

1

In a diffraction-grating experiment the maxima are produced on a screen.

What causes the separation of the maxima of the diffraction pattern to decrease?

[1 mark]

- A** using light with a longer wavelength
- B** increasing the distance between the screen and grating
- C** increasing the distance between the source and grating
- D** using a grating with a greater slit separation

☐☐☐☐☐

White light passes through a single narrow slit and illuminates a screen.

What is observed on the screen?

[1 mark]

- A** a set of equally spaced white fringes
- B** a central maximum made up of a spectrum surrounded by white fringes
- C** a white central maximum surrounded by coloured fringes
- D** a single narrow white line



3

Which of the following is correct when total internal reflection occurs?

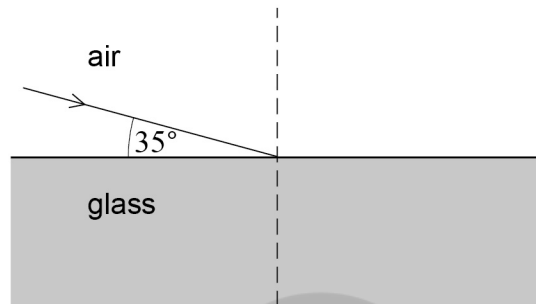
[1 mark]

- A** The angle of incidence is less than the critical angle.
- B** The light meets an optically less dense medium.
- C** The light enters a medium with a higher refractive index.
- D** The angles that the incident and refracted rays make with the normal are the same.

☐☐☐☐☐

4

The diagram shows a ray of light travelling in air and incident on a glass block of refractive index 1.5



What is the angle of refraction in the glass?

[1 mark]

A 22.5°

☐

B 23.3°

☐

C 33.1°

☐

D 59.4°

☐☐

5

What is the speed of light in glass of refractive index 1.42?

[1 mark]

A $4.26 \times 10^7 \text{ m s}^{-1}$

☐

B $2.11 \times 10^8 \text{ m s}^{-1}$

☐

C $3.00 \times 10^8 \text{ m s}^{-1}$

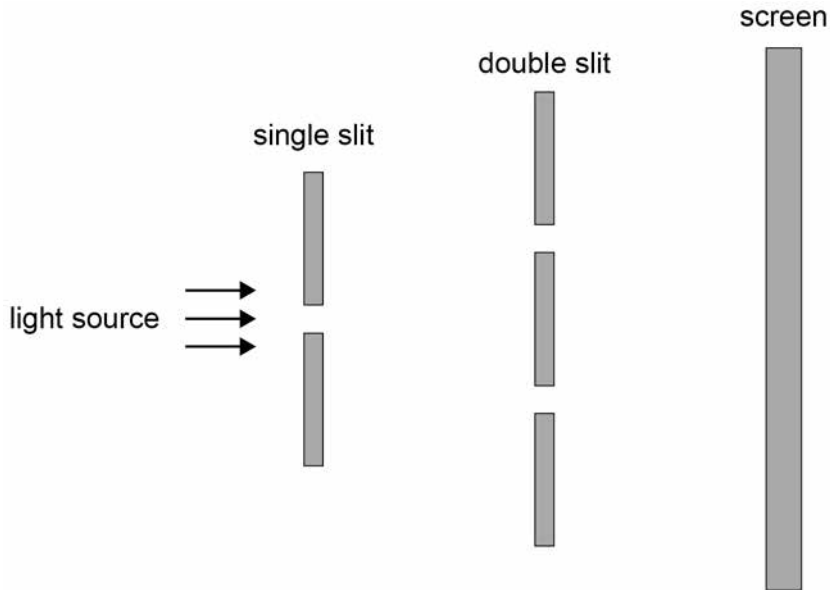
☐

D $4.73 \times 10^8 \text{ m s}^{-1}$

☐

6

Light from a point source passes through a single slit and is then incident on a double-slit arrangement. An interference pattern is observed on the screen.



What will increase the fringe spacing?

[1 mark]

- A** increasing the separation of the single slit and the double slit
- B** increasing the width of the single slit
- C** decreasing the distance between the double slits and the screen
- D** decreasing the separation of the double slits

☐☐☐☐☐

7

Which row shows the change in velocity, frequency and wavelength of an electromagnetic wave as it travels from an optically less dense to an optically more dense medium?

