 12 m from the screen. The irradiance at the screen is now

- A 0.50 W m^{-2}
- B 1.0 W m^{-2}
- C 2.0 W m^{-2}
- D 4.0 W m^{-2}
- E 8.0 W m^{-2} .

20. A student makes the following statements about an electron.

- I An electron is a boson.
- II An electron is a lepton.
- III An electron is a fermion.

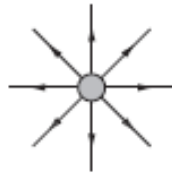
Which of these statements is/are correct?

- A I only
- B II only
- C III only
- D I and II only
- E II and III only

21. Radiation of frequency $9.40 \times 10^{14} \text{ Hz}$ is incident on a clean metal surface. The work function of the metal is $3.78 \times 10^{-19} \text{ J}$. The maximum kinetic energy of an emitted photoelectron is

- A $2.45 \times 10^{-19} \text{ J}$
- B $3.78 \times 10^{-19} \text{ J}$
- C $6.23 \times 10^{-19} \text{ J}$
- D $1.00 \times 10^{-18} \text{ J}$
- E $2.49 \times 10^{33} \text{ J}$.

22. The diagram represents the electric field around a single point charge.



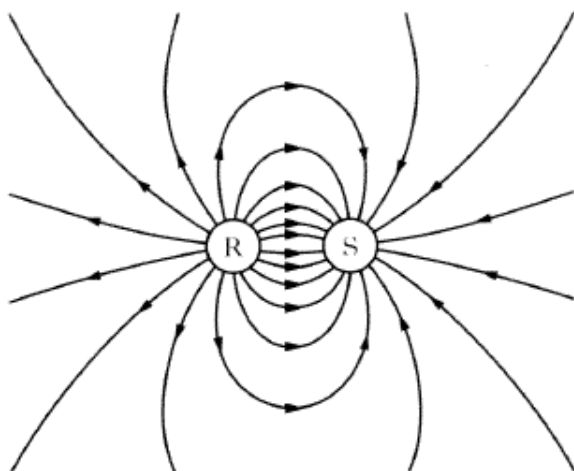
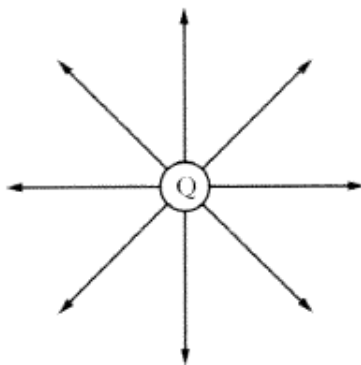
A student makes the following statements about this diagram.

- I The separation of the field lines indicates the strength of the field.
- II The arrows on the field lines indicate the direction in which an electron would move if placed in the field.
- III The point charge is positive.

Which of these statements is/are correct?

- A I only
- B II only
- C I and III only
- D II and III only
- E I, II and III

23. The electric field patterns around charged particles Q, R and S are shown.



Which row in the table shows the charges on particles Q, R and S?

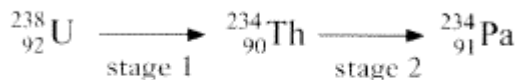
	<i>Charge on Q</i>	<i>Charge on R</i>	<i>Charge on S</i>
A	positive	positive	negative
B	negative	negative	positive
C	negative	positive	negative
D	negative	negative	negative
E	positive	positive	positive

24. An electron enters a region of magnetic field as shown.



The direction of the force exerted by the magnetic field on the electron as it enters the field is

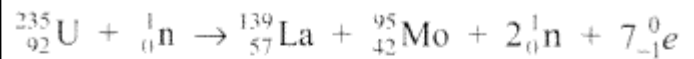
- A to the left
 B into the page
 C out of the page
 D towards the top of the page
 E towards the bottom of the page.
25. An isotope of uranium decays into an isotope of protactinium in two stages as shown.



Which row in the table identifies the radiations which must be emitted at each stage?

	stage 1	stage 2
A	alpha	gamma
B	beta	gamma
C	gamma	beta
D	beta	alpha
E	alpha	beta

26. The following statement represents a fission reaction.



The total mass of the particles before the reaction is 391.848×10^{-27} kg.

The total mass of the particles after the reaction is 391.478×10^{-27} kg.

