# Diffraction

## TOPIC QUESTIONS

| Level | A Level |
|---|---|
| Subject | Physics |
| Exam Board | AQA |
| Paper Type | Multiple Choice |

**Time Allowed : 30min**

1. 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 ordervisible with this grating at this wavelength?

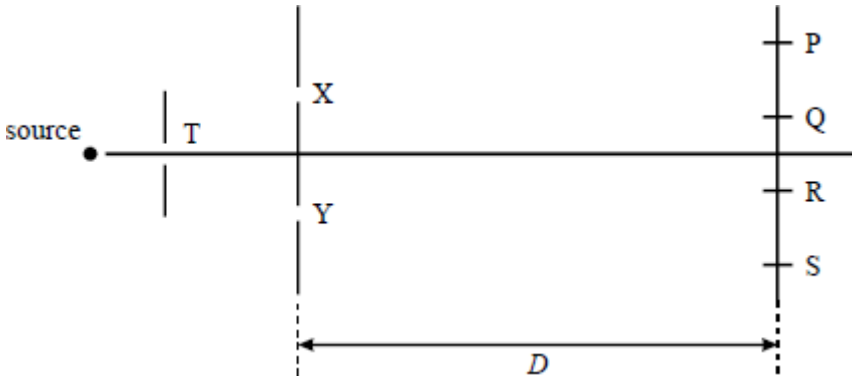
   **A** 2

   **B** 3

   **C** 4

   **D** 5

2.




Coherent monochromatic light of wavelength $\lambda$ 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 $2\lambda$ .



3. Monochromatic light of wavelength 590 nm is incident normally on a plane diffraction grating having $4 \times 10^5$ 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

4. In a double slit interference arrangement the fringe spacing is $w$ when the wavelength of the radiation is $\lambda$, 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** | $2\lambda$ | $2s$ | $2D$ |
| **B** | $2\lambda$ | $4s$ | $2D$ |
| **C** | $2\lambda$ | $2s$ | $4D$ |
| **D** | $4\lambda$ | $2s$ | $2D$ |

5. 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** $2 \times 10^4$

**B** $2 \times 10^5$

**C** $4 \times 10^5$

**D** $5 \times 10^5$

6. Which line, **A** to **D**, in the table gives a correct difference between a progressive wave and a stationary wave?

| | **progressive wave** | **stationary wave** |
|---|---|---|
| **A** | all the particles vibrate | some of the particles do not vibrate |
| **B** | none of the particles vibrate with the same amplitude | all the particles vibrate with the same amplitude |
| **C** | all the particles vibrate in phase with each other | none of the particles vibrate in phase with each other |
| **D** | some of the particles do not vibrate | all the particles vibrate in phase with each other |

7. Stationary waves are set up on a length of rope fixed at both ends. Which one of the following statements is true?

**A** Between adjacent nodes, particles of the rope vibrate in phase with each other.

**B** The mid point of the rope is always stationary.

**C** Nodes need not necessarily be present at each end of the rope.

**D** Particles of the rope at adjacent antinodes always move in the same direction.

8. A wave of frequency 5 Hz travels at 8 km $s^{-1}$ through a medium. What is the phase difference, in radians, between two points 2 km apart?

A 0

B $\frac{\pi}{2}$

C π

D $\frac{3\pi}{2}$

9. A source emits light of wavelength 600 nm as a train of waves lasting 0.01 μs. How many completewaves are sent out?
speed of light = $3 \times 10^8$ m $s^{-1}$