[1 mark]

	Velocity	Frequency	Wavelength	
A	decreases	decreases	unchanged	☐
B	increases	unchanged	increases	☐
C	decreases	unchanged	decreases	☐
D	increases	increases	unchanged	☐



8

Intensity maxima are produced on a screen when a parallel beam of monochromatic light is incident on a diffraction grating. Light of a longer wavelength can be used or the distance from the diffraction grating to the screen can be increased.

Which row gives the change in appearance of the maxima when these changes are made independently?

[1 mark]

	Longer wavelength	Distance from grating to screen increased	
A	closer together	more widely spaced	☐
B	more widely spaced	more widely spaced	☐
C	more widely spaced	closer together	☐
D	closer together	closer together	☐



9

Light of wavelength 500 nm is passed through a diffraction grating which has 400 lines per mm.

What is the angular separation between the two second-order maxima?

[1 mark]

A 11.5°

☐

B 23.1°

☐

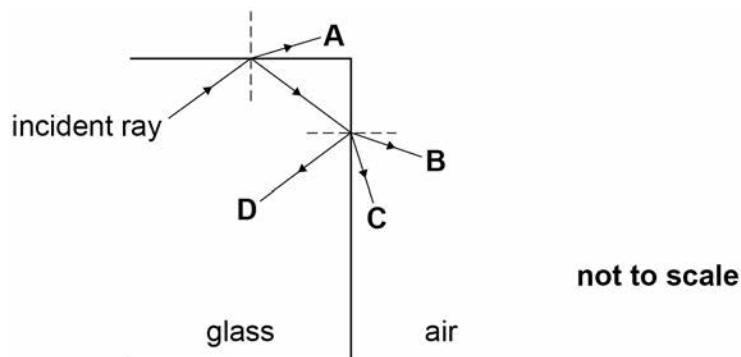
C 23.6°

☐

D 47.2°

☐☐

A ray of light is incident on a glass–air boundary of a rectangular block as shown.



The refractive index of this glass is 1.5

The refractive index of air is 1.0

The angle of incidence of the light at the first glass–air boundary is 44°

What is the path of the ray of light?

[1 mark]

A ☐

B ☐

C ☐

D ☐

☐

11 When a monochromatic light source is incident on two slits of the same width an interference pattern is produced.

One slit is then covered with opaque black paper.

What is the effect of covering one slit on the resulting interference pattern?

[1 mark]

A The intensity of the central maximum will increase



B The width of the central maximum decreases



C Fewer maxima are observed



D The outer maxima become wider



When light of wavelength 5.0×10^{-7} m is incident normally on a diffraction grating the fourth-order maximum is observed at an angle of 30° .

What is the number of lines per mm on the diffraction grating?

[1 mark]

A 2.5×10^2

B 2.5×10^5

C 1.0×10^3

D 1.0×10^6

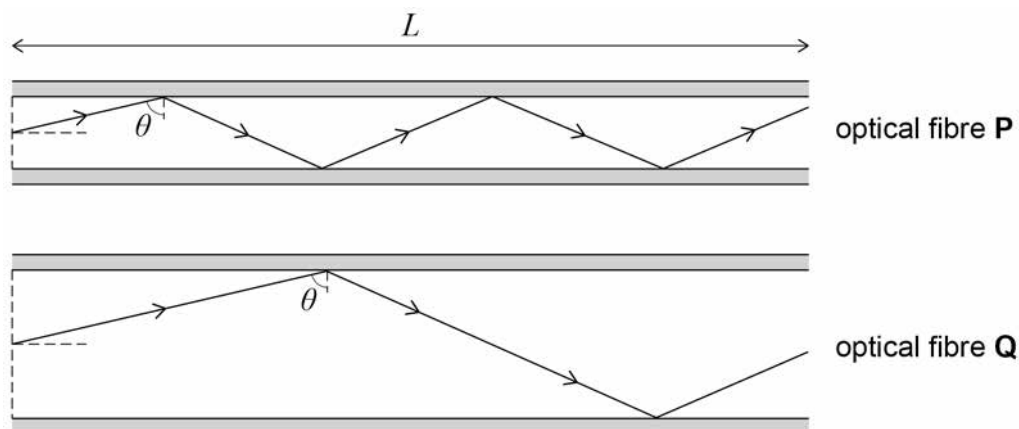


Rays of light are incident at the same angle θ on the core–cladding boundary of optical fibres **P** and **Q**.

