# SL Paper 1

Two waves meet at a point. The waves have a path difference of $\frac{\lambda}{4}$. The phase difference between the waves is

A. $\frac{\pi}{8}\text{rad.}$
B. $\frac{\pi}{4}\text{rad.}$
C. $\frac{\pi}{2}\text{rad.}$
D. $\pi$ rad.

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An object undergoes simple harmonic motion (SHM). The total energy of the object is proportional to

A. the amplitude of the oscillations.

B. the time period of the oscillations.

C. the frequency of the oscillations.

D. the mass of the object.

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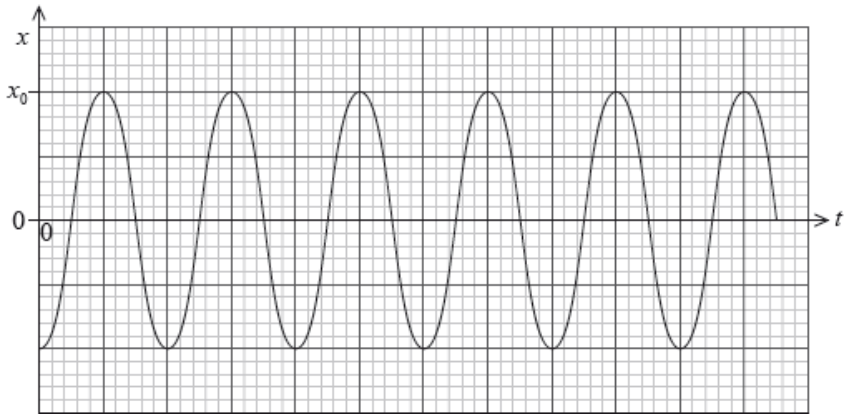
An object at the end of a spring oscillates vertically with simple harmonic motion. The graph shows the variation with time $t$ of the displacement $x$.

The amplitude is $x_0$ and the period of oscillation is $T$.




Which of the following is the correct expression for the maximum acceleration of the object?

A. $\frac{2\pi}{T}x_0$
B. $\frac{2\pi}{T^2}x_0$
C. $\frac{4\pi^2}{T^2}x_0$
D. $\frac{4\pi^2}{T}x_0$

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An object undergoes simple harmonic motion with time period $T$ and amplitude 0.5 m. At time $t$ = 0 s the displacement of the object is a maximum.

What is the displacement of the object at time $t = \frac{3T}{4}$?

A. -0.50 m
B. 0.50 m
C. 0.25 m
D. 0 m

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A particle undergoing simple harmonic motion (SHM) oscillates with time period $T$ and angular frequency $\omega$. The time period of the SHM changes to $2T$. Which of the following gives the new value of $\omega$?

A. $\frac{\omega}{4}$

B. $\frac{\omega}{2}$

C. $2\omega$

D. $4\omega$

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A particle of mass $m$ oscillates with simple harmonic motion (SHM) of angular frequency $\omega$. The amplitude of the SHM is $A$. What is the kinetic energy of the particle when it is half way between the equilibrium position and one extreme of the motion?

A. $\frac{mA^2\omega^2}{4}$

B. $\frac{3mA^2\omega^2}{8}$

C. $\frac{9mA^2\omega^2}{32}$

D. $\frac{15mA^2\omega^2}{32}$

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A particle undergoes simple harmonic motion (SHM) of maximum kinetic energy $E_{max}$ and amplitude $x_0$. The particle is released from rest at its maximum displacement amplitude.

What is the change in the kinetic energy when the particle has travelled a distance of $\frac{x_0}{3}$?

