College of Arts and Sciences
Department of Mathematics, Statistics, and Physics
Physics Program
Instructors: Drs. Dana Al-Abdulmalik and H. Merabet

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Name……..…..…..……
Student ID……..……..……..……List No.……
Section:……..……..……..……

Physics for Engineers I
PHYS 191 and PHYS 101 (all sections) Fall 2012
Exam 2
December 15, 2012

Please read the following instructions carefully before you start answering:

1. Make sure that you have 9! pages including two parts, A and B. Part A consists of 10 multiple choice questions, while Part B consists of 3 problems.
2. Answer all the questions and show all the steps of your work 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.

Useful Information:

$$\Sigma\vec{\mathbf{F}} = m\vec{\mathbf{a}} \quad ; \quad a_{\mathrm{R}} = \frac{v^2}{r} \quad ; W = Fd\cos\theta = \vec{\mathbf{F}}\cdot\vec{\mathbf{d}} \quad ; P = \vec{\mathbf{F}}\cdot\vec{\mathbf{v}}$$

$$W = \int_{\mathrm{a}}^{\mathrm{b}} \vec{\mathbf{F}}\cdot d\vec{\boldsymbol{\ell}} = \int_{\mathrm{a}}^{\mathrm{b}} F\cos\theta\, d\ell \qquad \Delta U = U_2 - U_1 = -\int_1^2 \vec{\mathbf{F}}\cdot d\vec{\boldsymbol{\ell}}$$

$$W_{net} = \Delta K\ ; \quad \Delta E = 0\ (conservative);\ \ \Delta E = -F_{fr}.d\ (non-conservative);\ P = \frac{dW}{dt} = \frac{dE}{dt}$$

$$\Delta\vec{\mathbf{p}} = \vec{\mathbf{p}}_{\mathrm{f}} - \vec{\mathbf{p}}_{\mathrm{i}} = \int_{t_{\mathrm{i}}}^{t_{\mathrm{f}}} \vec{\mathbf{F}}\, dt = \vec{\mathbf{J}} \qquad \vec{\mathbf{p}}_{\mathrm{A}} + \vec{\mathbf{p}}_{\mathrm{B}} = \vec{\mathbf{p}}'_{\mathrm{A}} + \vec{\mathbf{p}}'_{\mathrm{B}}$$

$$\tfrac{1}{2}m_{\mathrm{A}}v_{\mathrm{A}}^2 + \tfrac{1}{2}m_{\mathrm{B}}v_{\mathrm{B}}^2 = \tfrac{1}{2}m_{\mathrm{A}}v'^2_{\mathrm{A}} + \tfrac{1}{2}m_{\mathrm{B}}v'^2_{\mathrm{B}} \qquad \vec{\mathbf{P}} = \Sigma m_i\vec{\mathbf{v}}_i = M\vec{\mathbf{v}}_{\mathrm{CM}}$$

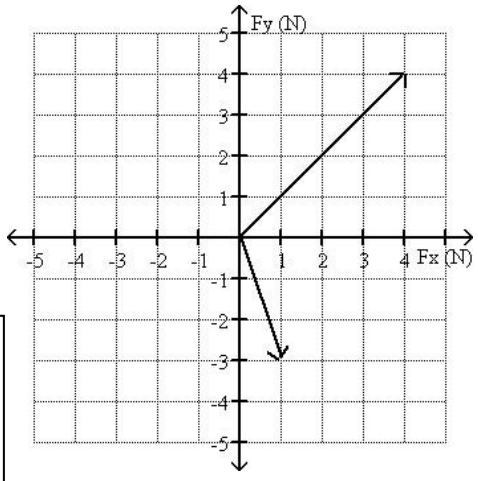
Part A: *Please choose the correct answer for each question and justify your choice in the space provided.*

Question 1: (6 pts) : What does the word "normal" mean in the phrase "normal force"?

(a) the force that is usually exerted by a surface
(b) the total force exerted by a surface
(c) the component of the force exerted by a surface parallel to the surface
(d) the component of the force exerted by a surface perpendicular to the surface
(e) the force is due to contact between two objects

Justification:

Question 2: (6 pts): The two forces indicated in the figure act on a 3.00-kg object. What is the acceleration of the object?



(a) (1.67 m/s^2) $\hat{i}$ − (0.333 m/s^2) j
(b) (5.00 m/s^2) $\hat{i}$ + (1.00 m/s^2) j
(c) (1.67 m/s^2) $\hat{i}$ + (2.333 m/s^2) j
(d) (15.0 m/s^2) $\hat{i}$ + (3.00 m/s^2) j
(e) (1.67 m/s^2) $\hat{i}$ + (0.333 m/s^2) j

Justification:

Question 3: (6 pts) 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) 0.29 kN (b) 0.49 kN (c) 0.69 kN (d) 0.20 kN (e) 0.40 kN

Question 4: (6 pts) A 600-kg car is going around a banked curve with a radius of 110 m at a speed of 27.5 m/s. What is the appropriate banking angle so that the car stays on its path without the assistance of friction?

(a) 35.0^o (b) 13.5^o (c) 33.8^o (d) 56.2^o (e) 60.9^o

Justification:

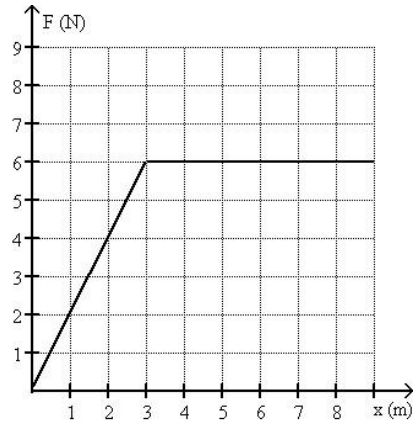
Question 5: (6 pts) A force is dependent on position and is given by $(4.00)x\,\hat{i} + (2.00)xy\,j$. An object begins at the origin. It first moves in a straight line to $x = 1.00$ m, $y = 0.00$ m. It then moves in a straight line to $x = 1.00$ m, $y = 1.00$ m. How much work is done on the object by the force during the motion described?

(a) 3.00 J
(b) 0.00 J
(c) 2.50 J
(d) 1.50 J
(e) 2.00 J

Justification:

Question 6: **(6 pts)** 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



Justification:

Question 7: **(6 pts)** 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) 9.0 N/m (d) 18 N/m (e) 20 N/m

Justification:

Question 8: **(6 pts)** A cyclist does work at the rate of 500 W while riding. How much force does her foot push with when she is traveling at 8.0 m/s?

