Multiple Choice SHM Paper Questions
Jan 2002—Jan 2010 (old spec)

1 A simple pendulum and a mass-spring system are taken to the Moon, where the gravitational field strength is less than on Earth. Which line, **A** to **D**, correctly describes the change, if any, in the period when compared with its value on Earth?

Jan 2002

	period of pendulum	period of mass-spring system
A	decrease	decrease
B	increase	increase
C	no change	decrease
D	increase	no change

2 A body moves with simple harmonic motion of amplitude A and frequency $\dfrac{b}{2\pi}$.

What is the magnitude of the acceleration when the body is at maximum displacement?

A zero

B $4\pi^2Ab^2$

C Ab^2

D $\dfrac{4\pi^2A}{b^2}$

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1 A mass M hangs in equilibrium on a spring. M is made to oscillate about the equilibrium position by pulling it down 10 cm and releasing it. The time for M to travel back to the equilibrium position for the first time is 0.50 s. Which line, **A** to **D**, is correct for these oscillations?

Jun 2002

	amplitude/cm	period/s
A	10	1.0
B	10	2.0
C	20	2.0
D	20	1.0

3 Which one of the following statements is true when an object performs simple harmonic motion about a central point O?

A The acceleration is always away from O.

B The acceleration and velocity are always in opposite directions.

C The acceleration and the displacement from O are always in the same direction.

D The graph of acceleration against displacement is a straight line.

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1 Which one of the following gives the phase difference between the particle velocity and the particle displacement in simple harmonic motion?

Jan 2003

A $\frac{\pi}{4}$ rad

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

C $\frac{3\pi}{4}$ rad

D 2π rad

2 A particle oscillates with undamped simple harmonic motion. Which one of the following statements about the acceleration of the oscillating particle is true?

A It is least when the speed is greatest.
B It is always in the opposite direction to its velocity.
C It is proportional to the frequency.
D It decreases as the potential energy increases.

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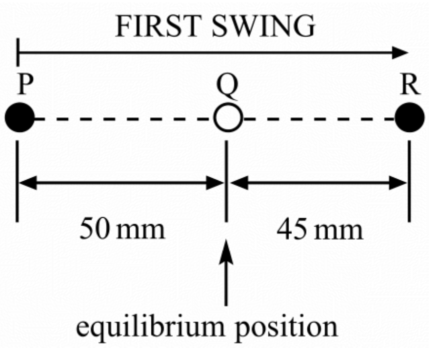
1 A particle, whose equilibrium position is at Q, is set into oscillation by being displaced to P, 50 mm from Q, and then released from rest. Its subsequent motion is simple harmonic, but subject to damping. On the first swing, the particle comes to rest momentarily at R, 45 mm from Q.

Jun 2003



During this first swing, the greatest value of the acceleration of the particle is when it is at

A P.
B Q.
C R.
D P and R.

2 A particle of mass 5.0×10^{-3} kg performing simple harmonic motion of amplitude 150 mm takes 47 s to make 50 oscillations. What is the maximum kinetic energy of the particle?

A 2.0×10^{-3} J
B 2.5×10^{-3} J
C 3.9×10^{-3} J
D 5.0×10^{-3} J

3 When the length of a simple pendulum is decreased by 600 mm, the period of oscillation is halved. What is the original length of the pendulum?

A 800 mm
B 1000 mm
C 1200 mm
D 1400 mm

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1 A body moves in simple harmonic motion of amplitude 0.90 m and period 8.9 s. What is the speed of the body when its displacement is 0.70 m?