A. $\frac{E_{max}}{9}$

B. $\frac{4E_{max}}{9}$

C. $\frac{5E_{max}}{9}$

D. $\frac{8E_{max}}{9}$

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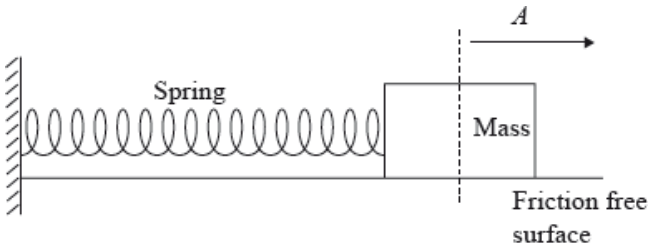
A mass on the end of a horizontal spring is displaced from its equilibrium position by a distance $A$ and released. Its subsequent oscillations have total energy $E$ and time period $T$.




An identical mass is attached to an identical spring. The maximum displacement is $2A$. Assuming this spring obeys Hooke's law, which of the following gives the correct time period and total energy?

| | New time period | New energy |
|---|---|---|
| A. | $T$ | $4E$ |
| B. | $T$ | $2E$ |
| C. | $\sqrt{2}T$ | $4E$ |
| D. | $\sqrt{2}T$ | $2E$ |

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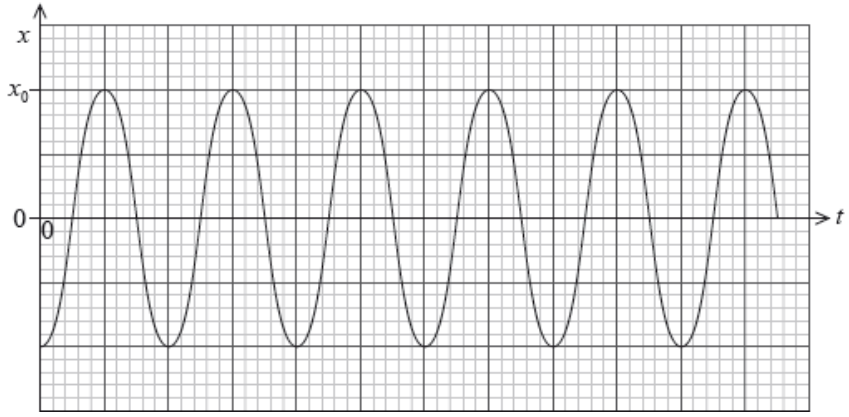
An object at the end of a spring oscillates vertically with simple harmonic motion. The graph shows the variation with time $t$ of the displacement $x$.

The amplitude is $x_0$ and the period of oscillation is $T$.




Which of the following is the correct expression for the displacement $x$?

A. $-x_0 \cos \frac{2\pi}{T} t$

B. $x_0 \cos \frac{2\pi}{T} t$

C. $-x_0 \sin \frac{2\pi}{T} t$

D. $x_0 \sin \frac{2\pi}{T} t$

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The period of a particle undergoing simple harmonic motion (SHM) is $T$.

The ratio $\frac{\text{acceleration of the particle}}{\text{displacement of the particle from its equilibrium position}}$ is proportional to

A. $T^{-2}$.

B. $T^{-1}$.

C. $T$.

D. $T^2$

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The equation for the velocity of an object performing simple harmonic motion is $v = v_0 \sin \omega t$. Which of the following is a correct alternative form of the equation?

A. $v = v_0 \sin\left(\frac{2\pi}{T}\right)t$

B. $v = v_0 \sin\left(\frac{t}{T}\right)$

C. $v = v_0 \sin \pi T t$

D. $v = v_0 \sin\left(\frac{T}{2\pi}\right)t$

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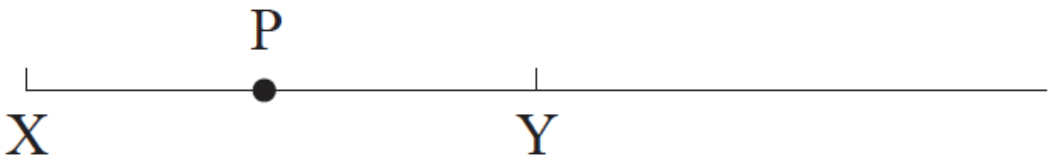
A particle P executes simple harmonic motion (SHM) about its equilibrium position Y.



