

Q1. A positive ion has a charge-to-mass ratio of $2.40 \times 10^7 \text{ C kg}^{-1}$. It is held stationary in a vertical electric field. Which line, **A** to **D**, in the table shows correctly both the strength and the direction of the electric field?

	Electric field strength / V m^{-1}	Direction
A	4.09×10^{-7}	upwards
B	4.09×10^{-7}	downwards
C	2.45×10^6	upwards
D	2.45×10^6	downwards

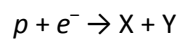
(Total 1 mark)

Q2. What are the numbers of hadrons, baryons and mesons in an atom of ${}^7_3\text{Li}$?

	hadrons	baryons	mesons	
A	7	3	3	<input type="checkbox"/>
B	7	4	4	<input type="checkbox"/>
C	7	7	0	<input type="checkbox"/>
D	10	7	0	<input type="checkbox"/>

(Total 1 mark)

Q3. Electron capture can be represented by the following equation.



Which row correctly identifies **X** and **Y**?

	X	Y	
A	p	K ⁻	<input type="checkbox"/>
B	e ⁻	e ⁺	<input type="checkbox"/>
C	n	ν _e	<input type="checkbox"/>
D	n	π ⁰	<input type="checkbox"/>

(Total 1 mark)

Q4. A calcium ion is formed by removing two electrons from an atom of ${}_{20}^{40}\text{Ca}$. What is the specific charge of the calcium ion?

- A** $3.2 \times 10^{-19} \text{ C kg}^{-1}$
- B** $2.9 \times 10^{-18} \text{ C kg}^{-1}$
- C** $4.8 \times 10^6 \text{ C kg}^{-1}$
- D** $4.8 \times 10^7 \text{ C kg}^{-1}$

(Total 1 mark)

Q5. Which of the following is **not** true?

- A** Each meson consists of a single quark and a single antiquark.
- B** Each baryon consists of three quarks.
- C** The magnitude of the charge on every quark is $\frac{1}{3}$
- D** A particle consisting of a single quark has not been observed.

(Total 1 mark)

Q6. A light source emits light which is a mixture of two wavelengths, λ_1 and λ_2 . When the light is incident on a diffraction grating it is found that the fifth order of light of wavelength λ_1 occurs at the same angle as the fourth order for light of wavelength λ_2 . If λ_1 is 480 nm what is λ_2 ?

- A** 400 nm
- B** 480 nm
- C** 600 nm
- D** 750 nm

(Total 1 mark)

Q7. The nucleus of ${}^9_4\text{Be}$ captures a proton and emits an α particle. What is the product nucleus?

A ${}^{10}_6\text{C}$

B ${}^7_3\text{Li}$

C ${}^6_3\text{Li}$

D ${}^6_2\text{He}$

(Total 1 mark)

Q8. When comparing X-rays with UV radiation, which statement is correct?

A X-rays have a lower frequency.

B X-rays travel faster in a vacuum.

C X-rays do not show diffraction and interference effects.

D Using the same element, photoelectrons emitted using X-rays have the greater maximum kinetic energy.

(Total 1 mark)

Q9. Monochromatic light of wavelength 490 nm falls normally on a diffraction grating that has 6×10^5 lines per metre. Which one of the following is correct?

A The first order is observed at angle of diffraction of 17° .

B The second order is observed at angle of diffraction of 34° .

C The third and higher orders are not produced.

D A grating with more lines per metre could produce more orders.

(Total 1 mark)

Q10. An electron collides with a neutral atom and ionizes it. Which of the following describes the particles present after the collision?

- A An electron and an excited atom.
- B An excited atom containing an excess electron.
- C Two electrons and a positive ion.
- D Two electrons and a neutral atom in the ground state.