(a) 31 N (b) 62 N (c) 80 N (d) 160 N (e) 4000 N

Justification:

Question 9: (6 pts) A 2.00-m rod of negligible mass connects two small objects. The mass of one object is 1.00 kg and the mass of the other is unknown. The center of mass of this system is on the rod a distance 1.80 m from the 1.00-kg mass object. What is the mass of the other object?

(a) 4.11 kg (b) 3.22 kg (c) 9.00 kg (d) 0.111 kg (e) 0.900 kg

Justification:

Question 10: (6 pts) A golf club exerts an average force of 1000 N on a 0.045-kg golf ball which is initially at rest. The club is in contact with the ball for 1.8 ms. What is the speed of the golf ball as it leaves the club?

(a) 35 m/s (b) 50 m/s (c) 40 m/s (d) 45 m/s (e) 30 m/s

Justification:

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

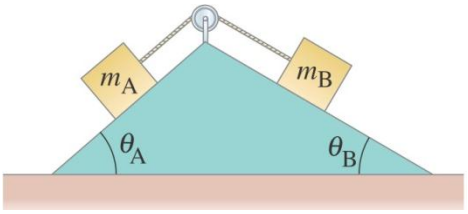
Problem 1: (16 pts) The mass m_A slides on the smooth (frictionless) incline and m_B slides on the rough incline with μ_B, as shown in the figure below.

(*a*) Show the free-body diagrams for the two masses on the figure. (4pts)

(*b*) Using the force approach, determine a formula for the acceleration of the system in terms of m_A, m_B, θ_A, θ_B, μ_B, and g when m_A moves up its incline and m_B moves downward. (4pts)

(*c*) If $m_A = 2.0$ kg, $m_B = 6.0$ kg, $\theta_A = 20^o$, $\theta_B = 45^o$, $\mu_B = 0.15$, find the value of the acceleration. (4pts)

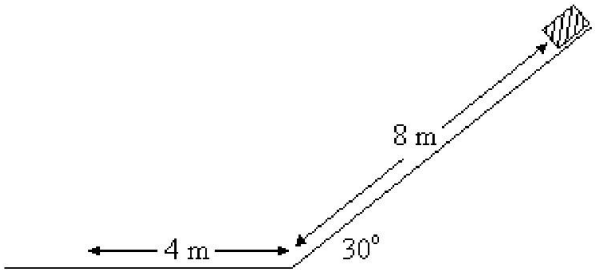
(*d*) What would be the tension in the cord (negligible mass) in this case? (4pts)



Problem 2: (16 pts) An object of mass *m* is at rest on a rough inclined plane with height *h*, length 8 m, and which makes an angle of 30° with the horizontal (figure below). The object is allowed to move down and it stops on a rough horizontal surface, at a distance of 4 m from the bottom of the inclined plane, as shown in the figure. The coefficient of kinetic friction on the inclined plane is $\mu_{k1} = 0.40$.

(a) Using conservation of energy, find the speed of the object at the bottom of the inclined plane? (8 pts)

(b) What is the coefficient of kinetic friction for the horizontal surface? (8 pts)



Problem 3: (8 pts) A 2000.-kg (m_1) Honda collides into a rear end of 4400.-kg (m_2) Cadillac stopped at a red light. The two cars lock together and skid (move) forward a distance $d = 3.6\ m$ before stopping. The police officer, who took the PHYS 191 course, knowing that the coefficient of kinetic friction between tires and road is $\mu_k = 0.40$, calculates the speed $v_1$of the Honda at impact. What was that speed (v_1)? (Hint: use conservation of total energy)

<u>Extra Credit Question:</u> (4 pts) A force acting on a 2.00 kg object is given by $F(x) = (2.00\ N/m)\ x + (1.00\ N/m^3)\ x^3$. The object stats at rest at $x = 1.00$ m. What is the speed of the object when it reaches $x = 2.00$ m?

End of the exam

College of Arts and Science
Department of Mathematics, Statistics and Physics
Physics program

General Physics for Engineering I PHYS191
General Physics I Phys 101
Spring 2014

EXAM 2 29th April 2014

Instructors:
Dr. K. Al-Qadi, Dr. M. Al-Muraikhi, Dr. L. Al-Sulaiti, and Dr. M.Zayed

Students name: _____

Students ID: _____

Section number:_____

Please read those instructions carefully:

- Make sure you have 7 pages after the cover page, including 2 parts A and B. Part A consist of 10 multiple choice questions where you select only one of the proposed answers. Part B consist of 4 problems that you have to solve.
- Calculators are permitted, but no electronic dictionaries and mobile phones are strictly forbidden.
- All work must be done on exam paper, no loose paper are allowed.
- This is a timed exam (120 minutes). Manage your time and do not spend too much time on any particular question.

Useful formulas

$K.E. = 0.5mv^2$ $\quad v^2=v_o^2+2ad$

$U_s = 0.5kx^2$

$U = mgh$

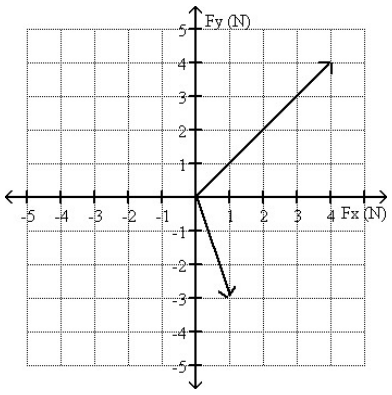
Quadratic equation:

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

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

Part (A) Solve all the ten multiple choice problems (10 Marks)

1) The two forces indicated in the figure act on a 3.00-kg object. What is the acceleration of the object?



A) $(1.67\ m/s^2)\ \hat{i}\ -\ (0.333\ m/s^2)\ \hat{j}$

B) $(5.00\ m/s^2)\ \hat{i}\ +\ (1.00\ m/s^2)\ \hat{j}$

C) $(1.67\ m/s^2)\ \hat{i}\ +\ (2.333\ m/s^2)\ \hat{j}$

D) $(15.0\ m/s^2)\ \hat{i}\ +\ (3.00\ m/s^2)\ \hat{j}$

E) $(1.67\ m/s^2)\ \hat{i}\ +\ (0.333\ m/s^2)\ \hat{j}$

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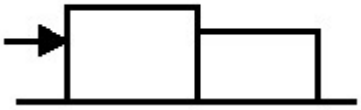
2) A 6.00-kg block is in contact with a 4.00-kg block on a frictionless surface as shown in the figure. The 6.00-kg block is being pushed by a 20.0-N force toward the 4.00-kg block. What is the magnitude of the force of the 6.00-kg block on the 4.00-kg block?

