

Q1. Electrons and protons in two beams are travelling at the same speed. The beams are diffracted by objects of the same size.

Which correctly compares the de Broglie wavelength λ_e of the electrons with the de Broglie wavelength λ_p of the protons and the width of the diffraction patterns that are produced by these beams?

	comparison of de Broglie wavelength	diffraction pattern	
A	$\lambda_e > \lambda_p$	electron beam width > proton beam width	<input type="checkbox"/>
B	$\lambda_e < \lambda_p$	electron beam width > proton beam width	<input type="checkbox"/>
C	$\lambda_e > \lambda_p$	electron beam width < proton beam width	<input type="checkbox"/>
D	$\lambda_e < \lambda_p$	electron beam width < proton beam width	<input type="checkbox"/>

(Total 1 mark)

Q2. A diffraction pattern is formed by passing monochromatic light through a single slit. If the width of the single slit is reduced, which of the following is true?

	Width of central maximum	Intensity of central maximum	
A	unchanged	decreases	<input type="checkbox"/>
B	increases	increases	<input type="checkbox"/>
C	increases	decreases	<input type="checkbox"/>
D	decreases	decreases	<input type="checkbox"/>

(Total 1 mark)

Q3. 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)

Q4. 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)

Q5. Monochromatic light may be characterised by its speed, frequency and wavelength. Which of the following quantities change when monochromatic light passes from air into glass?

- A Speed only.
- B Speed and wavelength only.
- C Speed and frequency only.
- D Wavelength and frequency only.

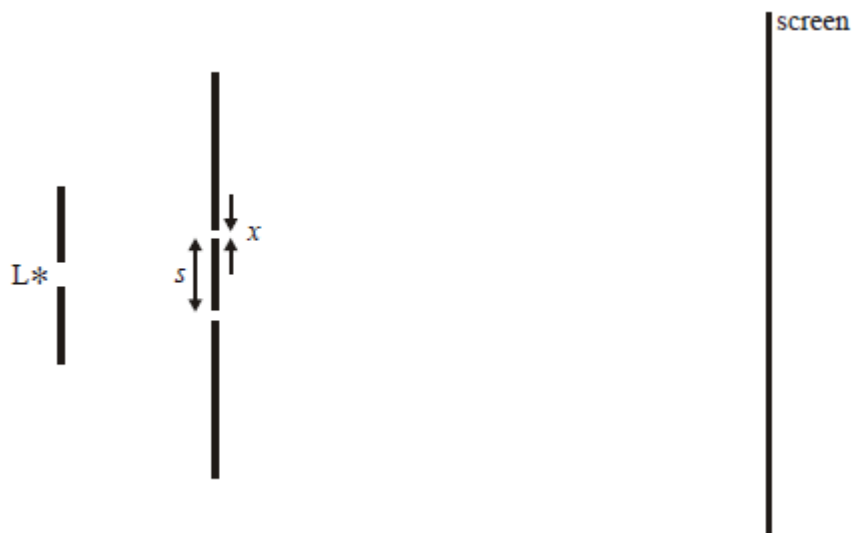
(Total 1 mark)

Q6. 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)

Q7.

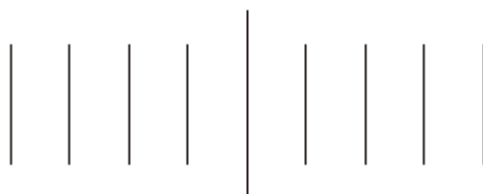


In a double slit system used to produce interference fringes, the separation of the slits is s and the width of each slit is x . L is a source of monochromatic light. Which one of the following changes would **decrease** the separation of the fringes seen on the screen?

