General Physics
Physics 101
Final – Fall 2011
Thursday – 12/13/11
Prof. Bob Ekey

Name (print):_____

I hereby declare upon my word of honor that
I have neither given nor received unauthorized
help on this work.

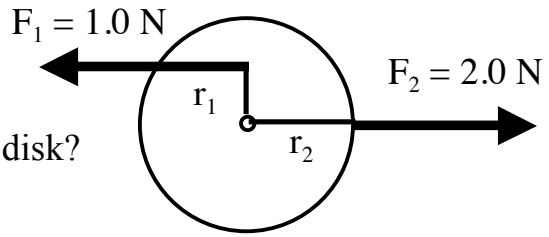
Signature:_____

Part I. Multiple Choice (3 pts each)

Instructions:

Please clearly circle one and only one answer for each of the following.
Show all of your work. Partial credit may be given if you include your work.

Questions:



1. Two forces are applied to the disk as shown, with the $r_1 = 1.0$ m and $r_2 = 2.0$ m. What is the net torque on the disk?

(a) 0.0 Nm
(b) 3.0 Nm
(c) 1.0 Nm
(d) -3.0 Nm

2. A pendulum oscillates at a specific frequency. Which of the following will definitely not change the frequency of oscillation?

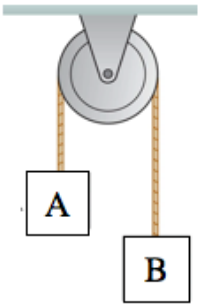
(a) Changing the amplitude of oscillation.
(b) Moving to a planet with a different acceleration due to gravity.
(b) Changing the length of the pendulum.
(d) Changing the mass of the pendulum.

3. A 1.0 kg rock is thrown straight downward from a tall tower. After the release, what is true about the magnitude of the net force applied to the ball?

(a) It is zero
(b) It is greater than 9.8 N
(c) It equals 9.8 N
(d) It is less than 9.8 N

4. The rock in the previous problem (3) leaves with a speed of 10 m/s, and hits the ground with a speed of 99 m/s. What is the vertical height of the tower?

(a) 494.9 m
(b) 0.50 km
(c) 2.0×10^3 m
(d) 4.5 m



5. You brought your Atwood's machine with you to planet X, and measure an acceleration for the system of 6.0 m/s^2. What is the acceleration due to gravity on Planet X? $m_A = 2.0$ kg and $m_B = 4.0$ kg

(a) 18 m/s^2
(b) 12 m/s^2
(c) 2.0 m/s^2
(d) 36 m/s^2

6. A process occurs in which a system's potential energy increases while the system does work on the environment. Ignoring thermal effects, what must happen to the kinetic energy of the system?

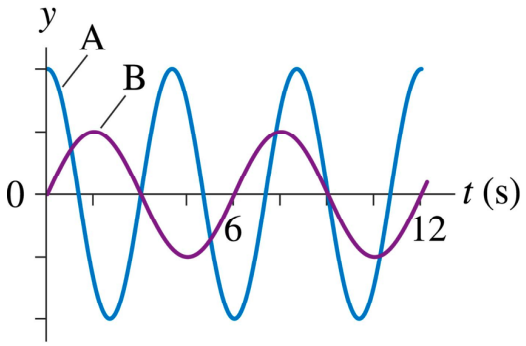
(a) Increase
(b) Decrease
(c) Remain the same
(d) Unable to determine

7. A 2.0 kg solid disc of radius 0.75 m is spun from rest to an angular velocity of 2.0 rad/s by a clock-wise torque of 5.0 Nm. What is the disc's angular acceleration?

(a) -8.8 rad/s^2
(b) 0.11 rad/s^2
(c) -4.4 rad/s^2
(d) Need more information

8. A 620 g bird has a 60 g stick in its mouth (680 g total) that is coasting in the air horizontal to the ground at 30 m/s. If the bird releases the 60 g stick, what is the bird's velocity just after the stick leaves the bird's mouth.

(a) 30 m/s
(b) 33 m/s
(c) 3.4×10^2 m/s
(d) 27 m/s



9. The two graphs shown are for two different vertical mass-spring systems. For A, what is the first time after the t=0 where the energy is all potential?

