College of Arts and Sciences
Department of Mathematics,
Statistics, and Physics
Physics Program

Physics for Engineers I
PHYS 191, Fall 2014
Exam 2
December 2, 2014

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25

Student Name:……..……..……..……..

Student ID:……..….**List #**……..…..…….

Section:……..……

Please read the following instructions carefully before you start answering:

1. Make sure that you have **8** pages including two parts, A and B. Part A consists of 15 multiple choice questions including 2 bonus questions, while Part B consists of 3 problems.
2. Answer all the questions and show all the steps of your work in part B in a clear tidy way.
3. Calculators are permitted but no electronic dictionaries.
4. Include units in all calculations and answers.
5. All your work must be done on your exam paper; no loose papers are allowed. If additional space is required use the last page and indicate that this has been done.
6. This is a timed exam (120 min). Do not spend too much time in any particular question.

$\sum \vec{F} = m\vec{a}$ $f_s \leq \mu_s n$ $f_k = \mu_k n$ $a_{rad} = \frac{v^2}{R}$

$W = \vec{F} \cdot \vec{s}$ $W = Fs\cos\phi$ $P = \vec{F} \cdot \vec{v}$

$$W = \int_{P_1}^{P_2} F\cos\phi\, dl = \int_{P_1}^{P_2} F_{\parallel}\, dl = \int_{P_1}^{P_2} \vec{F} \cdot d\vec{l}$$

$W_{tot} = K_2 - K_1 = \Delta K$

$K_1 + U_1 + W_{other} = K_2 + U_2$ $U_{grav} = mgy$ $U_{el} = \frac{1}{2}kx^2$

Good Luck

Part A: *Please choose the correct answer for each question*

13 points ---- You have two bonus equations!

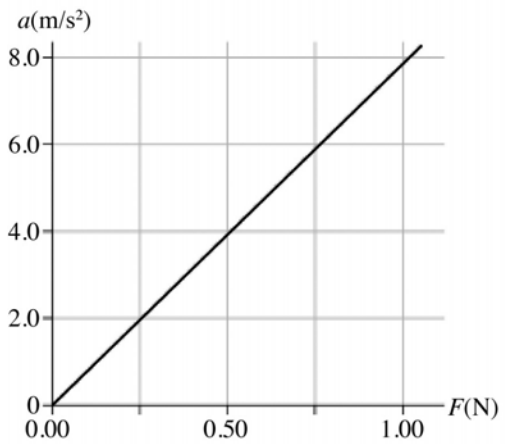
1. An object moving with constant velocity, then
a. The object is accelerating.
b. There are no forces acting on the object.
c. The net force acting on the object is zero.
d. The object is losing mass.

2. A ball hits a wall, it reverses direction then
a. The force of the ball on the wall = the force of the wall on the ball.
b. The force of the ball on the wall > the force of the wall on the ball.
c. The force of the ball on the wall < the force of the wall on the ball.
d. The force of the wall on the ball is zero.
e. None of the above.

3. As a car goes up a hill, there is a force of friction between the road and the tires rolling on the road. The maximum force of friction is equal to:
a. the weight of the car times the coefficient of friction.
b. the normal force of the road times the coefficient of friction.
c. the mass of the car times the coefficient of friction.
d. zero
e. None of the above

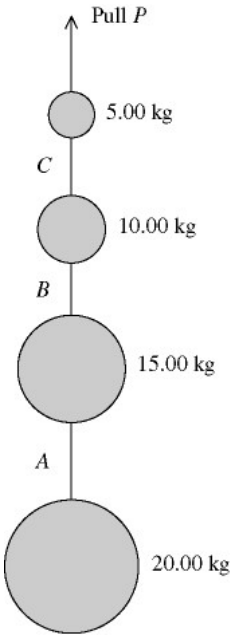
4. The figure shows a graph of the acceleration of an object as a function of the net force acting on it. The mass of this object, is closest to

a. 0.011 kg
b. 0.050 kg
c. 0.089 kg
d. 0.125 kg
e. 8.000 kg



5. A series of weights connected by very light cords are given an upward acceleration of 4.00 m/s^2 by a pull *P*, as shown in the figure. *A*, *B*, and *C* are the tensions in the connecting cords. The pull *P* is closest to

a. 690 N.
b. 490 N.
c. 290 N.
d. 200 N.
e. 50 N.