A) 6.00 N B) 12.0 N C) 8.00 N D) 4.00 N E) 10.0 N



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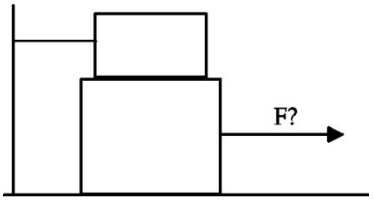
3) A 4.00-kg block rests between the floor and a 3.00-kg block as shown in the figure. The 3.00-kg block is tied to a wall by a horizontal rope. If the coefficient of static friction is 0.800 between each pair of surfaces in contact, what force must be applied horizontally to the 4.00-kg block to make it move?

A) 16.2 N B) 54.9 N C) 21.1 N D) 23.5 N E) 78.5 N



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4) A ball is tied to the end of a cable of negligible mass. The ball is spun in a circle with a radius 2.00 m making 0.700 revolutions per second. What is the centripetal acceleration of the ball?

A) 67.9 m/s^2 B) 38.7 m/s^2 C) 29.3 m/s^2 D) 14.8 m/s^2 E) 74.2 m/s^2

5) A Karwa taxi and a Karwa bus are driving at speeds of 64.8 km/h for the car, and 68.4 km/h for the bus. They approach a frictionless roundabout and take a path of radius 119 m. If the roundabout is banked at angle of 16^{o} with the horizontal, then what will happen to both vehicles?

A) The Bus will skid, but the car will not.
B) The car will skid, but the bus will not.
C) Since skidding does not depend on the mass of the vehicle, both will not skid.
D) Since there is no friction, both will skid.
E) Cannot determine the answer because we do not know the masses of the vehicles

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6) A man lifts a 20.0-kg bucket of concrete from the ground up to the top of a 30.0-m tall building. The bucket is initially at rest, but is traveling at 4.0 m/s when it reaches the top of the building. How much work was done by the man only in lifting the bucket?

A) 5.88 kJ B) 600 J C) 760 J D) 6.04 kJ E) 160 J

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7) How large a force is required to accelerate a 1600 kg car from rest to a speed of 25 m/s in a distance of 200 m?

A) 1600 N B) 0 N C) 200 N D) 400 N E) 2500 N

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8) If the net work done on an object is zero, then the object's kinetic energy

A) decreases.
B) remains the same.
C) increases.
D) is zero.
E) cannot be determined without knowing the object's mass.

9) A potential energy function is given by $U(x) = (3.00\ \text{N})x + (1.00\ \text{N/m}^2)x^3$. What is the force that is associated with this potential energy function?

A) $3.00\ \text{N} + (1.00\ \text{N/m}^2)x^2$

B) $-3.00\ \text{N} - (3.00\ \text{N/m}^2)x^2$

C) $(-0/500\ \text{N/m}^2)x^2 + (-1.00\ \text{N/m}^2)x^4$

D) $(0.500\ \text{N/m}^2)x^2 + (1.00\ \text{N/m}^2)x^4$

E) $-3.00\ \text{N} - (1.00\ \text{N/m}^2)x^2$

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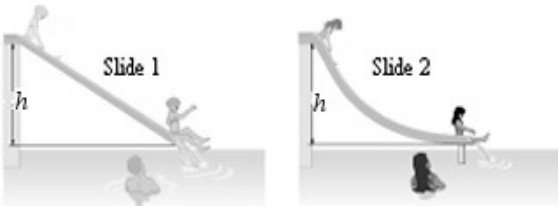
10) Swimmers at a water park have a choice of two frictionless water slides (see the figure). Although both slides drop over the same height, h, slide 1 is straight while slide 2 is curved, dropping quickly at first and then leveling out. How does the speed v_1 of a swimmer reaching the end of slide 1 compares with v_2, the speed of a swimmer reaching the end of slide 2?



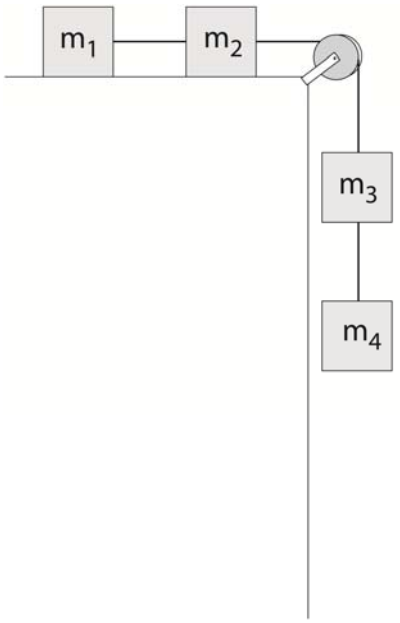
A) $v_1 > v_2$

B) $v_1 < v_2$

C) $v_1 = v_2$

D) No simple relationship exists between v_1 and v_2.

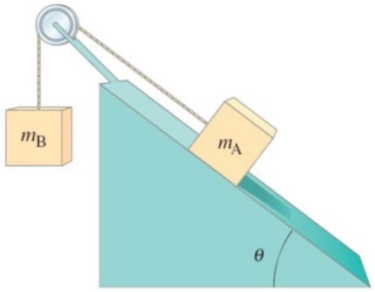
Part (B) Solve all four problems (15 MARKS)



Problem 1) (4 Marks) Two masses, $m_1 = 10.0\,\text{kg}$ and $m_2 = 5\,\text{kg}$, set on frictionless surface. The two masses are attached by string to mass $m_3 = 7.00\,\text{kg}$. Then, m_3 is attached to $m_4 = 3\,\text{kg}$, as in the figure. Consider the string as a perfect massless string. Calculate:

1) The acceleration of the system of the four masses.
2) Find the tension between m_2, and m_3.
3) Find the tension between m_1, and m_2.
4) If $m_1 = m_2 = m_3 = m_4$, then find the value of acceleration of the system of the four masses.

Problem 2) (4 Marks) Box A, of mass $m_A = 13.17\,kg$, rests on a surface inclined at 30° to the horizontal. It is connected by a lightweight cord, which passes over a massless and frictionless pulley, to a second box B, which hangs freely as shown.

