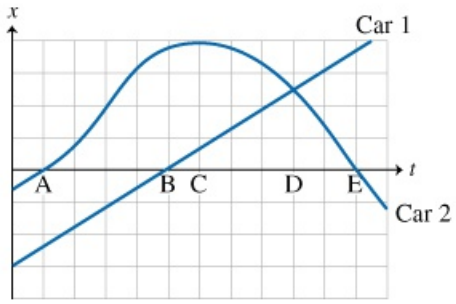
Practice Final Exam -- Physics 121 Fall 2017

1. A car is heading eastward on College Ave. at a speed of 24 m/s. A little dog runs into the road and the car skids to a stop. The time interval between when the brakes were first applied and when the car stopped was 3 seconds. Assuming a constant acceleration, what was the distance covered by the car during the braking time of 3 s?

2. Two cars travel down parallel lanes of a two-lane road. The graph below shows their displacement versus time, where the x axis is alligned along the length of the road. At which time do the cars pass each other, and what is their relative direction of motion?



A. time=D, opposite direction
B. time=D, same direction
C. time=B, same direction
D. time=C, same direction

3. A proton is moving along the positive x axis with an initial velocity v_{xo} of $1x10^3$ m/s. The proton moves into a region of high electric field and experiences a constant acceleration of 10^3 m/s^2 in the negative y direction. What is the proton's x-component of velocity after 2 seconds?

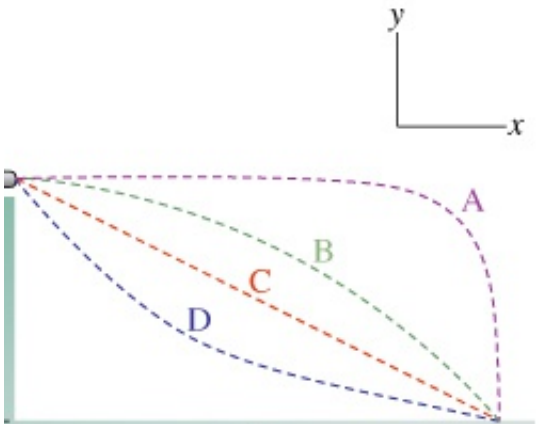
A. $v_x = 0 m/s$

B. $v_x = 2x10^3 m/s$

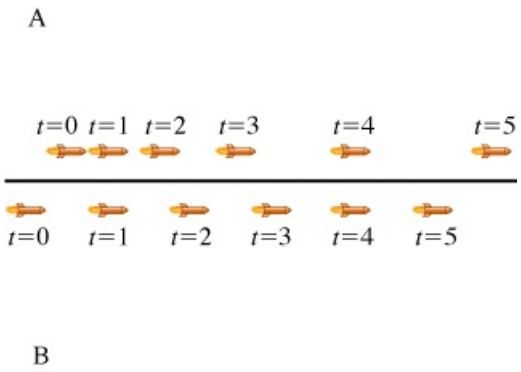
C. $v_x = -1x10^3 m/s$

D. $v_x = 1x10^3 m/s$

4. Referring to the proton in number 3, which path below best describes the path of the proton due to the constant force?



5. Two toy rockets are traveling in the same direction (taken to be the *x* axis). The figure below shows a time-exposure image where a stroboscope has illuminated the rockets at the uniform time intervals indicated.



At what time(s) do the rockets have the same velocity?

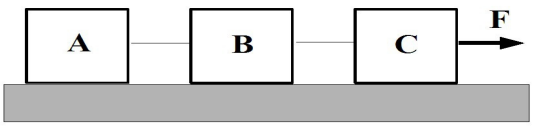
A. At time t=4 only
B. At times t=1 and t=4
C. At some instant in time between t=1 and t=4
D. At no time shown

6 In the figure from problem 5, consider the acceleration of rocket A (a_A) and the acceleration of rocket B (a_B). Which answer best describes their acclerations?