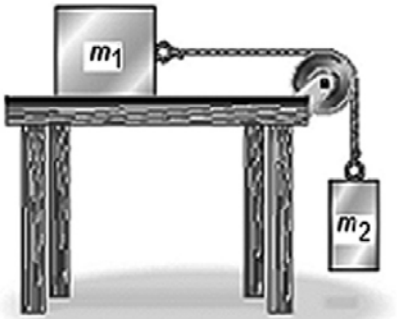


6. A 50-kg child riding a Ferris wheel (radius = 10 m) travels in a vertical circle. The wheel completes one revolution every 10 s. What is the magnitude of the force on the child by the seat at the highest point on the circular path?

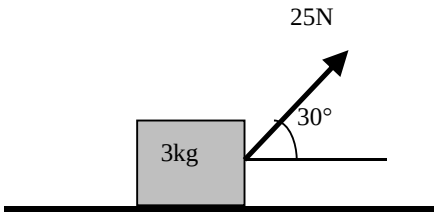
a. 0.69 kN
b. 0.49 kN
c. 0.40 kN
d. 0.29 kN
e. 0.20 kN

7. Two objects having masses m_1 and m_2 are connected to each other as shown in the figure and are released from rest. There is no friction on the table surface or in the pulley. The masses of the pulley and the string connecting the objects are completely negligible. What must be true about the tension *T* in the string just after the objects are released?

a. $T = m_2g$
b. $T > m_2g$
c. $T < m_2g$
d. $T = m_1g$
e. $T > m_1g$



8. A block is pulled on a horizontal frictionless surface with a force (F = 25 N) that makes an angle of 30° with the horizontal as shown. If M = 3 kg, what is the magnitude of the resulting acceleration of the block?

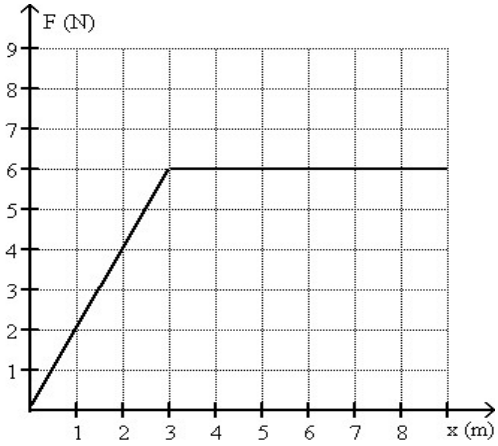


a. 4.2 m/s^2
b. 5.0 m/s^2
c. 7.2 m/s^2
d. 8.3 m/s^2
e. 21.7 m/s^2

9. Two equal-mass rocks tied to string are whirled in horizontal circles. The radius of circle 2 is twice that of circle 1. If period of motion is the same for both rocks, what is the tension in cord **2** compared to cord **1**

a. $T_2 = ¼\ T_1$
b. $T_2 = ½\ T_1$
c. $T_2 = T_1$
d. $T_2 = 2T_1$
e. $T_2 = 4T_1$

10. The force on an object as a function of position is shown in the figure. Determine the amount of work done by this force on an object that moves from x = 2.0 m to x = 7.0 m.



a. 29 J
b. 32 J
c. 24 J
d. 38 J
e. 33 J

11. How long will it take a 7.08 hp motor to lift a 250 kg beam directly upward at constant velocity from the ground to a height of 45.0 m? Assume frictional forces are negligible. (1 hp = 746 W)

a. 2.18×10^4 s
b. 1.56×10^4 s
c. 39.7 s
d. 20.9 s
e. 12 s

12. An 1100-kg car traveling at 27.0 m/s starts to slow down and comes to a complete stop in 578 m. What is the magnitude of the average braking force acting on the car?
    a. No braking force required
    b. 340 N
    c. 410 N
    d. 550 N
    e. 690 N

13. A mass of 2.0 kg traveling at 3.0 m/s along a smooth, horizontal plane hits a relaxed spring. The mass is slowed to zero velocity when the spring has been compressed by 0.15 m. What is the spring constant of the spring?