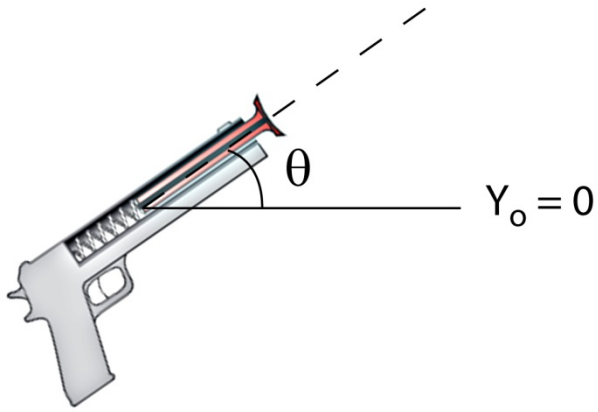


1) If the coefficient of static friction is 0.47, determine what range of values for mass B (m_B) will keep the system at rest.
2) If the coefficient of kinetic friction is 0.25, and $m_B = 12.1\,kg$, determine the acceleration of the system.

Problem 3) (4 marks) A force $\vec{F} = (17.0\hat{\imath} - 11.0\hat{\jmath} + 40.00\hat{k})N$ acts on an object. If the displacement of the object is $\vec{d} = (8.0\hat{\imath} + 7.0\hat{\jmath})m$, Calculate:

1) The work done by the force.
2) The magnitude of the force.
3) The magnitude of the displacement.
4) The angle between the force and the displacement.

<u>Problem 4) (3 Marks)</u> A dart of mass 0.125 kg is pressed against the spring of a toy dart gun, which makes an angle $\theta = 35.0^{o}$ with the horizontal, as shown in the figure. The spring (with spring stiffness constant k = 351 N/m and ignorable mass) is compressed 7.55 cm and released. Ignore air resistance and friction. The dart detaches from the spring when the spring reaches its natural length (x = 0). Determine;



1) The speed of the dart when it detaches from the spring.
2) Write the velocity vector of the dart in terms of $\hat{\imath}$ and $\hat{\jmath}$ components.
3) <u>Using conservation of energy ONLY</u>, calculate the maximum height of the dart with respect to Y_o after it is released.

College of Arts and Sciences
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Name.....
Student ID.....
Section:.....

Physics for Engineers I
PHYS 191, Fall 2013
Exam 2
November 30th , 2013

Please read the following instructions carefully before you start answering:

1. Make sure that you have 9 pages including two parts, A and B. Part A consists of 9 multiple choice questions, while Part B consists of 4 problems.
2. Answer all the questions and show all the steps of your work in a clear tidy way.
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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 back of the paper 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.

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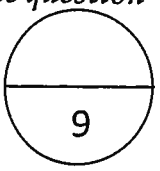
$$W = \int_{\mathrm{a}}^{\mathrm{b}} \vec{\mathbf{F}}\cdot d\vec{\boldsymbol{\ell}} = \int_{\mathrm{a}}^{\mathrm{b}} F\cos\theta \, d\ell \; ; \qquad \Delta U = U_2 - U_1 = -\int_1^2 \vec{\mathbf{F}}\cdot d\vec{\boldsymbol{\ell}}$$

$$\Delta K + \Delta U + \Delta(\text{other energy types}) = 0 \; ; \; P = \frac{dW}{dt} = \frac{dE}{dt}$$

For kinetic friction, $F_{fr} = \mu_k F_N$, for static friction, $F_{fr} \leq \mu_s F_N$

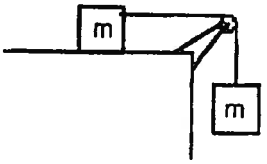
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.$$

Part A. ***Please choose the one alternative that best completes the statement or answers the question***



1. Two identical masses are attached by a light string that passes over a small pulley, as shown in Fig. A-1. The table and the pulley are frictionless. The masses are moving

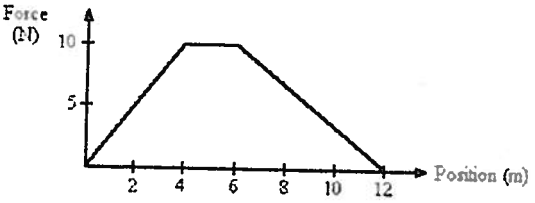
Fig. A-1



a. at constant speed
b. with an acceleration equal to g.
c. with an acceleration less than g.
d. with an acceleration greater than g.
e. with an acceleration that cannot be determined without additional information.

2. A 60.0-kg person rides in elevator while standing on a scale. The elevator has an acceleration 2.00 m/s² upward. What is the force equivalent to the reading on the scale
   a. 709 N
   b. 349 N
   c. Zero
   d. 589 N
   e. 469 N

3. An object is under the influence of a force as represented by the force vs. position graph in Figure below. What is the work done as the object moves from 4 m to 6 m?



   a. 20 J
   b. 0 J
   c. 30 J
   d. 40 J
   e. 70 J

4. If the net work done on an object is positive, then the object's kinetic energy
   a. decrease
   b. remains the same
   c. increases
   d. in zero
   e. cannot be determined without knowing the object's mass

5. 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 kinetic friction.
   b. the normal force of the road times the coefficient of kinetic friction.
   c. the normal force of the road times the coefficient of static friction.
   d. zero.
   e. None of the above
6. Mike performed 5 J of work in 10 sec. and Joe did 3 J of work in 5 sec. Who produce the greater power?
   a. Mike produces more power.
   b. Joe produces more power.
   c. Both produced the same amount of power.
   d. Zero power for both
   e. No enough information to predict.

Fig. A-2

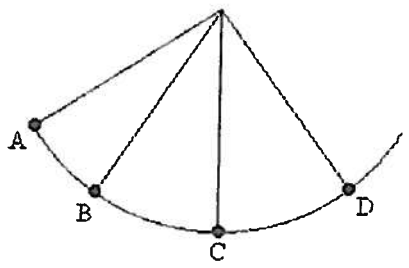


Figure A-2, mass is attached to one end of a string. The other end of the string is attached to a rigid support. The mass is released at A and swings in a vertical arc to points B, C, and D.

