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Physics Program
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Physics for Engineers I (PHYS 191)
and
General Physics I (PHYS 101)
Fall 2015
Exam 2
November 26, 2015

Please read the following instructions carefully before you start answering:

1. Make sure that you have 7 pages including two parts, A and B. Part A consists of 12 multiple choice 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 minutes). Do not spend too much time in any particular question.

Useful Information:

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

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

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

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

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

$g = 9.80\ m/s^2$

The solution of a quadratic equation:

$$ax^2 + bx + c = 0.$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Good Luck

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

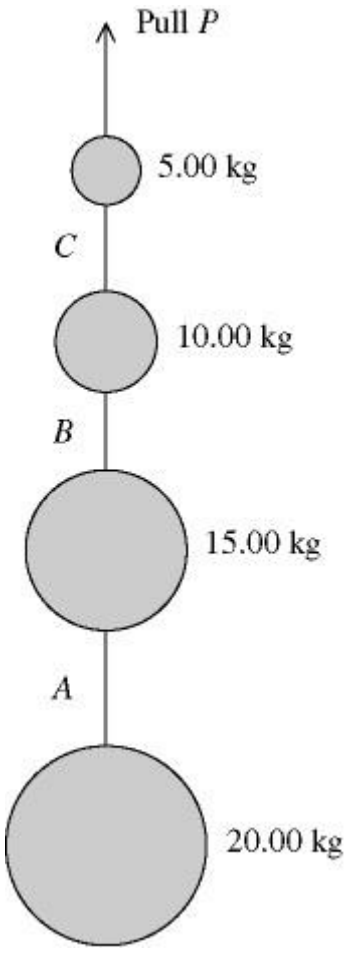
Question 1: **(1 pt)** An object is moving with constant velocity in a straight line. Which of the following statements is true?

A) A constant force is being applied in the direction of motion.
B) A constant force is being applied in the direction opposite of motion.
C) There are no forces acting on the object.
D) The net force on the object is zero.

Question 2: **(1 pt)** 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) 340 N
B) 410 N
C) 550 N
D) 690 N
E) 722 N

Question 3: **(1 pt)** 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 SMALLEST of the three tensions, *A*, *B*, and *C*, is closest to:



A) 80.0 N.
B) 196 N.
C) 276 N.
D) 483 N.
E) 621 N.

Question 4: **(1 pt)** : You ride on an elevator that is moving upward with constant speed while standing on a bathroom scale. The reading on the scale is

A) more than your true weight, mg.
B) equal to your true weight, mg.
C) less than your true weight, mg.
D) could be more or less than your true weight, mg, depending on the value of the speed.
E) None of the above.

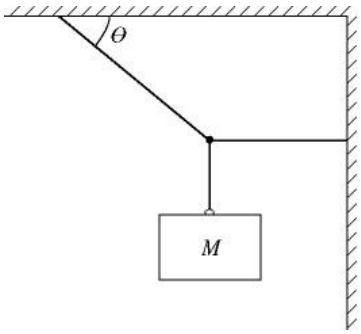
Question 5: **(1 pt)** Two objects have masses *m* and 5*m*, respectively. They both are placed side by side on a frictionless inclined plane and allowed to slide down from rest.

A) It takes the lighter object 5 times longer to reach the bottom of the incline than the heavier object.
B) It takes the lighter object 10 times longer to reach the bottom of the incline than the heavier object.
C) It takes the heavier object 5 times longer to reach the bottom of the incline than the lighter object.
D) It takes the heavier object 10 times longer to reach the bottom of the incline than the lighter object.
E) The two objects reach the bottom of the incline at the same time.

Question 6: **(1 pt)**) A car enters a 300-m radius horizontal curve on a rainy day when the coefficient of static friction between its tires and the road is 0.600. What is the maximum speed at which the car can travel around this curve without sliding?

A) 29.6 m/s
B) 33.1 m/s
C) 24.8 m/s
D) 42.0 m/s
E) 37.9 m/s

Question 7: **(1 pt)** In the figure, a block of mass *M* hangs at rest. The rope that is fastened to the wall is horizontal and has a tension off 52 N. The rope that is fastened to the ceiling has a tension of 91 N, and makes an angle θ with the ceiling. What is the angle θ?



A) 55°
B) 35°
C) 30°
D) 63°
E) 45°

Question 8: **(1 pt)** A car travels along the perimeter of a vertical circle (radius = 0.25 km) at a constant speed of 30 m/s. What is the magnitude of the resultant force on the 60-kg driver of the car at the lowest point on this circular path?