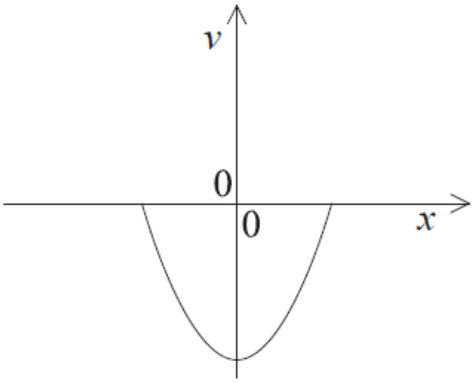

The amplitude of the motion is XY.

At which of the positions shown on the diagram is the acceleration of P equal to zero and the kinetic energy of P equal to zero?

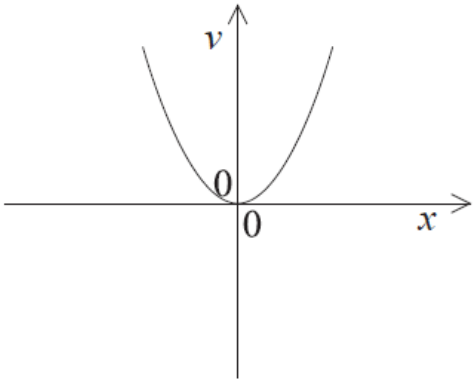
| | Acceleration | Kinetic energy |
|---|---|---|
| A. | Y | X |
| B. | X | X |
| C. | Y | Y |
| D. | X | Y |

Which graph shows how velocity *v* varies with displacement *x* of a system moving with simple harmonic motion?

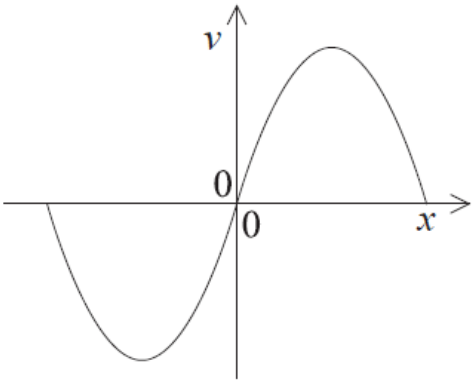
A.



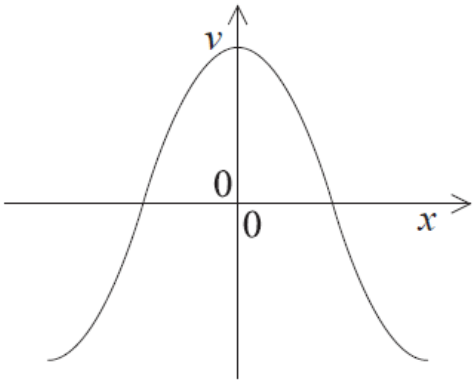

B.



