9.1 Simple Harmonic Motion
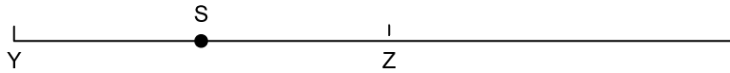
Question Paper

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

Time allowed: 20

Score: /10

Percentage: /100

Question 1

A point on a guitar string S oscillates about its equilibrium position Z in simple harmonic motion.

The amplitude of the oscillation is YZ.

Which positions show when the acceleration of point S is at a maximum and the velocity of point S is at zero?

	Acceleration	Velocity
A.	Z	Y
B.	Y	Y
C.	Z	Z
D.	Y	Z

[1 mark]

Question 2

A simple pendulum and a mass-spring system oscillate about their equilibrium positions with simple harmonic motion. On Earth, the period of the oscillations is *T*. The pendulum and the mass-spring system are taken to Mars where the acceleration of free fall is smaller than on Earth.

Which answer best describes the period of the pendulum and the mass-spring system on Mars?

	Simple Pendulum	Mass-spring System
A.	*T*	Greater than *T*
B.	*T*	*T*
C.	Greater than *T*	Greater than *T*
D.	Greater than *T*	*T*

[1 mark]

Question 3

Choose the correct statement describing the quantities that remain constant for an object in SHM.

   A. Frequency, *f*.

   B. Frequency, *f*, & period, *T*.

   C. Period, *T*, & the spring constant, *k*.

   D. Period, *T*, frequency, *f*, spring constant, *k*, & acceleration of freefall, *g*.

[1 mark]

Question 4

A mass–spring system oscillates with simple harmonic motion. The mass *m* has an amplitude *A* and the spring has a total energy *E*. The mass is increased by half and the amplitude increased to 4*A*.

What is the total energy in the spring?

   A. 24*E*

   B. 12*E*

   C. 8*E*

   D. 6*E*

[1 mark]

Question 5

A pendulum oscillating with simple harmonic motion has an amplitude x_0 and a maximum kinetic energy E_k.

What is the potential energy of the system when the pendulum bob is at a distance $0.4x_0$ from its maximum displacement?

   A. $0.36E_k$

   B. $0.4E_k$

   C. $0.6E_k$

   D. $0.64E_k$

[1 mark]

Question 6

Which of the following is a correct arrangement for the maximum displacement of a particle performing simple harmonic motion?

A. $x_0 = -\dfrac{a_{max}\, f^2}{4\pi^2}$

B. $x_0 = -\dfrac{a_{max}}{2\pi f^2}$
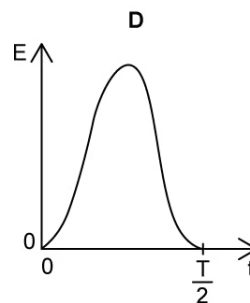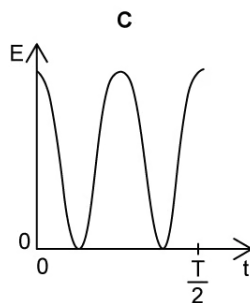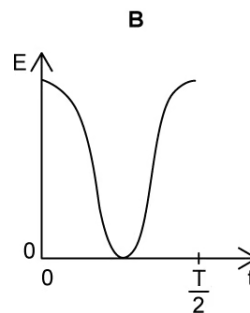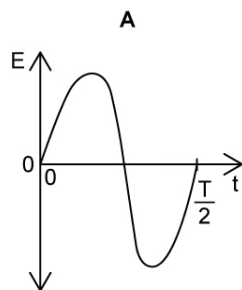
C. $x_0 = -\dfrac{a_{max}}{4\pi^2 T^2}$

D. $x_0 = -\dfrac{a_{max}\, T^2}{4\pi^2}$

[1 mark]

Question 7

An ion in a crystal lattice structure oscillates with simple harmonic motion. The period of the oscillation is T. T is measured from equilibrium.

Which graph shows the change in kinetic energy of the ion from time $t = 0$ to $t = \dfrac{T}{2}$?

[1 mark]

Question 8

A simple pendulum performs simple harmonic motion. The pendulum bob has a mass m, the string has a length l, and the pendulum has a period T.
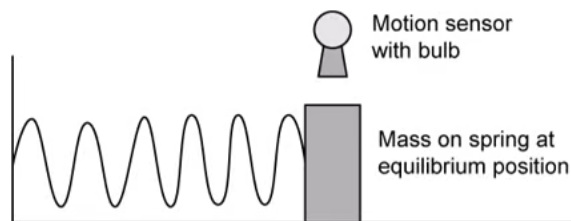
Which is the correct value for the period T if the mass of the pendulum bob is doubled and the length of the string is halved?

   A. 1.4 T

   B. 0.7 T

   C. 0.5 T

   D. 0.25 T

[1 mark]

Question 9

A mass-spring system oscillates about its equilibrium position in simple harmonic motion. A bulb on the motion sensor lights up each time the block passes the equilibrium position.

The block has a mass m and oscillates with a period T.
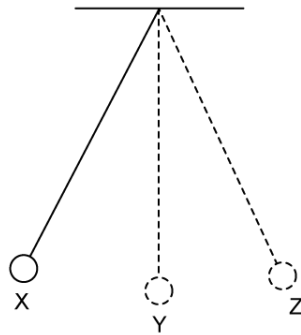
Select the new mass that would cause the period to double.

   A. 0.5m

   B. 1.4m

   C. 2m

   D. 4m

[1 mark]

Question 10

A simple pendulum oscillates with simple harmonic motion as shown.

At which positions are the acceleration at zero, the displacement at a negative maximum, and velocity at a maximum?

	Acceleration	Displacement	Velocity
A.	Z	Y	X
B.	Y	X	Y
C.	X	Z	Z
D.	Y	X	Z

[1 mark]