7. Refer to Fig.A-2. At what point does the mass have the most potential energy?
   a. A
   b. B
   c. C
   d. D
   e. none of the given points
8. A force on an object is given by $F(x) = (2.00\ \text{N/m})x + (-3.00\ \text{N/m}^3)x^3$. What is a potential energy function for this conservative force (U(0)=0)?

   a. $-2.00\ \text{N/m} + (-3.00\ \text{N/m}^3)x^2$
   b. $2.00\ \text{N/m} - 9.00x^2$
   c. $-2.00\ \text{N/m} + 9.00x^2$

d. $(-2.00\ \text{N/m})x2 + (3.00\ \text{N/m}^3)x4$
e. $(-1.00\ \text{N/m})x2 + (0.750\ \text{N/m}^3)x4$

9. 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. If an object begins at the same initial position with the same initial velocity in both systems, how is the motion in the two systems related?

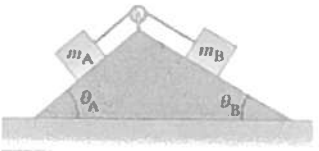
a. The motion in the first system will be with greater speed than in the second system because of the lower potential energy.
b. The motion in the second system will be at greater speeds in one direction and lower speeds in the other direction relative to the first system.
c. The motion in the two systems is identical.
d. The motion in the second system will be with greater speed than in the first system because of the greater potential energy.
e. The motion in the two systems will be in opposite directions.

16

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

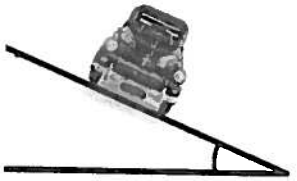
Problem 1: The masses m_A and m_B slide on the smooth (frictionless) inclines fixed as shown in Fig. B–1. (*a*) Determine a formula for the acceleration of the system in terms of m_A, m_B, θ_A, θ_B and g (2 marks). (*b*) If $\theta_A = 32^\circ$ and $\theta_B = 23^\circ$ and $m_A = 5.0\,\text{kg}$, what value of m_B would keep the system at rest (1 mark)? What would be the tension in the cord (negligible mass) in this case (1 mark)? (*c*) What ratio, m_A/m_B, would allow the masses to move at constant speed along their ramps in either direction (1 mark)?

Fig.B-1



Problem 2: A car is traveling on with speed $(v = 72\frac{km}{h})$ around a banked curve of diameter $(d = 190\ m)$ Calculate the following:

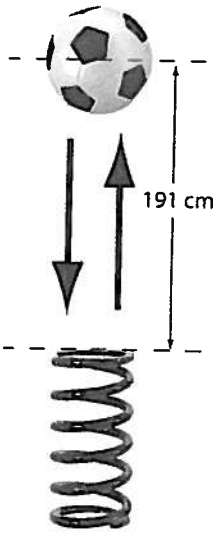
a. The centripetal acceleration of the car (1 mark).
b. The banked angle to keep the car from sliding. Assume no friction (1 mark).
c. Assume the curve is leveled horizontally (i.e.$\theta = 0.0^o$), determine the coefficient of static friction $\mu_s$to keep the car from sliding (1 mark).
d. Calculate the centripetal force at the given speed on a car of mass $(m_c = 1000\ kg)$ and a truck of mass $(m_t = 12500\ kg)$. If μ_s is decreased due to rain, determine which of the vehicles will skid (1 mark).



Problem 3: A 265-kg load is lifted 23.0 m vertically with an acceleration $a = 0.15g$ by a single cable. Determine:

(a) the tension in the cable (1 mark);
(c) the work done by the cable on the load (1 mark);
(c) the work done by gravity on the load (1 mark);
(d) the net work done on the load (1 mark);

Problem 4: A ball of mass m = 425 g, starting from rest, falls vertically on an unstretched ideal vertical spring. The vertical distance between the top of the spring and initial position of the ball is ($h = 191\ cm$). The spring stiffness constant is (k = 1500 N/m). Assume the spring has negligible mass, and ignore air resistance. Calculate the following:



a. The speed of the ball just before it hits the spring. (1 mark)
b. At what height the ball will be at half of its maximum speed. (1 mark)
c. The compressed distance the spring will have. (2 marks)

End of Exam
Good Luck

College of Arts and Sciences
Department of Mathematics, Statistics, and Physics
Physics Program
Instructors: Dr. Maitha Al-Muraikhi, Dr. Hocine Merabet, Dr. Ahmad Ayesh,
Dr. Mohammad Gharaibeh

25

Name:.....
Student ID:.....List No.....
Section:.....

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 13 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*

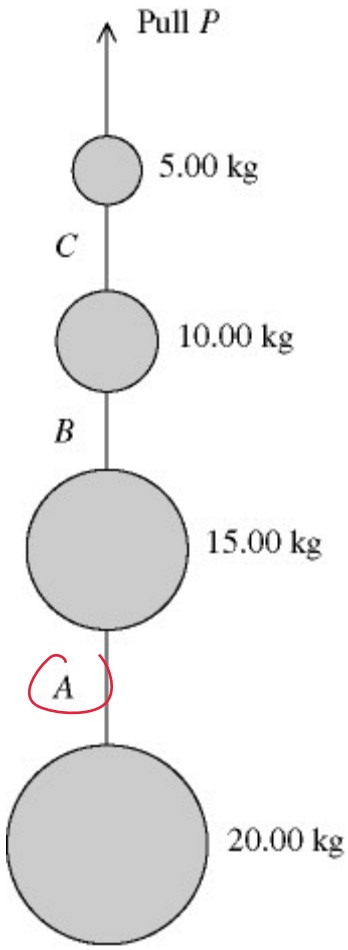
Question 1: (1 pt) An object is moving with constant velocity in a straight line. Which of the following statements is true?

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.
E) None of the above.

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.

$T_A - 20*9.8$

$= 20*4$

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

$\Sigma F = 0$

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.

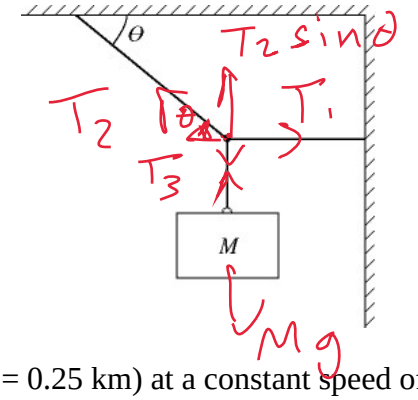
A) It takes the lighter object 5 times longer to reach the bottom of the incline than the heavier object.
B) It takes the lighter object 10 times longer to reach the bottom of the incline than the heavier object.
C) It takes the heavier object 5 times longer to reach the bottom of the incline than the 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
E) 354 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

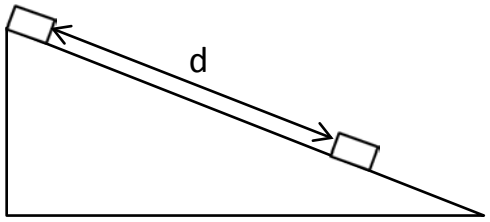
A) $v_B = v_A$.
B) $v_B = \sqrt{2}v_A$
C) $v_B = 2v_A$
D) $v_B = 4v_A$
E) $v_A = 2v_B$

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 (d) before coming to rest?

