

Simple Harmonic Motion

TOPIC QUESTIONS

Level	AS Level
Subject	Physics
Exam Board	AQA
Paper Type	Multiple Choice

Time Allowed : 30min



EXAM PAPERS PRACTICE

1. The wheel of the London Eye has a diameter of 130 m and rotates at a steady speed, completing one rotation every 30 minutes. What is the centripetal acceleration of a person in a capsule at the rim of the wheel?

- A $1.2 \times 10^{-4} \text{ ms}^{-2}$
- B $2.5 \times 10^{-4} \text{ ms}^{-2}$
- C $3.9 \times 10^{-4} \text{ ms}^{-2}$
- D $7.9 \times 10^{-4} \text{ ms}^{-2}$

2. A small body of mass m rests on a horizontal turntable at a distance r from the centre. If the maximum frictional force between the body and the turntable is $\frac{mg}{2}$, what is the angular speed at which the body starts to slip?

A $\sqrt{\frac{gr}{2}}$

B $\frac{g}{r}$

C $\sqrt{\frac{g}{2r}}$

D $\frac{1}{2} \sqrt{\frac{g}{r}}$

3. A body of mass 0.50 kg, fixed to one end of a string, is rotated in a vertical circle of radius 1.5 m at an angular speed of 5.0 rad s^{-1} . What is the maximum tension in the string?
- A 5.0 N
 - B 9.0 N
 - C 14 N
 - D 24 N



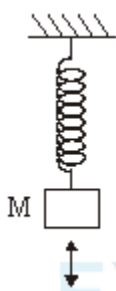
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4. A particle of mass m oscillates in a straight line with simple harmonic motion of constant amplitude. The total energy of the particle is E . What is the total energy of another particle of mass $2m$, oscillating with simple harmonic motion of the same amplitude but double the frequency?
- A E
 - B $2E$
 - C $4E$
 - D $8E$



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5. When a mass suspended on a spring is displaced, the system oscillates with simple harmonic motion. Which one of the following statements regarding the energy of the system is **incorrect**?
- A The potential energy has a minimum value when the spring is fully compressed or fully extended.
 - B The kinetic energy has a maximum value at the equilibrium position.
 - C The sum of the kinetic and potential energies at any time is constant.
 - D The potential energy has a maximum value when the mass is at rest
6. A mass M on a spring oscillates along a vertical line with the same period T as an object O in uniform circular motion in a vertical plane. When M is at its highest point, O is at its lowest point.



What is the least time interval between successive instants when the acceleration of M is exactly in the opposite direction to the acceleration of O ?

- A $\frac{T}{4}$
- B $\frac{T}{2}$
- C $\frac{3T}{4}$
- D T

7. A particle of mass m oscillates with amplitude A at frequency f . What is the maximum kinetic energy of the particle?

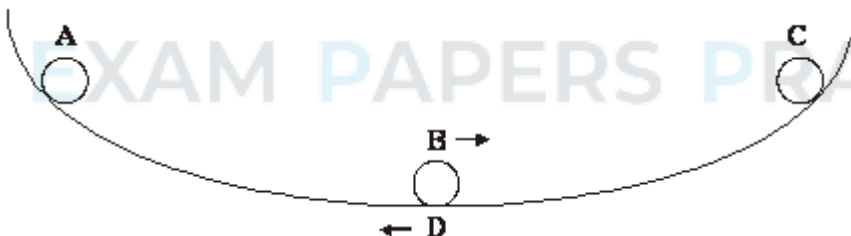
- A $\frac{1}{2} \pi^2 m f^2 A^2$
- B $\pi^2 m f^2 A^2$
- C $2 \pi^2 m f^2 A^2$
- D $4 \pi^2 m f^2 A^2$



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8. For a particle moving in a circle with uniform speed, which **one** of the following statements is correct?
- A The displacement of the particle is in the direction of the force.
 - B The force on the particle is in the same direction as the direction of motion of the particle.
 - C The momentum of the particle is constant.
 - D The kinetic energy of the particle is constant.

9. A ball bearing rolls on a concave surface, as shown in the diagram, in approximate simple harmonic motion. It is released from **A** and passes through the lowest point **B** before reaching **C**. It then returns through the lowest point **D**. At which stage, **A**, **B**, **C** or **D**, does the ball bearing experience maximum acceleration to the left?



10. A body moves with simple harmonic motion of amplitude A and frequency $\frac{b}{2\pi}$.
What is the magnitude of the acceleration when the body is at maximum displacement?

- A zero
- B $4\pi^2 Ab^2$
- C Ab^2
- D $\frac{4\pi^2 A}{b^2}$

11. A mass M hangs in equilibrium on a spring. M is made to oscillate about the equilibrium position by pulling it down 10 cm and releasing it. The time for M to travel back to the equilibrium position for the first time is 0.50 s. Which line, A to D, is correct for these oscillations?

	amplitude/c m	period/s
A	10	1.0
B	10	2.0
C	20	2.0
D	20	1.0

12. Which one of the following statements is true when an object performs simple harmonic motion about a central point O?

- A The acceleration is always away from O.
- B The acceleration and velocity are always in opposite directions.
- C The acceleration and the displacement from O are always in the same direction.

- D The graph of acceleration against displacement is a straight line.



