SAT Physics Practice Paper 8

SET 1

1. An object of mass 2 kg has a linear momentum of magnitude 6 kg • m/s. What is this object's kinetic energy?

A. 3 J

B. 6 J

C. 9 J

D. 12 J

E. 18 J

2. A ball of mass 0.5 kg, initially at rest, acquires a speed of 4 m/s immediately after being kicked by a force of strength 20 N. For how long did this force act on the ball?

A. 0.01 s

B. 0.02 s

C. 0.1 s

D. 0.2 s

E. 1 s

3. A box with a mass of 2 kg accelerates in a straight line from 4 m/s to 8 m/s due to the application of a force whose duration is 0.5 s. Find the average strength of this force.

A. 2 N

B. 4 N

C. 8 N

D. 12 N

E. 16 N

4. A ball of mass *m* traveling horizontally with velocity *v* strikes a massive vertical wall and rebounds back along its original direction with no change in speed. What is the magnitude of the impulse delivered by the wall to the ball?

A. 0

B. $\frac{1}{2}mv$

C. mv

D. 2*mv*

E. 4*mv*

5. Two objects, one of mass 3 kg and moving with a speed of 2 m/s and the other of mass 5 kg and speed 2 m/s, move toward each other and collide head-on. If the collision is perfectly inelastic, find the speed of the objects after the collision.

A. 0.25 m/s

B. 0.5 m/s

C. 0.75 m/s

D. 1 m/s

E. 2 m/s

6. Object #1 moves toward object #2, whose mass is twice that of object #1 and which is initially at rest. After their impact, the objects lock together and move with what fraction of object #1's initial kinetic energy?

A. $\frac{1}{18}$

B. $\frac{1}{9}$

C. $\frac{1}{6}$

D. $\frac{1}{3}$

E. None of the above

7. Two objects move toward each other, collide, and separate. If there was no net external force acting on the objects, but some kinetic energy was lost, then

A. the collision was elastic and total linear momentum was conserved

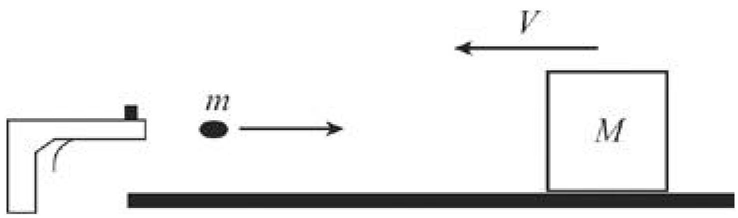
B. the collision was elastic and total linear momentum was not conserved

C. the collision was not elastic and total linear momentum was conserved

D. the collision was not elastic and total linear momentum was not conserved

E. None of the above

8. A wooden block of mass *M* is moving at speed *V* in a straight line.



How fast would the bullet of mass *m* need to travel to stop the block (assuming that the bullet became embedded inside)?

A. $mV/(m + M)$

B. $MV/(m + M)$

C. mV/M

D. MV/m

E. $(m + M)V/m$

9. Which of the following best describes a perfectly inelastic collision free of external forces?

A. Total linear momentum is never conserved.

B. Total linear momentum is sometimes (but not always) conserved.

C. Kinetic energy is never conserved.

D. Kinetic energy is sometimes (but not always)conserved.

E. Kinetic energy is always conserved.

SET 2

1. An object of mass 0.5 kg, moving in a circular path of radius 0.25 m, experiences a centripetal acceleration of constant magnitude 9 m/s^2. What is the object's angular speed?

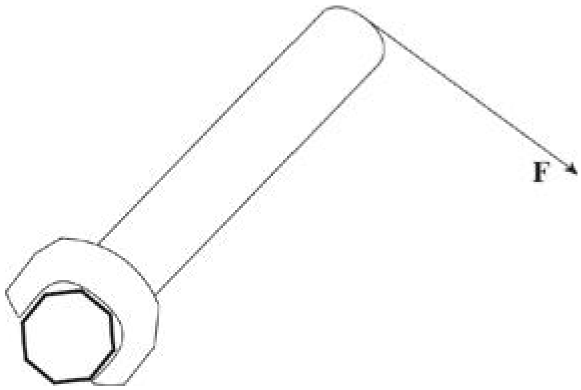
A. 2.3 rad/s

B. 4.5 rad/s

C. 6 rad/s

D. 12 rad/s

E. Cannot be determined from the information given



2.

In an effort to tighten a bolt, a force **F** is applied as shown in the figure above. If the distance from the end of the wrench to the center of the bolt is 20 cm and **F** = 20 N, what is the magnitude of the torque produced by **F** ?