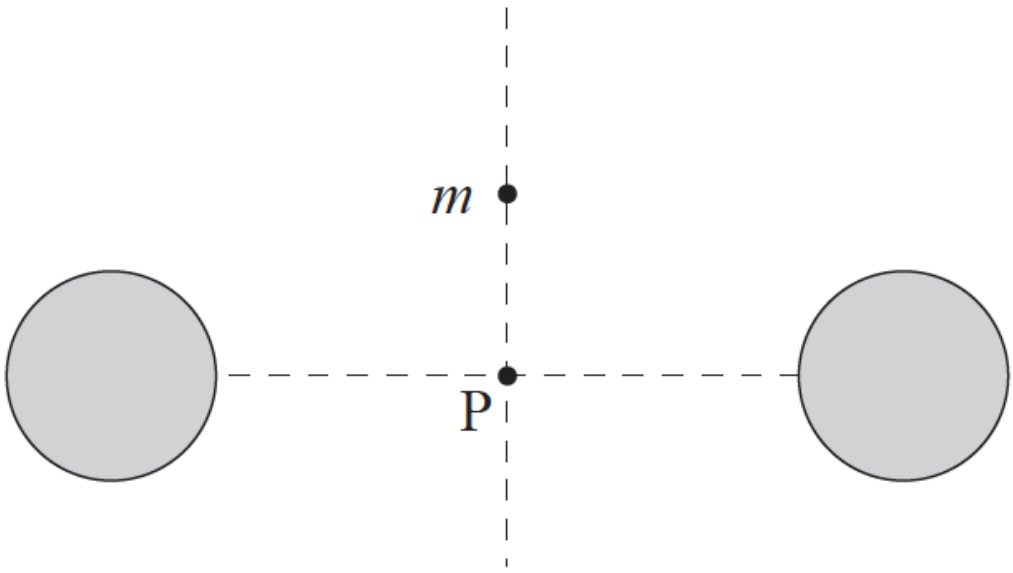

C.




D.




A small point mass *m* is placed at the same distance from two identical fixed spherical masses far from any other masses.




The point mass is released from rest. The point mass will

A. move upwards.
B. stay where it is.
C. move towards P and stop there.
D. oscillate about point P.

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An object is undergoing simple harmonic motion (SHM) about a fixed point P. The magnitude of its displacement from P is *x*. Which of the following is correct?

| | Magnitude of resultant force | Direction of resultant force |
|---|---|---|
| A. | proportional to $x$ | towards P |
| B. | inversely proportional to $x$ | towards P |
| C. | proportional to $x$ | away from P |
| D. | inversely proportional to $x$ | away from P |

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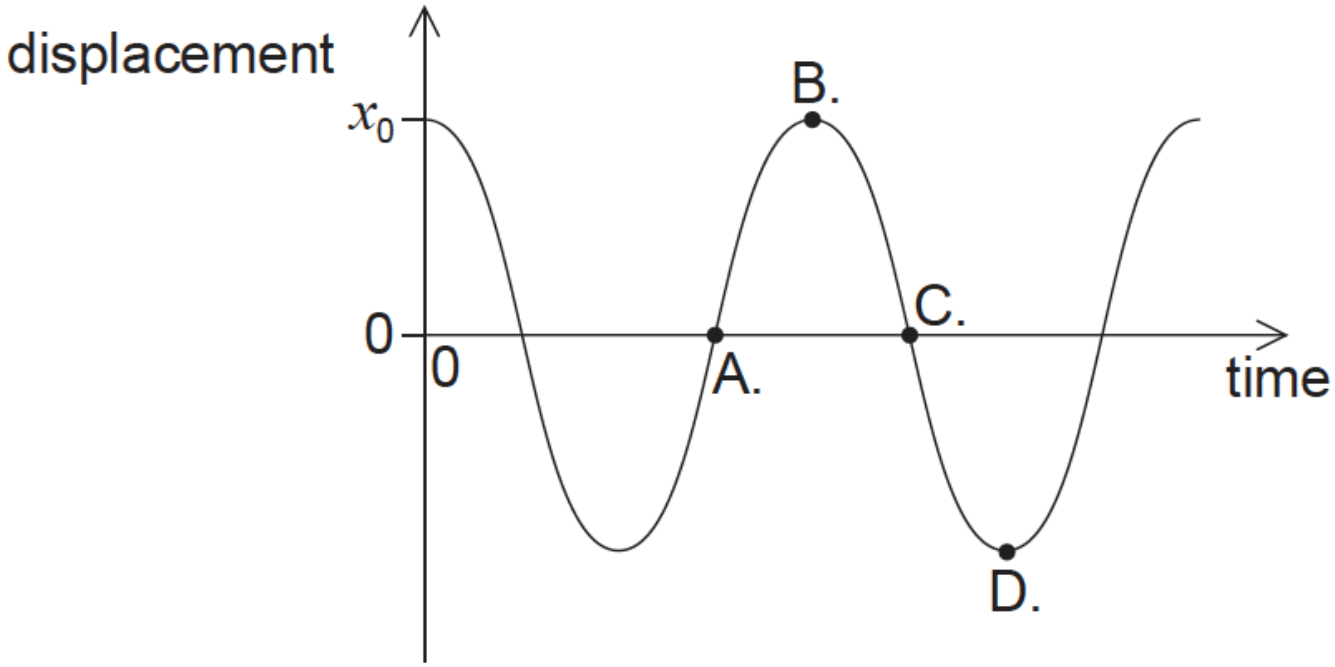
The bob of a pendulum has an initial displacement $x_0$ to the right. The bob is released and allowed to oscillate. The graph shows how the displacement varies with time. At which point is the velocity of the bob at maximum towards the right?