(Total 1 mark)

Q11. A radioactive nucleus emits a β^- particle then an α particle and finally another β^- particle. The final nuclide is

- A an isotope of the original element
- B the same element with a different proton number
- C a new element of higher proton number
- D a new element of lower nucleon number

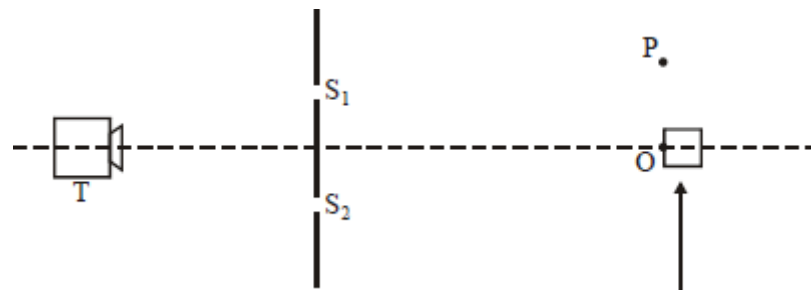
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Q12. Interference maxima produced by a double source are observed at a distance of 1.0 m from the sources. In which one of the following cases are the maxima closest together?

- A red light of wavelength 700 nm from sources 4.0 mm apart
- B sound waves of wavelength 20 mm from sources 50 mm apart
- C blue light of wavelength 450 nm from sources 2.0 mm apart
- D surface water waves of wavelength 10 mm from sources 200 mm apart

(Total 1 mark)

Q13. The diagram shows a microwave transmitter T which directs microwaves of wavelength λ at two slits S_1 and S_2 formed by metal plates. The microwaves that pass through the two slits are detected by a receiver.



receiver
at O

When the receiver is moved to P from O, which is equidistant from S_1 and S_2 , the signal received decreases from a maximum to a minimum. Which one of the following statements is a correct deduction from this observation?

- A The path difference $S_1O - S_2O = 0.5 \lambda$
- B The path difference $S_1O - S_2O = \lambda$
- C The path difference $S_1P - S_2P = 0.5 \lambda$
- D The path difference $S_1P - S_2P = \lambda$

(Total 1 mark)

Q14.



Point sources of sound of the same frequency are placed at S_1 and S_2 . When a sound detector is slowly moved along the line PQ, consecutive maxima of sound intensity are detected at W and Y and consecutive minima at X and Z. Which one of the following is a correct expression for the wavelength of the sound?

- A $S_1X - S_1W$
- B $S_1Y - S_1X$
- C $S_1X - S_2X$
- D $S_1Y - S_2Y$

(Total 1 mark)

Q15. In a Young's double slit interference experiment, monochromatic light placed behind a single slit illuminates two narrow slits and the interference pattern is observed on a screen placed some distance away from the slits. Which one of the following **decreases** the separation of the fringes?

- A increasing the width of the single slit
- B decreasing the separation of the double slits
- C increasing the distance between the double slits and the screen
- D using monochromatic light of higher frequency

(Total 1 mark)

Q16. Interference fringes, produced by monochromatic light, are viewed on a screen placed a distance D from a double slit system with slit separation S . The distance between the centres of two adjacent fringes (the fringe separation) is w . If both S and D are doubled, what will be the new fringe separation?

- A $\frac{w}{4}$
- B w
- C $2w$
- D $4w$

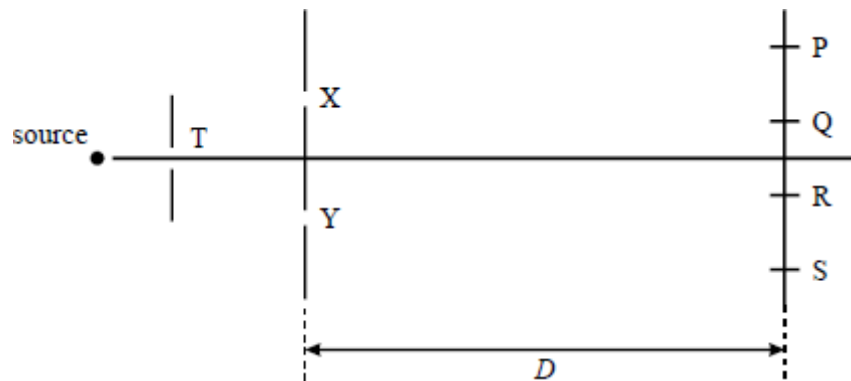
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Q17. Artificial radioactive nuclides are manufactured by placing naturally-occurring nuclides in a nuclear reactor. They are made radioactive in the reactor as a consequence of bombardment by

- A α particles.
- B β particles.
- C protons.
- D neutrons.