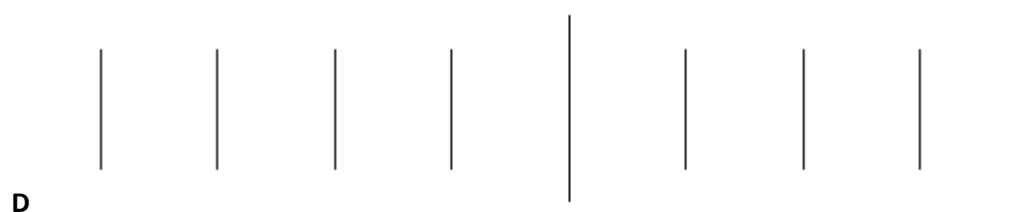
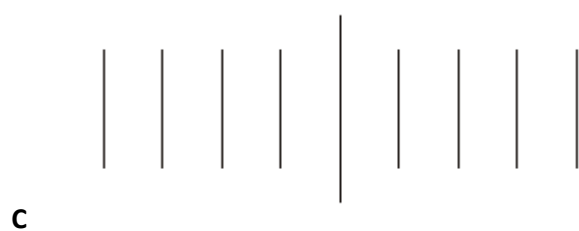
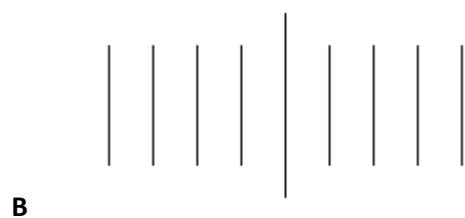
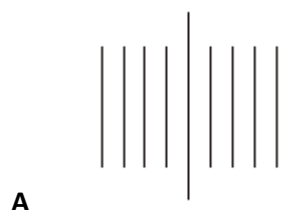
- A moving the screen closer to the double slits
- B decreasing the width, x , of each slit, but keeping s constant
- C decreasing the separation, s , of the slits
- D exchanging L for a monochromatic source of longer wavelength

(Total 1 mark)

Q8.



The diagram above shows the first four diffraction orders each side of the zero order when a beam of monochromatic light is incident normally on a diffraction grating of slit separation d . All the angles of diffraction are small. Which one of the patterns, **A** to **D**, drawn on the same scale, is obtained when the grating is exchanged for one with a slit separation $\frac{d}{2}$?



(Total 1 mark)

Q9. 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

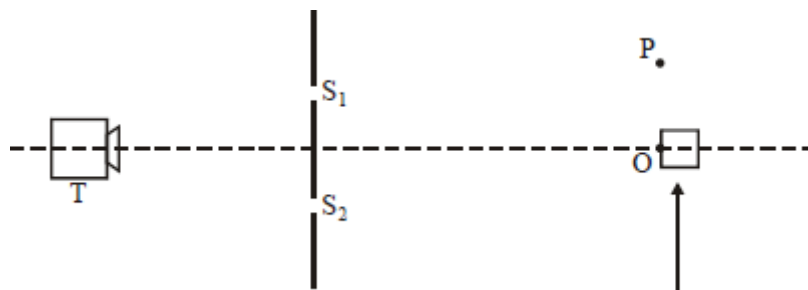
(Total 1 mark)

Q10. Light of wavelength λ is incident normally on a diffraction grating for which adjacent lines are a distance 3λ apart. What is the angle between the second order maximum and the straight-through position?

- A** 9.6°
- B** 20°
- C** 42°
- D** There is no second order maximum.

(Total 1 mark)

Q11. 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.



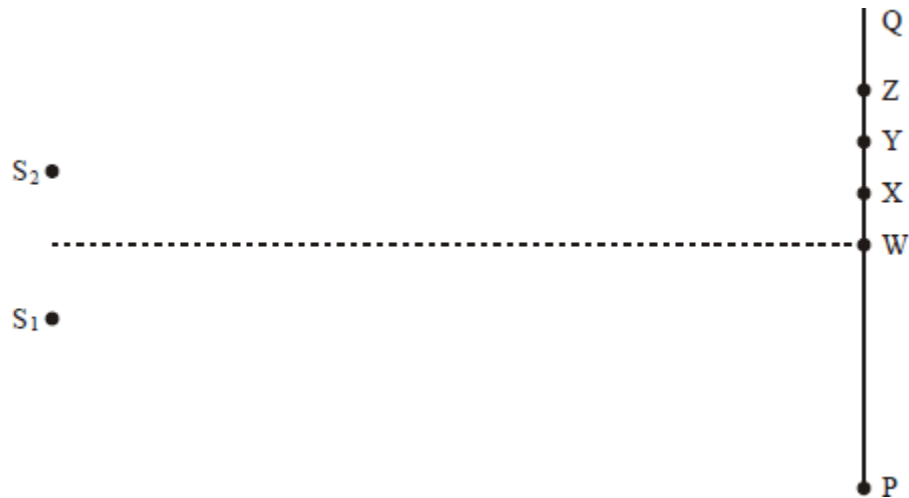
receiver
at O

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)

Q12.



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)

Q13. 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)

Q14. Light of wavelength λ is incident normally on a diffraction grating of slit separation 4λ . What is the angle between the second order maximum and third order maximum?