A particle is undergoing simple harmonic motion (SHM) in a horizontal plane. The total mechanical energy of the system is $E$. Which of the following correctly gives the kinetic energy of the particle at the positions of maximum displacement and equilibrium?

| | Maximum displacement | Equilibrium |
|---|---|---|
| A. | $\frac{1}{2}E$ | $\frac{1}{2}E$ |
| B. | $0$ | $E$ |
| C. | $\frac{1}{2}E$ | $0$ |
| D. | $E$ | $0$ |

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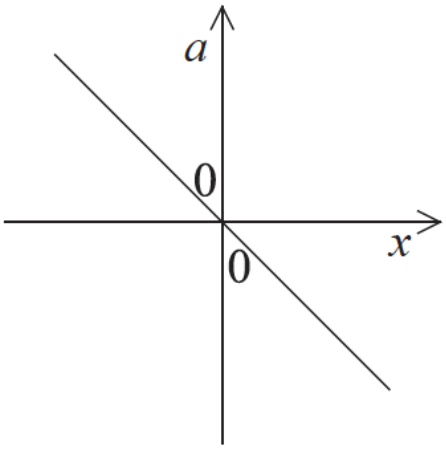
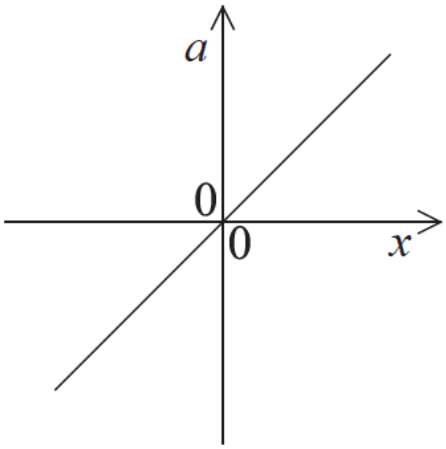
An object undergoes simple harmonic motion. Which graph shows the relationship between the acceleration $a$ and the displacement $x$ from the equilibrium position?

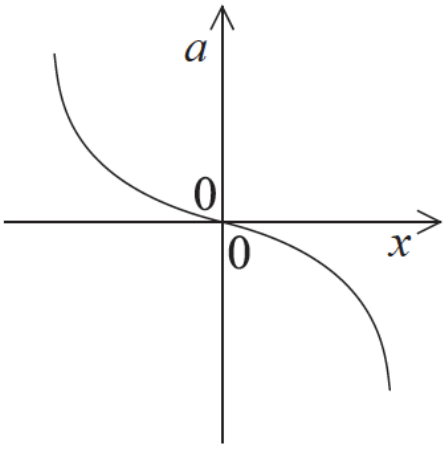
A.



