Science Olympiad Foundation Uganda

Uganda National Physics Olympiad 2020 - Round 3

Exam ID: 119

Name: _____

Date: _____

Question: 1 of 14 QID: 387 Marks: 1

The circular motion of a particle whose speed is constant is _____

Please mark (✓) for the correct answer.

- **A.** Periodic but not simple harmonic
- **B.** Simple harmonic but not periodic
- **C.** Periodic and simple harmonic
- **D.** Neither periodic not simple harmonic

Question: 2 of 14 QID: 388 Marks: 1

Which of the following is a simple harmonic motion?

Please mark (✓) for the correct answer.

- **A.** Particle moving in a circle with uniform speed
- **B.** Wave moving through a string fixed at both ends
- **C.** Earth spinning about its axis
- **D.** Ball bouncing between two vertical walls

Question: 3 of 14 QID: 389 Marks: 1

A particle executes simple harmonic motion along the x-axis. The force acting on it is given by?

Please mark (✓) for the correct answer.

- **A.** Acos(kx)
- **B.** $Ae^{(-kx)}$
- **C.** Akx
- **D.** –Akx

Question: 4 of 14 QID: 390 Marks: 1

Which one of the following represents simple harmonic motion?

Please mark (✓) for the correct answer.

- **A.** Acceleration = kx
- **B.** Acceleration = $k_0 x + k_1 x^2$
- **C.** Acceleration = -k(x+a)
- **D.** Acceleration = k(x+a)

Question: 5 of 14 QID: 391 Marks: 1

A particle executing simple harmonic motion of amplitude 5cm has a maximum speed of 31.4 cm/s. The frequency of its oscillation is?

Please mark (✓) for the correct answer.

- **A.** 4Hz
- **B.** 3Hz
- **C.** 2Hz
- **D.** 1Hz

Question: 6 of 14 QID: 392 Marks: 1

A particle executes simple harmonic oscillation. Its amplitude is a. The period of oscillation is T. The minimum time taken by the particle to travel half of the amplitude from the equilibrium position is_____

Please mark (✓) for the correct answer.

- **A.** T/8
- **B.** T/12
- **C.** T/2
- **D.** T/4

Question: 7 of 14 QID: 393 Marks: 1

A simple harmonic oscillator has an amplitude A and time period T. The time require by it to travel from x = A to x = A/2 is _____

Please mark (✓) for the correct answer.

- **A.** T/6
- **B.** T/4
- **C.** T/3
- **D.** T/2

Question: 8 of 14 QID: 394 Marks: 1

If a simple harmonic oscillator has got a displacement of 0.02m and acceleration equal to $2m/s^2$ at any time, the angular frequency of the oscillator is equal to _____

Please mark (✓) for the correct answer.

- **A.** 10 rad/s
- **B.** 0.1 rad/s
- **C.** 100 rad/s
- **D.** 1 rad/s

Question: 9 of 14 QID: 395 Marks: 1

The phase difference between the acceleration of a particle executing simple harmonic motion and the instantaneous velocity is?

Please mark (✓) for the correct answer.

- **A.** π
- **B.** 0.707π
- **C.** Zero
- **D.** 0.5π

Question: 10 of 14 QID: 396 Marks: 1

Which one of the following statements is true for the speed v and the acceleration of a particle executing simple harmonic motion?

Please mark (✓) for the correct answer.

- ◯ **A.** When c is maximum, a is maximum
- ◯ **B.** Value of a is zero, whatever may be the value of v
- ◯ **C.** When v is zero, a is zero
- ◯ **D.** When v is maximum, a is zero

Question: 11 of 14 QID: 383 Marks: 6

Geoff, a rock climber, is following his friend Marie up an overhanging cliff. Marie is attached to the rock and ensures that the rope between herself and Geoff is taut at all times. Unfortunately, Geoff falls off and subsequently swings. Unless otherwise stated, ignore air resistance.

Geoff passes through the equilibrium position, for the second time, after 4.5 s. At this point, he is travelling at a speed of 5 ms^{-1} Calculate the following:

a) The frequency of his oscillations **(2 marks)**
b) The amplitude of his oscillations **(2 marks)**
c) His velocity 2.25 s after he falls. **(2 marks)**

Please write your answer below.

Question: 12 of 14 QID: 384 Marks: 4

For a simple pendulum undergoing simple harmonic motion, $\omega^2 = g / l$, where l is the length of the pendulum and g is the acceleration due to gravity. For the small angles involved in simple harmonic motion, $\cos \theta \approx 1 - (\theta^2 / 2)$ and $\sin \theta \approx \theta$.

(d) By expressing the angle θ in terms of Geoff's displacement, x, and the rope's length, l, derive an expression for cos ωt in terms of l, A and θ. **(2 marks)**

(e) Using this result, show that his kinetic energy is given by $0.5m\omega^2(A^2 - l^2\theta^2)$. **(2 marks)**

Please write your answer below.

Question: 13 of 14 QID: 385 Marks: 3

e) By considering his vertical displacement, derive an expression for his potential energy in terms of l, g, θ and his mass, m. **(3 marks)**

Please write your answer below.

Question: 14 of 14 QID: 386 Marks: 3

f) Hence show that energy is conserved (from previous solution) **(3 marks)**

Please write your answer below.

--- END OF QUESTION PAPER ---

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Answer Key

No	Question Type	QID	Correct Answer
Question - 1	Multiple Choice (Radiobutton)	387	A
Question - 2	Multiple Choice (Radiobutton)	388	B
Question - 3	Multiple Choice (Radiobutton)	389	D
Question - 4	Multiple Choice (Radiobutton)	390	C
Question - 5	Multiple Choice (Radiobutton)	391	D
Question - 6	Multiple Choice (Radiobutton)	392	B
Question - 7	Multiple Choice (Radiobutton)	393	A
Question - 8	Multiple Choice (Radiobutton)	394	A
Question - 9	Multiple Choice (Radiobutton)	395	C
Question - 10	Multiple Choice (Radiobutton)	396	D
Question - 11	Essay (Evaluted by Admin)	383	Essay Type Question
Question - 12	Essay (Evaluted by Admin)	384	Essay Type Question
Question - 13	Essay (Evaluted by Admin)	385	Essay Type Question
Question - 14	Essay (Evaluted by Admin)	386	Essay Type Question

--- END OF ANSWER KEY ---