

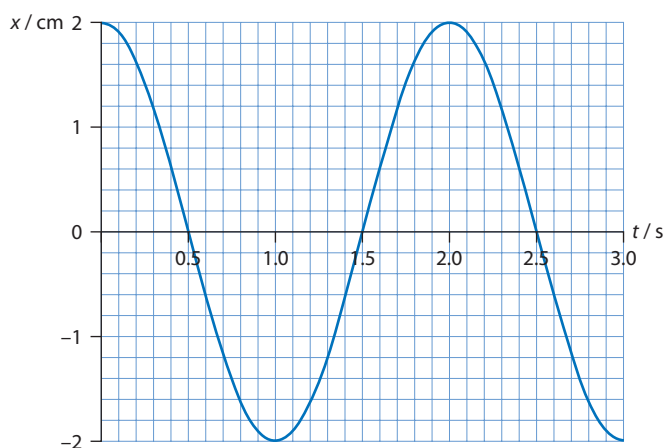
Self-test questions

Topic 9

1 A block of mass m is suspended from a vertical spring of spring constant k . At equilibrium the spring is extended by a distance x_0 . The block is pulled down a further distance y_0 from the equilibrium position and is then released. What is the maximum speed of the block during the oscillations that take place?

- A $y_0 \sqrt{\frac{k}{m}}$
- B $y_0 \sqrt{\frac{m}{k}}$
- C $(x_0 + y_0) \sqrt{\frac{k}{m}}$
- D $(x_0 + y_0) \sqrt{\frac{m}{k}}$

2 The graph shows the variation with time of the displacement of a particle executing simple harmonic oscillations.



What is the velocity, in m s^{-1} , of the particle at time $t = 0.50$ s?

- A 6.28
 - B -6.28
 - C 6.28×10^{-2}
 - D -6.28×10^{-2}
- 3 In simple harmonic motion what is the phase difference between the graphs of displacement versus time and acceleration versus time?
- A 0
 - B $\frac{\pi}{4}$
 - C $\frac{\pi}{2}$
 - D π

4 Light is incident normally on a thin film of soap water of thickness d that is suspended in air. The wavelength of light in air is λ . The refractive index of soap water is n . The light reflected from the film suffers destructive interference. Which of the following gives a possible thickness of the film?

- A $\frac{\lambda}{4}$
- B $\frac{\lambda}{2}$
- C $\frac{\lambda}{4n}$
- D $\frac{\lambda}{2n}$

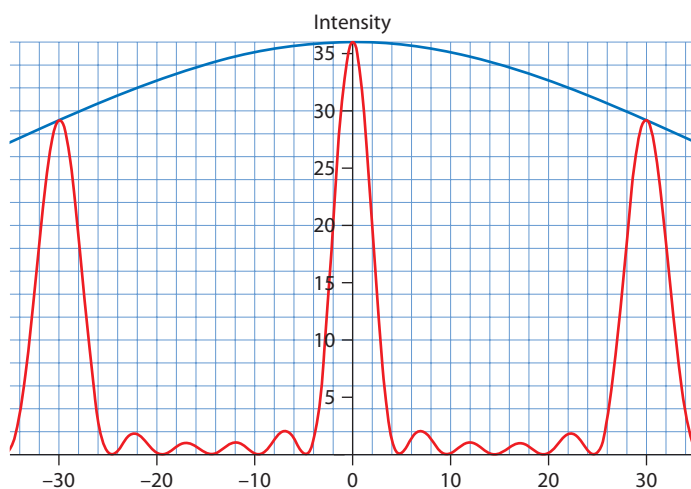
5 In a diffraction experiment with a single slit the intensity of the central maximum of the diffraction pattern is I and the angle at which the first minimum is observed is θ . What is the effect on I and θ of reducing the slit width? The light source stays the same.

	I	θ
A	increases	increases
B	increases	decreases
C	decreases	increases
D	decreases	decreases

6 In a Young type two slit interference experiment the third maximum away from the central maximum of the two slit interference pattern coincides with the first minimum of the single slit diffraction pattern. What is the relation between the slit separation d and the slit width b ?

- A $d = \frac{b}{3}$
- B $d = 3b$
- C $d = \frac{b}{6}$
- D $d = 6b$

7 The graph shows the intensity pattern from interference by N slits (red curve) modulated by the single slit diffraction pattern (blue curve).



What is the value of N and what is the relationship between the slit separation d and the wavelength λ ?

	N	Relationship
A	4	$d = 2\lambda$
B	4	$d = \frac{\lambda}{2}$
C	6	$d = 2\lambda$
D	6	$d = \frac{\lambda}{2}$

- 8 Two stars are observed by a number of radio telescopes of different dish diameters. The stars emit a range of wavelengths. The images of the stars by a particular telescope are not well resolved. Which of the changes below would be most likely to result in resolution of the star images?

	Wavelength	Dish diameter
A	Observe stars at shorter wavelengths	Use larger dish telescope
B	Observe stars at shorter wavelengths	Use smaller dish telescope
C	Observe stars at longer wavelengths	Use larger dish telescope
D	Observe stars at longer wavelengths	Use smaller dish telescope

- 9 A diffraction grating has 500 lines per mm and is 2.0 cm wide. Light of average wavelength 600 nm is incident on the diffraction grating. What is the least difference in wavelength that can be resolved by this diffraction grating in the third order?

- A** 0.010 nm
B 0.020 nm
C 0.030 nm
D 0.040 nm

- 10 A jet plane is moving away from a stationary observer at a speed that is half the speed of sound in still air. The jet emits sound of frequency f . What is the frequency received by the observer?

- A** $2f$
B $\frac{f}{2}$
C $\frac{2f}{3}$
D $\frac{3f}{2}$