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13. A girl of mass 40 kg stands on a roundabout 2.0 m from the vertical axis as the roundabout rotates uniformly with a period of 3.0 s. The horizontal force acting on the girl is approximately

- A zero.
- B 3.5×10^2 N.
- C 7.2×10^2 N.
- D 2.8×10^4 N.

14. For a particle moving in a circle with uniform speed, which one of the following statements is **incorrect**?

- A The velocity of the particle is constant.
- B The force on the particle is always perpendicular to the velocity of the particle.
- C There is no displacement of the particle in the direction of the force.
- D The kinetic energy of the particle is constant.

15. A simple pendulum and a mass-spring system are taken to the Moon, where the gravitational field strength is less than on Earth. Which line, **A** to **D**, correctly describes the change, if any, in the period when compared with its value on Earth?

	period of pendulum	period of mass-spring system
A	decrease	decrease
B	increase	increase
C	no change	decrease
D	increase	no change

16. When a mass M attached to a spring X , as shown in **Figure 1**, is displaced downwards and released it oscillates with time period T . An identical spring is connected in series and the same mass M is attached, as shown in **Figure 2**.

What is the new time period?

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Figure 1

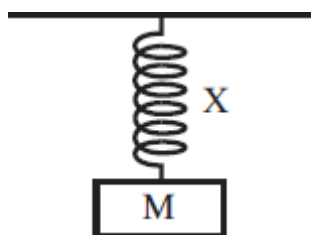
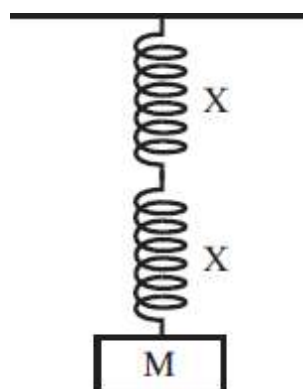


Figure 2



A $\frac{T}{2}$

B $\frac{T}{\sqrt{2}}$

- C $\sqrt{2T}$
- D $2T$

17. For a particle moving in a circle with uniform speed, which one of the following statements is **incorrect**?

- A There is no displacement of the particle in the direction of the force.
- B The force on the particle is always perpendicular to the velocity of the particle.
- C The velocity of the particle is constant.
- D The kinetic energy of the particle is constant

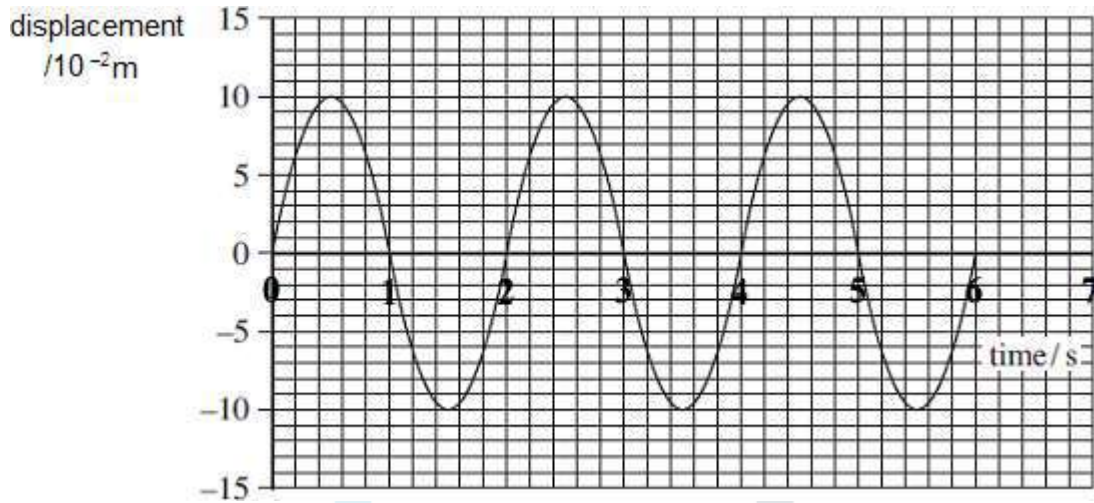
18. A revolving mountain top restaurant turns slowly, completing a full rotation in 50 minutes. A man is sitting in the restaurant 15 m from the axis of rotation. What is the speed of the man relative to a stationary point outside the restaurant?

- A $\frac{\pi}{100} \text{ m s}^{-1}$
- B $\frac{3\pi}{5} \text{ m s}^{-1}$
- C $\frac{\pi}{200} \text{ m s}^{-1}$
- D $\frac{\pi}{1500} \text{ m s}^{-1}$

19. A particle of mass 0.20 kg moves with simple harmonic motion of amplitude $2.0 \times 10^{-2} \text{ m}$. If the total energy of the particle is $4.0 \times 10^{-5} \text{ J}$, what is the time period of the motion?

- A $\frac{\pi}{4}$ seconds
- B $\frac{\pi}{2}$ seconds
- C π seconds
- D 2π seconds

20. The graph shows the variation in displacement with time for an object moving with simple harmonic motion.



What is the maximum acceleration of the object?

- A 0.025 m s⁻²
- B 0.99 m s⁻²
- C 2.5 m s⁻²
- D 9.8 m s⁻²