(Total 1 mark)

Q18.



Coherent monochromatic light of wavelength λ emerges from the slits X and Y to form dark fringes at P, Q, R and S in a double slit apparatus. Which one of the following statements is true?

- A When the distance D is increased, the separation of the fringes increases.
- B When the distance between X and Y is increased, the separation of the fringes increases.
- C When the width of the slit T is decreased, the separation of the fringes decreases.
- D There is a dark fringe at P because $(YP - XP)$ is 2λ .

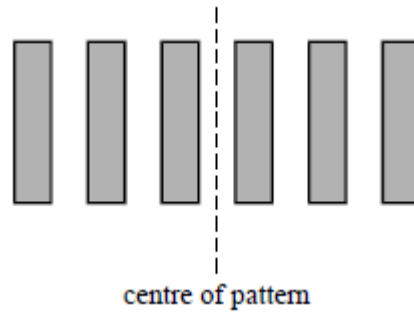
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Q19. In a double slit interference arrangement the fringe spacing is w when the wavelength of the radiation is λ , the distance between the double slits is s and the distance between the slits and the plane of the observed fringes is D . In which one of the following cases would the fringe spacing also be w ?

	wave length	distance between slits	distance between slits and fringes
A	2λ	$2s$	$2D$
B	2λ	$4s$	$2D$
C	2λ	$2s$	$4D$
D	4λ	$2s$	$2D$

(Total 1 mark)

Q20.



A double slit interference experiment is performed using monochromatic light of wavelength λ . The centre of the observed pattern is a bright fringe. What is the path difference between two waves which interfere to give the third dark fringe from the centre?

- A 0.5λ
- B 1.5λ
- C 2.5λ
- D 3.5λ

(Total 1 mark)

Q21. In a Young's double slits interference arrangement the fringe separation is s when the wavelength of the radiation is λ , the slit separation w and the distance between the slits and the plane of the observed fringes D . In which one of the following cases would the fringe separation also be s ?

	wavelength	slit separation	distance between slits and fringes
A	2λ	$2w$	$2D$
B	2λ	$4w$	$2D$
C	2λ	$2w$	$4D$
D	4λ	$2w$	$2D$

(Total 1 mark)

Q22. Young's two slit interference pattern with red light of wavelength 7.0×10^{-7} m gives a fringe separation of 2.0 mm.

What separation, in mm, would be observed at the same place using blue light of wavelength 45×10^{-7} m?

- A** 0.65
- B** 1.3
- C** 2.6
- D** 3.1

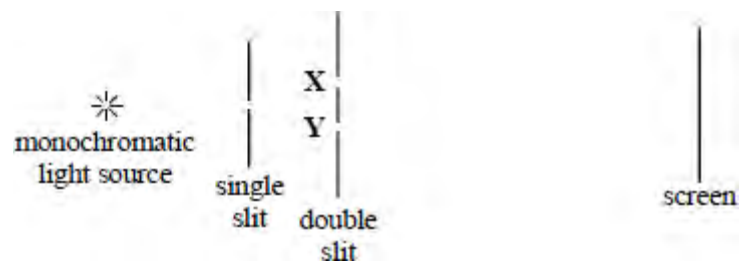
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Q23. In a nuclear reaction $^{14}_7\text{N}$ is bombarded by neutrons. This results in the capture of one neutron and the emission of one proton by one nucleus of $^{14}_7\text{N}$. The resulting nucleus is

- A $^{13}_7\text{N}$
- B $^{14}_6\text{C}$
- C $^{12}_6\text{C}$
- D $^{14}_8\text{O}$

(Total 1 mark)

Q24. The diagram represents the experimental arrangement used to produce interference fringes in Young's double slit experiment.



The spacing of the fringes on the screen will increase if

- A the width of the single slit is increased
- B the distance **XY** between the two slits is increased
- C a light source of lower frequency is used
- D the distance between the single and double slits is decreased

(Total 1 mark)