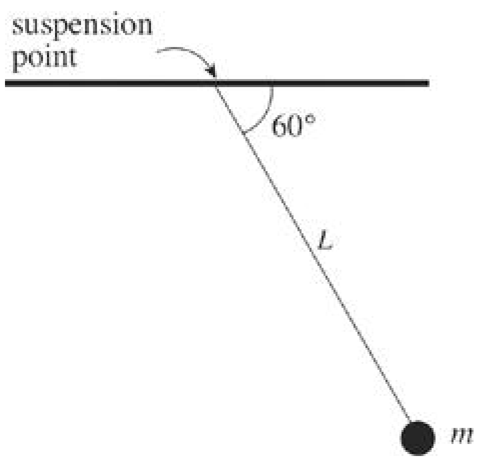
A. 0 N × m

B. 1 N × m

C. 2 N × m

D. 4 N × m

E. 10 N × m



3.

In the figure above, what is the torque about the pendulum's suspension point produced by the weight of the bob, given that the mass is 40 cm below the suspension point, measured vertically, and *m* = 0.50 kg ?

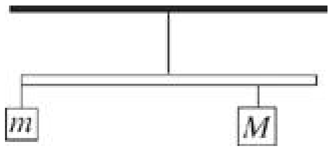
A. 0.49 N × m

B. 1.15 N × m

C. 1.7 N × m

D. 2.0 N × m

E. 3.4 N × m

4. 

A uniform meter stick of mass 1 kg is hanging from a thread attached at the stick's midpoint. One block of mass m = 3 kg hangs from the left end of the stick, and another block, of unknown mass m, hangs below the 80 cm mark on the meter stick. If the stick remains at rest in the horizontal position shown above, what is m ?

A. 4 kg

B. 5 kg

C. 6 kg

D. 8 kg

E. 9 kg

5. An object moves at constant speed in a circular path. True statements about the motion include which of the following?

I. The velocity is constant.

II. The acceleration is constant.

III. The net force on the object is zero since its speed is constant.

A. II only

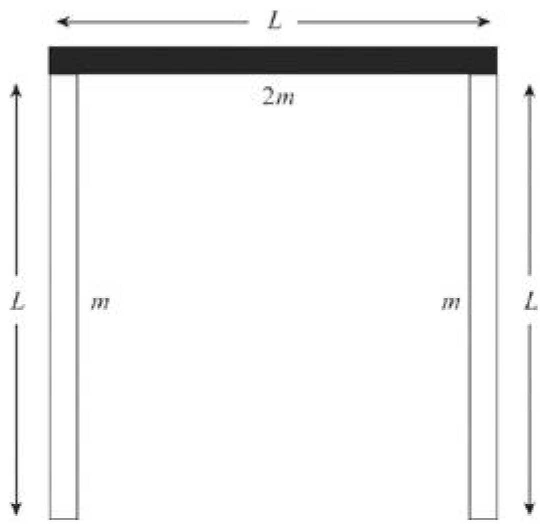
B. I and III only

C. II and III only

D. I and II only

E. None of the above

6. Three thin, uniform rods each of length L are arranged in the shape of an inverted U.



The two rods on the arms of the U each have mass *m*; the third rod has mass 2*m*. How far below the midpoint of the horizontal rod is the center of mass of this assembly?

A. $\frac{L}{8}$

B. $\frac{L}{4}$

C. $\frac{3L}{8}$

D. $\frac{L}{2}$

E. $\frac{3L}{4}$

7. A satellite is currently orbiting Earth in a circular orbit of radius *R*; its kinetic energy is K_1. If the satellite is moved and enters a new circular orbit of radius 2*R*, what will be its kinetic energya?

A. $\frac{K_1}{4}$

B. $\frac{K_1}{2}$

C. K_1

D. $2K_1$

E. $4K_1$

8. A moon of Jupiter has a nearly circular orbit of radius R and an orbit period of T. Which of the following expressions gives the mass of Jupiter?

A. $\frac{2\pi R}{T}$

B. $\frac{4\pi^2 R}{T}$

C. $\frac{2\pi R^3}{(GT^2)}$

D. $\frac{4\pi^2 R^2}{(GT^2)}$

E. $\frac{4\pi^2 R^3}{(GT^2)}$

9. The mean distance from Saturn to the sun is 9 times greater than the mean distance from Earth to the sun. How long is a Saturn year?

A. 18 Earth years

B. 27 Earth years

C. 81 Earth years

D. 243 Earth years

E. 729 Earth years

10. Two satellites orbit the earth in circular orbits, each traveling at a constant speed. The radius of satellite A's orbit is R, and the radius of satellite B's orbit is $3R$. Both satellites have the same mass. How does F_A, the centripetal force on satellite A, compare with F_B, the centripetal force on satellite B ?

