Multiple Choice -- TEST II

--The following information pertains to Problems 1 through 5: Projectiles A, B, C, and D are fired at the same time from a height h meters above the ground. With the exception of Projectile D, which is dropped from rest, all the projectiles (i.e., Projectiles A, B, and C) have the same muzzle velocity v_o, (though each is fired at a different angle--see the sketches below and note that the angle defined as θ is the same in all cases). It takes t_1 seconds for Projectile A to get to the top of its flight. It takes t_2 seconds for Projectile D to reach the ground.

Projectile A   Projectile B   Projectile C   Projectile D

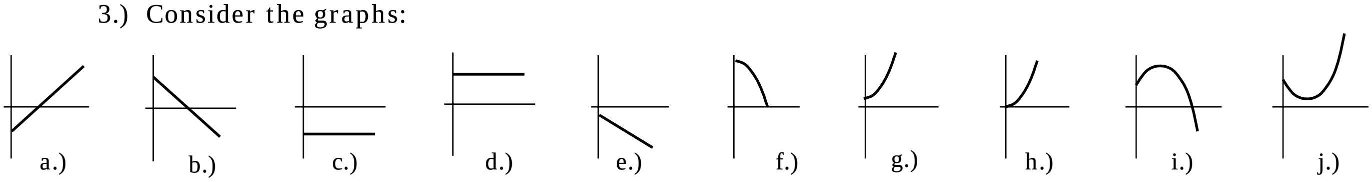
1.) At time t_1, Projectile A's:

a.) Velocity will be perpendicular to its acceleration.
b.) Velocity will be $v_o\cos\theta$.
c.) X-component of acceleration will be twice what it was at t = 0.
d.) All of the above responses are true.

2.) Projectile A's:

a.) Acceleration is greater on the way up than on the way down.
b.) Velocity changes at the same rate going up as going down.
c.) Y-component acceleration sign is the same as its y-component velocity sign while going up.
d.) Velocity, when at h going upward, will be the same as its velocity when at h coming down.
e.) Both b and d.

3.) Consider the graphs:



Projectile A's:

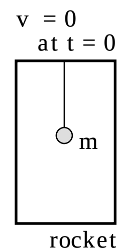
a.) Y-component of Position vs. Time graph looks like graph a.
b.) X-component of Position vs. Time graph looks like graph j.
c.) Y-component of Velocity vs. Time graph looks like graph b.
d.) X-component of Velocity vs. Time graph looks like graph c.
e.) Y-component of Acceleration vs. Time graph looks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

4.) The time t_2:

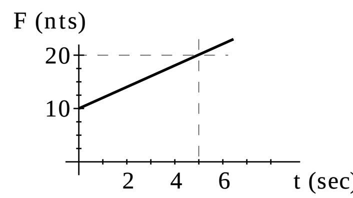
a.) Depends only on h and constant(s).

b.) Is the same time it takes Projectile B to hit the ground.
c.) Is more than the time it takes Projectile C to hit the ground, but less than the time it takes Projectile A to hit.
d.) Both a and b.
e.) All of the above except d.

5.) If h were doubled, Projectile D's:
a.) Time to touch down will double.
b.) Velocity just before touch down will double.
c.) Acceleration just before touch down will double.
d.) None of the above.



6.) A mass m is attached to a string hung from the ceiling of a rocket. The rocket accelerates from rest upward with an acceleration equal to a_1. Just an instant after t = 0:
a.) The tension in the line is mg.
b.) The tension in the line is $m(g + a_1)$.
c.) The tension in the line is $m(g - a_1)$.
d.) None of the above.



7.) A 2.5 kg mass moves one-dimensionally over a frictionless surface. A single, external force F = 2t + 10 is applied (see graph to the right). The body's velocity changes from 0 m/s to 30 m/s during the first 5 seconds:
a.) The net work done by the force is 75 joules (the area under the graph).
b.) The net work done by the force is 1125 joules.
c.) The net work done by the force is -1125 joules.
d.) The net work done by the force is 2813 joules.
e.) The net work done by the force is -2813 joules.