Jan 2004

A $0.11\,\mathrm{m\,s^{-1}}$
B $0.22\,\mathrm{m\,s^{-1}}$
C $0.40\,\mathrm{m\,s^{-1}}$
D $0.80\,\mathrm{m\,s^{-1}}$

2 To find a value for the acceleration of free fall, g, a student measured the time of oscillation, T, of a simple pendulum whose length, l, is changed. The student used the results to plot a graph of T^2 (y axis) against l (x axis) and found the slope of the line to be S. It follows that g is

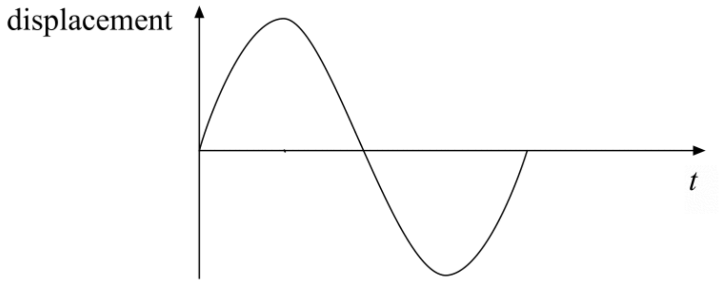
A $\dfrac{4\pi^2}{S}$.

B $4\pi^2 S$.

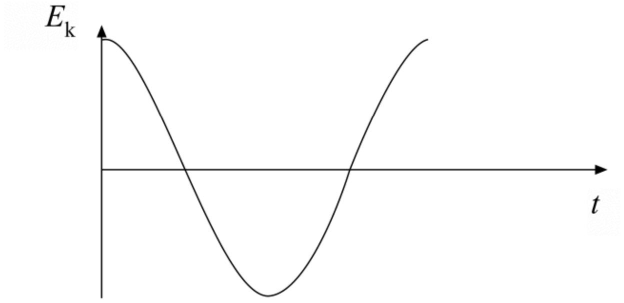
C $\dfrac{2\pi}{S}$.

D $2\pi S$.

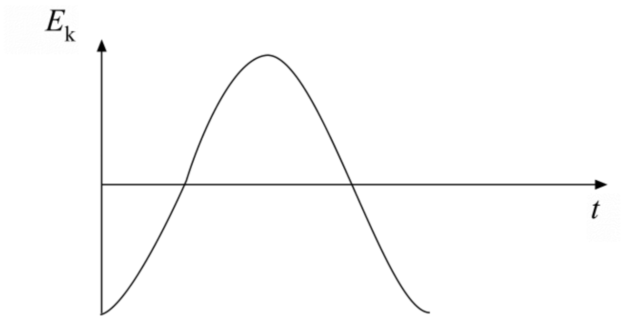
3 The top graph is a displacement/time graph for a particle executing simple harmonic motion. Which one of the other graphs shows correctly how the kinetic energy, E_k, of the particle varies with time?



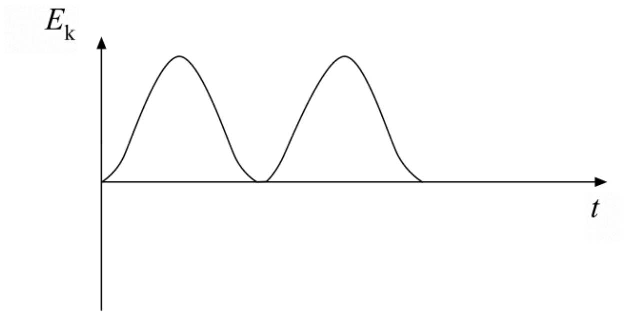
A



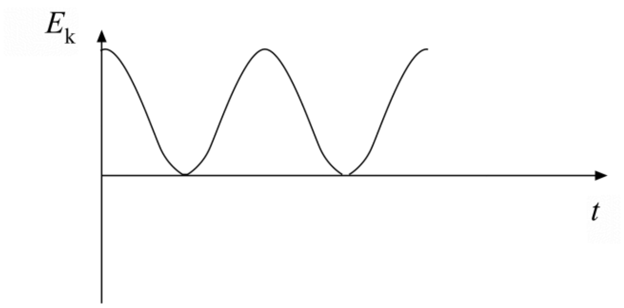
B



C



D



1 A body is in simple harmonic motion of amplitude 0.50 m and period 4π seconds. What is the speed of the body when the displacement of the body is 0.30 m?

