Q1.

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?

A 260 nm ⬭

B 390 nm ⬭

C 690 nm ⬭

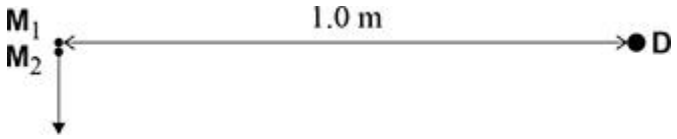
D 780 nm ⬭

(Total 1 mark)

Q2.

Sources $\mathbf{M}_1$ and $\mathbf{M}_2$ emit coherent microwaves of wavelength 5.0 cm.

When $\mathbf{M}_1$ and $\mathbf{M}_2$ are very close, a maximum of intensity occurs at a point **D** that is 1.0 m away.



$\mathbf{M}_2$ is moved away from $\mathbf{M}_1$ along the line perpendicular to $\mathbf{M}_1\mathbf{D}$.

The next maximum of intensity occurs at **D** when the distance between $\mathbf{M}_1$ and $\mathbf{M}_2$ is

A 5.0 cm ⬭

B 10 cm ⬭

C 16 cm ⬭

D 32 cm ⬭

(Total 1 mark)

Q3.

The cladding of a step-index optical fibre

A must not be transparent ⬭

B must have a higher refractive index than the core ⬭

C reduces signal loss ⬭

D reduces material dispersion ⬭

(Total 1 mark)

Q4.

Point sources of sound of the same frequency are placed at S_1 and S_2.

A sound detector is moved slowly along the line **PQ**. Consecutive maxima of sound intensity are detected at **W** and **Y** and consecutive minima are detected at **X** and **Z**.

What is the wavelength of the sound?

A $(S_1Y - S_2Y) - (S_1W - S_2W)$ ⬭

B $(S_1X - S_2X) - (S_1W - S_2W)$ ⬭

C $(S_1Y - S_2Y) - (S_1X - S_2X)$ ⬭

D $(S_1Z - S_2Z) - (S_1W - S_2W)$ ⬭

(Total 1 mark)

Q5.

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

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 ⬭

(Total 1 mark)

Q6.

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?

A 13.3° ⬭

B 16.2° ⬭

C 36.9° ⬭

D 53.1° ⬭

(Total 1 mark)

Q7.

S_1 and S_2 are coherent sources of microwaves that produce waves of the same amplitude.
A microwave detector gives a zero reading when placed at a point that is the same distance from S_1 and S_2.

What is the phase difference between microwaves from S_1 and S_2 at the detector?

A zero ⬭

B 1.6 rad ⬭

C 3.1 rad ⬭

D 6.3 rad ⬭

(Total 1 mark)

Q8.

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?

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

(Total 1 mark)

Q9.

Electrons with a certain kinetic energy pass through a powdered crystalline sample and are incident on a fluorescent screen.
The diagram shows a sketch of the diffraction pattern produced.

A change is made and this second pattern is produced.

Which change could produce the second pattern?

A decreasing the kinetic energy of the electrons ⬭

B replacing the electrons with protons with the same kinetic energy ⬭

C using a crystalline sample with a wider spacing between its atoms ⬭

D moving the screen closer to the crystalline sample ⬭

(Total 1 mark)

Q10.

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?

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

(Total 1 mark)

Q11.

A single narrow slit is illuminated with monochromatic light and a diffraction pattern is produced.

The slit width is increased.

What happens to the width and brightness of the central maximum of the diffraction pattern?

	Width of central maximum	Brightness of central maximum	
A	increases	increases	⬭
B	increases	decreases	⬭
C	decreases	increases	⬭
D	decreases	decreases	⬭

(Total 1 mark)

Q12.

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?

A 3 ⬭

B 4 ⬭

C 5 ⬭

D 7 ⬭

(Total 1 mark)

Q13.

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

	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	⬭

(Total 1 mark)

Q14.

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?

A 2.2×10^{-5} m ⬭

B 9.9×10^{-5} m ⬭

C 1.1×10^{-4} m ⬭

D 2.2×10^{-4} m ⬭

(Total 1 mark)

Q15.

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?

A 4 ⬭

B 5 ⬭

C 8 ⬭

D 9 ⬭

(Total 1 mark)