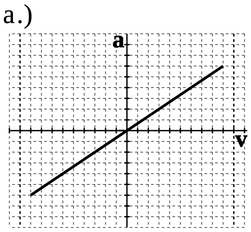
8.) A 20 centimeter diameter ball whose moment of inertia is $(2/5)mR^2$ accelerates down a 30^o incline plane. After traveling .2 meters down the incline, its angular velocity is 14 rad/sec. Assume the magnitude of g is 10 m/s^2.
a.) The velocity of the ball's center of mass at the .2 meter point is 140 m/s.
b.) After traveling an additional .2 meters, the ball's angular velocity will be 28 rad/sec.
c.) The ball's angular acceleration is 35.7 rad/sec^2.
d.) Both a and c are true statements.

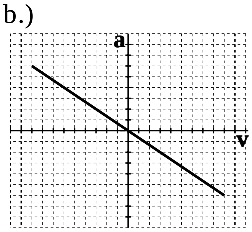
9.) A .5 kg ball moving with velocity v = (20 m/s)i strikes a massive wall over a .02 second period and, reversing itself, leaves with a velocity magnitude equal to 16 m/s.
a.) The impulse applied to the ball during the collision is (2 nt·sec)i, and the magnitude of the average applied force is 100 nts.

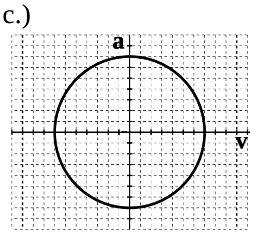
b.) The impulse applied to the ball during the collision is (18 nt·sec)i, and the magnitude of the average applied force is 900 nts.
c.) The impulse applied to the ball during the collision is (-2 nt·sec)i, and the magnitude of the average applied force is 100 nts.
d.) The impulse applied to the ball during the collision is (-18 nt·sec)i, and the magnitude of the average applied force is 900 nts.
e.) None of the above.

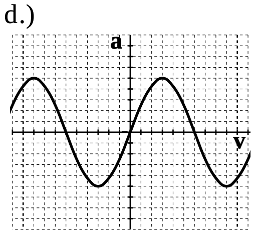
10.) A satellite 3R units from the surface of a planet of radius R has potential energy U_1. Its gravitational potential energy 6R units from the surface (call this potential energy U_2) will be:
a.) Larger and equal to $(1/2)U_1$.
b.) Larger and equal to $2U_1$.
c.) Larger and equal to $(4/7)U_1$.
d.) Smaller and equal to $(4/7)U_1$.
e.) None of the above.

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

a.)


b.)


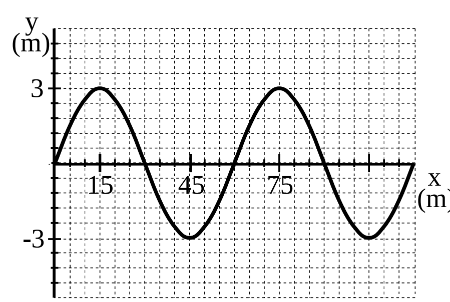
c.)


d.)


e.) None of these.

12.) A 30 newton force acting at 30^o below the horizontal acts over a 12 meter distance. The work done by F:
a.) Is -360 joules.
b.) Is +360 joules.
c.) Would be the same if the angle had been above the horizontal.
d.) Both a and c.
e.) Both b and c.

13.) At a particular point in time during the motion of a wave, the displacement vs. position function is as graphed to the right.

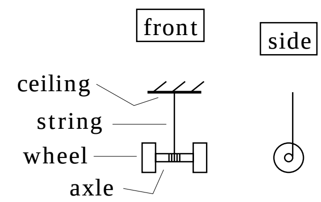


a.) The amplitude of the wave is 3 meters, its wave-length is 60 meters, and its frequency is .5 Hz.
b.) The amplitude of the wave is 6 meters, its wavelength is 30 meters, and its frequency is impossible to tell with the information given.
c.) The amplitude of the wave is 3 meters, its

wavelength is impossible to tell with the information given, and its frequency is impossible to tell with the information provided.

d.) None of the above.

14.) A string attached to the ceiling at one end has its other end wrapped around an axle whose radius is R (see sketch). Attached to the axle are two wheels of mass m each, one at each end. The moment of inertia of the entire assembly along the axle's length is $1.4mR^2$. All numerical values are measured in the MKS system. The system is released to freefall. During the fall:



a.) Energy is conserved but angular momentum is not conserved.

