9.1 Simple Harmonic Motion
Medium
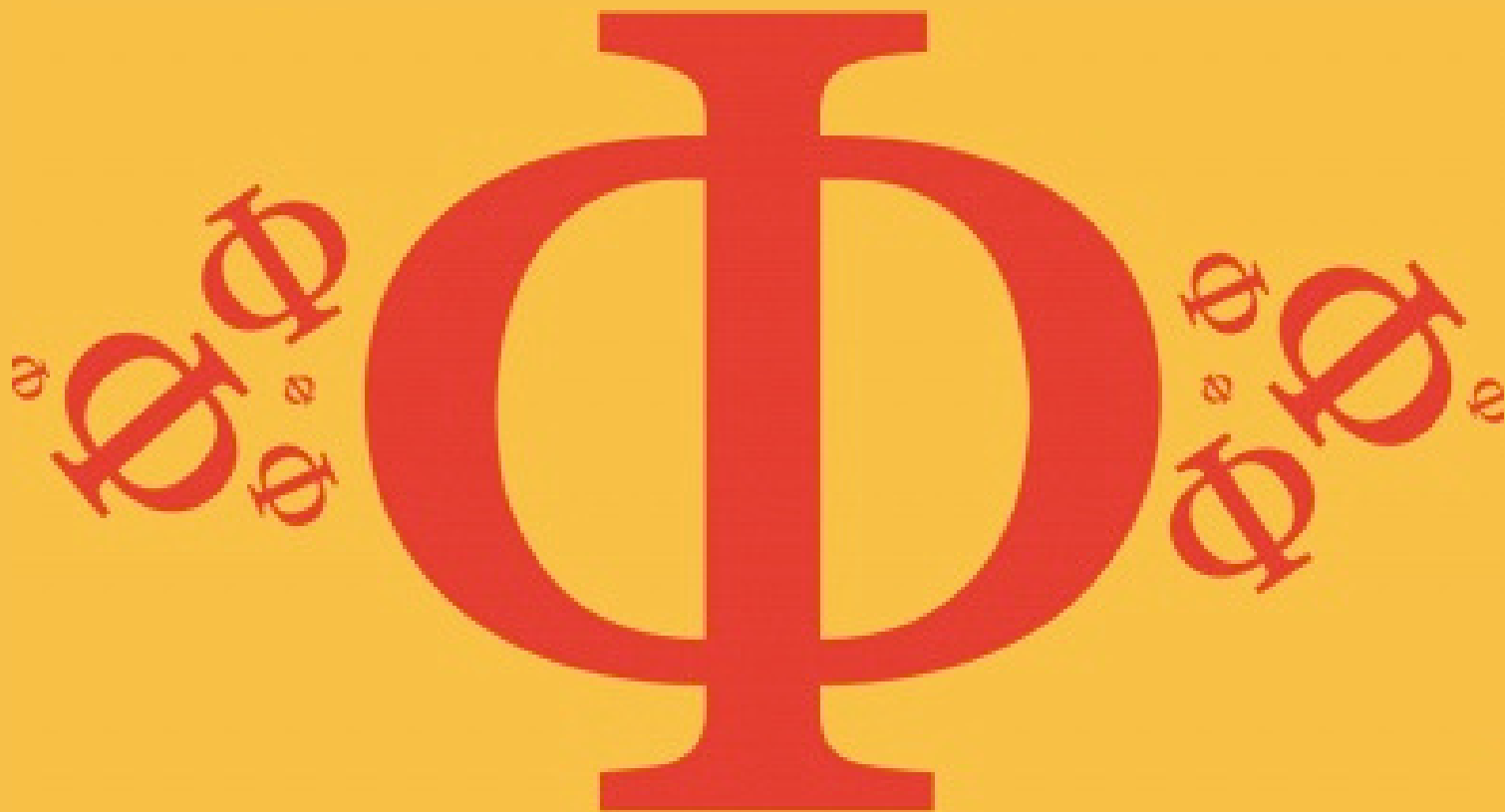
PHYSICS

IB HL

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

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 2

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 $4A$.

What is the total energy in the spring?

A. $24E$

B. $12E$

C. $8E$

D. $6E$

[1 mark]

Question 3

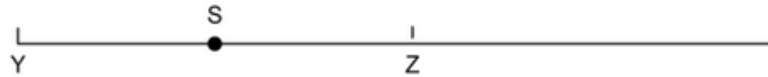A pendulum oscillating with simple harmonic motion has an amplitude x_0 and a maximum kinetic energy E_k.

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 4

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 5

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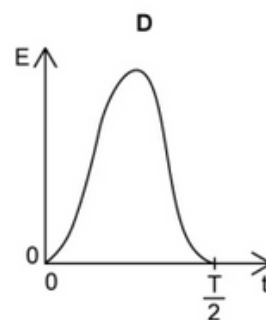
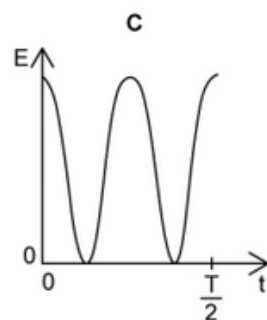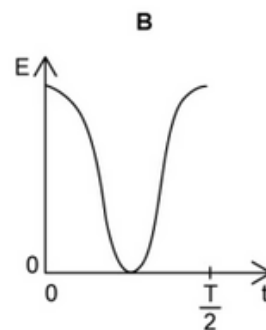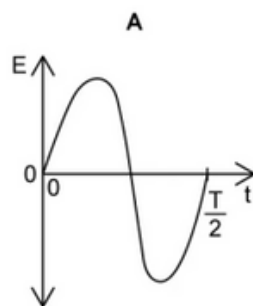C. $x_0 = -\dfrac{a_{max}}{4\pi^2 T^2}$

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.
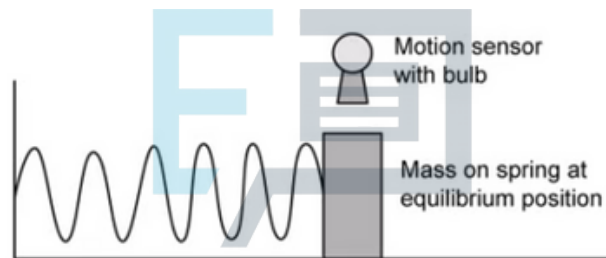
Which is the correct value for the period T if the mass of the pendulum bob is doubled and the length of the string is halved?

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.

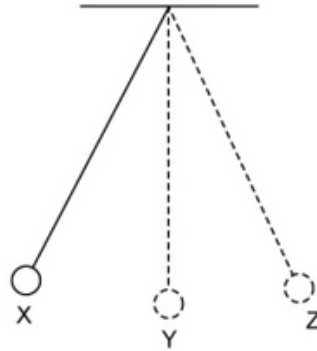
The block has a mass m and oscillates with a period T.

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]