Q1. A positive ion has a charge−to−mass ratio of 2.40×10^{7} 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 $^{7}_{3}$Li?

	hadrons	**baryons**	**mesons**	
A	7	3	3	⬭
B	7	4	4	⬭
C	7	7	0	⬭
D	10	7	0	⬭

(Total 1 mark)

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

$$p + e^- \rightarrow X + Y$$

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

	X	**Y**	
A	p	K^-	⬭
B	e^-	e^+	⬭
C	n	V_e	⬭
D	n	π^0	⬭

(Total 1 mark)

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

A 3.2×10^{-19} C kg^{-1} ⬭

B 2.9×10^{-18} C kg^{-1} ⬭

C 4.8×10^{6} C kg^{-1} ⬭

D 4.8×10^{7} 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 wavelength, 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 $^{9}_{4}Be$ captures a proton and emits an α particle. What is the product nucleus?

A $^{10}_{6}C$ ⬭

B $^{7}_{3}Li$ ⬭

C $^{6}_{3}Li$ ⬭

D $^{6}_{2}He$ ⬭

(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 ⬭

(Total 1 mark)

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

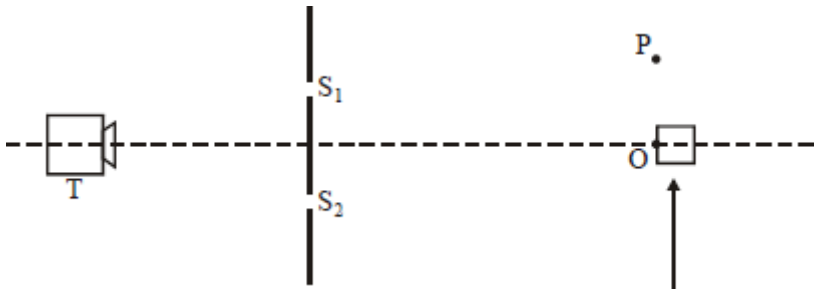
B sound waves of wavelength 20 mm from sources 50 mm apart

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 eat 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 $S_1O - S_2O = 0.5\,\lambda$

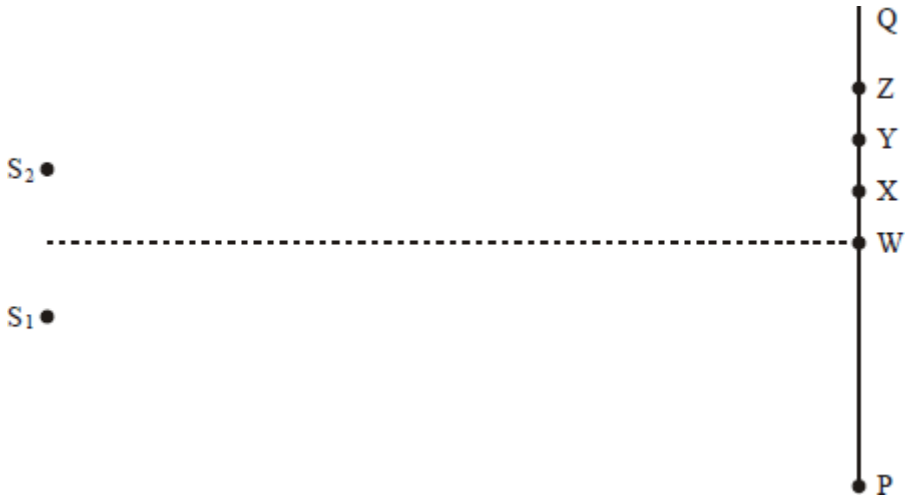
B The path difference $S_1O - S_2O = \lambda$

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 $4w$

(Total 1 mark)

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.

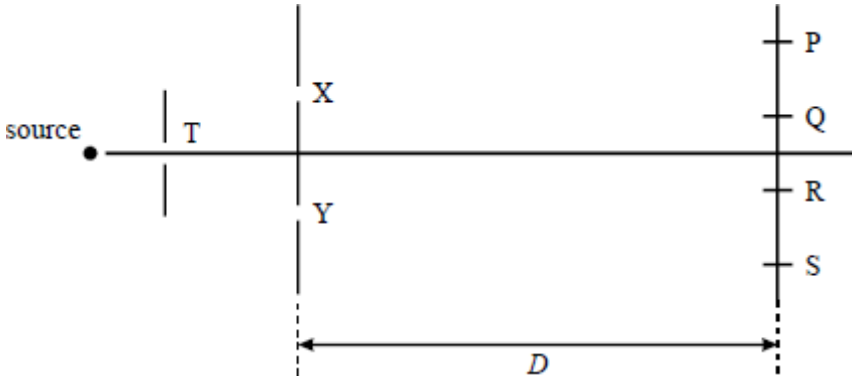
B β particles.

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 .

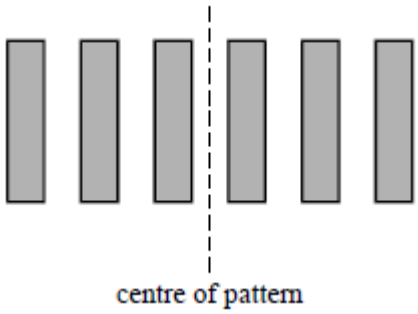
(Total 1 mark)

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 0.5 λ

B 1.5 λ

C 2.5 λ

D 3.5 λ

(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

(Total 1 mark)

Q23. In a nuclear reaction $^{14}_{7}N$ is bombarded by neutrons. This results in the capture of one neutron and the emission of one proton by one nucleus of $^{14}_{7}N$. The resulting nucleus is

A $^{13}_{7}N$

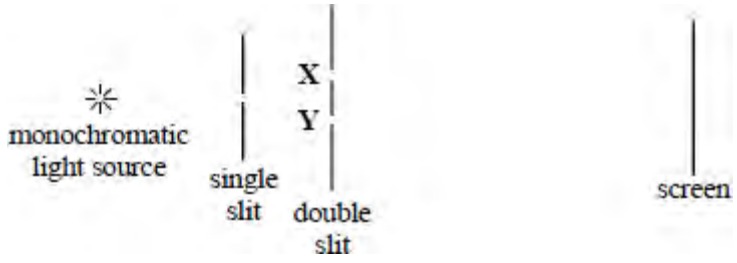
B $^{14}_{6}C$

C $^{12}_{6}C$

D $^{14}_{8}O$

(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)