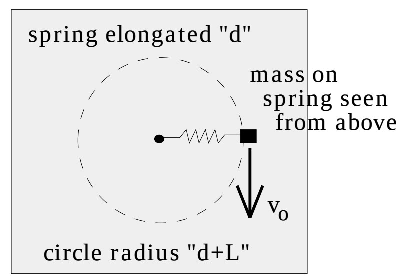
b.) The body's angular acceleration α is numerically greater than the acceleration a of the body's center of mass.

c.) The body's angular acceleration α will be numerically less than the acceleration a of the body's center of mass only if the radius of the axle is greater than 1 meter.

d.) Both a and b.

e.) Both a and c.

15.) A spring produces a force whose magnitude is kx, where x is the elongation of the spring and k is a constant. Our spring's un-stretched spring length is L. One end of the spring is attached to a mass m and the other end of the spring is hooked frictionlessly over a pin at the center of a table. The spring is elongated a distance d beyond L, and the mass is given a constant velocity magnitude v_o so that the whole system moves in a circular path as shown to the right (the view is looking down from above).



a.) With the velocity magnitude a constant, the acceleration for this motion must be zero.

b.) The acceleration is non-zero and k = mg.

c.) The acceleration is non-zero and $k = (mv_o^2)/[x(d + L)]$.

d.) The acceleration is non-zero and $k = (mv_o^2)/(x)$.

16.) Two 2 kilogram masses collide. The first, Body A, has 25 joules of kinetic energy before the collision. The second mass is initially stationary. The two masses experience a perfectly inelastic collision. After the collision, mass B's kinetic energy is:

a.) 12.5 joules.

b.) 2.5 joules.

c.) 6.25 joules.

d.) None of the above.

17.) An orbiting 1200 kg satellite has a period of 43 minutes (2580 seconds) in an orbit that is 15,000 meters above a planet of radius 10^6 meters. The satellite's speed is:

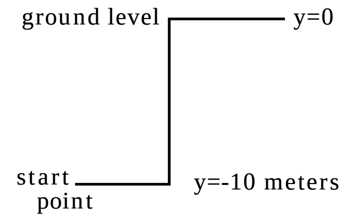
a.) 2472 m/s.

b.) 2435 m/s.

c.) 32.5 m/s.

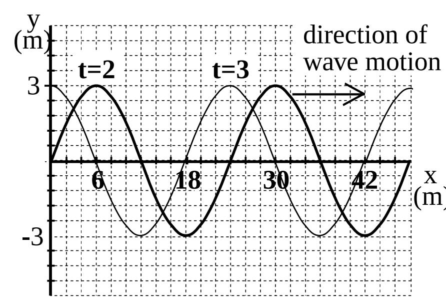
d.) None of the above.

18.) 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 g's magnitude is 10 m/s^2). The potential energy is defined as zero at a point 10 meters below ground level where the body begins its motion (see sketch):



a.) The work gravity does to the top of the body's flight is -3000 joules, and the body's maximum height is 30 meters above ground level.
b.) The work gravity does to the top of the body's flight is -3000 joules, and the body's maximum height is 20 meters above ground level.
c.) The work gravity does to the top of the body's flight is -4000 joules, and the body's maximum height is 30 meters above ground level.
d.) The work gravity does to the top of the body's flight is -4000 joules, and the body's maximum height is 20 meters above ground level.

19.) A graph of a traveling wave as seen at t = 2 seconds and t = 3 seconds is shown to the right. At the rate it is traveling, how far will it travel between t = 2 seconds and t = 5 seconds?

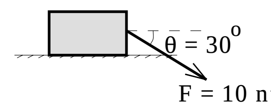


a.) 12 meters.
b.) 18 meters.
c.) 54 meters.
d.) None of the above.

20.) Newton's Second Law is applied to a system. After a free body diagram is drawn and the forces summed, the equation $-32x^2 = 2a$ emerges, where x is the position and a is the acceleration of the body at an arbitrary point in time.
a.) This equation does not characterize an oscillatory system.
b.) This equation does characterize an oscillatory system and the motion is simple harmonic in nature.
c.) This equation does characterize an oscillatory system and the motion's frequency is 4 radians per second.
d.) Both Response b and c.
e.) None of the above.

