

Name _____

Date _____

Score: _____ / 15

30 minutes · 15 marks · calculator and data booklet allowed

- Answer all the questions.
- For each question, choose the answer you think is best and circle the letter.
- Each question is worth 1 mark.
- Take $g = 9.8 \text{ m s}^{-2}$.

1. Which statement describes the acceleration of an object that moves with simple harmonic motion?

- A.** It is proportional to the displacement and in the same direction as the displacement.
- B.** It is proportional to the displacement and directed towards the equilibrium position.
- C.** It has a constant size and is always directed towards the equilibrium position.
- D.** It is proportional to the velocity and opposite in direction to the velocity.

2. Which motion is simple harmonic?

- A.** a ball bouncing up and down on a hard floor, with no air resistance
- B.** a ball rolling to and fro inside a V-shaped groove
- C.** a child on a swing that is pushed to an angle of 60°
- D.** a block oscillating on a horizontal spring on a smooth table, with a small amplitude

3. A mass-spring system oscillates with period T . The mass is made 4 times larger and the spring is replaced by one with twice the spring constant. What is the new period?

- A.** $\sqrt{2} T$
- B.** $2T$
- C.** $T/\sqrt{2}$
- D.** $2\sqrt{2} T$

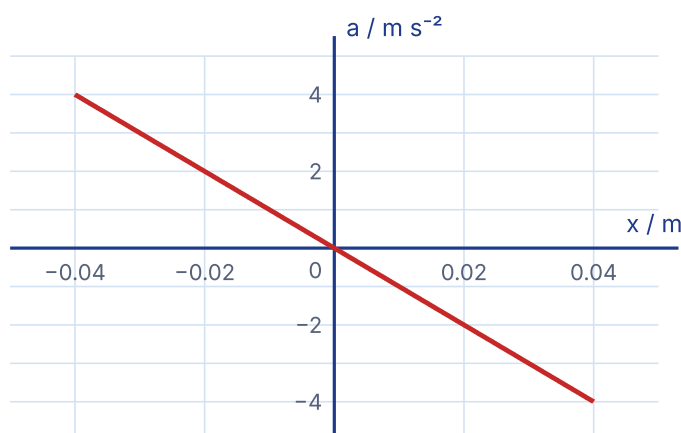
4. A simple pendulum on the Earth has a period of 2.4 s. What is its length? ($g = 9.8 \text{ m s}^{-2}$)

- A.** 0.60 m
- B.** 3.7 m
- C.** 1.4 m
- D.** 0.15 m

5. An object oscillates in SHM. When its displacement is 2.4 cm from the equilibrium position, the size of its acceleration is 6.0 m s^{-2} . What is the period of the oscillation?

- A. 0.025 s
- B. 2.5 s
- C. 0.063 s
- D. 0.40 s

6. The graph shows how the acceleration a of an oscillating object varies with its displacement x .



What is the frequency of the oscillation?

- A. 16 Hz
- B. 1.6 Hz
- C. 0.63 Hz
- D. 10 Hz

7. For an object of mass m in SHM, a graph of the resultant force F on the object against its displacement x is a straight line through the origin. What is the gradient of the line?

- A. $-m\omega^2$
- B. $-\omega^2$
- C. $-m/\omega^2$
- D. $-\omega$

8. An object in SHM is at its maximum positive displacement. Which describes its velocity and its acceleration at this instant?

- A. velocity zero; acceleration zero
- B. velocity maximum; acceleration zero
- C. velocity zero; acceleration maximum and negative
- D. velocity maximum and negative; acceleration maximum and negative

- 9.** Which statement about the displacement, velocity and acceleration of an object in SHM is correct?
- A.** The acceleration is in phase with the displacement.
 - B.** The velocity is $\pi/2$ out of phase with the displacement.
 - C.** The velocity is π out of phase with the displacement.
 - D.** The acceleration is $\pi/2$ out of phase with the displacement.
-
- 10.** (HL) The displacement–time graph of a particle in SHM is a sine curve. The distance from a peak to the next trough, measured along the displacement axis, is 6.0 cm. The time from one peak to the next is 0.40 s. What is the maximum speed of the particle?
- A.** 0.47 m s^{-1}
 - B.** 0.30 m s^{-1}
 - C.** 0.94 m s^{-1}
 - D.** 0.075 m s^{-1}
-
- 11.** The kinetic energy of an object in SHM is zero at $t = 0$. It is next zero at $t = 0.25 \text{ s}$. What is the period of the oscillation?
- A.** 0.25 s
 - B.** 1.0 s
 - C.** 0.125 s
 - D.** 0.50 s
-
- 12.** (HL) An object moves in SHM with amplitude x_0 and total energy E . What is its kinetic energy when its displacement is $x_0/2$?
- A.** $0.50E$
 - B.** $0.25E$
 - C.** $0.75E$
 - D.** $0.87E$
-
- 13.** (HL) An oscillation is described by $x = x_0 \sin(\omega t + \phi)$. At $t = 0$ the displacement is $-x_0/2$ and the object is moving towards the equilibrium position. What is ϕ ?
- A.** $7\pi/6$
 - B.** $\pi/6$
 - C.** $5\pi/6$
 - D.** $11\pi/6$
-

14. (HL) A particle oscillates in SHM with amplitude 8.0 cm and angular frequency 5.0 rad s^{-1} . What is its speed when its displacement is 4.0 cm?

- A.** 0.20 m s^{-1}
 - B.** 0.35 m s^{-1}
 - C.** 0.40 m s^{-1}
 - D.** 0.45 m s^{-1}
-

15. (HL) A mass hangs from a vertical spring. It is pulled down and released, and oscillates in SHM. The spring stays stretched all the time.

- I. The period is the same as for the same mass and spring oscillating on a smooth horizontal table.
- II. The elastic potential energy stored in the spring is largest at the lowest point.
- III. The elastic potential energy stored in the spring is zero at the equilibrium position.

Which statements are correct?

- A.** I and II only
 - B.** I and III only
 - C.** II and III only
 - D.** I, II and III
-