The cores of **P** and **Q** have the same refractive index n .

P and **Q** are the same length L .

The core diameter of **P** is half that of **Q**.



The time for the ray to travel along optical fibre **P** is

$$\frac{nL}{c \sin \theta}$$

where c is the speed of light in a vacuum.

What is the time for the ray to travel along optical fibre **Q**?

[1 mark]

A $\frac{nL}{c \sin \theta}$

☐

B $\frac{nL}{2c \sin \theta}$

☐

C $\frac{2nL}{c \sin \theta}$

☐

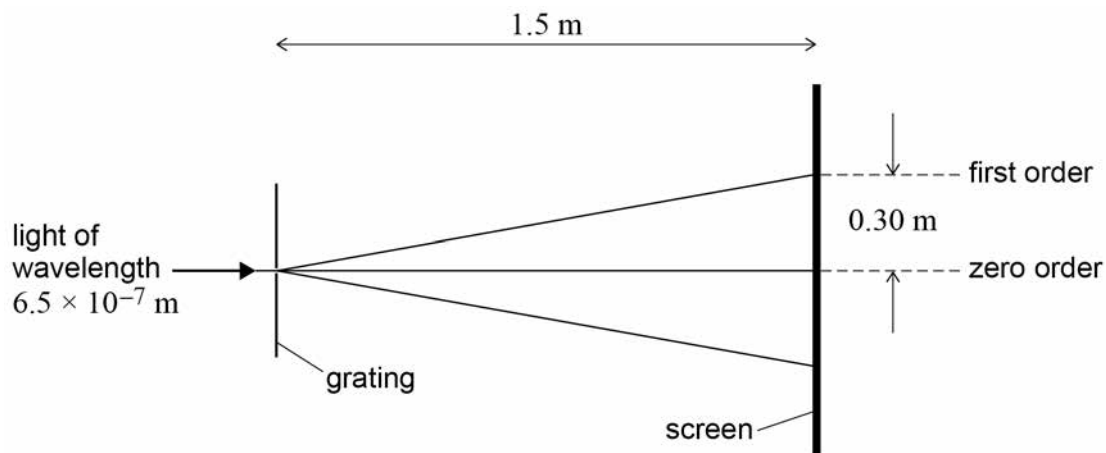
D $\frac{4nL}{c \sin \theta}$

☐
☐

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A diffraction grating is illuminated normally with light of wavelength $6.5 \times 10^{-7} \text{ m}$. When a screen is 1.5 m from the grating, the distance between the zero and first-order maxima on the screen is 0.30 m .



What is the number of lines per mm of the diffraction grating?

[1 mark]

A 3.3×10^{-6}

B 3.3×10^{-3}

C 3.0×10^2

D 3.0×10^5

☐☐☐☐☐

- 15 A diffraction grating has 500 lines per mm. When monochromatic light is incident normally on the grating the third-order spectral line is formed at an angle of 60° from the normal to the grating.

What is the wavelength of the monochromatic light?

[1 mark]

- A** 220 nm
B 580 nm
C 960 nm
D 1700 nm

☐☐☐☐☐

An electromagnetic wave enters a fibre-optic cable from air. On entering the cable, the wave slows down to three-fifths of its original speed.

What is the refractive index of the core of the fibre-optic cable?

[1 mark]

A 0.67

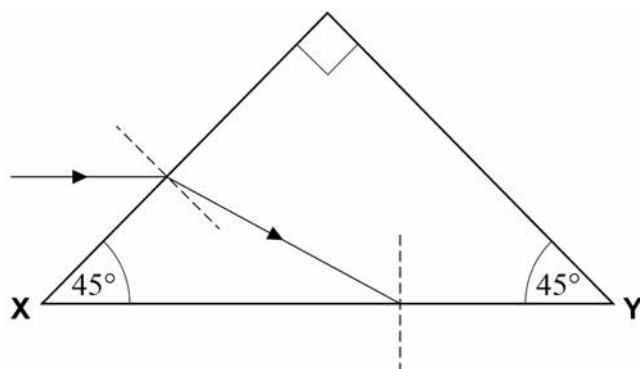
B 1.33

C 1.50

D 1.67

☐☐☐☐☐

The diagram shows part of the path of a ray of light through a right-angled prism.

