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	⬭
B	$\lambda_e < \lambda_p$	electron beam width > proton beam width	⬭
C	$\lambda_e > \lambda_p$	electron beam width < proton beam width	⬭
D	$\lambda_e < \lambda_p$	electron beam width < proton beam width	⬭

(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	⬭
B	increases	increases	⬭
C	increases	decreases	⬭
D	decreases	decreases	⬭

(Total 1 mark)

Q3. 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)

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°. ⬭

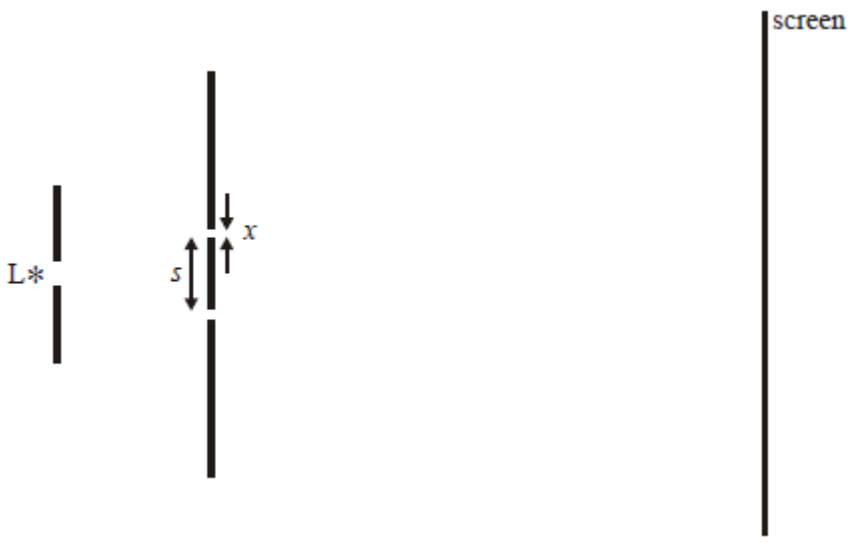
B The second order is observed at angle of diffraction of 34°. ⬭

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

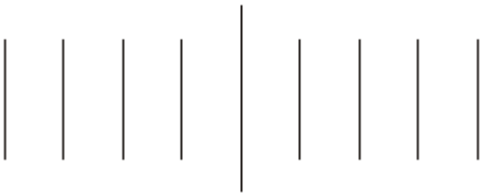
B decreasing the width, *x*, of each slit, but keeping *s* constant

C decreasing the separation, *s*, of the slits

D exchanging L for a monochromatic source of longer wavelength

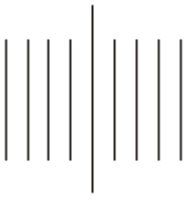
(Total 1 mark)

Q8.

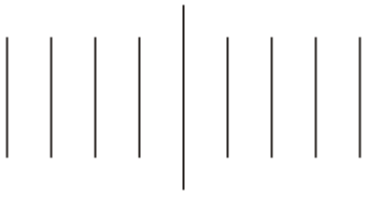


The diagram above shows the first four diffraction orders each side of the zero order when a beam of monochromatic light is incident normally on a diffraction grating of slit separation d. All the angles of diffraction are small. Which one of the patterns, **A** to **D**, drawn on the same scale, is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

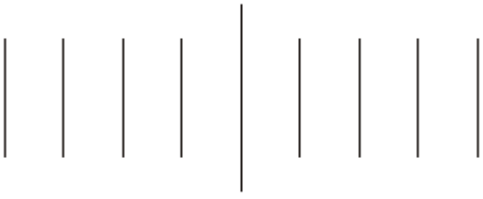
A



B



C



D

(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°

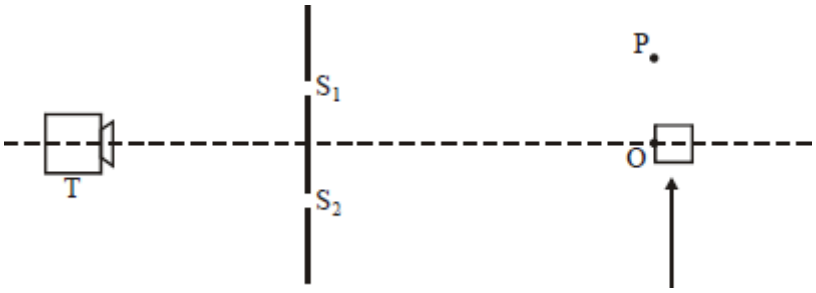
B 20°

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 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 $S_1O - S_2O = 0.5\,\lambda$