Jun 2004

A 0.10 m s^{-1}
B 0.15 m s^{-1}
C 0.20 m s^{-1}
D 0.40 m s^{-1}

2 Which one of the following statements about an oscillating mechanical system at resonance, when it oscillates with a constant amplitude, is **not** correct?

A The amplitude of oscillations depends on the amount of damping.
B The frequency of the applied force is the same as the natural frequency of oscillation of the system.
C The total energy of the system is constant.
D The applied force prevents the amplitude from becoming too large.

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1 Which one of the following statements always applies to a damping force acting on a vibrating system?

Jan 2005

A It is in the same direction as the acceleration.
B It is in the opposite direction to the velocity.
C It is in the same direction as the displacement.
D It is proportional to the displacement.

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1 A spring is suspended from a fixed point. A mass attached to the spring is set into vertical undamped simple harmonic motion. When the mass is at its lowest position, which one of the following has its minimum value?

Jun 2005

A the potential energy of the system
B the kinetic energy of the mass
C the acceleration of the mass
D the tension in the spring

2 The time period of a simple pendulum is doubled when the length of the pendulum is increased by 3.0 m. What is the original length of the pendulum?

A 1.0 m
B 1.5 m
C 3.0 m
D 6.0 m

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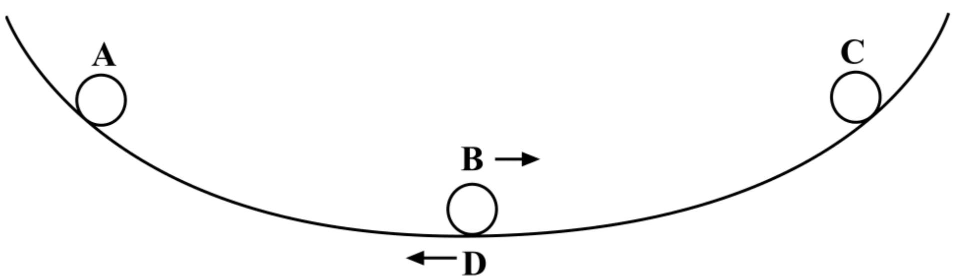
1 A ball bearing rolls on a concave surface, as shown in the diagram, in approximate simple harmonic motion. It is released from **A** and passes through the lowest point **B** before reaching **C**. It then returns through the lowest point **D**. At which stage, **A**, **B**, **C** or **D**, does the ball bearing experience maximum acceleration to the left?

Jan 2006



2 A body moves with simple harmonic motion of amplitude A and frequency $\frac{b}{2\pi}$.

What is the magnitude of the acceleration when the body is at maximum displacement?

A zero

B $4\pi^2 Ab^2$

C Ab^2

D $\frac{4\pi^2 A}{b^2}$

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1 A mass M on a spring oscillates along a vertical line with the same period T as an object O in uniform circular motion in a vertical plane. When M is at its highest point, O is at its lowest point.

Jun 2006

What is the least time interval between successive instants when the acceleration of M is exactly in the opposite direction to the acceleration of O?

A $\frac{T}{4}$

B $\frac{T}{2}$

C $\frac{3T}{4}$

D T

2 A particle of mass m oscillates with amplitude A at frequency f. What is the maximum kinetic energy of the particle?

A $\frac{1}{2}\pi^2 mf^2A^2$

B $\pi^2 mf^2A^2$

C $2\pi^2 mf^2A^2$

D $4\pi^2 mf^2A^2$

1 A particle oscillates with undamped simple harmonic motion. Which one of the following statements about the acceleration of the oscillating particle is true?

Jan 2007

A It is least when the speed is greatest.
B It is always in the opposite direction to its velocity.
C It is proportional to the frequency.
D It decreases as the potential energy increases.

