



A-Level Physics

Periodic Motion (Multiple Choice)

Question Paper

Time available: 29 minutes

Marks available: 20 marks

www.accesstuition.com

1. A particle performs simple harmonic motion with a time period of 1.4 s and an amplitude of 12 mm.

What is the maximum speed of the particle?

- A 8.6 mm s^{-1}
- B 27 mm s^{-1}
- C 54 mm s^{-1}
- D 110 mm s^{-1}

(Total 1 mark)

2. A planet has a mass M and a radius R .
Loose material at the equator only just remains in contact with the surface of the planet.
This is because the speed at which the planet rotates is very large.

What is the period of rotation of the planet?

- A $2\pi\sqrt{\frac{R^2}{GM}}$
- B $2\pi\sqrt{\frac{GM}{R^2}}$
- C $2\pi\sqrt{\frac{R^3}{GM}}$
- D $2\pi\sqrt{\frac{GM}{R^3}}$

(Total 1 mark)

3.

A particle of mass m is oscillating with simple harmonic motion. The period of the oscillation is T and the amplitude is A .

What is the maximum kinetic energy of the particle?

A $\frac{mA^2}{2T^2}$

B $\frac{\pi^2 mA^2}{2T^2}$

C $\frac{2mA^2}{T^2}$

D $\frac{2\pi^2 mA^2}{T^2}$

(Total 1 mark)

4.

A particle of mass m undergoes simple harmonic motion with amplitude A and frequency f .

What is the total energy of the particle?

A $2\pi mfA^2$

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

C $4\pi^2 m^2 f^2 A$

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

(Total 1 mark)

5.

The period of a simple pendulum is doubled when the pendulum length is increased by 1.8 m.

What is the original length of the pendulum?

A 0.45 m

B 0.60 m

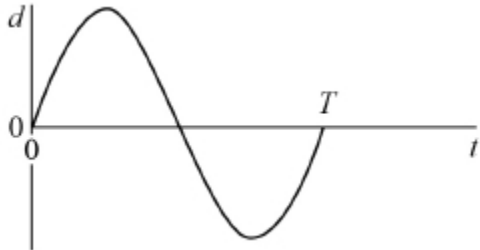
C 0.90 m

D 3.6 m

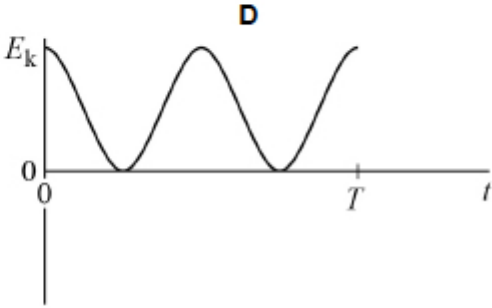
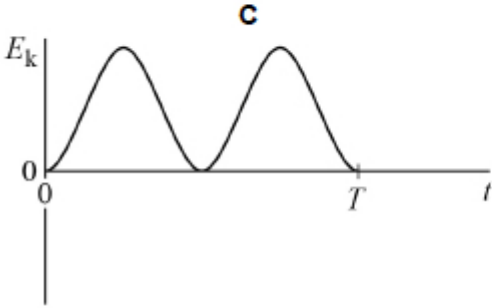
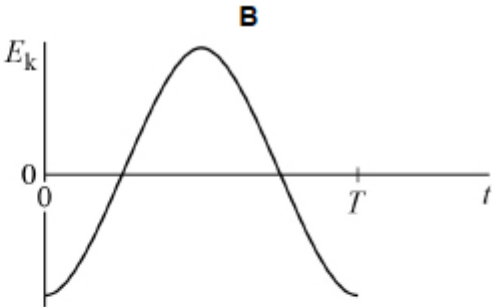
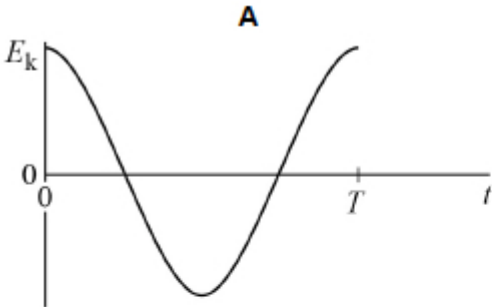
(Total 1 mark)

6.

The graph shows the variation of displacement d with time t for a particle moving with simple harmonic motion of period T .



Which graph shows the variation of kinetic energy E_k of the particle with time?



- A
- B
- C
- D

(Total 1 mark)

7.