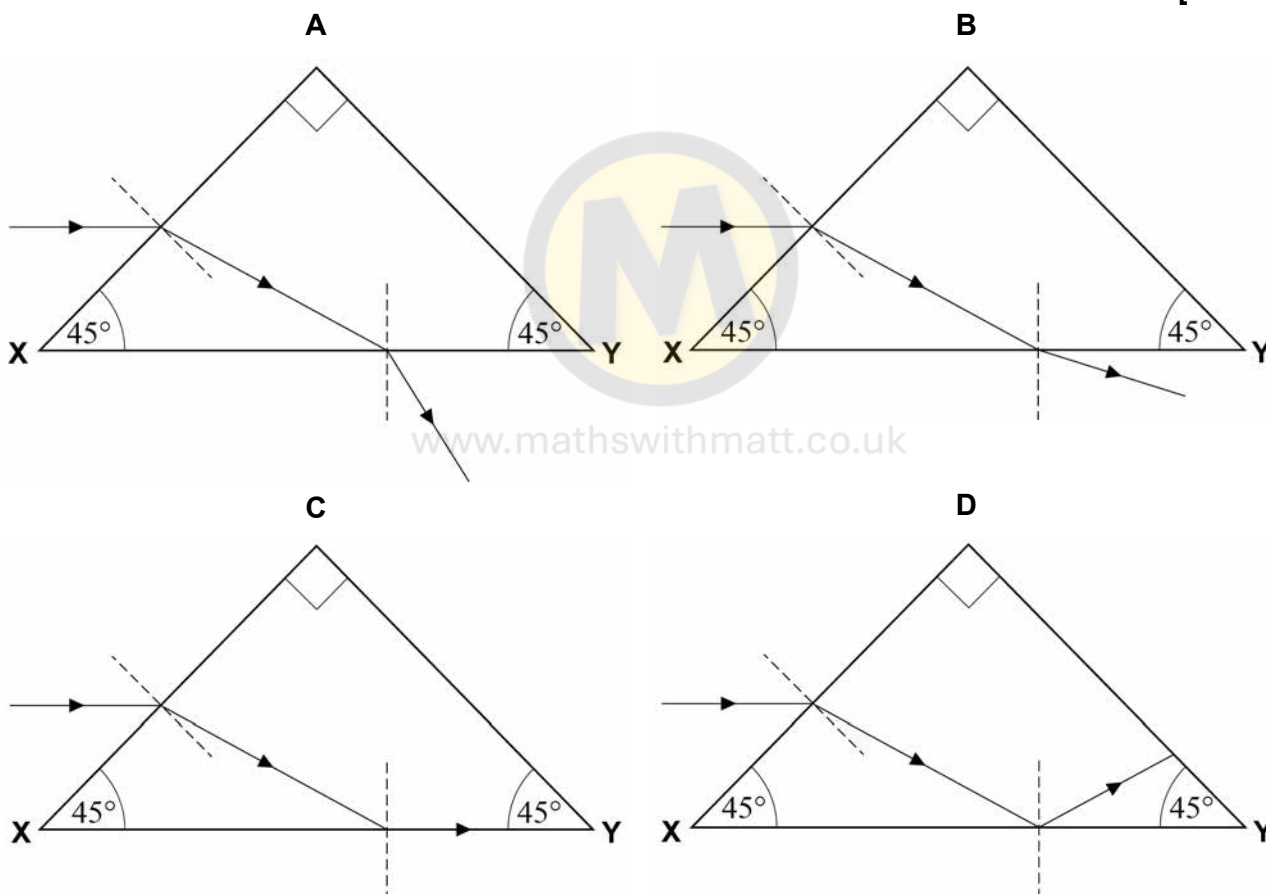


The prism is made of glass of refractive index 1.5

The incident light ray is parallel to the face **XY**. The ray is refracted towards the face **XY**.

What is the path of the ray after it is incident on face **XY**?

[1 mark]



- | | |
|---|--------------------------|
| A | ☐ |
| B | ☐ |
| C | ☐ |
| D | ☐ |



18

In a Young's double-slit experiment, the spacing of the double slits is s and the distance between the slits and the screen on which fringes are formed is D . When monochromatic light of wavelength λ is incident on the slits the distance between adjacent fringes on the screen is w .

Which row shows another arrangement that produces a fringe spacing of w ?