A. $F_A = 9F_B$

B. $F_A = 3F_B$

C. $F_A = F_B$

D. $F_B = 3F_A$

E. $F_B = 9F_A$

SET 3

1. Characteristics of simple harmonic motion include which of the following?

I. The acceleration is constant.

II. The restoring force is proportional to the displacement.

III. The frequency is independent of the amplitude.

A. II only

B. I and II only

C. I and III only

D. II and III only

E. I, II, and III

2. A block attached to an ideal spring undergoes simple harmonic motion. The acceleration of the block has its maximum magnitude at the point where

A. the speed is the maximum

B. the potential energy is the minimum

C. the speed is the minimum

D. the restoring force is the minimum

E. the kinetic energy is the maximum

3. A block attached to an ideal spring undergoes simple harmonic motion about its equilibrium position ($x = 0$) with amplitude A. What fraction of the total energy is in the form of kinetic energy when the block is at position $x = \frac{1}{2}A$?

A. $\frac{1}{3}$

B. $\frac{3}{8}$

C. $\frac{1}{2}$

D. $\frac{2}{3}$

E. $\frac{3}{4}$

4. A student measures the maximum speed of a block undergoing simple harmonic oscillations of amplitude *A* on the end of an ideal spring. If the block is replaced by one with twice the mass but the amplitude of its oscillations remains the same, then the maximum speed of the block will

A. decrease by a factor of 4

B. decrease by a factor of 2

C. decrease by a factor of $\sqrt{2}$

D. remain the same

E. increase by a factor of 2

5. A spring–block simple harmonic oscillator is set up so that the oscillations are vertical. The period of the motion is *T*. If the spring and block are taken to the surface of the moon, where the gravitational acceleration is $\frac{1}{6}$ of its value here, then the vertical oscillations will have a period of

A. $\frac{T}{6}$

B. $\frac{T}{3}$

C. $\frac{T}{\sqrt{6}}$

D. T

E. T$\sqrt{6}$

6. A linear spring of force constant *k* is used in a physics lab experiment. A block of mass *m* is attached to the spring and the resulting frequency, *f*, of the simple harmonic oscillations is measured. Blocks of various masses are used in different trials, and in each case, the corresponding frequency is measured and recorded. If f^2 is plotted versus $1/m$, the graph will be a straight line with slope

A. $4\pi^2/k^2$

B. $4\pi^2/k$

C. $4\pi^2k$

D. $k/(4\pi^2)$

E. $k^2/(4\pi^2)$

7. A block of mass m = 4 kg on a frictionless, horizontal table is attached to one end of a spring of force constant k = 400 N/m and undergoes simple harmonic oscillations about its equilibrium position (x = 0) with amplitude A = 6 cm. If the block is at x = 6 cm at time t = 0, then which of the following equations (with x in centimeters and t in seconds) gives the block's position as a function of time?

A. $x = 6 \sin(10t + \frac{1}{2}\pi)$

B. $x = 6 \sin(10\pi t)$

C. $x = 6 \sin(10\pi t - \frac{1}{2}\pi)$

D. $x = 6 \sin(10t)$

E. $x = 6 \sin(10t - \frac{1}{2}\pi)$

8. A student is performing a lab experiment on the simple harmonic motion. She has two different springs (with force constants k_1 and k_2) and two different blocks (of masses m_1 and m_2). If $k_1 = 2k_2$ and $m_1 = 2m_2$, which of the following combinations would give the student the spring–block simple harmonic oscillator with the shortest period?

A. The spring with force constant k_1 and the block of mass m_1

B. The spring with force constant k_1 and the block of mass m_2

C. The spring with force constant k_2 and the block of mass m_1

D. The spring with force constant k_2 and the block of mass m_2

E. All the combinations above would give the same period.

9. A simple pendulum swings about the vertical equilibrium position with a maximum angular displacement of 5 and period T. If the same pendulum is given a maximum angular displacement of 10°, then which of the following best gives the period of the oscillations?

A. $\frac{T}{2}$

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

C. T

D. $T\sqrt{2}$

E. 2T

10. A simple pendulum of length L and mass m as wings about the vertical equilibrium position (θ = 0) with a maximum angular displacement of θ_{max}. What is the tension in the connecting rod when the pendulum's angular displacement is $\theta = \theta_{max}$?

A. $mg \sin\theta_{max}$

B. $mg \cos\theta_{max}$

C. $mgL \sin\theta_{max}$

D. $mgL \cos\theta_{max}$

E. $mgL(1 - \cos\theta_{max})$