1 In a horizontal spring-mass system, a mass *m* oscillates with a frequency *f* and an amplitude *x*. The total energy of the oscillating system is *E*.

What is the total energy of a spring-mass system with a mass 0.50 *m*, frequency 3.0 *f* and amplitude 0.40 *x*?

A 0.24*E* **B** 0.60*E* **C** 0.72*E* **D** 1.8*E*

2 Which statement is true of a lightly-damped system?

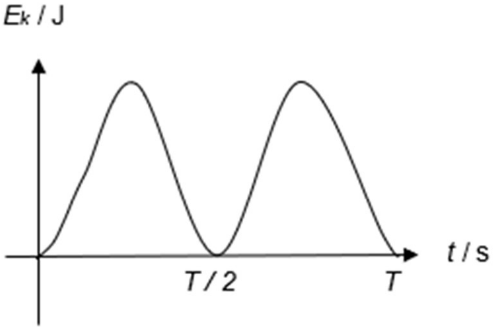
A Increased damping will decrease the frequency of the system.
B Increased damping will not affect the period of the system.
C The amplitude of the system remains constant over time.
D The period of the system increases over time.

3 An object placed on a horizontal platform is oscillating vertically in simple harmonic motion with a frequency of 1.5 Hz.

What is the maximum amplitude of oscillation that will allow the object to remain in contact with the platform throughout the motion?

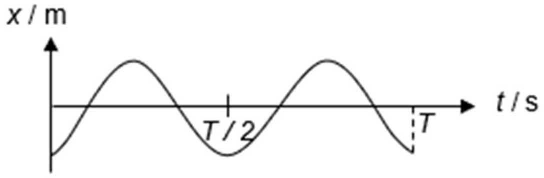
A 0.11 m **B** 1.0 m **C** 6.5 m **D** 9.0 m

4 The following graph shows the variation of kinetic energy, E_k with time, t of a particle undergoing simple harmonic motion about a point Q. The period of the motion is T.

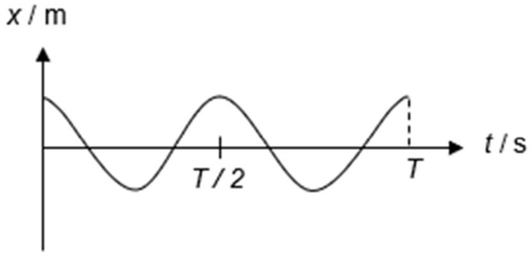


Which of the following graphs best shows the variation with time of its displacement, x from point Q?