2 A simple pendulum and a mass-spring system both have the same time period T at the surface of the Earth. If taken to another planet where the acceleration due to gravity is twice that on Earth, which line, **A** to **D**, in the table gives the correct new periods?

	simple pendulum	**mass-spring**
A	$T\sqrt{2}$	$\frac{T}{\sqrt{2}}$
B	$\frac{T}{\sqrt{2}}$	T
C	$T\sqrt{2}$	T
D	$\frac{T}{\sqrt{2}}$	$T\sqrt{2}$

3 A particle of mass 0.20 kg moves with simple harmonic motion of amplitude 2.0×10^{-2} m. If the total energy of the particle is 4.0×10^{-5} J, what is the time period of the motion?

A $\frac{\pi}{4}$ seconds

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

C π seconds

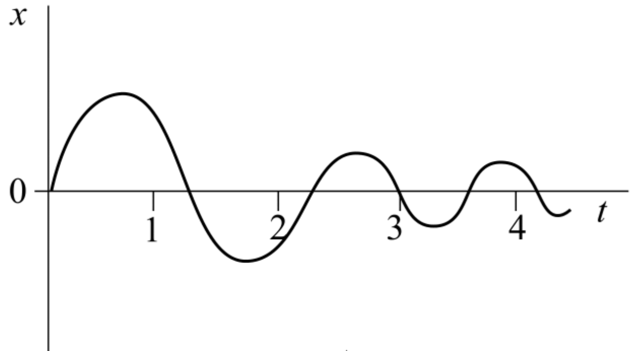
D 2π seconds

1 The frequency of a body moving with simple harmonic motion is doubled. If the amplitude remains the same, which one of the following is also doubled?

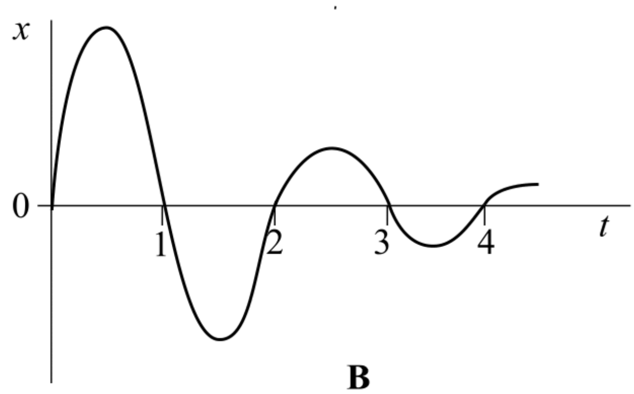
Jun 2007

A the time period
B the total energy
C the maximum velocity
D the maximum acceleration

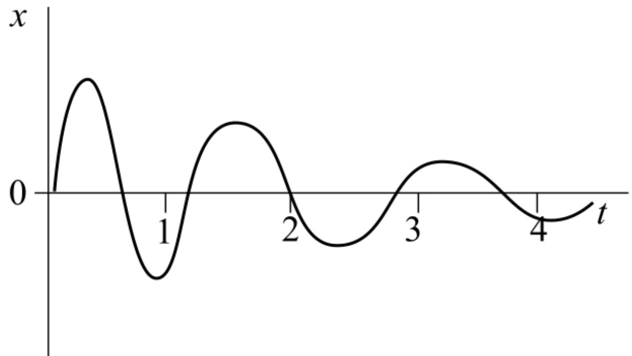
2 Which one of the graphs, **A** to **D**, best shows how the displacement, x, of a damped oscillator that performs simple harmonic motion varies with time t?



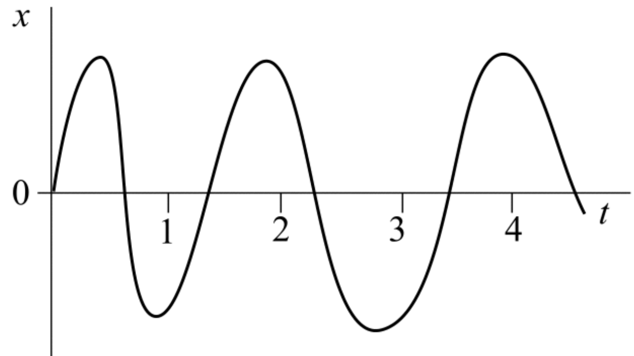
A



B



C



D

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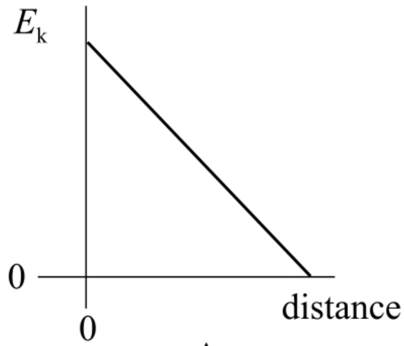
1 Which one of the following statements is true when an object performs simple harmonic motion about a central point O?