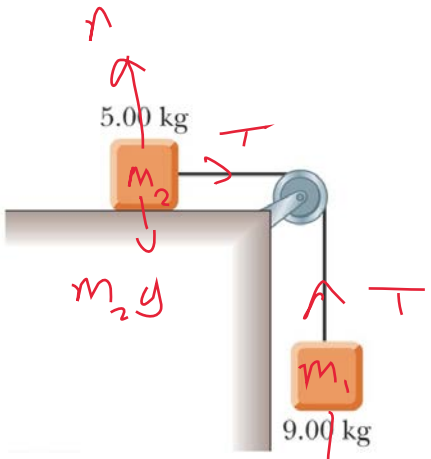
A) 0.30 m
B) 1.0 m
C) 1.3 m
D) 3.0 m
E) 1.8 m



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. (1 pt)
b) Find the acceleration of the two objects. (2 pts)
c) Find the tension in the string. (1 pts)



$\Sigma F_{ext} = m_{syst}\, a$

$m_1 g = (m_1 + m_2)\, a$

m_1 i-

$m_1 g - T = m_1 a$ ---(1)

$m_1 g$

$T = m_2 a$ ---(2)

m_2

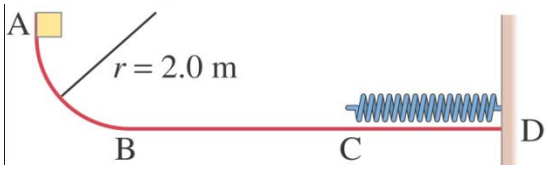
(1) + (2) $m_1 g = (m_1 + m_2)\, a$

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 $\vec{\mathbf{F}}$. (3 pts)
(b) if the object starts from rest, what is the final speed of the object at *x* = 5.00 m? (1 pts)

Problem 3: (5 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. (1.5 pt)
(*b*) Find the work of the friction force produced as the block slides from B to C. (1.5 pt)
(*c*) What is the velocity of the block at point C. (1 pt)
(*d*) Find the force constant *k* for the spring. (1 pt)



End of Exam

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

General Physics for Engineering I
PHYS 191
Spring 2016

4th May 2016

Instructors: Dr. M. Al-Muraikhi, Dr. A. Shalaby, Dr. H. Merabet,
Dr. D. Al-Abdulmalik, Dr. L. Al-Sulaiti, Dr. M. Gharaibeh

EXAM 2

25

Student Name:

Student ID:

Section number:

Please read the following instructions carefully before you start answering

1. Make sure that you have 6 pages including two parts, A and B. Part A consists of 8 multiple choice questions, and part B consists of 3 problems.
2. Calculators are permitted but no electronic dictionaries or mobile phones.
3. All your work must be done on your exam paper; no loose papers are allowed.
4. This is a timed exam (120 min). Do not spend too much time on any particular question.

Useful Formulae and Constants

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

$W = \vec{F} \cdot \vec{s}$, $W = \int_{P_1}^{P_2} \vec{F}.d\vec{l}$, $W_{tot} = \Delta K$, $K = \frac{1}{2}mv^2$, $P_{av} = \frac{\Delta W}{\Delta t}$, $P = \vec{F}.\vec{v}$

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

$F_x(x) = -\frac{dU(x)}{dx}$

g = 9.80 m/s^2

Best Wishes

Part A. Please choose the correct answer for each question. ***Circle your choice using pen*.**

8

Make sure that only ONE of the alternatives is chosen for each question. Two answers to one question will result in loss of the mark of that question

1. If the only forces acting on a 2.0-kg mass are $\vec{F}_1 = (3i - 8j)$ N and $\vec{F}_2 = (5i + 3j)$ N, what is the magnitude of the acceleration of the mass?

A. 1.5 m/s^2
B. 4.7 m/s^2
C. 6.5 m/s^2
D. 7.2 m/s^2
E. 9.4 m/s^2

2. A 20-ton truck collides with a 1.5-ton car and causes a lot of damage to the car. Since a lot of damage is done on the car

A. the force on the truck is smaller than the force on the car.
B. the force on the truck is greater than the force on the car.
C. the force on the truck is equal to the force on the car.
D. the car did not slow down during the collision.
E. the truck did not slow down during the collision.

3. A 50-kg child riding a Ferris wheel with a radius of 10 m travels in a vertical circle. The wheel completes one revolution every 10 s. If the seats of the wheel remains upright during the revolution, what is the magnitude of the force on the child by the seat at the highest point on the circular path?

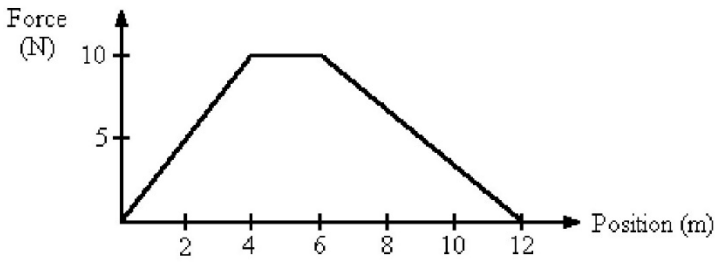
A. 0.20 kN
B. 0.29 kN
C. 0.40 kN
D. 0.49 kN
E. 0.69 kN

4. A car enters a level, unbanked semi-circular curve of 300 m radius at a speed of 40 m/s. The coefficient of friction between the tires and the road is 0.25. If the car maintains a constant speed of 40 m/s, it will

A. arrive safely at the end of the curve.
B. tend to turn toward the center of the curve.
C. tend to turn toward the outside of the curve.
D. turn toward the center of the curve for the first quarter-circle, then turn toward the outside of the curve for the second quarter-circle.

5. An object is under the influence of a force as represented by the force vs. position in the graph below. What is the work done as the object moves from 0 m to 4 m?