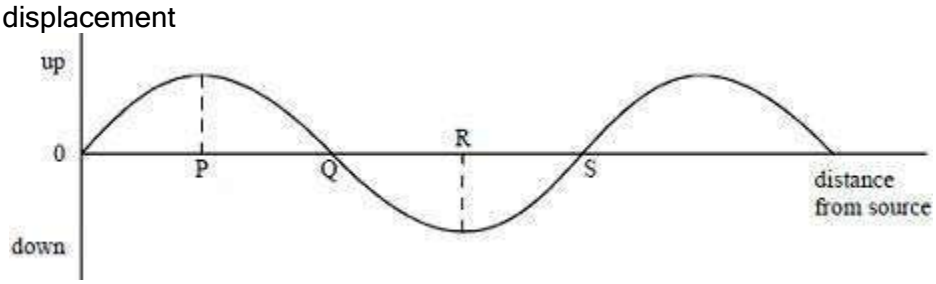
A $5 \times 10^6$

B $18 \times 10^7$

C $5 \times 10^9$

D $5 \times 10^{22}$

**10.**




The graph shows, at a particular instant, the variation of the displacement of the particles in a transverse progressive water wave, of wavelength 4 cm, travelling from left to right. Which one of the following statements is **not** true?

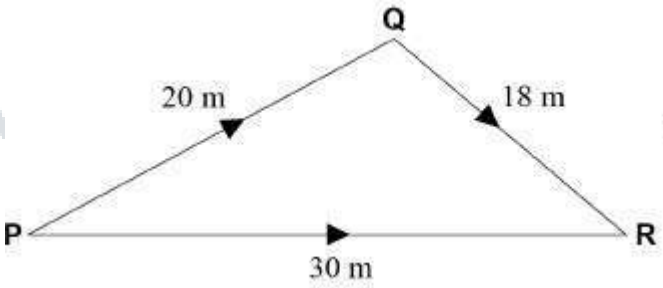
**A** The distance PS = 3 cm.

**B** The particle velocity at Q is a maximum.

**C** The particle at S is moving downwards

**D** Particles at P and R are in phase.

11. In the diagram, **P** is the source of a wave of frequency 50 Hz




The wave travels to **R** by two routes, **P** → **Q** → **R** and **P** → **R**. The speed of the wave is 30 m s−1

What is the path difference between the two waves at **R** in terms of the wavelength $\lambda$ of the waves?

**A** $4.8\lambda$

**B** $8.0\lambda$

**C** $13.3\lambda$

**D** $20.0\lambda$

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

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

**A** 0.67

**B** 1.33

**C** 1.50

**D** 1.67

13. A diffraction grating has 500 lines per mm. When monochromatic light is incident normally on thegrating 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?

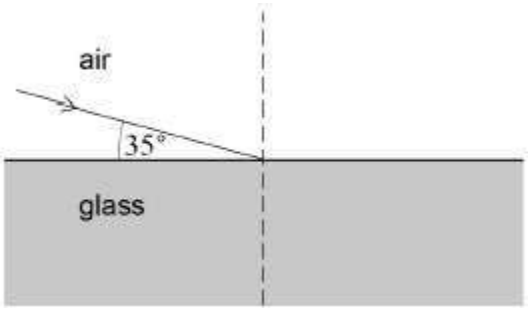
**A** 220 nm

**B** 580 nm

**C** 960 nm

**D** 1700 nm

14. The diagram shows a ray of light travelling in air and incident on a glass block of refractive index1.5




What is the angle of refraction in the glass?

**A** 22.5°

**B** 23.3°

**C** 33.1°

**D** 59.4°

15. When light of wavelength $5.0 \times 10^{-7}$ m is incident normally on a diffraction grating thefourth-order maximum is observed at an angle of 30°.