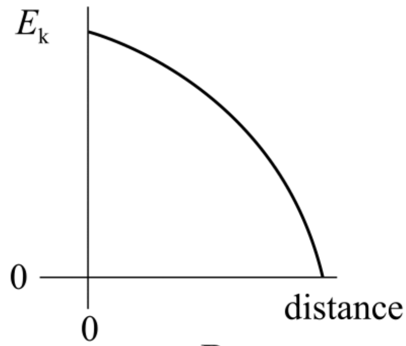
Jan 2008

A The acceleration is always directed away from O.
B The acceleration and velocity are always in opposite directions.
C The acceleration and the displacement from O are always in the same direction.
D The graph of acceleration against displacement is a straight line.

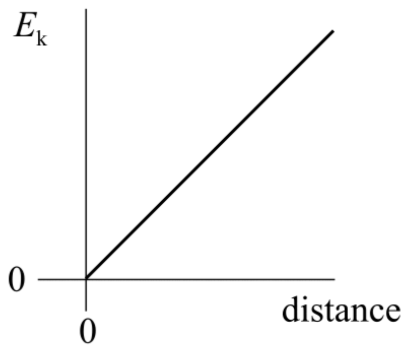
2 A body executes simple harmonic motion. Which one of the graphs, **A** to **D**, best shows the relationship between the kinetic energy, E_k, of the body and its distance from the centre of oscillation?



A



B



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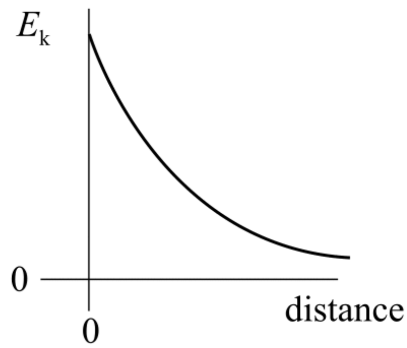

D

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1 Which one of the following statements concerning the acceleration of an object moving with simple harmonic motion is correct?

Jun 2008

A It is constant.
B It is at a maximum when the object moves through the centre of the oscillation.
C It is zero when the object moves through the centre of the oscillation.
D It is zero when the object is at the extremity of the oscillation.

2 When the length of a simple pendulum is decreased by 600 mm, the period of oscillation is halved. What was the original length of the pendulum?

A 800 mm
B 1000 mm
C 1200 mm
D 1400 mm

1 The tip of each prong of a tuning fork emitting a note of frequency 320 Hz vibrates in simple harmonic motion with an amplitude of 0.50 mm.
What is the speed of each tip when its displacement is zero? **Jan 2009**

A zero
B 0.32π mm s^{-1}
C 160π mm s^{-1}
D 320π mm s^{-1}

2 What is the phase difference between the acceleration and the displacement for a particle moving with simple harmonic motion?

A $\frac{\pi}{2}$ radians

B π radians

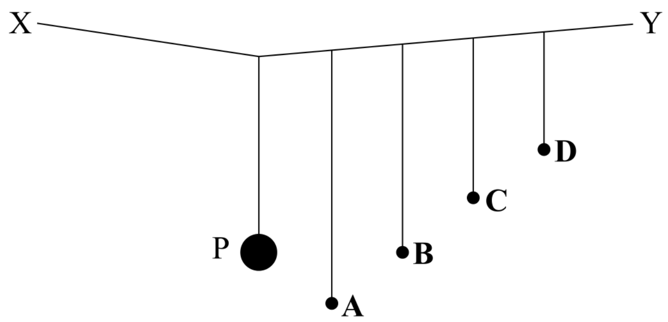
C $\frac{3\pi}{2}$ radians

D 2π radians

1 The bob of a simple pendulum moves with undamped simple harmonic motion.
Which one of the following statements is correct? **Jun 2009**

A The total energy of the bob is constant.
B The linear momentum of the bob is constant.
C The acceleration of the bob is a maximum when its displacement is zero.
D The period of oscillation is the time between two successive passages through the point of zero displacement.