A. 0 J
B. 20 J
C. 30 J
D. 40 J
E. 70 J



6. A 1500-kg car accelerates from 0 to 25 m/s in 7.0 s with negligible friction and air resistance. What is the average power delivered by the engine? (1 hp = 746 W)

A. 50 hp
B. 60 hp
C. 70 hp
D. 80 hp
E. 90 hp

7. As an object moves from point A to point B only two forces act on it: one force is nonconservative and does –30 J of work, the other force is conservative and does +50 J of work. Between A and B,

A. the kinetic energy of the object decreases, and the mechanical energy decreases.
B. the kinetic energy of the object decreases, and the mechanical energy increases.
C. the kinetic energy of the object increases, and the mechanical energy increases.
D. the kinetic energy of the object increases, and the mechanical energy decreases.
E. none of the above.

8. A potential energy function is given by $U(x) = (3.00\ \mathrm{N/m})x - (1.00\ \mathrm{N/m^3})x^3$. At what position or positions is the force equal to zero?

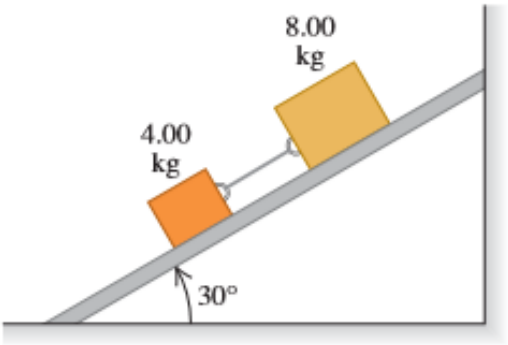
A. 1.00 m and -1.00 m
B. 3.00 m and -3.00 m
C. $\sqrt{6.00}$ m and $-\sqrt{6.00}$ m
D. 0.00 m, $\sqrt{3.00}$ m, and $-\sqrt{3.00}$ m
E. The force is not zero at any location.

Part B. Please solve the following problems using *pen* and showing *all the steps of your solution in a clear tidy way*.

17

1. Two blocks with masses 4.00 kg and 8.00 kg are connected by a string and slide down a 30.0° inclined plane as shown in the figure. The coefficient of kinetic friction between the 4.00-kg block and the plane is 0.25 and that between the 8.00-kg block and the plane is 0.35.

A. Draw free-body diagram for each block. (2 points)
B. Calculate the acceleration of the blocks. (4 points)
C. Calculate the tension in the string. (1 point)

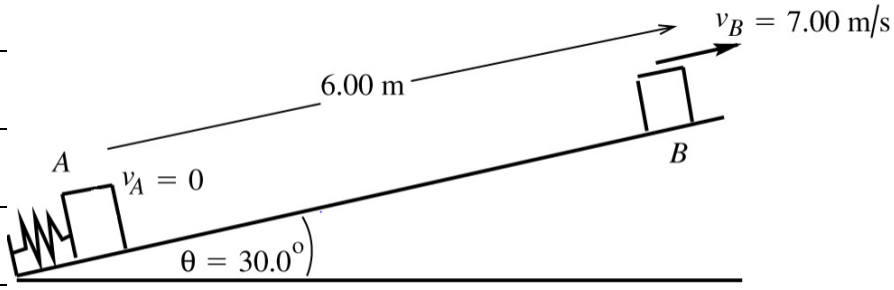


2. A 5.00 kg package slides 1.50 m down a long ramp that is inclined at 24.0^{o} below the horizontal. The coefficient of kinetic friction between the package and the ramp is 0.310.

A. Calculate the total work done on the package. (3 points)

B. If the package has a speed of 2.20 m/s at the top of the ramp, what is its speed after sliding the 1.50 m down the ramp? (2 points)

3. A wooden block with mass 1.50 kg is placed against a compressed spring at the bottom of an incline of slope 30.0° (point A). When the spring is released, it projects the block to point B, 6.00 m from point A up the incline. At point B, the block is moving up the incline at 7.00 m/s and is no longer in contact with the spring. The coefficient of kinetic friction between the block and the incline is 0.50 and the mass of the spring is negligible. Calculate the amount of potential energy that was initially stored in the spring. (5 points)



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

General Physics I (PHYS101) & General Physics for Engineering I (PHYS191)
Spring 2017

3rd May 2017

Instructors: Dr. L. Al-Sulaiti, Dr. M. Al-Muraikhi, Dr. A. Ayesh, Dr. M. Ajaib, Dr. M. Gharaibeh

EXAM 2

25

Student Name:

Student ID:

Section number: List Number:

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 10 multiple choice questions, and part B consists of 3 problems.
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3. All your work must be done on your exam paper; no loose papers are allowed.
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$U_{grav} = mgy$, $U_{el} = \frac{1}{2}kx^2$, $W_{grav} = -\Delta U_{grav}$, $W_{el} = -\Delta U_{el}$, $K_1 + U_1 + W_{other} = K_2 + U_2$

$F_x(x) = -\frac{dU(x)}{dx}$

g = 9.80 m/s^2

Best Wishes

Part A. Please choose the correct answer for each question. ***Circle your choice using pen*.**

10

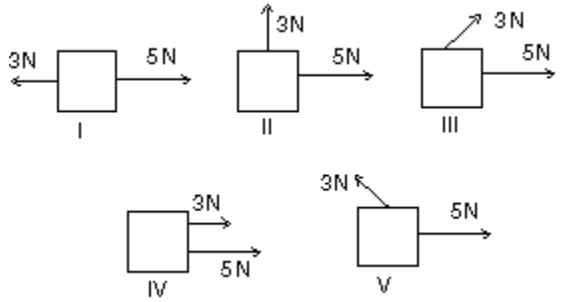
Make sure that only ONE of the alternatives is chosen for each question. Two answers to one question will result in loss of the mark of that question.

1- You are standing in a moving bus, facing forward, and you suddenly fall forward as the bus comes to an immediate stop. The force acting on you that causes you to fall forward is?

A) The force of gravity.
B) The normal force due to your contact with the floor of the bus.
C) The force due to static friction between you and the floor of the bus.
D) The force due to kinetic friction between you and the floor of the bus.
E) No forces were acting on you to cause you to fall.

2- Two forces, one with a magnitude of 3 N and the other with a magnitude of 5 N, are applied to an object. For which orientations of the forces shown in the diagrams is the magnitude of the acceleration of the object the least?