(a) 1.5 s
(b) 2.0 s
(c) 3.0 s
(d) 4.0 s

10. A 2.0 kg, 1.0 m diameter solid sphere rotates about its edge. What is the moment of inertia of the sphere?

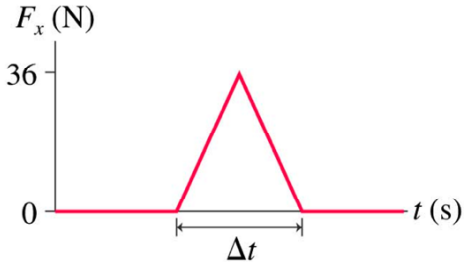
(a) 0.70 kg m^2
(b) 0.20 kg m^2
(c) 2.2 kg m^2
(d) 0.83 kg m^2

11. The volume of a sphere is calculated as 1 in^3. What is the volume in cm^3?

(a) 0.394 cm^3
(b) 0.06 cm^3
(c) 16.4 cm^3
(d) 2 x 10^1 cm^3

12. A horizontal spring, k=100 N/m, is compressed 20 cm and used to launch a 2.5 kg block across a frictionless horizontal surface. After the box travels some distance the surface becomes rough. The coefficient of friction between the box and the surface is 0.15. How far does the block slides across the rough surface before stopping?

(a) 0.54 m
(b) 1.1 m
(c) 1.8 m
(d) 5.3 m



13. If for the collision shown the change in momentum of the particle is 3.00 Ns, how long did the collision last?

(a) 83.3 ms
(b) 12.0 s
(c) 6.00 s
(d) 0.167 s

14. A flywheel spins with an angular velocity of 125.6 rad/s and has a moment of inertia of 70.31 kg m^2. If half of the energy stored in the flywheel is delivered to a motor in 2.00 seconds, what is the average power delivered to the motor?

(a) 5.55 x 10^5 J/s
(b) 139 kW
(c) 2.78 x 10^5 W
(d) 1.39 x 10^4 J

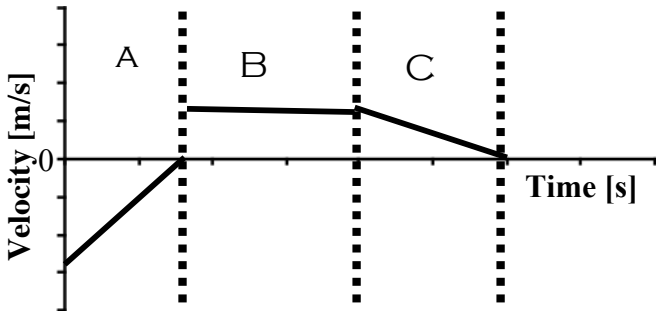
15. While studying for the test, you fell asleep and pushed your book off the table 1.0 m above the floor. The book left the level table with a speed of 1.0 m/s. How far did it travel in the horizontal direction?

(a) 0.20 m
(b) 0.45 m
(c) 1.5 m
(d) 1.0 m

16. A 100 kg bumper car is traveling to the left with a speed of 4.0 m/s and collides elastically with a 150 kg bumper car that is initially at rest. What is the speed of the 150 kg car post collision?

(a) -3.2 m/s
(b) 0.80 m/s
(c) -4.8 m/s
(d) 3.2 m/s

17. For the following velocity vs. time graph, which statement is false?



(a) The object has a negative decreasing velocity in A.

(b) The magnitude of acceleration in A is greater than the acceleration in C.

(c) The velocity in B is zero.

(d) The object is moving in the negative direction in A.

18. A 10.0 cm long spring hangs vertically from the ceiling. A 5.00 kg mass is hung from the mass and is lowered gently into equilibrium. If the end of the spring is stretched by 20.0 cm, what is the spring constant of the spring?

(a) 245 N
(b) 4.9×10^2 N/m
(c) 16.3×10^1 N/m
(d) 2.45×10^2 N/m

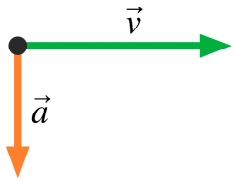
19. A high-speed drill rotates with a speed of 10 rad/s as it comes to rest while experiencing an angular acceleration in the opposite direction of its motion of 2.0 rad/s^2. What angle does the drill turn through as it comes to a halt?

(a) 2.5º
(b)100 rad
(c) 25 rad
(d) 2.0 rad

20. Bob can throw a 500 g rock with a speed of 30 m/s starting from rest. He moves his hand forward 1.0 m while doing so. How much force does Bob apply to the rock?

(a) 450 N
(b) 4.5×10^5 J
(c) 2.3×10^2 kg m/s^2
(d) 1.8 N

21. The particle shown follows a…



(a) Parabolic trajectory
(b) Straight-line trajectory
(c) Circular trajectory
(d) Not possible to tell

22. A 5.0 kg block hangs from a spring with spring constant 2000 N/m. The block is pulled down 5.0 cm from the equilibrium position and given an initial velocity of 1.0 m/s back towards equilibrium. What is the amplitude of the oscillation?

(a) 5.0 cm
(b) 7.1 cm
(c) 49 cm
(d) 10 cm

23. Your pushing a 25 kg wooden file cabinet across a wood floor and it is accelerating at 0.30 m/s^2. Determine the magnitude of your pushing force.