A) 0.37 kN
B) 0.80 kN
C) 0.22 kN
D) 0.59 kN
E) 0.45 kN

Question 9: **(1 pt)** A spring stretches by 21.0 cm when a 135 N object is attached. What is the weight of a fish that would stretch the spring by 31 cm?

A) 91.0 N
B) 145 N
C) 199 N
D) 279 N

Question 10: (1 pt) A crane lifts a 425 kg steel beam vertically a distance of 117 m. How much work does the crane do on the beam if the beam accelerates upward at 1.8 m/s^2? Neglect frictional forces.

A) 5.8×10^5 J
B) 3.4×10^5 J
C) 4.0×10^5 J
D) 4.9×10^5 J
E) 6.7×10^5 J

Question 11: (1 pt) Carts A and B have equal masses and travel equal distances D on side-by-side straight frictionless tracks while a constant force F acts on A and a constant force $2F$ acts on B. Both carts start from rest. The velocities v_A and v_B of the bodies at the end of distance D are related by

A) $v_B = v_A$.
B) $v_B = \sqrt{2}v_A$
C) $v_B = 2v_A$
D) $v_B = 4v_A$
E) $v_A = 2v_B$

Question 12: (1 pt) A vehicle of 2000 kg mass moves up a 15.0° slope at a constant velocity of 6.00 m/s. The rate of change of gravitational potential energy with time (power) is

A) 5.25 kW.
B) 24.8 kW.
C) 30.4 kW.
D) 118 kW.
E) 439 kW.

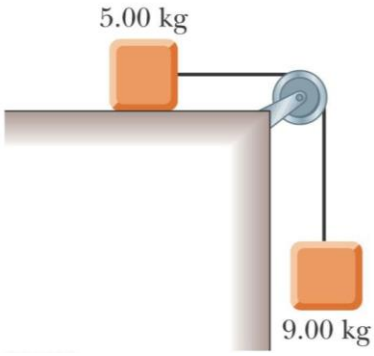
Question 13: (1 pt) A 2.0-kg block is projected down a plane that makes an angle of 20° with the horizontal with an initial kinetic energy of 2.0 J. If the coefficient of kinetic friction between the block and plane is 0.40, how far will the block slide down the plane before coming to rest?

A) 0.30 m
B) 1.0 m
C) 1.3 m
D) 3.0 m
E) 1.8 m

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

Problem 1: (4 pts) A 5.00-kg object placed on a frictionless, horizontal table is connected to a cable that passes over a pulley and then is fastened to a hanging 9.00-kg object, as in the figure below. Using the force approach:

a) Draw free-body diagrams of both objects.
b) Find the acceleration of the two objects.
c) Find the tension in the string.



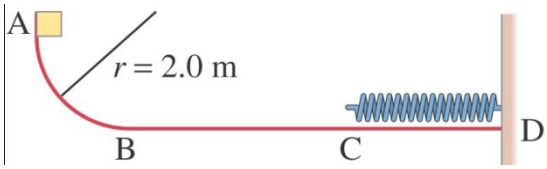
Problem 2: **(4 pts)** A force $\vec{\mathbf{F}} = (3x\hat{\boldsymbol{\imath}} - 2xy\hat{\boldsymbol{\jmath}})$ N acts on an object as the object moves in the *x* direction from the origin to *x* = 5.00 m (no motion in *y*-axis). The object has a mass m=5.00 kg.

(a) Find the work done on the object by the force $\vec{\mathbf{F}}$.

(b) if the object starts from rest, what is the final speed of the object at *x* = 5.00 m?

Problem 3: (4 pts) Consider the track shown in the figure below. The section AB is one quadrant of a circle of radius 2.0 m and is frictionless. B to C is a horizontal span 5.0 m long with a coefficient of kinetic friction $\mu_{k1} = 0.25$. The section CD under the spring has a different coefficient of kinetic friction $\mu_{k2} = 0.40$. A block of mass 2.0 kg is released from rest at A. After sliding on the track, it compresses the spring by 0.30 m. Using the energy approach:

(*a*) Determine the velocity of the block at point B.
(*b*) Find the work of the friction force produced as the block slides from B to C.
(*c*) What is the velocity of the block at point C.
(*d*) Find the force constant *k* for the spring.



End of Exam