[1 mark]

	Spacing of double slits	Distance between the slits and the screen	Wavelength of the light
A	$4s$	$2D$	2λ
B	$2s$	$4D$	2λ
C	$2s$	$2D$	4λ
D	$2s$	$2D$	2λ



- 19 Monochromatic electromagnetic radiation of wavelength 5.8×10^{-7} m is incident normally on a diffraction grating with 3.0×10^5 lines per metre.

What is the highest order maximum produced?

[1 mark]

A 5

☐

B 6

☐

C 10

☐

D 13

☐☐

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20 Which characteristics of monochromatic light change when the light passes from air into glass?

[1 mark]

A Speed, wavelength and frequency.

☐

B Speed and frequency only.

☐

C Speed and wavelength only.

☐

D Wavelength and frequency only.

☐☐

21

Which is a description of the pattern produced when monochromatic light passes through a very narrow slit?

[1 mark]

- A** A series of equally-spaced light and dark fringes.
- B** A narrow central maximum with wider side fringes.
- C** A few bright fringes that are widely spaced.
- D** A wide central maximum with narrower side fringes.



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22

Light of wavelength λ is incident normally on two parallel slits of separation s . Fringes of spacing w are seen on a screen at a distance D from the slits.

Which row gives another arrangement that produces a fringe spacing of w ?

[1 mark]

	Wavelength	Slit separation	Distance between slits and screen
A	2λ	$2s$	$2D$
B	2λ	$4s$	$2D$
C	2λ	$2s$	$4D$
D	4λ	$2s$	$2D$

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☐

23

A narrow beam of monochromatic light is incident normally to a diffraction grating. The first-order diffracted beam makes an angle of 20° with the normal to the grating.

What is the highest order visible with this grating at this wavelength?

[1 mark]

A 2

☐

B 3

☐

C 4

☐

D 5

☐☐

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24

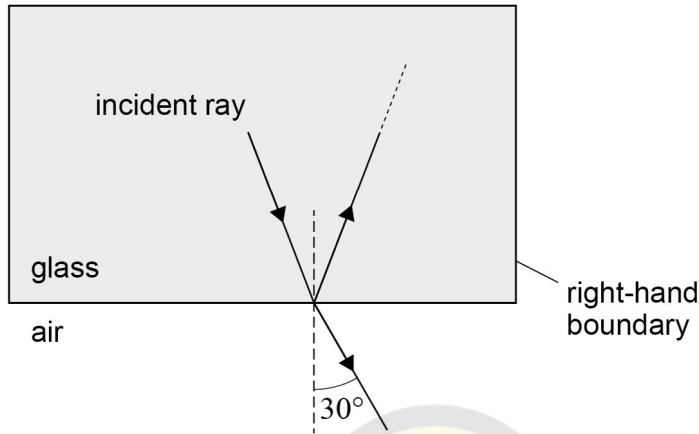
A ray of light is incident on the internal boundary of a rectangular glass block in air.

Part of the light refracts out of the block at an angle of 30° .

Some of the remaining light reflects within the block to become incident on the right-hand boundary.

refractive index of glass = 1.48

not to scale



What is the angle of incidence of the ray at the right-hand boundary?

[1 mark]

A 20° ☐

B 42° ☐

C 48° ☐

D 70° ☐



25 The speed of light decreases by 40% when it travels from air into a transparent medium.

What is the refractive index of the medium?

[1 mark]

A 0.6

☐

B 1.4

☐

C 1.7

☐

D 2.5

☐☐

26 A monochromatic light wave travels from glass into air.

Which row shows what happens to the wavelength, speed and photon energy?

[1 mark]

	Wavelength	Speed	Photon energy
A	increases	increases	increases
B	does not change	decreases	does not change
C	does not change	decreases	increases
D	increases	increases	does not change

☐☐☐☐☐

- 27 Monochromatic light is incident normally on a diffraction grating that has $4.50 \times 10^5 \text{ lines m}^{-1}$.
The angle between the second-order diffraction maxima is 44° .

What is the wavelength of the light?

[1 mark]

A 208 nm

☐

B 416 nm

☐

C 772 nm

☐

D 832 nm

☐

28

A diffraction grating is illuminated normally.

The second-order maximum for light of wavelength 650 nm occurs at the same angle as the third-order maximum for light of wavelength λ .

What is λ ?