An object of mass 0.15 kg performs simple harmonic motion. It oscillates with amplitude 55 mm and frequency 0.80 Hz

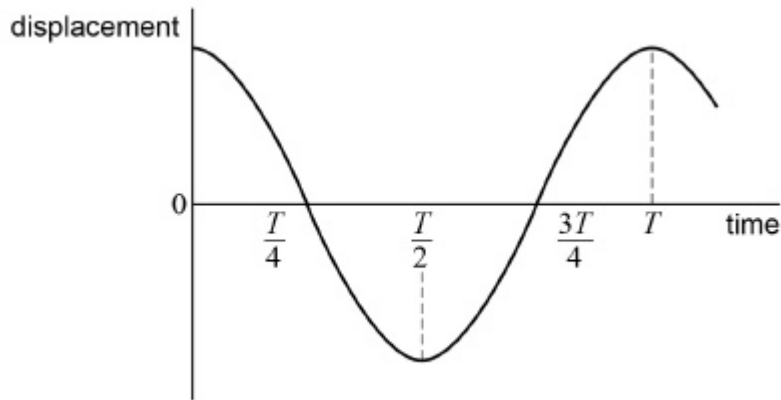
What is the maximum value of its kinetic energy?

- A 5.7×10^{-3} J
- B 11×10^{-3} J
- C 0.57 J
- D 11 J

(Total 1 mark)

8.

The graph shows how the displacement of a particle performing simple harmonic motion varies with time.



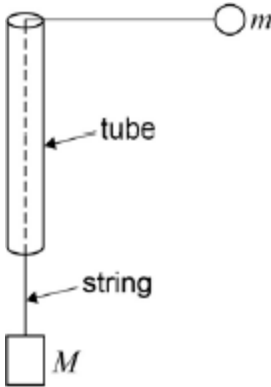
Which statement is **not** correct?

- A The speed of the particle is a maximum at time $\frac{T}{4}$
- B The potential energy of the particle is zero at time $\frac{3T}{4}$
- C The acceleration of the particle is a maximum at time $\frac{T}{2}$
- D The restoring force acting on the particle is zero at time T

(Total 1 mark)

9.

A string passes through a smooth thin tube. Masses m and M are attached to the ends of the string. The tube is moved so that the mass m travels in a horizontal circle of constant radius r and at constant speed v .



Which of the following expressions is equal to M ?

- A $\frac{mv^2}{2r}$
- B mv^2rg
- C $\frac{mv^2}{rg}$
- D $\frac{mv^2g}{r}$

(Total 1 mark)

10.

A simple pendulum and a mass-spring system have the same oscillation frequency f at the surface of the Earth. The pendulum and the mass-spring system are taken down a mine where the acceleration due to gravity is less than at the surface. What is the change in the frequency of the simple pendulum and the change in the frequency of the mass-spring system?

| | simple pendulum | mass-spring | |
|---|-----------------|---------------------|--------------------------|
| A | f increases | f decreases | <input type="checkbox"/> |
| B | f decreases | f decreases | <input type="checkbox"/> |
| C | f increases | f stays unchanged | <input type="checkbox"/> |
| D | f decreases | f stays unchanged | <input type="checkbox"/> |

(Total 1 mark)

11. What is the angular speed of a car wheel of diameter 0.400 m when the speed of the car is 108 km h^{-1} ?

- A 75 rad s^{-1}
- B 150 rad s^{-1}
- C 270 rad s^{-1}
- D 540 rad s^{-1}

(Total 1 mark)

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

- A The acceleration is always directed away from the central point.
- B The acceleration and velocity are always 180° out of phase.
- C The velocity and displacement are always in the same direction.
- D Acceleration and displacement are always 180° out of phase.

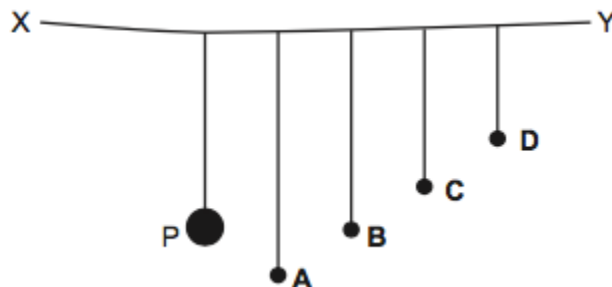
(Total 1 mark)

13. A mass hanging on the end of a spring undergoes vertical simple harmonic motion. At which point(s) is the magnitude of the resultant force on the mass a minimum?

- A at both the top and bottom of the oscillation
- B only at the top of the oscillation
- C only at the bottom of the oscillation
- D at the centre of the oscillation

(Total 1 mark)