A) I
B) II
C) III
D) IV
E) V



3- A 90-kg man stands in an elevator that has a downward acceleration of 1.6 m/s^2. The force exerted by him on the floor is about:

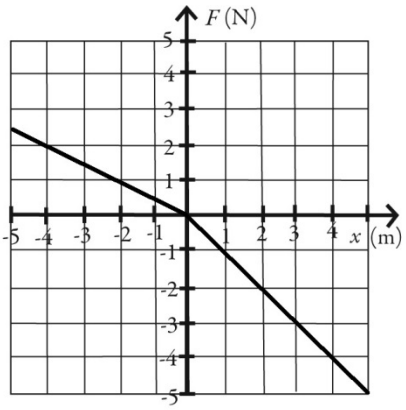
A) zero
B) 90 N
C) 760 N
D) 738 N
E) 1026 N

4- A Ferris wheel has radius of 5 m and makes one revolution in 5.0 seconds. A person weighing 670 N is sitting on one of the benches attached at the rim of the wheel. What is the apparent weight (that is, the normal force exerted on her by the bench) of the person as she passes through the lowest point of her motion?

A) 130 N
B) 220 N
C) 1210 N
D) 375 N
E) 460 N

5- A graph of the force on an object as a function of its position is shown in the figure. Determine the amount of work done by this force on the object during a displacement from x = -4.00 m to x = 1.00 m. (Assume an accuracy of 3 significant figures for the numbers on the graph.)

A) 4.50 J
B) -3.00 J
C) -1.00 J
D) 3.50 J
E) 3.00 J



6- A crane lifts a 425 kg steel beam vertically a distance of 117 m. How much work does **<u>the crane</u>** do on the beam if the beam accelerates upward at 2.0 m/s^2? Neglect frictional forces.

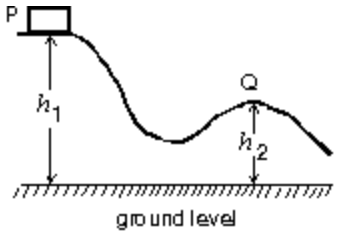
A) 2.80×10^5 J
B) 3.88×10^5 J
C) 4.00×10^5 J
D) 4.90×10^5 J
E) 5.87×10^5 J

7- How long will it take a 6 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) 24.6 s
B) 20.9 s
C) 16.4 s
D) 18.5 s
E) 21.1 s

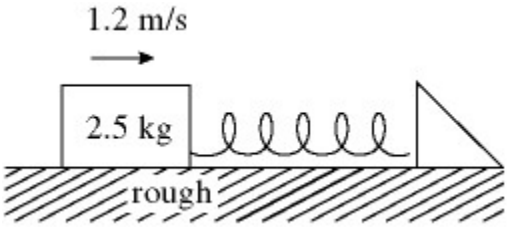
8- A block is released from rest at point P and slides along the frictionless track shown. At point Q, its speed is:

A) $2g\sqrt{h_1 - h_2}$
B) $\sqrt{2g(h_1 - h_2)}$
C) $(h_1 - h_2)/2g$
D) $2g(h_1 - h_2)$
E) $(h_1 - h_2)^2/2g$



9- A 2.5-kg box, sliding on a rough horizontal surface, has a speed of 1.2 m/s when it makes contact with a spring (see the figure). The block comes to a momentary stop when the compression of the spring is 5.0 cm. The work done by the friction, from the instant the block makes contact with the spring until it comes to a momentary halt, is -0.60 J. What is the spring constant of the spring

A) 1040 N/m
B) 10 N/m
C) 960 N/m
D) 1920 N/m
E) 0.1040 N/m



10- A potential energy function for system 1 is given by $U_1(x) = Cx^2 + Bx^3$. The potential energy function for system 2 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 on system 2 at a given position?

A) The force on the two systems will be in opposite directions.
B) The force on the second system will be with less than the force on the first system.
C) There is no relationship between the forces on the two systems.
D) The force is identical on the two systems.
E) The force on the second system will be with greater than the force on the first system.

Part B. Please solve the following problems using *pen* and showing *all the steps of your solution in a clear tidy way*.

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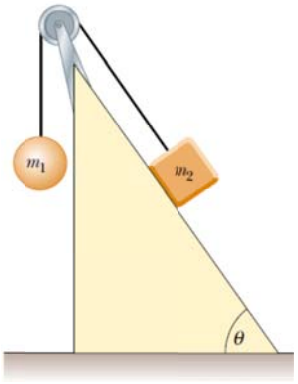
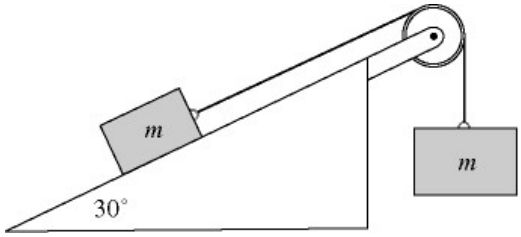
1. Two objects are connected by a light string that passes over a frictionless pulley, as in the figure. The incline is frictionless and if m_1 = 3.00 kg, m_2 = 9.00 kg, and θ = 60.0°.

(a) Draw free-body diagrams of both objects. **(2 Points)**
(b) Find the accelerations of the objects. **(2 Points)**
(c) Calculate the tension in the string. **(1 Points)**



2. In the figure, two boxes, each of mass 24 kg, are at rest and connected as shown. The coefficient of kinetic friction between the inclined surface and the box is 0.2 . The blocks are then released and moved 2.6 m. (**Use only the principles of Chapter 6**).

(a) Find the work of the gravity on the hanged block. **(1 Points)**
(b) Find the work of gravity on the mass on the inclined surface. **(1 Points)**
(c) Find the work of the friction. **(1 Points)**
(d) Find the work of tension. **(0.5 Points)**
(e) Find the total work on the system. **(0.5 Points)**
(f) Find the speed of blocks for this described motion. **(1 Points)**



3. As in the figure, a 0.50-kg block is held in place against the spring by a 67-N horizontal external force and compressed it to x = 1.46 cm. The external force is removed (Position P1), and the block is projected with a velocity v_2 = 1.4 m/s upon separation from the spring (Position P2). The block descends a ramp and has a velocity v_3 = 2.2 m/s at the bottom (Position P3). The track is frictionless between points *A* and *B*. The block enters a rough section at *B*, extending to *E*. The coefficient of kinetic friction over this section is 0.3. The block moves on to *D* (Position P4), where it stops. Find the following:

(a) Spring constant. **(1 Points)**
(b) *h.* **(2 Points)**
(c) *S*. **(2 Points)**