21.) A spring oscillates with frequency 1 cycle per second. What approximate length must a simple pendulum have to oscillate with that same frequency?
a.) 25 cm.
b.) 50 cm.
c.) 67 cm.
d.) 90 cm.

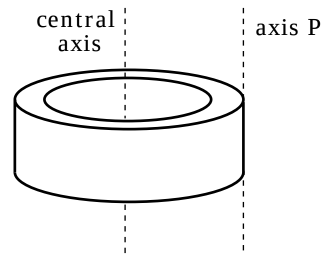
22.) A body moves 25 meters. For the entire motion, a 10 newton force acts on the body as shown to the right.



a.) The work done by the force is 250 joules.
b.) The work done by the force is -250 joules.

c.) The work done by the force is 217 joules.
d.) The work done by the force is -217 joules.
e.) None of the above.

23.) The moment of inertia about the central axis of a ring is $(1/2)m(R_1^{\ 2}+R_2^{\ 2})$, where R_1 is the inside radius and R_2 is the outside radius of the ring (see sketch). The moment of inertia about axis labeled P in the sketch is:

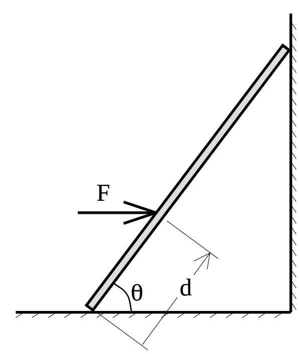


a.) $(1/2)mR_1^{\ 2} + (1/2)mR_2^{\ 2} + (1/2)m[(R_1 + R_2)/2]^2$.
b.) $(3/2)mR_1^{\ 2} + (1/2)mR_2^{\ 2}$.
c.) $(1/2)mR_1^{\ 2} + (3/2)mR_2^{\ 2}$.
d.) None of the above.

24.) A .3 kg body moves down a 30^o incline. At a point .7 meters from the bottom the body is found to be moving with a velocity magnitude of .2 m/s. At that point a frictional force of .5 newtons begins to act. Assume the magnitude of the gravitational acceleration is 10 m/s^2.
a.) The body will not make it to the bottom of the ramp.
b.) The body will just barely make it to the bottom of the ramp.
c.) The body will make it to the bottom of the ramp, and its velocity at that point will be 4.73 m/s.
d.) None of the above.

25.) The position function for an oscillating body is $x = 20 \sin (.6t - \pi/2)$. The approximate frequency of the motion is:
a.) 20 Hz.
b.) 1.57 Hz.
c.) .6 Hz.
d.) .1 Hz.

26.) 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 (see sketch) keeps the ladder from angularly accelerating.



a.) The torque applied by mg about the point of contact with the floor is negative because mg is directed in the -j direction.
b.) The torque applied by the normal force at the wall about the contact point with the floor is negative because N is directed in the -i direction.
c.) About the floor contact, the torque due to F is negative as it tends to motivate the ladder to angularly accelerate clockwise.
d.) Both a and b.

27.) A mass m blows into two pieces having a mass ratio of 5 to 9 (call these masses m_a to m_b,):

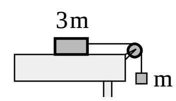
a.) The ratio of the kinetic energies (E_a to E_b) will be 5 to 9 respectively, and the ratio of the momenta (p_a to p_b) will be 5 to 9.
b.) The ratio of the kinetic energies (E_a to E_b) will be 9 to 5 respectively, and the ratio of the momenta (p_a to p_b) will be 9 to 5.
c.) The ratio of the kinetic energies (E_a to E_b) will be 9 to 5 and the ratio of the momenta (p_a to p_b) will be 1 to 1.
d.) None of the above is true.

28.) Two stars circle in elliptical orbits about their collective center of mass. If one star is three times the size of the second star, which of the following is true?

	momentum of center of mass	system's total angular momentum	system's total energy	for the smaller star, T^2 is proportional to r^3
a.)	conserved	conserved	not conserved	yes
b.)	not conserved	not conserved	not conserved	no
c.)	conserved	conserved	conserved	yes
d.)	conserved	conserved	conserved	no

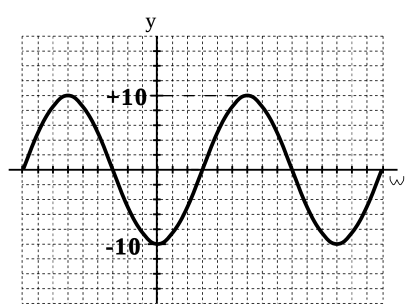
e.) None of the above.

