9.1 Simple Harmonic Motion

Question Paper

Course	DP IB Physics
Section	9. Wave Phenomena (HL only)
Topic	9.1 Simple Harmonic Motion
Difficulty	Easy

Time allowed: 20

Score: /10

Percentage: /100

Question 1

Which equation is used for calculating the displacement as a function of time for an oscillator that begins its oscillation from the equilibrium position?

A. $x = x_0 \sin \omega t$

B. $v = \omega x_0 \cos \omega t$

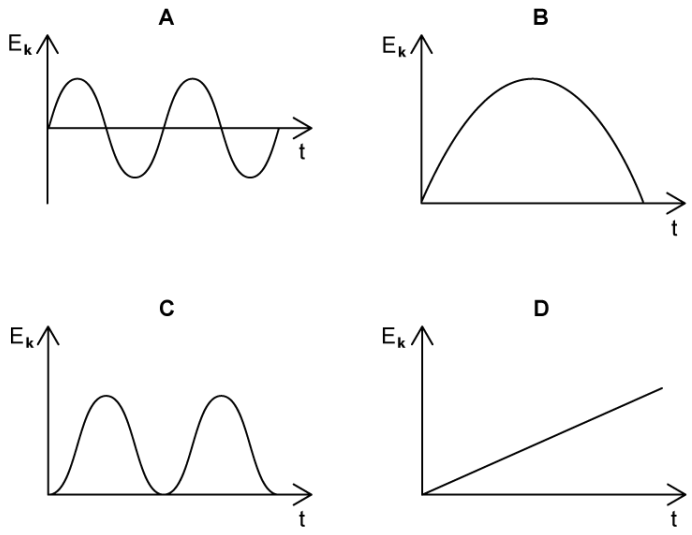
C. $a = -\omega^2 x_0 \sin \omega t$

D. $a = -\omega x$

[1 mark]

Question 2

Which graph correctly shows how the kinetic energy of an oscillator varies as a function of time through one complete oscillation?



[1 mark]

Question 3

Which equation correctly shows the kinetic energy-displacement relation for simple harmonic motion?

A. $K_E = \frac{1}{2}mv^2$

B. $E_T = \frac{1}{2}m\omega^2 {x_0}^2$

C. $E_P = \frac{1}{2}k\Delta x^2$

D. $E_K = \frac{1}{2}m\omega^2({x_0}^2 - x^2)$

[1 mark]

Question 4

The defining equation of SHM describes the relationship between acceleration, a, angular frequency, ω, and displacement, x, from the equilibrium position:

$$a = -\omega^2 x$$

Which value correctly shows the resulting acceleration if the angular frequency was doubled?

A. $-4a$

B. $\frac{1}{4}a$

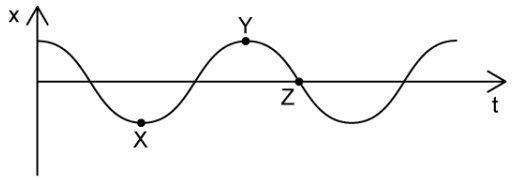
C. $2a$

D. $4a$

[1 mark]

Question 5

The graph shows the displacement over time of a simple pendulum oscillating in simple harmonic motion.



What is the potential energy of the pendulum at points X, Y and Z?

	X	Y	Z
A.	Max	Zero	Max
B.	Zero	Max	Zero
C.	Max	Max	Zero
D.	Zero	Zero	Max

[1 mark]

Question 6

A spring loaded with mass *m* oscillates with simple harmonic motion. The amplitude of the motion is *A* and the spring has total energy *E*.

What is the total energy of the spring when both the mass and the amplitude are doubled?

A. E_T

B. $2E_T$

C. $4E_T$

D. $8E_T$

[1 mark]

Question 7

A simple pendulum undergoes simple harmonic motion. The kinetic energy of the pendulum is at a maximum at the equilibrium position.

How many times during one oscillation is the kinetic energy of the pendulum equal to its gravitational potential energy?

A. 1

B. 2

C. 3

D. 4

[1 mark]

Question 8

A mass with mass, *m*, is attached to a spring with a spring constant, *k*, and oscillates in simple harmonic motion with a period, *T*.

A new spring is introduced with a spring constant of 4*k*. How does this affect the period of the oscillation?

A. $\frac{1}{4}T$

B. $\frac{1}{2}T$

C. $2T$

D. $4T$

[1 mark]

Question 9

A small ball is attached to a thread of length *l*, and set to oscillate isochronously.

If the length of the thread is reduced by 10%, what effect will this have on the period, *T*, of the oscillation?

A. $0.1\ T$

B. $0.3T$

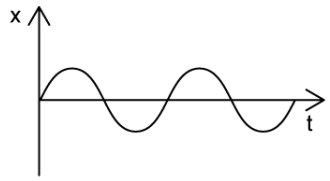
C. $0.6T$

D. $0.9T$

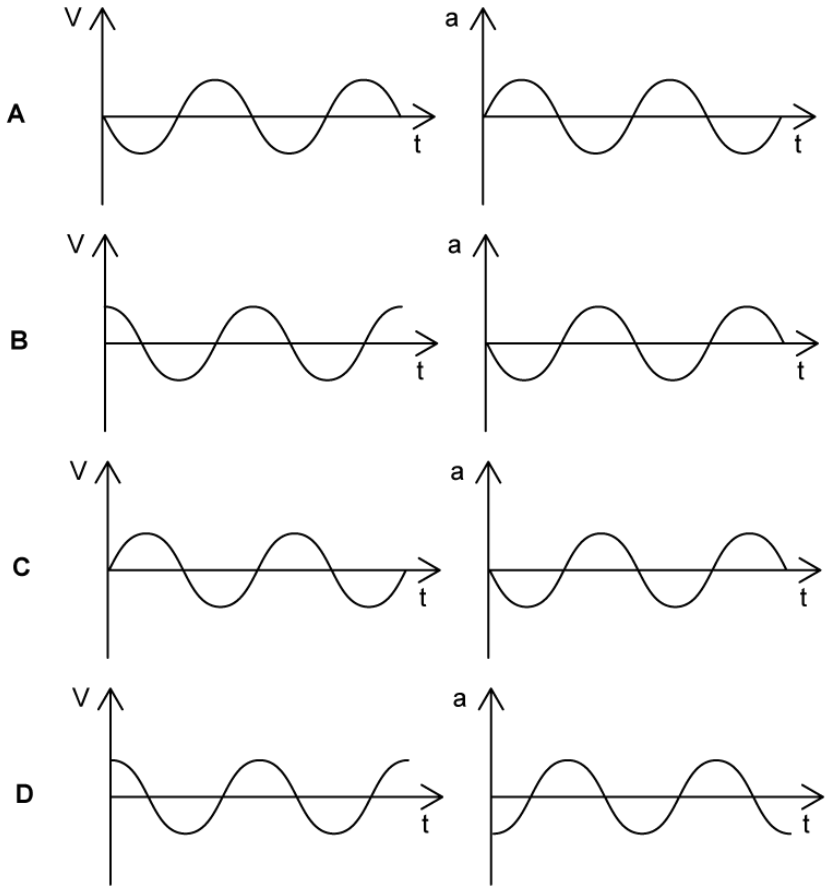
[1 mark]

Question 10

A particle oscillates in simple harmonic motion. The particle's displacement over time is shown in the following graph.



Which graphs are the correct velocity-time and acceleration-time graphs for this particle?



[1 mark]