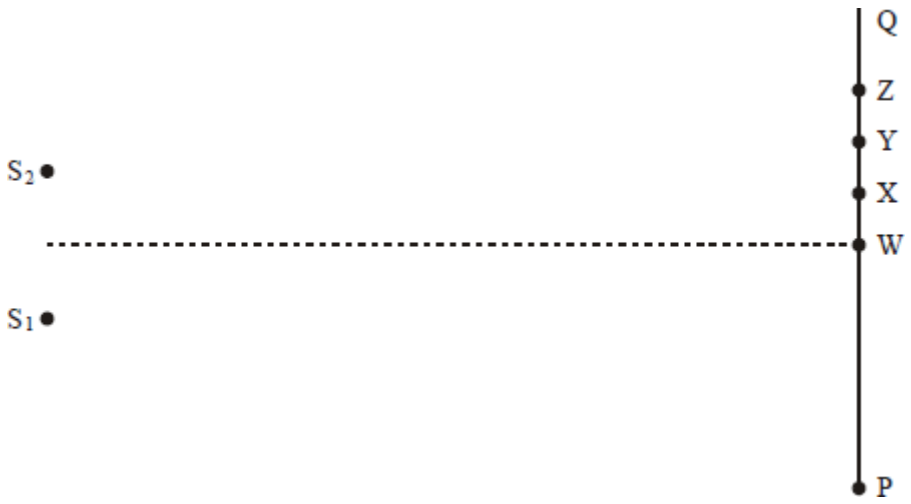
B The path difference $S_1O - S_2O = \lambda$

C The path difference $S_1P - S_2P = 0.5\,\lambda$

D The path difference $S_1P - S_2P = \lambda$

(Total 1 mark)

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

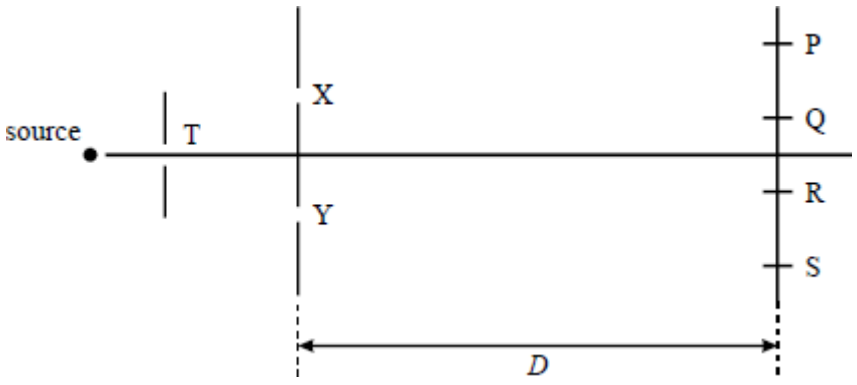
B 3

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

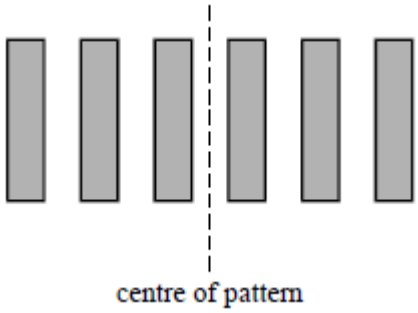
B 2×10^5

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 0.5 λ

B 1.5 λ

C 2.5 λ

D 3.5 λ

(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.

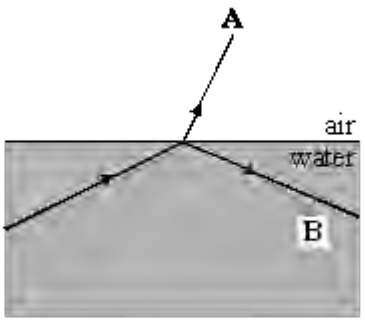


Figure 1

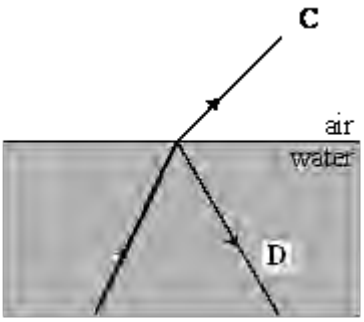


Figure 2

(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

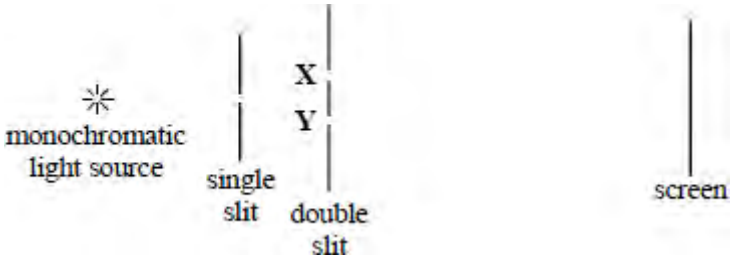
B 1.3

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)