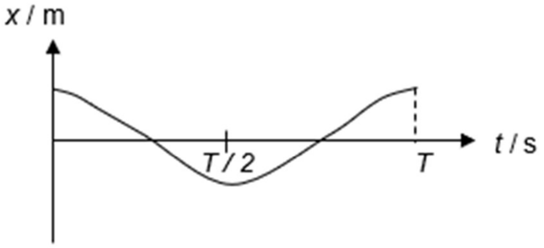
A



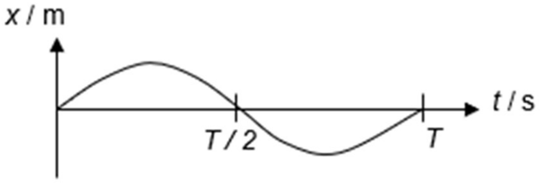
B



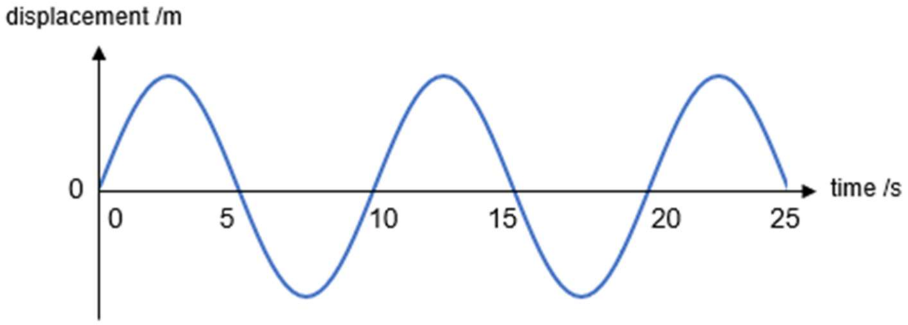
C



D

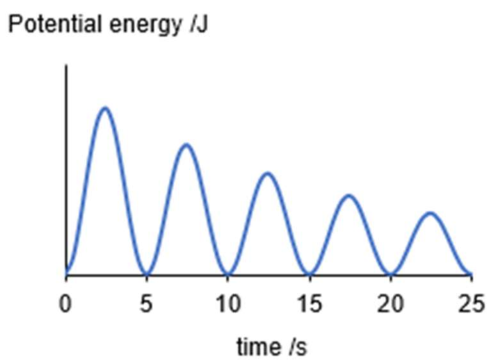


5 The diagram below shows the displacement-time graph for a system oscillating freely with negligible damping.

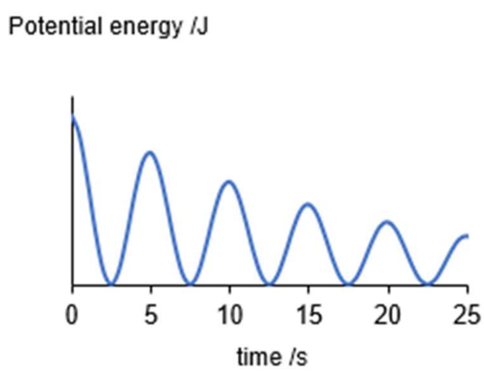


The system is **now** placed in an environment with **significant** damping and set into oscillation. At time t = 0 s, the displacement of the object is 0 m. Which one of the following graphs best describes how the potential energy of the system varies with time?

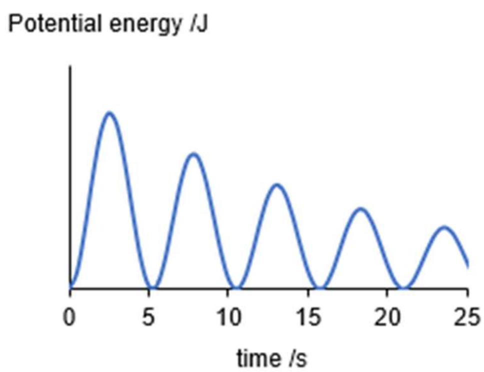
A



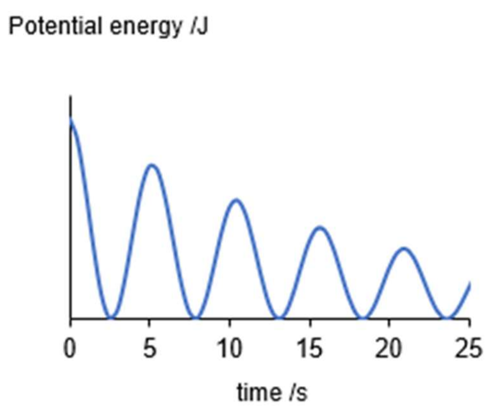
B



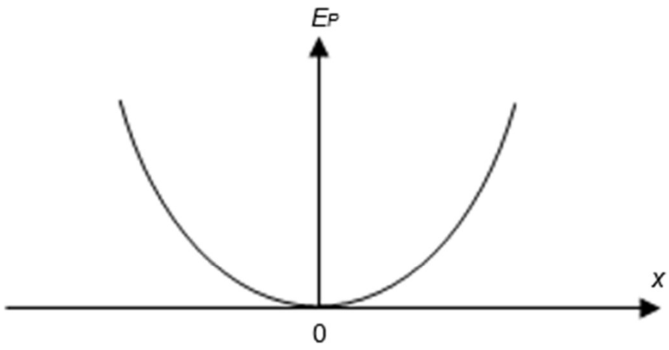
C



D



6 The graph shows the variation of potential energy E_P of a body with its displacement x from a fixed point O.



Which feature of the graph indicates that the net force on the body is always directed towards O?

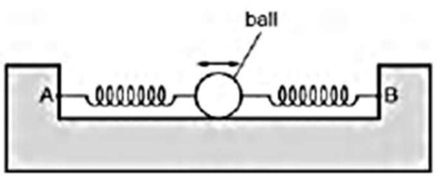
A The graph passes through the origin.

B The graph is symmetrical about the vertical axis.

C The potential energy increases as the body moves away from O.

D The value of the potential energy is always positive.

7 A ball is held between two fixed points A and B by means of two stretched springs, as shown.



The ball is held at an initial displacement x_0 by a force F. Upon being released, the ball oscillates horizontally with an amplitude A and frequency f.

The springs are changed such that a larger force $2F$ is now required to hold the ball at the same initial displacement x_0.

What are the amplitude and frequency of the oscillations of the ball upon being released, if all the springs do not exceed their limits of proportionality during the oscillations?

	amplitude	frequency
A	$\frac{1}{2}A$	$\sqrt{2}f$
B	A	$\sqrt{2}f$
C	A	$2f$
D	$2A$	$2f$

8 One end of a spring is fixed to a support. A block of mass 2.0 kg is attached to the other end of the spring, which causes the spring to extend by 5.0 cm.

The block is then pulled down a distance of 2.5 cm and released to perform a simple harmonic motion of period 0.45 s.