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

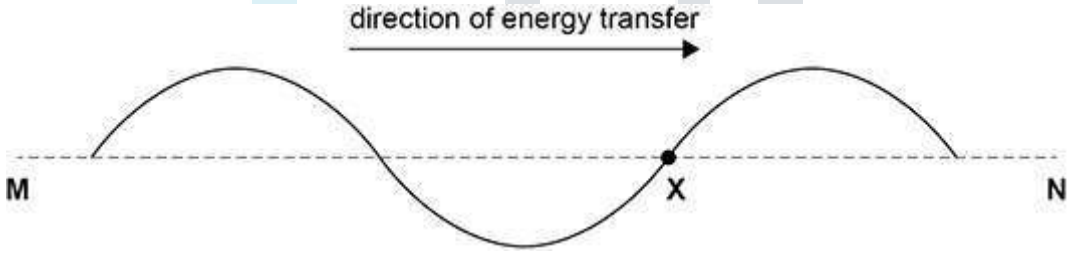
**A** $2.5 \times 10^{2}$

**B** $2.5 \times 10^{5}$

**C** $1.0 \times 10^{3}$

**D** $1.0 \times 10^{6}$

16. A progressive wave travels along a rope in the direction **M** to **N**.**X** marks a point on the rope.




The wave has a frequency of 5.0 Hz, a wavelength of 1.0 m and an amplitude of 0.20 m.

Where will **X** be after 0.15 s?

**A** below **MN** by 0.20 m

**B** above **MN** by 0.20 m

**C** nearer **N** by 0.15 m

**D** nearer **N** by 0.75 m

17. The diagram shows a string stretched between two fixed points **O** and **R** which are 120 cm apart.

**P** and **Q** are points on the string.

**OP** = 30 cm
**OQ** = 90 cm


At a certain frequency the string vibrates at its first harmonic.

**P** and **Q** oscillate in phase.

The frequency is gradually increased.

What is the next harmonic at which **P** and **Q** will oscillate in phase?

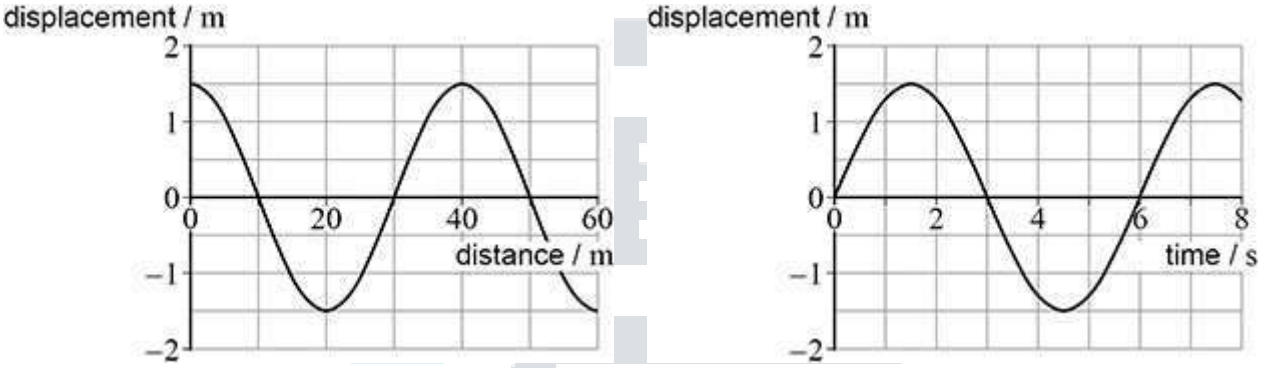
**A** second

**B** third

**C** fourth

**D** fifth

18. The diagrams show the displacement-distance graph for a wave and the displacement-time graph for a point in the wave.




Which is correct for this wave?

**A** The amplitude is 3.0 m.

**B** The wavelength is 6 m.

**C** The speed is 8.3 m $s^{-1}$.

**D** The frequency is 0.17 Hz.

19. The diagram shows a stationary wave on a string at one instant in time.

**P**, **Q** and **R** are three points on the string.

Which row is correct?

| | | |
|---|---|---|
| **A** | **P** is in antiphase with **R** | **P** has the same amplitude as **Q** |
| **B** | **P** is out of phase with **R** | **P** has the same amplitude as **R** |
| **C** | **P** is in phase with **Q** | **P** has the same amplitude as **R** |
| **D** | **P** is out of phase with **Q** | **P** has a smaller amplitude than **R** |

20. Two waves with amplitudes $a$ and $3a$ interfere.

The ratio is

**A** 2

**B** 3

**C** 4

**D** infinit