Simple Harmonic Motion Worksheet

1.(a) On object undergoes simple harmonic motion. State the condition that applies to the unbalanced force acting on the object.

(b) Give three examples of simple harmonic motion (SHM).

2.(a) State the equation which defines SHM.

(b) (i) Show by differentiation that *each* of the following is a solution of the equation for SHM: $y = A\cos\omega t$ and $y = A\sin\omega t$.

(ii) State the condition under which the equation for SHM is given by *each* of the following: $y = A\cos\omega t$ and $y = A\sin\omega t$

(c) Derive the equation for the velocity $v = \pm\omega\sqrt{A^2 - y^2}$ using:

(i) $y = A\cos\omega t$

(ii) $y = A\sin\omega t$.

3. An object moves with SHM with a frequency of 5 Hz and an amplitude of 40 mm.

(a) Find the acceleration at the centre and extremities of the motion.

(b) Determine the velocity at the centre and extremities of the motion.

(c) Calculate the acceleration and velocity at a point midway between the centre and extremity of the motion.

4. A horizontal platform oscillates vertically with SHM with a slowly increasing amplitude. The period of the oscillations is 0.10 s.
What is the maximum amplitude which will allow a mass resting on the platform to remain in contact with the platform?

5. (a) Derive expressions for the kinetic energy and potential energy of a particle executing SHM.

(b) An object of mass 0.20 kg oscillates with SHM with an amplitude of 100 mm. The frequency of the oscillations is 0.50 Hz.

i. Calculate the maximum value of the kinetic energy of the object. State where this occurs.

ii. State the minimum value of the kinetic energy. State where this occurs.

iii. Find the maximum value of the potential energy of the object. State where this occurs.

iv. What can you state about the value of the sum of the potential energy and the kinetic energy at any point?

v. Calculate the potential energy and the kinetic energy at a point mid-way between the centre and extremity of the motion.

6. The displacement, y, in mm of a particle is expressed by $y = 0.44\sin 28t$.

i. Find the amplitude of the motion.

ii. Find the frequency of the motion.

iii. Find the period of the motion.

iv. Find the time taken for the particle to move 0.20 mm from the equilibrium position.

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i. What effect does damping have on an oscillatory system?

ii. Briefly explain the terms critical damping and overdamping.

iii. Give two examples where damping is useful.