What is the amplitude and angular frequency of the motion?

	amplitude / cm	angular frequency / rad s^{-1}
A	7.5	0.45
B	7.5	14
C	2.5	0.45
D	2.5	14

9 Which of the following shows oscillation of decreasing order of damping?

A critical damping, light damping, heavy damping.

B critical damping, heavy damping, light damping.

C heavy damping, critical damping, light damping.

D critical damping, heavy damping, free oscillation.

10 A horizontal plate is oscillating vertically in simple harmonic motion at a frequency of 3.2 Hz.

What is the maximum amplitude of oscillation such that a coin placed on the plate will always remain in contact with the plate?

A 0.024 m **B** 0.15 m **C** 0.49 m **D** 0.96 m

11 Fig. 12.1 shows the variation with displacement x of velocity v of a simple harmonic oscillator. Fig. 12.2 shows the variation with time t of the acceleration a of the oscillator.

Which of the points on the a-t graph corresponds to the state of motion represented by point **P**?

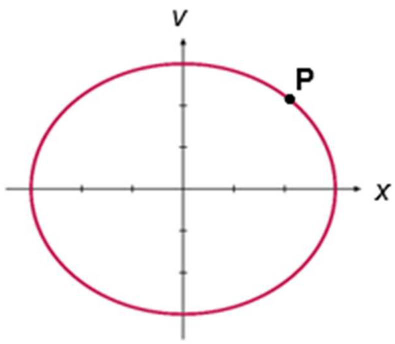


Fig. 12.1

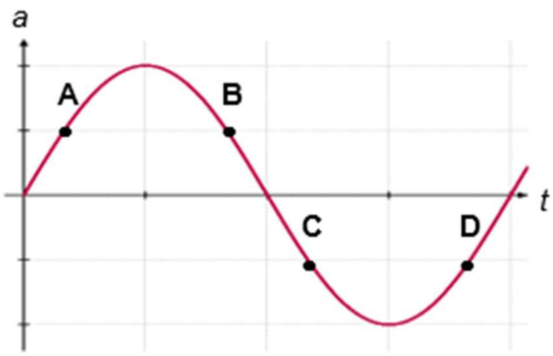


Fig. 12.2

12 An object that undergoes simple harmonic motion has an amplitude A and total energy E.

What is the displacement of the object from the equilibrium position when its kinetic energy is ¾ E?

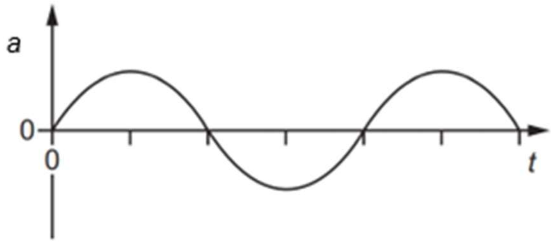
A 0.25 A

B 0.50 A

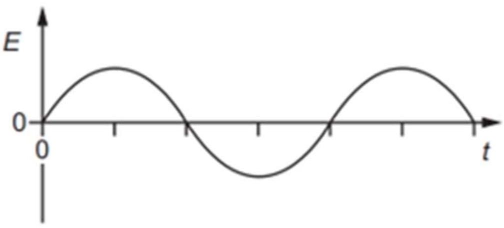
C 0.75 A

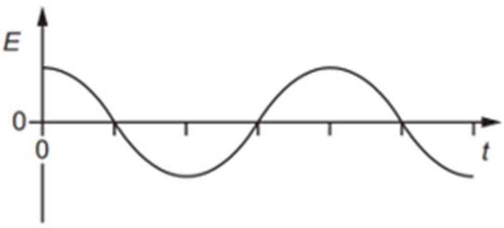
D 0.87 A

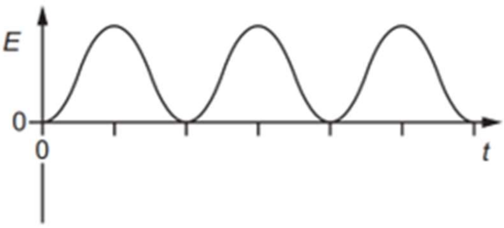
13 An undamped oscillator is executing simple harmonic motion. A graph of the acceleration *a* against time *t* for this oscillator is shown.

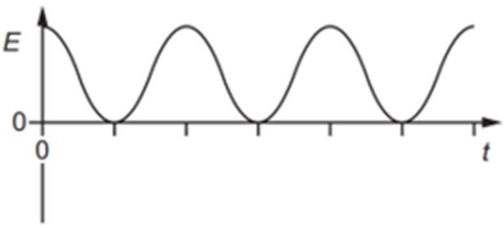


Which graph shows the variation of the kinetic energy *E* of the oscillator with time *t*?

