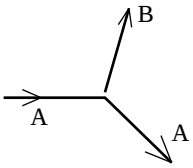
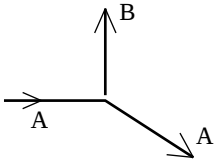
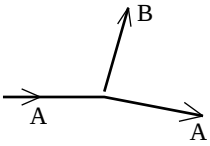
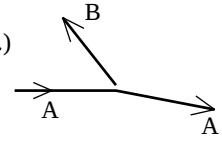
Multiple Choice -- TEST III

1.) An atomic particle A whose mass is 210 atomic mass units collides with a stationary atomic particle B whose mass is 12 atomic mass units. Which of the sketches below most closely approximates a probable collision scenario?

a.) 

b.) 

c.) 

d.) 

2.) A satellite orbits with a constant velocity v in a circular path around a planet. At one point in the flight, a short thruster burst is used to do work on the satellite, motivating it into an elliptical path. After the burst, the average velocity per orbit of the satellite is less than v. In what direction were the thrusters fired?

a.) In the direction of the satellite's motion.
b.) In the direction opposite the satellite's motion.
c.) Perpendicular and inward relative to the satellite's motion.
d.) There is not enough information given to tell.

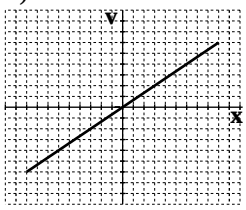
3.) A jackhammer pounds the ground with a frequency of 5 hertz. If each cycle is driven by a hydraulic spring whose effective spring constant is 800 nt/m, and if the throw of the device (i.e., the distance over which the bit is accelerated before contact) is .32 meters:

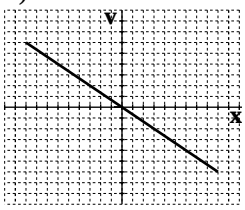
a.) The energy provided by each stroke will be approximately 40 joules.
b.) The work done per stroke will be approximately 40 joules.
c.) The power provided per stroke will be approximately 200 watts.
d.) All of the above.
e.) None of the above.

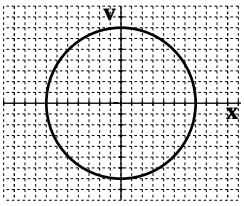
4.) A 12 kg projectile is fired straight up. Halfway to the top of its flight, its kinetic energy is 300 joules. Taking g's magnitude to be 10 m/s^2:

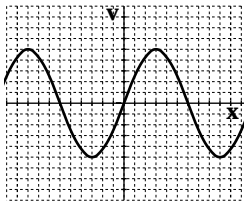
a.) The projectile's velocity at the half-way point is 50 m/s.
b.) The projectile's maximum height is 5 meters.
c.) The projectile's initial velocity (i.e., at ground level) is 8 m/s.
d.) None of the above.

5.) A graph of the velocity vs. position of a body oscillating in simple harmonic motion looks like:

a.) 

b.) 

c.) 

d.) 

e.) None of these.

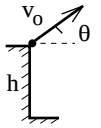
6.) During a 10 second period, a wheel has a constant torque applied to it that diminishes its angular speed from 1 rad/sec to .8 rad/sec. In 20 seconds, the angular speed will be:

a.) .64 rad/sec.
b.) .60 rad/sec.
c.) .40 rad/sec.
d.) .10 rad/sec.

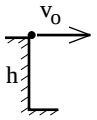
7.) At a given instant, a mass m is observed to be moving with velocity v_o up a frictional incline plane of angle θ.

a.) The direction of the mass's acceleration is opposite the direction of its velocity.
b.) The acceleration would be greater if the block were traveling down the incline.
c.) If θ were made smaller, the coefficient of kinetic friction would change, and the acceleration would be lessened.
d.) Both a and b.
e.) Both a and c.