- A 14.5°
- B 18.6°
- C 48.6°
- D 71.4°

(Total 1 mark)

Q15. 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 $4w$

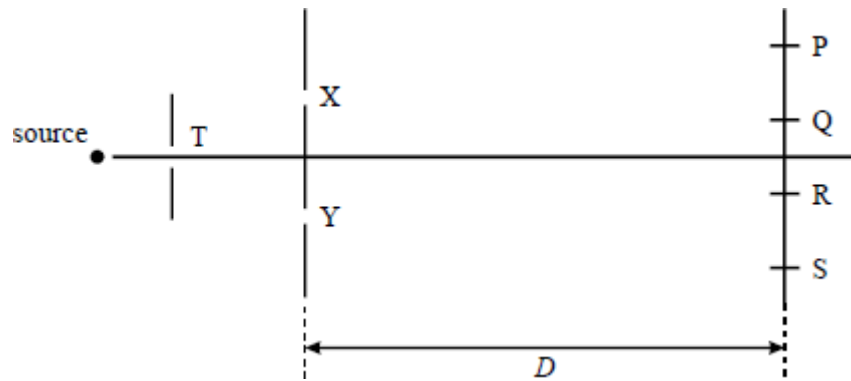
(Total 1 mark)

Q16. A narrow beam of monochromatic light falls on a diffraction grating at normal incidence. The second order diffracted beam makes an angle of 45° with the grating. What is the highest order visible with this grating at this wavelength?

- A 2
- B 3
- C 4
- D 5

(Total 1 mark)

Q17.



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)

Q18. Monochromatic light of wavelength 590 nm is incident normally on a plane diffraction grating having 4×10^5 lines m^{-1} . An interference pattern is produced. What is the highest order visible in this interference pattern?

- A 2
- B 3
- C 4
- D 5

(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	$2s$	$2D$

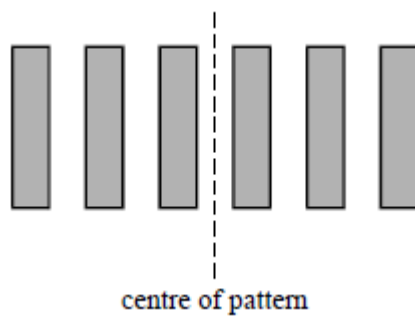
(Total 1 mark)

Q20. Using a diffraction grating with monochromatic light of wavelength 500 nm incident normally, a student found the 2nd order diffracted maxima in a direction at 30° to the central bright fringe. What is the number of lines per metre on the grating?

- A** 2×10^4
- B** 2×10^5
- C** 4×10^5
- D** 5×10^5

(Total 1 mark)

Q21.



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)

Q22. 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)

Q23. Figures 1 and 2 each show a ray of light incident on a water-air boundary. **A**, **B**, **C** and **D** show ray directions at the interface.

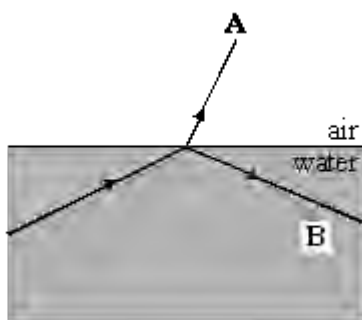


Figure 1

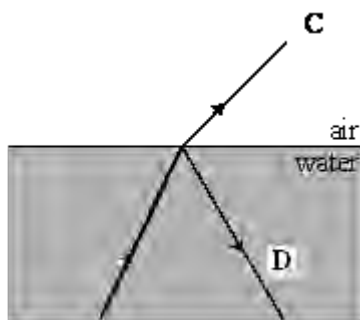


Figure 2

(a) Circle the letter below that corresponds to a direction in which a ray **cannot** occur.

A **B** **C** **D**

(1)

(b) Circle the letter below that corresponds to the direction of the faintest ray.

A **B** **C** **D**

(1)

(Total 2 marks)

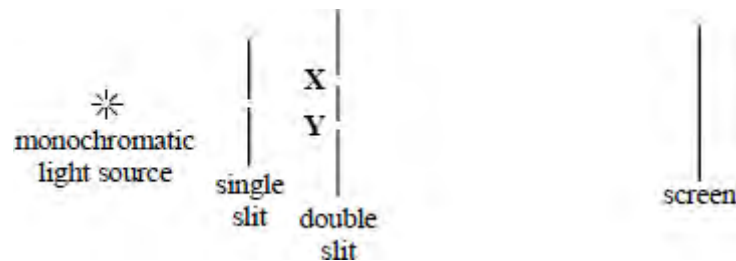
Q24. Young's two slit interference pattern with red light of wavelength 7.0×10^{-7} m gives a fringe separation of 2.0 mm.

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)

Q25. 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)