(a) 57 N
(b) 49 N
(c) 42 N
(d) 1.3×10^2 N

24. Which of the following statements is false?

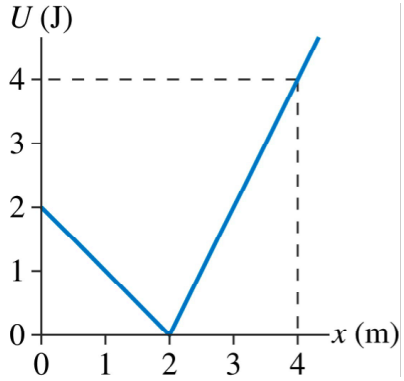
(a) In circular motion, the net acceleration always points radially inward.

(b) In projectile motion, the velocity can be non-zero at the maximum height.

(c) The unit “candela” is an SI base unit

(d) In a conservative system, the total mechanical energy is always constant.

25. A particle moves along the x-axis with potential energy shown. The x-component of the force on the particle when it is at x=1.0 m is?



(a) 8.0 N
(b) -1.0 N
(c) 1.0 N
(d) -2.0 N

26. A mass-spring system (m=2.00 kg) oscillates with a 2.0 Hz frequency and a 0.25 m amplitude. Which of the following could be an equation of motion for the system? Units inside sine/cosine are suppressed.

(a) $v(t) = (0.25\ m) \cos (4.0\ \pi\ t)$
(b) $a(t) = -(9.9\ m/s^2) \cos (4.0\ t)$
(c) $v(t) = -(3.1\ m/s) \sin (4.0\ \pi\ t)$
(d) $x(t) = (0.25\ m) \cos (2.0\ t)$

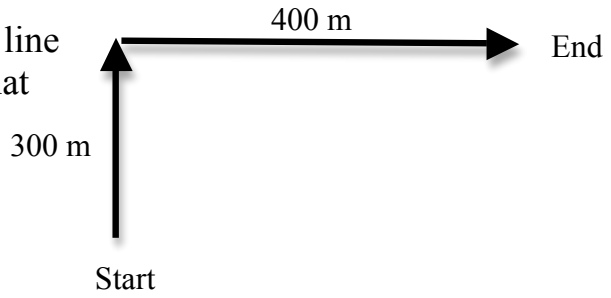
27. Which configuration has the largest centripetal force?

(a) m, v, r
(b) 2m, 2v, 2r
(c) ½m, 2v, ½r
(d) 2m, v, ¼r

28. Your rocket sled is sliding backwards on a frozen lake with a velocity of -10 m/s, so you fire the rocket and you accelerate at 2.0 m/s^2. After 10 seconds, what is the total displacement of the your sled?

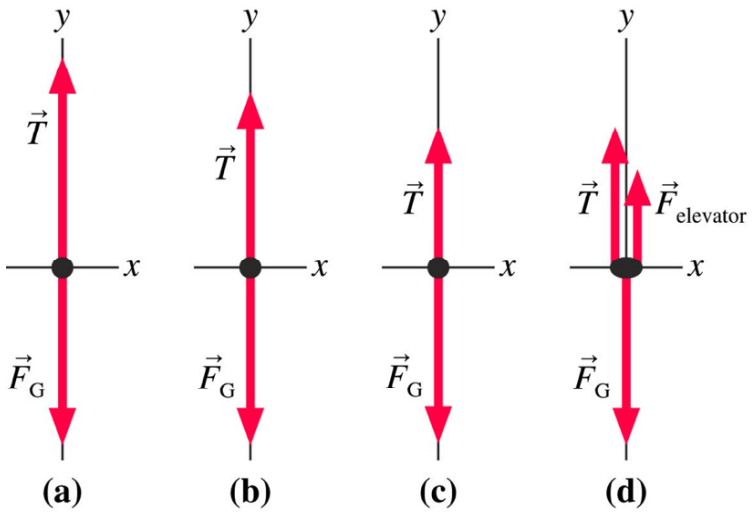
(a) 200.0 m
(b) 90 m
(c) 2.0×10^2 m
(d) 0.0 m

29. In the middle of a field, you walk in a straight line 300 m to the north and then 400 m to the east. What total distance did you travel?



(a) 700 m
(b) 500 m
(c) 100 m
(d) 220 m

30. An elevator suspended by a cable is moving upward and slowing to a stop. Which free-body diagram is correct?



Part II. Short answer problems (12 pts each)

Instructions:

Solve four of the following six problems. If you try to solve all six problems, please clearly indicate which problems you wish to have graded. If you do not indicate this, I will assume you want me to grade problems one, two, three and four.

Please show all of your work, including equations without numbers.
Please provide units with all answers.
Partial credit may be given if you include your work.