14. The diagram shows a string XY supporting a heavy pendulum P and four pendulums A, B, C and D of smaller mass.

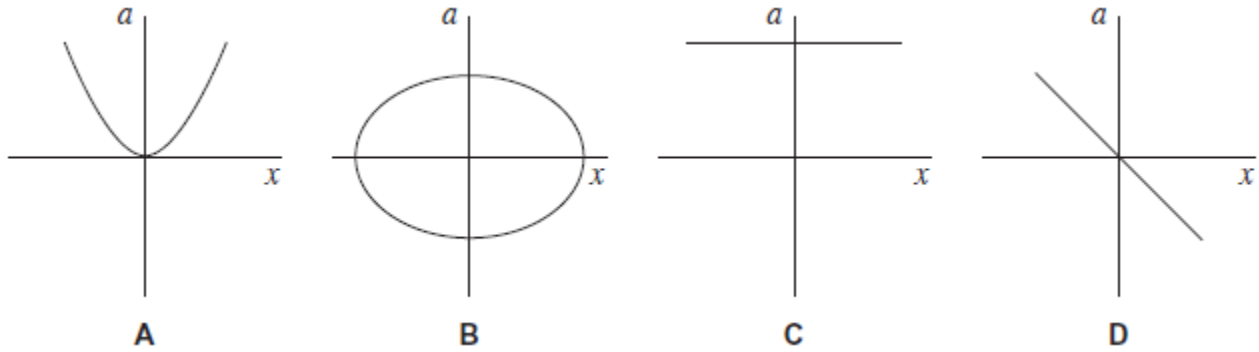


Pendulum P is set in oscillation perpendicular to the plane of the diagram.

Which one of the pendulums, A to D, then oscillates with the largest amplitude?

(Total 1 mark)

15. Which one of the following graphs shows how the acceleration, a , of a body moving with simple harmonic motion varies with its displacement, x ?



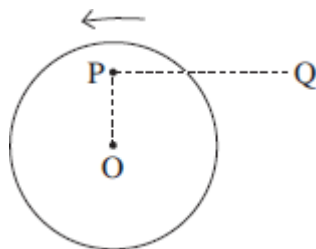
(Total 1 mark)

16. A simple pendulum has a time period of 1.42 s on Earth. The gravitational field strength at the surface of Mars is 0.37 times that at the surface of the Earth. What is the time period of the pendulum on Mars?

- A 0.53 s
- B 0.86 s
- C 2.33 s
- D 3.84 s

(Total 1 mark)

17. A small mass is placed at P on a horizontal disc which has its centre at O. The disc rotates anti-clockwise about a vertical axis through O with constant angular speed.



Which one of the following describes the force which keeps the mass at rest relative to the disc when in the position shown?

- A the weight of the mass
- B a frictional force from P to Q
- C a frictional force directed away from O
- D a frictional force directed towards O

(Total 1 mark)

18.

Which line, **A** to **D**, in the table gives the amplitude and frequency of a body performing simple harmonic motion whose displacement x at time t is given by the equation $x = P \cos Qt$?

| | Amplitude | Frequency |
|----------|---------------|------------------|
| A | $\frac{P}{2}$ | $\frac{Q}{2\pi}$ |
| B | P | $2\pi Q$ |
| C | P | $\frac{Q}{2\pi}$ |
| D | $2P$ | $\frac{Q}{2\pi}$ |

(Total 1 mark)

19.

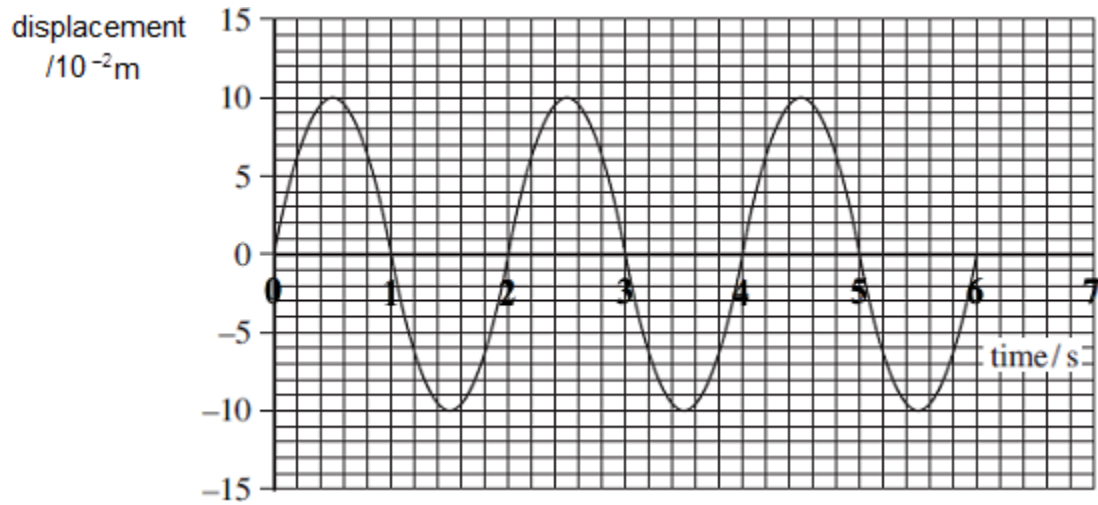
When a mass suspended on a spring is displaced, the system oscillates with simple harmonic motion. Which one of the following statements regarding the energy of the system is **incorrect**?

- 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.

(Total 1 mark)

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

(Total 1 mark)