--The following information pertains to Problems 8 through 10:
Projectiles A and B are fired at the same time from a height h meters above the ground. Both projectiles have the same muzzle velocity v_o. It takes t_1 seconds for Projectile A to get to the top of its flight. A sketch of the two situations is shown below.



projectile A



projectile B

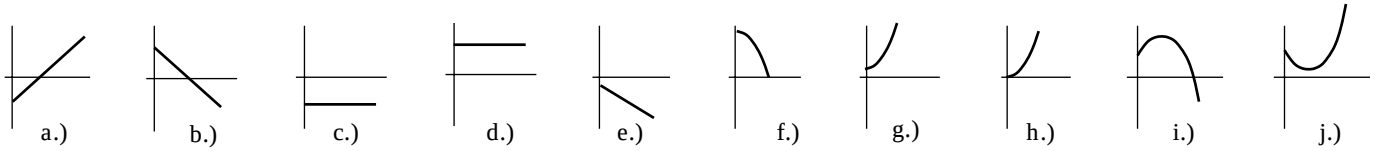
8.) If Projectile A travels a net horizontal distance equal to x_1 meters:

a.) Projectile B will travel a net horizontal distance less than x_1 meters.
b.) Projectile B will travel a net horizontal distance equal to x_1 meters.
c.) Projectile B will travel a net horizontal distance greater than x_1 meters.
d.) The relative distances between Projectiles A and B will depend upon the angle θ.

9.) The initial velocity of Projectile B will:

a.) Be equal to the initial velocity of Projectile A.
b.) Be equal to the velocity of Projectile A at time t_1.
c.) Be equal to the velocity of Projectile A just an instant before touch down.
d.) None of the above.

10.) Consider the graphs shown below:



Projectile B's:

a.) Y-component of Position vs. Time graph looks like graph a.

b.) X-component of Position vs. Time graph looks like graph j.
c.) Magnitude of Velocity vs. Time graph looks like graph g.
d.) X-component of Velocity vs. Time graph looks like graph c.
e.) Y-component of Acceleration vs. Time graph looks like graph b.

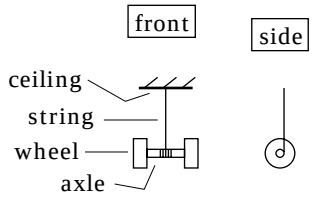
11.) A car moving with velocity v_o rounds a flat curve of radius R. If the car had been moving a bit faster, it would have lost traction and skidded.

a.) If the car had broken traction and skidded, it would have moved away from the curved path it was supposed to take. The force that moved it out of its curved path is called a centrifugal force.
b.) Kinetic friction in this situation will be less than mv_o^2/R.
c.) The coefficient of static friction is equal to mv_o^2/R.
d.) None of the above.

12.) A 10 kg projectile moving vertically has 1500 joules of gravitational potential energy at the same time that it has 1500 joules of kinetic energy. (Assume the gravitational potential energy function is defined as zero at ground level, and assume g's magnitude is 10 m/s^2). At this point:

a.) The body's velocity is exactly half that of its maximum value.
b.) The body's velocity is more than half that of its maximum value.
c.) The body's velocity is less than half of its maximum value.
d.) This cannot be answered as the maximum velocity is not a quantity we can calculate.

13.) A string is attached to the ceiling at one end and has its other end wrapped around an axle of mass m and radius R (see sketch). Attached to the axle are two wheels of mass m and radius 3R each, one at each end. The moment of inertia of the entire assembly along the axle's length is $1.5mR^2$. All numerical values are measured in the MKS system. The system is released to freefall. During the fall, the acceleration of the body's center of mass is:



a.) .40g.
b.) .67g.
c.) 2.0g.
d.) None of the above.

14.) A 1 kg mass is found to be moving 18 m/s up a 30^o incline. How fast is the mass moving 3 seconds later? Take g to be 10 m/s^2.

a.) 2 m/s.
b.) 3 m/s.
c.) 6 m/s.
d.) None of the above.

15.) A satellite of mass m orbits a planet of mass M and radius R in a circular orbit. If the orbit is 3R units above the planet's surface, the velocity of the satellite must be:

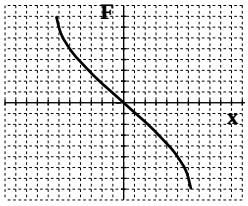
a.) $[GM/(3R)]^{1/2}$.
b.) $[GM/(4R)]^{1/2}$.
c.) $[GM/(16R^2)]^{1/2}$.
d.) $GM/(4R)$.