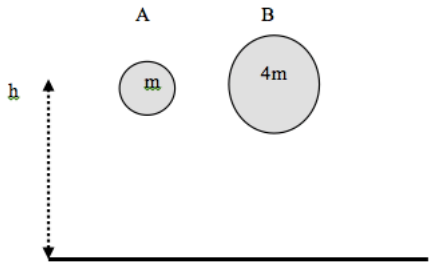
    a. 800 N/m
    b. 400 N/m
    c. 20 N/m
    d. 18 N/m
    e. 9.0 N/m

14. A potential energy function for a certain system is given by $U_1(x) = Cx^2 + Bx^3$. The potential energy function for a second system is given by $U_2(x) = A + Cx^2 + Bx^3$, where A is a positive quantity. How does the force on system 1 relate to the force in system 2 at a given position

    a. The force in the two systems will be in opposite directions
    b. The force is identical in the two systems
    c. The force in the second system will be with less than the force in the first system
    d. There is no relationship between the force in the two systems
    e. The force in the second system will be with greater than the force in the first system

15. Two balls are dropped from rest from the top of a building with height (h) above the ground. Ball B has four times the mass of ball A. When the balls are about to hit the ground, the relation between their kinetic energies, K_A and K_B is

    a. $K_B = 4\ K_A$
    b. $K_A = 4\ K_B$
    c. $K_A = K_A$
    d. $K_B = 2\ K_A$
    e. $K_A = 4\ K_B$

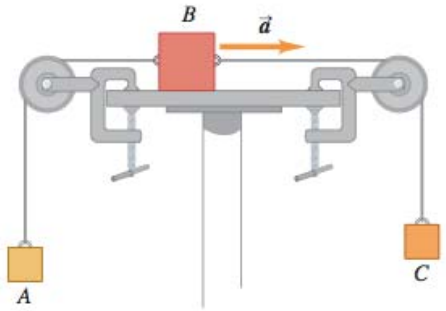


Part B: *Please solve the following problems showing all the steps of your solutions*

Problem 1: (4 pts)

Block A in the following figure has a mass of 4.00 kg, and block B has a mass of 12.0 kg. The coefficient of kinetic friction between block B and the horizontal surface is 0.25. Block B is speeding up to the right with an acceleration of 2.00 m/s^2.

a) Draw free body diagram for the three blocks
b) What is the tension between bock A and B?
c) What is the tension between block B and block C?
d) What is the mass of block C?



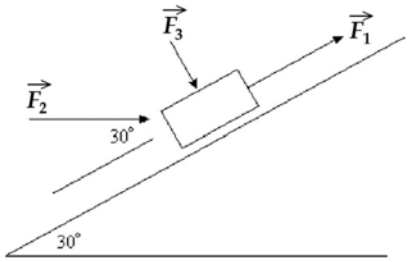
Problem 2: **(4 pts)**

Three forces, F_1 = 20.0 N, F_2 = 40.0 N, and F_3 = 10.0 N act on an object with a mass of 2.00 kg which can move along a frictionless inclined plane as shown in the figure. The questions refer to the instant when the object has moved through a distance of 0.600 m along the surface of the inclined plane in the upward direction.
Calculate the amount of work done by:

(a) F_1

(b) F_2

(c) F_3



Problem 3: **(4 pts)**

In a truck-loading station at a post office, a small 0.200-kg package is released from rest at point A on a track that is one-quarter of a circle with radius 1.60 m see the figure below. The size of the package is much less than 1.60 m, so the package can be treated as a particle. It slides down the track and reaches point B with a speed of 4.80 m/s. From point B, it slides on a level surface a distance of 3.00 m to point C, where it comes to rest.

(a) What is the coefficient of kinetic friction on the horizontal surface?

(b) How much work is done on the package by friction as it slides down the circular arc from A to B?