2 The diagram shows a string XY supporting a heavy pendulum P and four lighter pendulums **A**, **B**, **C** and **D**.



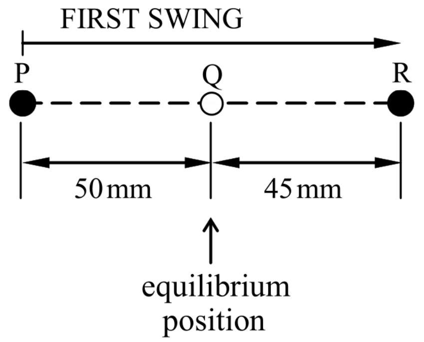
Pendulum P is set in oscillation perpendicular to the plane of the diagram.
Which one of the lighter pendulums, **A** to **D**, then oscillates with the largest amplitude?

3 A particle of mass 5.0×10^{-3} kg, moving with simple harmonic motion of amplitude 0.15 m, takes 47 s to make 50 oscillations. What is the maximum kinetic energy of the particle?

A 2.0×10^{-3} J
B 2.5×10^{-3} J
C 3.9×10^{-3} J
D 5.0×10^{-3} J

1 A particle, whose equilibrium position is at Q, is set into oscillation by being displaced to P, 50 mm from Q, and then released from rest. Its subsequent motion is simple harmonic, but subject to damping. On the first swing, the particle comes to rest momentarily at R, 45 mm from Q.

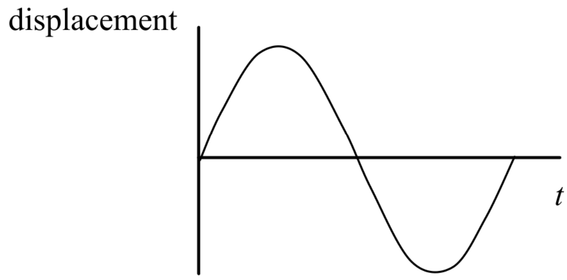
Jan 2010



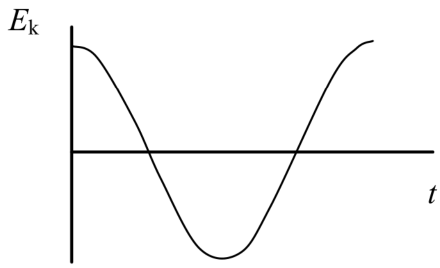
During this first swing, the greatest value of the acceleration of the particle is when it is at

A P
B Q
C R
D P and R

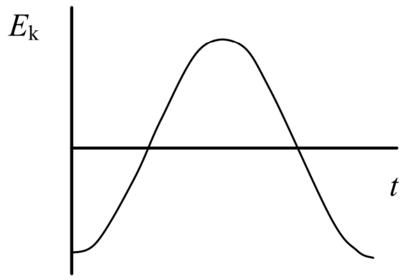
2 The top graph is a displacement/time graph for a particle executing simple harmonic motion. Which one of the other graphs shows correctly how the kinetic energy, E_k, of the particle varies with time, t?



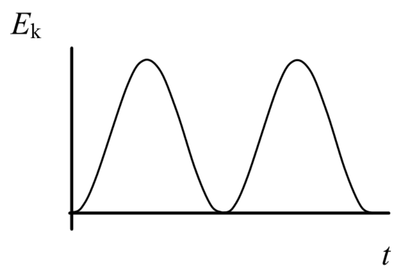
A



B



C



D