A. $a_A > 0$ and $a_B = 0$
B. $a_A = 0$ and $a_B = 0$
C. $a_A > 0$ and $a_B < 0$
D. $a_A < 0$ and $a_B = 0$

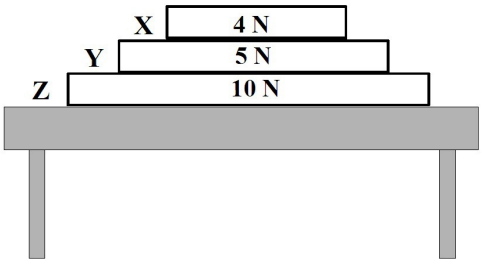
7. A constant force of 8.0 N is exerted for 4.0 s on a 16-kg object initially at rest. The final speed of this object will be
A. 0.5 m/s
B. 2.0 m/s
C. 4.0 m/s
D. 8.0 m/s
E. 32 m/s

8. Three blocks (A, B, C), each having mass *M*, are connected by strings as shown. Block C is pulled to the right be a force **F** that causes the entire system to accelerate. Neglecting friction, the *net* force acting on block B is:



A. zero
B **F**/3
C. **F**/2
D. 2**F**/3
E. **F**

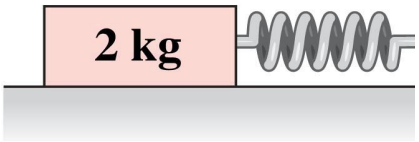
9. Three books (X, Y, and Z) rest on a table. The weight of each book is indicated. The *net* force on book Y is:



A. 4 N down
B. 5 N up
C. 9 N down
D. zero
E. none of the above

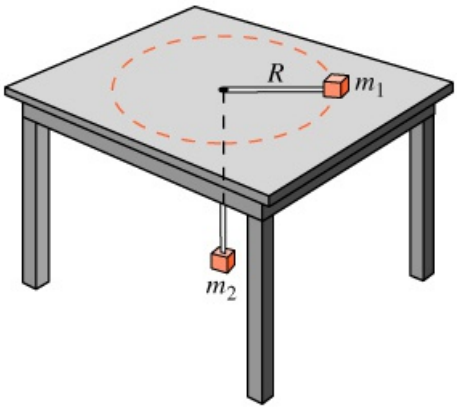
10. For the stack of books in shown in problem 3, the force of book Z on book Y is
A. 0
B. 5 N
C. 9 N
D. 14 N
E. 19 N

11. A block of mass m=2 kg is resting on a rough surface where the coefficient of static friction between the block and surface is 0.3. A spring is attached to the right side of the block and it is stretched until the block begins to move. If the spring constant is 30 N/m, how far is the spring stretched when the block first moves?



A. 3.0 m
B. 2.0 m
C. 0.5 m
D. 0.2 m
E. 0.02 m

12. In the figure below, masses m_1 and m_2 are connected by a rope that passes through a hole in the table. There is no friction between the rope and the edges of the hole. Mass m_1 spins on the frictionless, horizontal surface of the table with a speed of 2 m/s and circular radius of 0.10 m. If $m_2 = 20$ kg, the mass m_1 must be



A. 196 kg
B. 20 kg
C. 9.8 kg
D. 4.9 kg
E. none of the above

13. A volkswagon with a mass of 1000 kg and a hummer with mass 2000 kg are moving with the same constant speed of 20 m/s along a circular track of radius 75 m. The magnitudes of their accelerations are
A. in the ratio of $\sqrt{2}:1$
B. in the ratio of $2:1$
C. in the ratio of $4:1$
D. equal
E. zero

14. Calculate the force of the track on the hummer in the above problem (be sure to state the magnitude and direction).

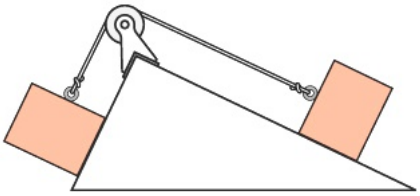
15. A dust ball with mass 1 g rests on a flat rotating turntable at a distance of 10 cm from the center. The rotation rate of the turntable is increased until the dust ball slides off of the table at a speed of 25 cm/s. What is the coefficient of static friction between the dust ball and turntable?