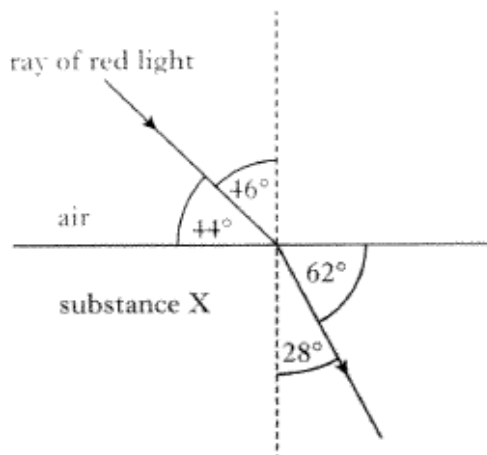
The energy released in this reaction is

- A 3.53×10^{-8} J
 B 3.52×10^{-8} J
 C 3.33×10^{-11} J
 D 1.67×10^{-11} J
 E 1.11×10^{-19} J.
27. The spectrum of white light from a filament lamp may be viewed using a prism or a grating.
- A student, asked to compare the spectra formed by the two methods, makes the following statements.
- I The prism produces a spectrum by refraction and the grating produces a spectrum by interference.
 II The spectrum formed by the prism consists of all the wavelengths present in the white light and the spectrum formed by the grating consists of only a few specific wavelengths.
 III The prism produces a single spectrum and the grating produces more than one spectrum.

Which of the statements is/are correct?

- A I only
 B II only
 C I and II only
 D I and III only
 E I, II and III

28. The diagram shows the path of a ray of red light as it passes from air into substance X.



The critical angle for the light in substance X is

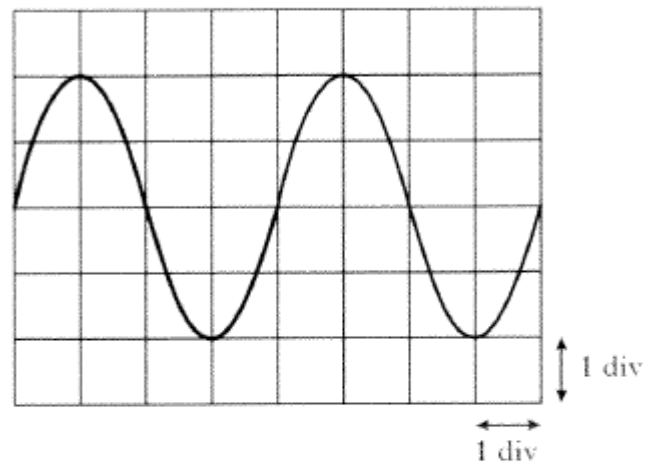
- A 32°
 - B 41°
 - C 45°
 - D 52°
 - E 90° .
29. The irradiance of light from a point source is 160 units at a distance of 0.50 m from the source.

At a distance 2.0 m from this source, the irradiance is

- A 160 units
- B 80 units
- C 40 units
- D 10 units
- E 5 units.

30. An oscilloscope is connected to the output terminals of a signal generator.

The trace displayed on the screen is shown below.



The timebase of the oscilloscope is set at 30 ms/div.

The frequency of the output signal from the signal generator is

- A 4.2×10^{-3} Hz
- B 8.3×10^{-3} Hz
- C 0.28 Hz
- D 4.2 Hz
- E 8.3 Hz.

Answers and Original Source of Question

Question Number	Answer	Source
1	C	Revised Higher 2013 Q10
2	B	Revised Higher 2013 Q13
3	D	Revised Higher 2013 Q12
4	E	Revised Higher 2013 Q11
5	C	Revised Higher 2013 Q14
6	B	Revised Higher 2013 Q15
7	D	Revised Higher 2013 Q16
8	E	Revised Higher 2012 Q9
9	D	Revised Higher 2012 Q10
10	A	Revised Higher 2012 Q11
11	A	Revised Higher 2012 Q12
12	D	Revised Higher 2012 Q13
13	B	Revised Higher 2012 Q14
14	E	Revised Higher 2012 Q15
15	B	Revised Higher 2012 Q16
16	E	CfE Higher Specimen Q7
17	C	CfE Higher Specimen Q8
18	C	CfE Higher Specimen Q9
19	A	CfE Higher Specimen Q10
20	E	CfE Higher Specimen Q11
21	A	CfE Higher Specimen Q12
22	C	CfE Higher Specimen Q13
23		Revised Higher 2014 Q8
24		Revised Higher 2014 Q9
25		Revised Higher 2014 Q10
26		Revised Higher 2014 Q11
27		Revised Higher 2014 Q12
28		Revised Higher 2014 Q13
29		Revised Higher 2014 Q14
30		Revised Higher 2014 Q15