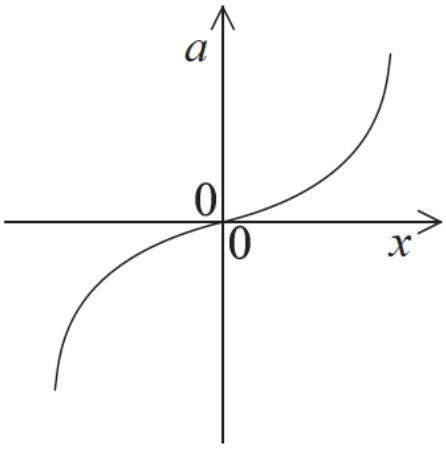

B.




C.




D.

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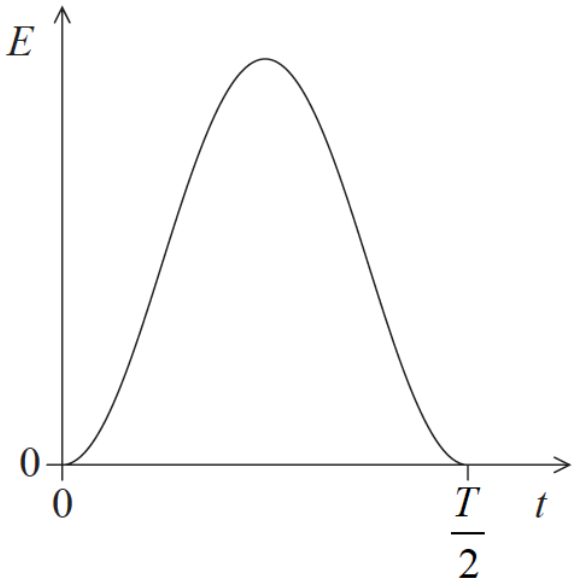
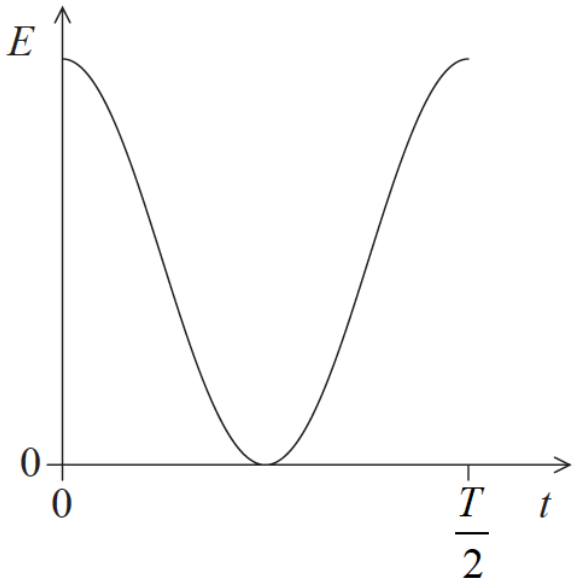
A particle executes simple harmonic motion (SHM) with period $T$.

Which sketch graph correctly shows how the total energy $E$ of the particle varies with time $t$ from $t = 0$ to $t = \frac{T}{2}$?

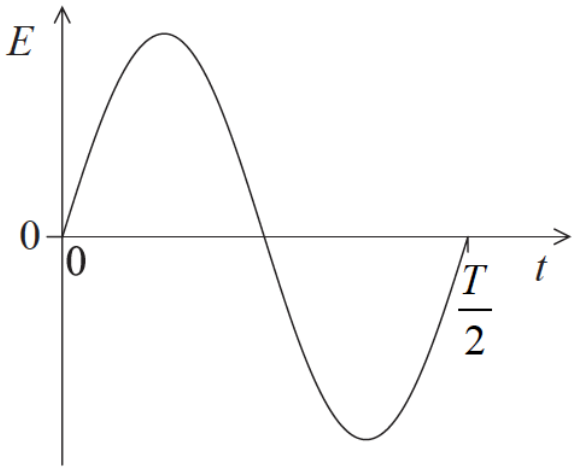
A.