A. 0.06
B. 0.10
C. 0.30
D. 0.60
E. 0.99

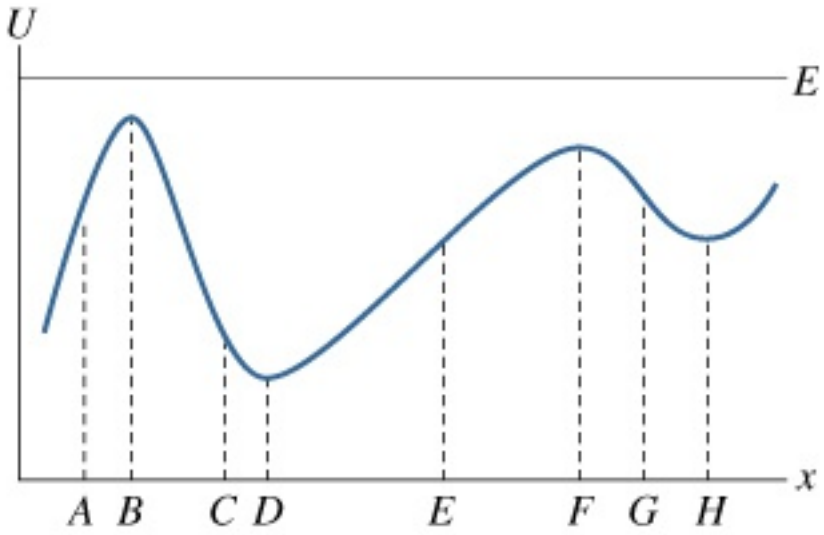
16. For the mass m_1 moving on the horizontal table in problem 7, what is the work done on m_1 by the tension force of the string, computed over one complete revolution?

A. 0
B. 0.6 J
C. 9.8 J
D. 31 J
E. 126 J

17. (15 pts) In the figure below, the two masses are connected by rope over a frictionless pulley. Suppose that left and right angles of the ramp are 70^o and 20^o, and that the left-hand mass m_1 is 2.1 kg. Calculate the value of the right-hand mass m_2 if it is accelerating downslope (toward the right) with a magnitude a=0.64 m/s^2. <u>You must draw complete free body diagrams for each mass to receive full credit.</u>



18. Consider the potential energy diagram for a particle shown below. The curve shows the value of the potential energy U as a function of the particle's position x. The horizontal line above the curve represents the value of the particle's total energy E.



A. List all of the labeled points where the acceleration of the particle would be zero.

B. Identify the labeled point where the particle would experience the greatest force in the negative x direction.

C. Identify the labeled point where the particle's speed would be the greatest.

D. (True/False): The sum of the potential and kinetic energies of the particle is greater at point B than at point F.

Six automobles are initially traveling at the indicated velocities. The automobiles have different masses and velocities. The drivers step on the brakes and all automobiles are brought to rest.

A **B** **C** **D** **E** **F**

19. Rank these automobiles on the basis of the impulse needed to stop them, from largest to smallest.

20. If a constant braking force of 5×10^3 N is applied to car **F**, calculate how long must the brakes be applied in order to bring the car to rest.

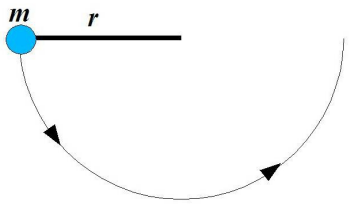
21. An elevator is pulled upward by a cable and rises at a constant speed. List all of the statements below that are true.

I. The tension in the cable is constant.
II. The kinetic energy of the elevator is constant.
III. The gravitational potential energy of the Earth-elevator system is constant.
IV. The acceleration of the elevator is zero.
V. The mechanical energy of the Earth-elevator system is constant.

22. A man sits in the back of a canoe in still water. He then moves to the front of the canoe and sits there. After he sits down, the canoe

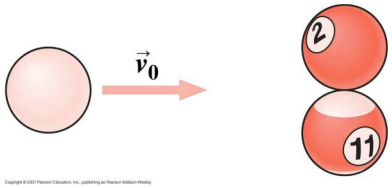
A. is forward of its initial position and moving forward
B. is forward of its inital postion and moving backward.
C. is rearward of its initial position and moving backward.
D. is rearward of its initial position and moving forward.
E. is rearward of its initial position and not moving.

23. A small object of mass m, on the end of a light cord, is held horizontally at a distance r from a fixed support as shown below. The object is then released. What is the tension in the cord when the object is at the lowest point of its swing?