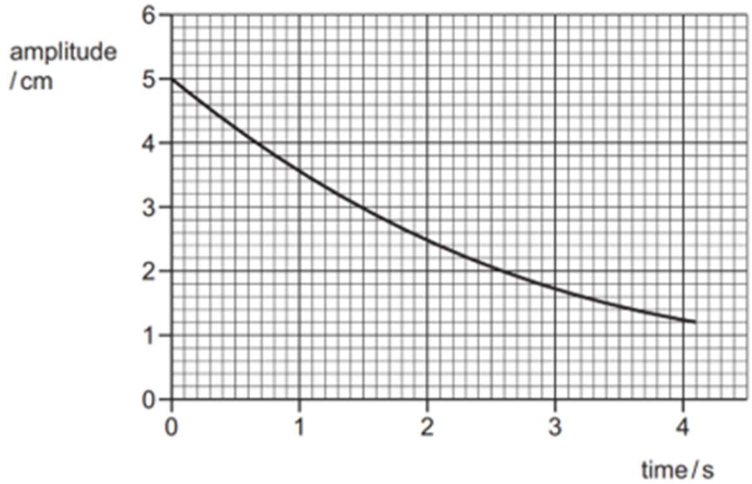
A


B


C


D


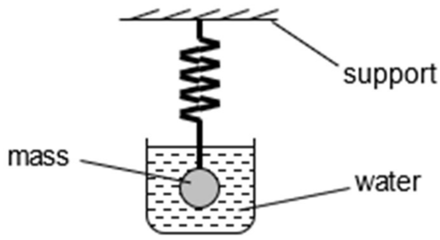
14 The graph shows how the amplitude of a simple pendulum decays with time from an initial amplitude of 5.0 cm.



What is the fraction of the initial energy that has been lost in the first 4.0 s?

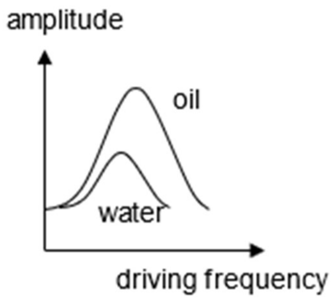
A $\frac{1}{16}$ **B** $\frac{1}{4}$ **C** $\frac{3}{4}$ **D** $\frac{15}{16}$

15 A mass oscillates vertically in water as shown in the figure below.

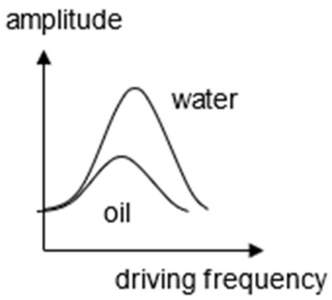


The support vibrates with a driving frequency, which can be varied. Another similar setup is used, with oil replacing water.
Which graph best represents the variation with driving frequency of the amplitude of oscillation of the mass?

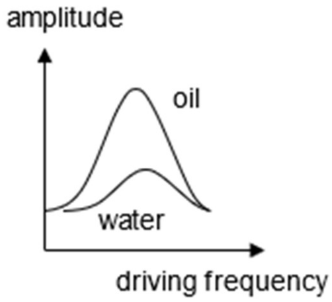
A



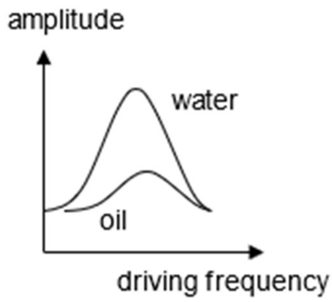
B



C



D



16 A sinusoidal transverse wave is travelling along a rope. Any point on the rope

A moves in the same direction as the wave
B moves periodically with a different frequency from that of the wave
C moves periodically perpendicular to the direction of the wave
D moves circularly with a different speed from that of the wave

17 **Fig. 11.1** shows the variation with displacement x of the velocity v of a simple harmonic oscillator. **Fig. 11.2** shows the variation with time t of the net force F acting on the oscillator.

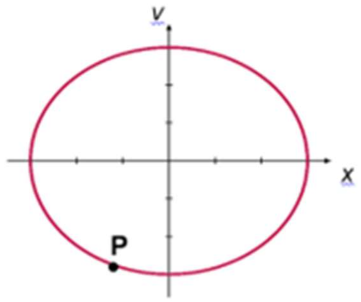


Fig. 11.1

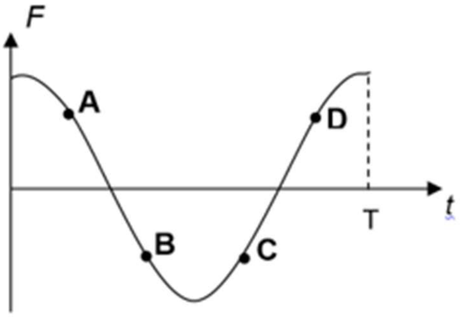


Fig. 11.2

Which of the points in **Fig. 11.2** corresponds to the state of motion represented by point P in **Fig. 11.1**?