16.) During time t_1, a single, constant force is applied to body A changing its velocity from zero to 30 m/s. For an unknown period of time t_2, the same force is applied to a second, identical body (call it B). During t_2, B's velocity changes from zero to 15 m/s.

a.) The net work done on A will be twice as much as done on B. Also, the distance over which the force is applied to A is twice that applied to B.
b.) The net work done on A will be twice as much as done on B, but the distance over which the force is applied will not be twice as long.
c.) The net work done on A will be less than twice as much as done on B. Also, the distance over which the force is applied to A is less than twice that for B.
d.) The net work done on A will be more than twice as much as done on B. Also, the distance over which the force is applied to A is more than twice that for B.
e.) None of the above.

17.) A pendulum bob's mass is decreased by a factor of 4 while its length is increased by a factor of 4.

a.) Its frequency will stay the same as will its period.
b.) Its frequency will increase and its period will increase.
c.) Its frequency will decrease and its period will increase.
d.) Its frequency will decrease and its period stays the same.
e.) Its frequency will increase and its period will decrease.

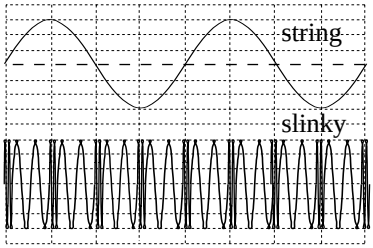


18.) For <u>small amplitude oscillations</u>, the force on an unusually designed spring is very close to being proportional to the displacement of the spring. For <u>large amplitude oscillations</u>, the force becomes non-linear. A graph of the force vs. displacement is shown to the right. When this spring executes large amplitude oscillations:

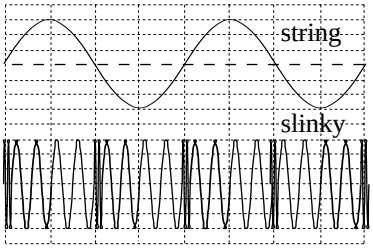
a.) Its period will be the same as in the small oscillations case, and its frequency will also be the same.
b.) Its period will be smaller than in the small oscillations case, and the frequency will also be smaller.
c.) Its period will be smaller than in the small oscillations case, but the frequency will be larger.
d.) Its period will be larger than in the small oscillations case, but the frequency will be smaller.
e.) None of the above.

19.) A string carries a transverse wave down its axis. A slinky carries a longitudinal wave down its axis. At a given instance, the string looks like the top sketches on each grid below. Assuming the slinky's frequency is twice that of the wave on the string, which of the slinky waveforms matches this situation?

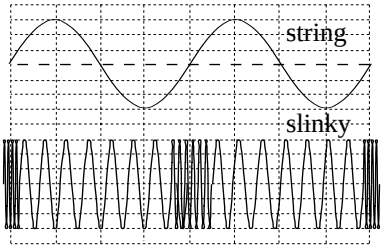
a.)



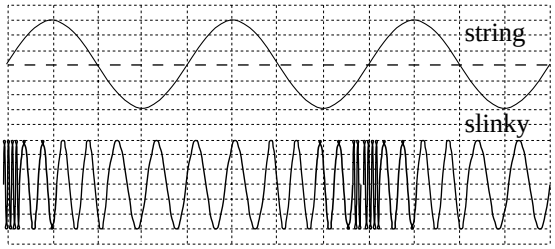
b.)



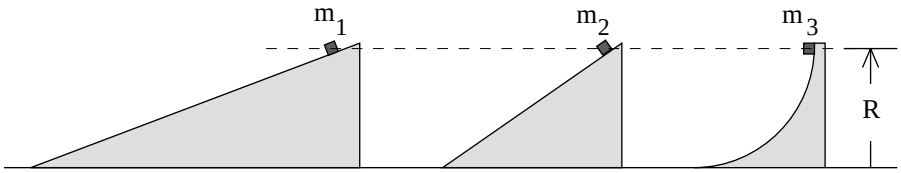
c.)



d.)



e.) There is not enough information to tell.