Question 1. **Grade this problem? Yes or No (circle one)**

A 80 kg person is riding on a 20 kg cart (100 kg total for the system). You pull the cart with a 20 N force over a 3.0 m distance, and achieve a final velocity of 0.75 m/s

(a) What is the work done by the pull force?

(b) What is the net-work done on the system?

(c) What is the work done by friction?

(d) After the pull has ended, what is the net force acting upon the system?
No calculations are necessary, but words and a force diagram showing all forces acting on the system are.

Question 2. **Grade this problem? Yes or No (circle one)**

A 1.0 kg ball and a 2.0 kg ball are connected by a 1.0 m long rigid, mass-less rod and it is rotating counter-clockwise about its center of mass at 20 rpm.

(a) Where is the center of mass of the system? Be sure to define the origin's location.

(b) What is the total moment of inertia for the system?

(c) What torque will bring the balls to a halt in 5.0 s?

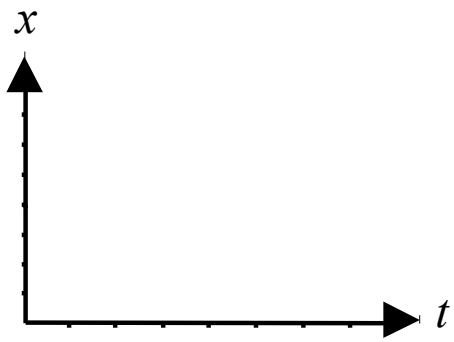
(d) If you spun the system again with the same initial angular velocity and the length of the mass-less rod some how doubles in length (unrealistic, I know but it is mass-less already, so why not have it change length), what would happen to the angular speed? Justify your answer with words and possibly equations, but no calculations are necessary.

Question 3. **Grade this problem? Yes or No (circle one)**

A 20 g ice cube slides down a frictionless ramp that is tilted at an angle of 20º with respect to the horizontal. The block slides 3.0 m down the ramp, and then slides across the dirty floor which slows it down to a stop.

(a) Draw a motion diagram for this situation including the velocity and acceleration vectors and labeled starting and ending position.

(b) Sketch a position (x) vs time plot that could represent the motion of the cube on the floor. Please explain the shape & meaning of the graph.



(c) Calculate the velocity of the ice-cube at the bottom of the ramp. Explicitly state the direction it is traveling.

(d) If the coefficient of kinetic friction between the ice-cube and the dirty floor is 0.20, what is the acceleration of the block on the floor?

Question 4. **Grade this problem? Yes or No (circle one)**

Recently the MythBusters™ had an accident...

"The cannonball was supposed to land harmlessly in a nearby hill -- but something went wrong ... and the ball, traveling at about 1000 ft/s, went over the hill bordering Camp Parks Military Firing Reservation, and into the neighboring town of Dublin, crashing through two separate houses before finally coming to rest ... inside someone's minivan." *http://www.starpulse.com/news/TMZ/2011/12/07/mythbusters_experiment_goes_wrong_can*

The ball traveled a horizontal distance of 8.0×10^2 m before coming to rest, and we'll assume $v_x = 300$ m/s and $v_y = 80$ m/s. Note: The start & stop altitude are not the same.

(a) Determine the flight time of the ball from launch to landing.

(b) What are the x and y velocity components of the cannon ball just prior to impact?

(c) Eventually the ball crashes into a minivan. Assuming a 10 m/s speed of the 1.0 kg ball prior to impact, what impulse does the ball experience as it comes to rest?

(d) Explain using words where the momentum of the ball went after the collision. Note: The minivan and ball were at rest post-collision.

Question 5. **Grade this problem? Yes or No (circle one)**

A 5.0 kg mass oscillates vertically on a spring and you measure 10 oscillations to occur in 50 seconds.

(a) What is the spring constant for this system?

(b) If you displace the mass a distance of 10 cm from equilibrium, what is the total energy in the system?

(c) Explain where the maximum positive velocity occurs in the system and in what direction is it traveling. Words and sketches may help. No calculations are necessary.

(d) Calculate the speed of the mass when it is at a displacement of 2.0 cm.

Question 6. **Grade this problem? Yes or No (circle one)**

A 1.0 kg and 2.0 kg block are being pushed by a force being applied to the 1.0 kg causing the system to accelerate at 1.0 m/s^2.

(a) What is the force (mag + dir) of the 2.0 kg block acting on the 1.0 kg bock?

(b) You stop the blocks and press a button causing the blocks to explode apart. If the velocity of 1.0 kg block is -1.0 m/s, what is the velocity of the 2.0 kg block?

(c) During the explosion which block experiences a larger acceleration? Explain your answer with words and possibly a diagram, no calculations are necessary.

(d) Following the explosion, how far apart are the blocks after 1.0 seconds? Assume friction free.