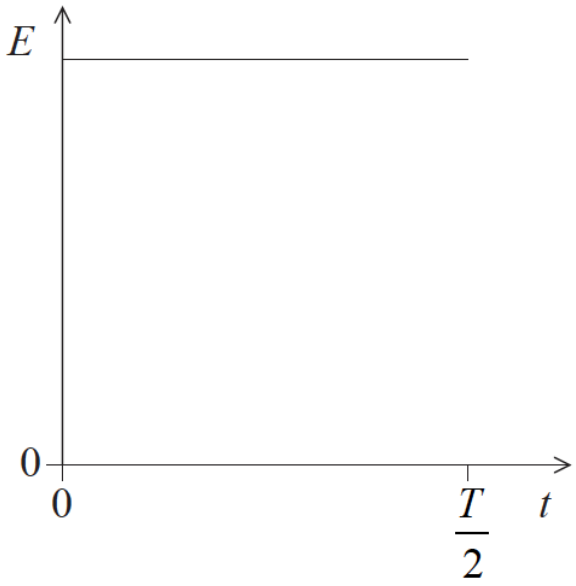

B.




C.




D.

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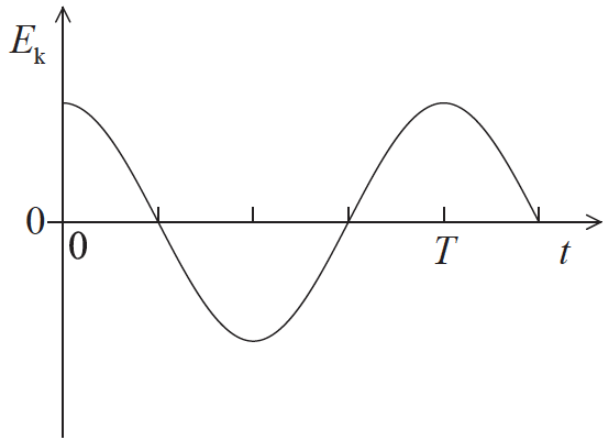
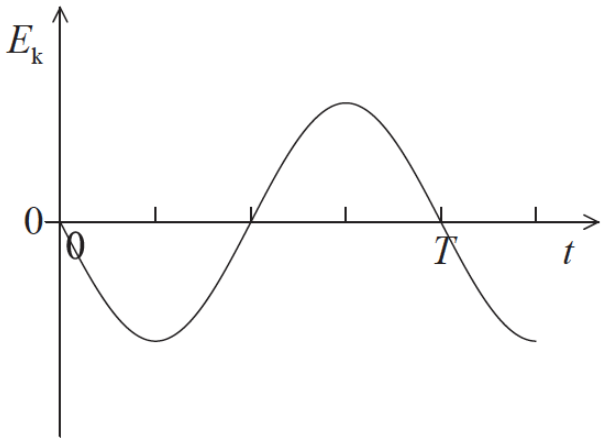
A particle oscillates with simple harmonic motion with period $T$.

At time $t$=0, the particle has its maximum displacement. Which graph shows the variation with time $t$ of the kinetic energy $E_k$ of the particle?

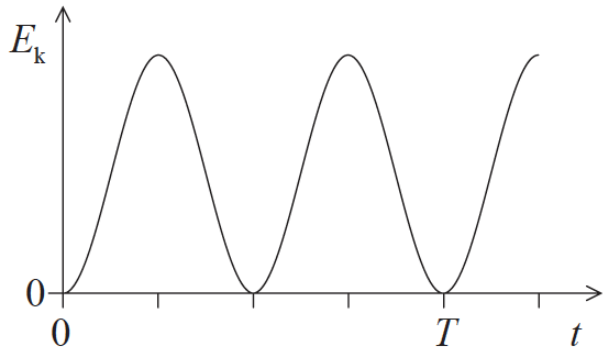
A.




B.




C.




D.