20.) Three frictionless inclines are shown below. The sketches are drawn approximately to scale with the curved incline being a quarter circle. The masses are different sizes. All three masses are released at once. Mass m_2 travels the same distance as does mass m_3. The first mass to the bottom will be:

a.) Mass m_1.

b.) Mass m_2.

c.) Mass m_3.

d.) Mass m_2 and m_3.

e.) They will all reach the bottom at the same time.

21.) A metal hoop and a hollow rubber ball have the same radius and mass. The two are placed side by side at the top of an incline.

a.) The hoop will arrive at the bottom first, but its rotational kinetic energy will be less than the rotational kinetic energy of the ball when it arrives at the bottom.

b.) The hoop will arrive at the bottom first, and its rotational kinetic energy will be greater than the rotational kinetic energy of the ball when it arrives at the bottom.

c.) The ball will arrive at the bottom first, but its rotational kinetic energy will be less than the rotational kinetic energy of the hoop when it arrives at the bottom.

d.) The ball will arrive at the bottom first, and its angular velocity will be greater than the angular velocity of the hoop when it arrives at the bottom.

22.) A block of mass 2 kg is found sliding with velocity 5 m/s against a frictional, circular wall of radius 3 meters. If the frictional force is a constant 4 newtons:

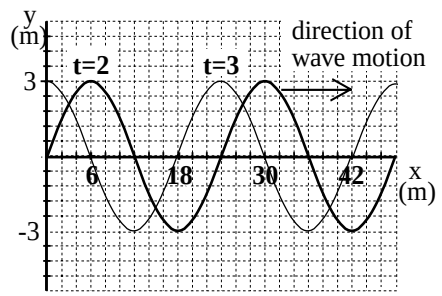
a.) The net force acting on the block at the instant alluded to is 4 newtons, and the distance the block travels before coming to rest is 1.25 meters.

b.) The net force acting on the block at the instant alluded to is 16.7 newtons, and the distance the block travels before coming to rest is 1.25 meters.

c.) The net force acting on the block at the instant alluded to is 17.1 newtons, and the distance the block travels before coming to rest is 6.25 meters.

d.) None of the above.

23.) A graph of a traveling wave as seen at t = 2 seconds and t = 3 seconds is shown to the right. The wave's velocity is:



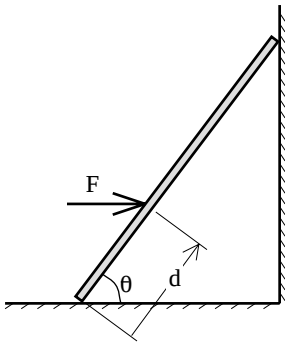
a.) 18 m/s.

b.) 6 m/s.

c.) 4 m/s.

d.) None of the above.

24.) A ladder of mass m and length L sits on a frictionless floor perched against a frictionless wall. A force F acting at a distance d units up the ladder keeps the ladder from angularly accelerating. If F is removed:



a.) There will be only two forces acting on the ladder as it begins to accelerate.

b.) The vertical force V acting at the floor will equal mg.

c.) The normal force at the wall must go to zero.

d.) None of the above.

25.) A spinning skater has rotational kinetic energy equal to 32 joules when spinning with an angular velocity of 4 rad/sec. If the skater had kept the same position but had spun with an angular velocity of only 2 rad/sec, his kinetic energy would have been:

a.) Half the original amount, or 16 joules.

b.) A quarter the original amount, or 8 joules.

c.) Double the original amount, or 64 joules.

d.) Quadruple the original amount, or 128 joules.

26.) A box of mass m sits on the bed of a flatbed pick-up truck. The maximum acceleration the truck can experience without the box breaking loose is a_1. Assume the truck accelerates to the right.

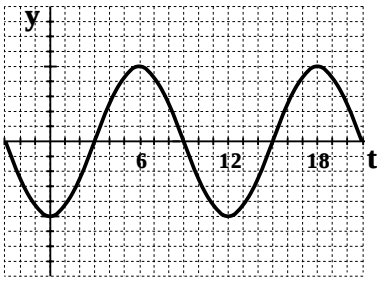
a.) The coefficient of static friction must be equal to a_1/g.

b.) The direction of the static frictional force acting on the box is to the left.

c.) The direction of the static frictional force acting on the box is to the right.

d.) Both a and b.

e.) Both a and c.