29.) The frictional force acting on the 3m mass shown to the right is .6mg. If the hanging mass is m, the system's acceleration is:



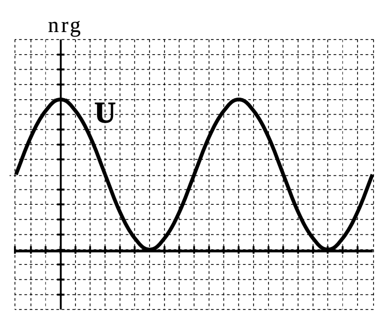
a.) .1g.
b.) .4g.
c.) .133g.
d.) Indeterminable as there isn't enough information.

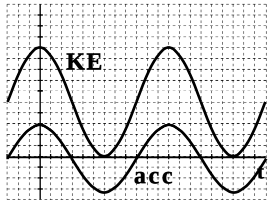
30.) A graph of the position function for a body oscillating with an angular frequency of π radians per second in simple harmonic motion is shown to the right.

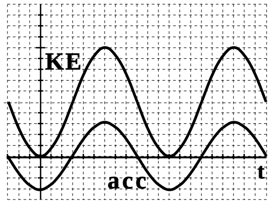


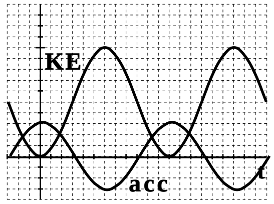
a.) The amplitude is 10, the period is 2 seconds per cycle, and the phase shift is $\pi/2$ radians.
b.) The amplitude is 20, the period is 5 seconds per cycle, and the phase shift is $-\pi/2$ radians.
c.) The amplitude is 10, the period is 2 seconds per cycle, and the phase shift is $-\pi/2$ radians.
d.) None of the above.

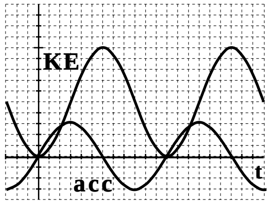
31.) The potential energy vs. time graph for an oscillating system is shown to the right. The kinetic energy vs. time and acceleration vs. time graphs look like:



a.) 

b.) 

c.) 

d.) 

e.) None of these.

32.) At Point A in its motion, 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. The body starts its motion at ground level, and it takes t_1 seconds to reach the point alluded to above. (Assume the gravitational potential energy function is defined to be zero at ground level, and assume g's magnitude is 10 m/s^2).

a.) The maximum height above the ground the body reaches will be 15 meters.
b.) It will take $2t_1$ seconds for the body to reach the top of its flight.
c.) Point A is exactly halfway to the top of the body's flight.
d.) None of the above.

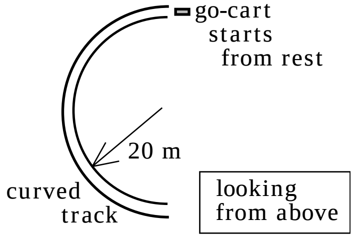
33.) A skater with arms outstretched goes into a spin during which her arms are brought in near her body. During the movement:

a.) Energy is conserved and angular momentum is conserved.
b.) Energy is conserved and angular momentum is not conserved.
c.) Energy is not conserved and angular momentum is conserved.
d.) Energy is not conserved and angular momentum is not conserved.

34.) A sound wave moving at 330 m/s has a frequency of 220 Hz. What is the phase difference between two points .3 meters apart?

a.) 1/5 of a cycle, or $.4\pi$ radians.
b.) 2/3 of a cycle, or $4\pi/3$ radians.
c.) 3/2 of a cycle, or 3π radians.
d.) None of the above.

35.) A go-cart sitting on a flat, circular section of track of radius 20 meters accelerates at a rate of 1 m/s^2. If the car's mass is 100 kg and the coefficient of static friction between the road and its tires is .5, approximately how long will it take before friction can no longer hold the cart in circular motion and the cart spins out? Approximate g to be 10m/s^2.



a.) 2.4 seconds.
b.) 8.2 seconds.
c.) 10.0 seconds.
d.) 13.6 seconds.