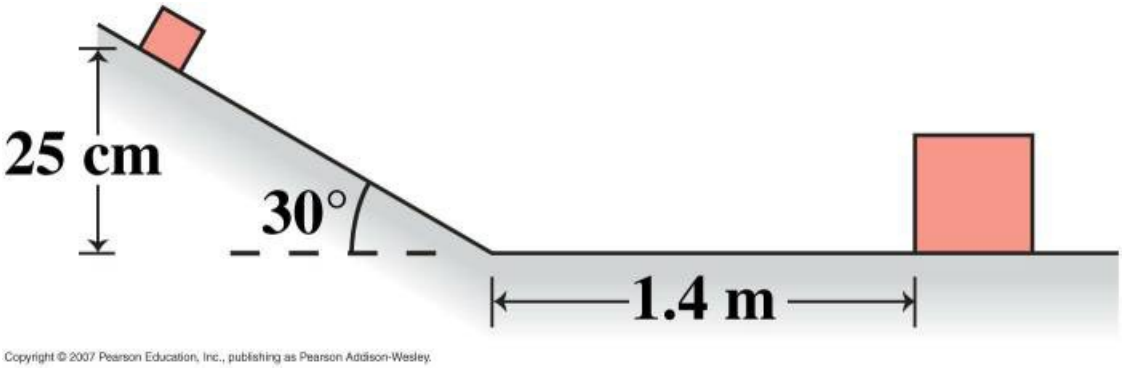
A. $mg/2$
B. mg
C. $2mg$
D. $3mg$
E. mgr

24. Two identical billiard balls are initially at rest when they are struck symmetrically by a third identical ball moving with velocity $v_o \boldsymbol{i}$ as shown in the figure below. There are no external forces acting on the system of three balls. What is the velocity of the center of mass of the system after the collision?



A. $(v_o/3)\,\boldsymbol{i}$
B. $(v_o - 2v_o\cos 30)\,\boldsymbol{i}$
C. $v_o\,\boldsymbol{i}$
D. $(v_o/2)\,\boldsymbol{i} + (v_o/2)\,\boldsymbol{j}$
E. $v_o\,\boldsymbol{i} + 2v_o\,\boldsymbol{j}$

25. A block of mass 200 g is initially at rest on a frictionless ramp. It then slides down the ramp and collides with a block of mass 800 g, also initially rest, as shown in the figure below. The blocks stick together and move along the horizontal, frictionless surface. Find the speed of the center of mass after the collision.



26. A force with a given magnitude is to be applied to a wheel. The torque on the wheel can be maximized by

A. applying the force near the axle, radially outward from the axle.
B. applying the force near the rim, radially outward from the axle.
C. applying the force near the axle, parallel to a tangent to the rim.
D. applying the force at the rim, tangent to the rim.
E. applying the force at the rim, at 45° to the tangent.

27. A simple pendulum consisting of a bob of mass m attached to a string of length L swings with a period T. If the pendulum is brought on the moon the gravitational acceleration is about $g/6$, approximately what will its period now be?

A. $T/6$
B. $6T$
C. T
D 2.4T
E. $T/2.4$

28. Sinusoidal waves travel on five identical strings. Four of the strings have the same tension but the fifth has a different tension. Use the mathematical forms of the waves, given below, to identify the string with the different tension. In the expressions, x and y are in centimeters and t is in seconds.

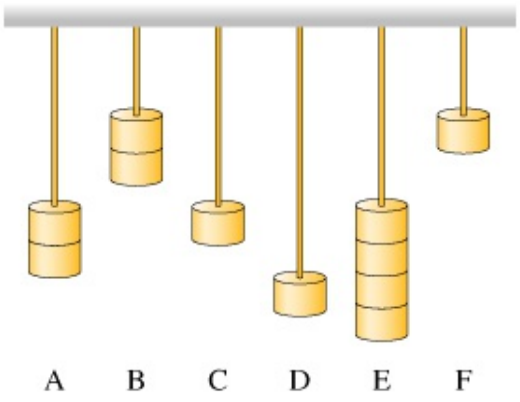
A. $y(x,t) = (2\text{ cm})\sin(2x - 4t)$
B. $y(x,t) = (2\text{ cm})\sin(4x - 10t)$
C. $y(x,t) = (2\text{ cm})\sin(6x - 12t)$
D. $y(x,t) = (2\text{ cm})\sin(8x - 16t)$
E. $y(x,t) = (2\text{ cm})\sin(10x - 20t)$

29. A 450-g mass on a spring is oscillating at 2.4 Hz. The total energy of the oscillation is 0.51 J. What is the amplitude of the oscillation?

A. 10 cm
B. 15 cm
C. 20 cm
D. 25 cm
E. 30 cm

30. A musical instrument is illustrated below. Six pieces of identical piano wire (cut to different lengths) are hung from the same support, and masses are hung from the free end of each wire. Each wire is 1, 2, or 3 units long, and each supports 1, 2, or 4 units of mass. The mass of each wire is small compared to the total mass hanging from it. When a strong breeze blows, the wires vibrate and create an audible sound.

(a) Which string vibrates with the highest fundamental frequency?



(b) Which string vibrates with the lowest fundamental frequency?