Simple Harmonic Motion

TOPIC QUESTIONS

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

Time Allowed : 30min

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 therim of the wheel?

   A 1.2×10^{-4} ms^{-2}

   B 2.5×10^{-4} ms^{-2}

   C 3.9×10^{-4} ms^{-2}

   D 7.9×10^{-4} 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 speedat 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 atan 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

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 $8E$

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 exactlyin 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 $\frac{1}{2}\pi^2 mf^2A^2$

B $\pi^2 mf^2A^2$

C $2\pi^2 mf^2A^2$

D $4\pi^2 mf^2A^2$

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

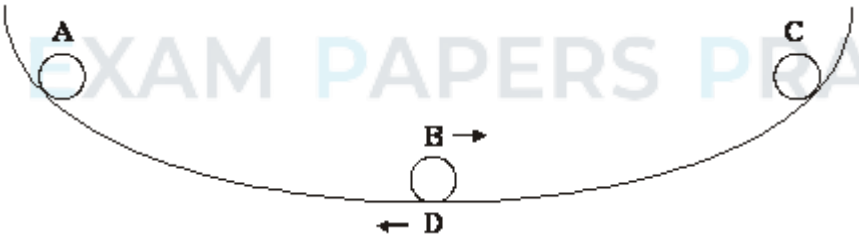
   A The displacement of the particle is in the direction of the force.

   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**. Itthen 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 $4\pi^2Ab^2$

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 bypulling 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/cm	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 motionabout 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.

13. A girl of mass 40 kg stands on a roundabout 2.0 m from the vertical axis as the roundabout rotatesuniformly 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 fieldstrength 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 releasedit 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?

Figure 1

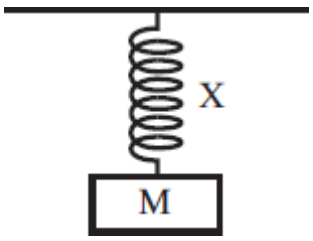
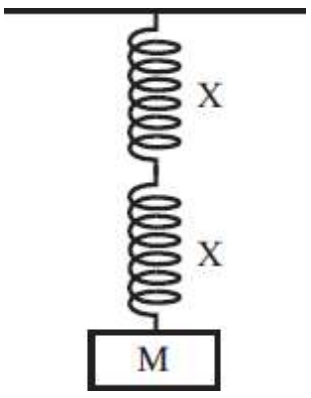


Figure 2



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 $\frac{\pi}{100}$ m s^{-1}

B $\frac{3\pi}{5}$ m s^{-1}

C $\frac{\pi}{200}$ m s^{-1}

D $\frac{\pi}{1500}$ m s^{-1}

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

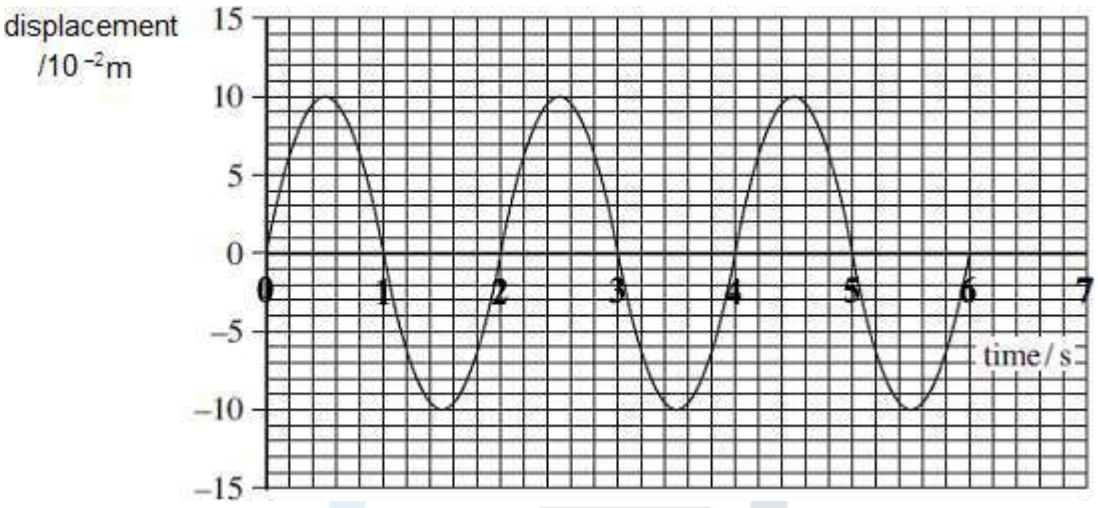
A $\frac{\pi}{4}$ seconds

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}