27.) A position versus time graph for a body oscillating in simple harmonic motion is shown to the right. The motion's angular frequency is:

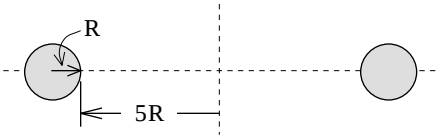
a.) $\pi/12$ radians/second.
b.) $\pi/6$ radians/second.
c.) 1/12 radians/second.
d.) None of the above.

28.) When a 10 kg body is .5 meters up a 30^o incline plane, its velocity up the incline is observed to be 20 m/s. A constant 50 newton frictional force acts on the body.

a.) The net work done on the body will be negative and the body will slow down.
b.) The net work done on the body will be positive and the body will slow down.
c.) The body will have come to rest at the end of 4 meters of motion.
d.) Both b and c.

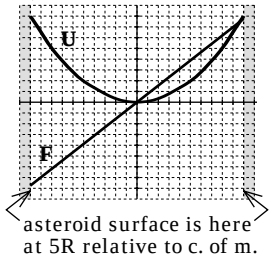
29.) A 2 kg mass with 100 joules of kinetic energy strikes a second body that is half the mass of the first. The collision is perfectly inelastic. What is the approximate velocity of the two bodies after the collision?

a.) 10.0 m/s.
b.) 8.16 m/s.
c.) 6.7 m/s.
d.) 3.3 m/s.

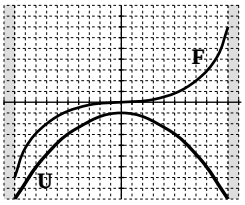


30.) Two asteroids, both of mass M and radius R, orbit one another in circular paths (the origin of the coordinate axis is at the center of mass of the two asteroids). A mass m is moved from the surface of the left asteroid to the surface of the right asteroid. The distance between the two asteroids is 10 R (see sketch). Which of the graphs shown best describes the force on the mass and the mass's potential energy as it makes it trip?

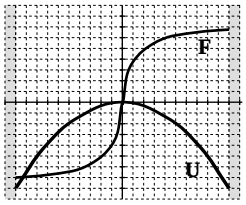
a.)



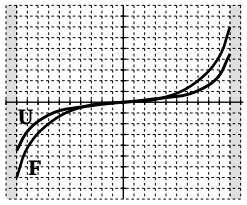
b.)



c.)



d.)



e.) None of these.

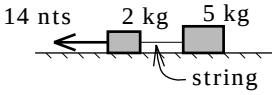
31.) The position function for an oscillating body is $x = 20 \sin (.6t - \pi/2)$. At t = 0, the body is at:

a.) Equilibrium.
b.) Its maximum positive displacement.
c.) Its maximum negative displacement.
d.) None of the above.

32.) The moment of inertia about the central axis of a disk (call it disk A) of radius R and mass m is known to equal I_A. A similar disk (call this disk B) has half the mass of A and half of its radius.

a.) The moment of inertia about disk B's central axis will be the same as that of disk A.
b.) The moment of inertia about disk B's central axis will be $(1/2)I_A$.
c.) The moment of inertia about disk B's central axis will be $(1/4)I_A$.
d.) None of the above.

33.) Two blocks on a frictionless surface are attached by a string (see sketch). If a 14 newton force is applied as shown, the tension in the string will be:



a.) 2.0 nts.
b.) 2.8 nts.
c.) 4.67 nts.
d.) 10.0 nts.

34.) A stationary mass A is struck head on and elastically by a second body B of the same mass and whose velocity before the collision is v_o. After the collision, mass A's velocity is:

a.) Zero.
b.) $v_o/4$.
c.) $v_o/2$.
d.) v_o.
e.) None of the above.

35.) A 1 kg body sits a distance h = 2 meters above a tabletop. The tabletop is d = 1.2 meters high. Three students calculate the body's potential energy. Assuming the magnitude of the gravitational acceleration is 10 m/s^2, which student got it right?

a.) Student A with a calculated potential energy of 20 joules.
b.) Student B with a calculated potential energy of 30 joules.
c.) Student C with a calculated potential energy of 0 joules.
d.) All of the above could be right.