[1 mark]

A 217 nm

☐

B 325 nm

☐☐

C 433 nm

☐

D 975 nm

☐

29

In a Young's double-slit experiment, monochromatic light is incident on two narrow slits and the resulting interference pattern is observed on a screen.

Which change **decreases** the fringe separation?

[1 mark]

A decreasing the separation between the two slits

☐

B increasing the distance between the slits and the screen

☐

C using monochromatic light of higher frequency

☐

D using monochromatic light of longer wavelength

☐☐

30

Light of wavelength 5.2×10^{-7} m is used in a Young's double-slit experiment.
The distance from the slits to the screen is 1.5 m.
The width of ten fringes is 3.5 cm.

What is the separation of the two slits?

[1 mark]

A 2.2×10^{-5} m

☐

B 9.9×10^{-5} m

☐

C 1.1×10^{-4} m

☐

D 2.2×10^{-4} m

☐

- 31 Monochromatic light of wavelength 5.8×10^{-7} m is incident normally on a plane transmission diffraction grating that has a slit separation of 2.5×10^{-6} m.

How many maxima are produced by the grating?

[1 mark]

A 4

☐

B 5

☐☐

C 8

☐

D 9

☐

- 32 Monochromatic visible light is incident normally on a plane transmission diffraction grating that has 4.8×10^5 lines m^{-1} .
First-order maxima are observed at angles of 16° to the central maximum.

How many maxima in total can be observed?

[1 mark]

A 3

☐

B 4

☐

C 5

☐

D 7

☐☐

33

Which combination produces the smallest modal dispersion in an optical fibre?

[1 mark]

	Refractive index of core	Refractive index of cladding
A	1.5	1.4
B	1.4	1.5
C	1.5	1.3
D	1.3	1.5

☐☐☐☐☐

- 34 Light of wavelength λ is incident normally on a diffraction grating.
The separation between adjacent slits is equal to 5λ .

What is the smallest angle between the third-order maximum and fourth-order maximum diffracted beams?

[1 mark]

A 13.3°

☐

B 16.2°

☐

C 36.9°

☐

D 53.1°

☐☐

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35

A central diffraction maximum is observed when monochromatic light of wavelength λ passes through a single slit of width s .

Which combination of changes to λ and s will always produce a wider central diffraction maximum?

[1 mark]

	Change to λ	Change to s	
A	decrease	decrease	☐
B	decrease	increase	☐
C	increase	decrease	☐
D	increase	increase	☐

36

A double slit with a separation s is illuminated by light of wavelength λ .
Fringes with spacing w are produced on a screen placed a distance D from the slits.

The distance from the slits to the screen is changed to $\frac{D}{2}$.

Which combination of slit separation and wavelength produces a fringe spacing of $1.5w$ on the screen?

[1 mark]

	Slit separation	Wavelength
A	$0.22s$	0.66λ
B	$0.50s$	0.75λ
C	$0.60s$	1.20λ
D	$1.20s$	0.40λ

☐
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☐
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☐

- 37 Monochromatic light of wavelength 520 nm is incident normally on a diffraction grating. The third-order maximum occurs at a diffraction angle θ .

Light of wavelength λ is incident normally on the same grating. The fourth-order maximum also occurs at angle θ .

What is λ ?

[1 mark]

A 260 nm

☐

B 390 nm

☐

C 690 nm

☐

D 780 nm

☐☐

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38

The cladding of a step-index optical fibre

[1 mark]

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A must not be transparent.

☐

B must have a higher refractive index than the core.

☐

C reduces signal loss.

☐

D reduces material dispersion.

☐☐

39

Monochromatic light is used in a Young's double-slit interference experiment after passing through a single slit. The resulting fringe pattern is observed on a screen.

The separation of the fringes can be increased by

[1 mark]

A using monochromatic light of lower frequency.

B decreasing the width of the single slit.

C increasing the separation of the double slits.

D decreasing the distance between the double slits and the screen.

☐☐☐☐

40

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?

[1 mark]

- 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.

☐☐☐☐

Which one of the following provides direct experimental evidence that light is a transverse wave motion rather than a longitudinal wave motion?

[1 mark]

- A** Two light waves that are coherent can be made to interfere.
- B** Light can be diffracted.
- C** Light can be polarised.
- D** The intensity of light from a point source falls off inversely as the square of the distance from the source.

☐☐☐☐☐