Memorial University of Newfoundland

Physics 1020

Final Examination ***Name_____***

December 11, 2006 *MUN NO._____*

Time 2 Hours **Instructor_____**

INSTRUCTIONS:

1. Non-programmable calculators are permitted. Programmable ones are subject to scrutiny.

2. There are three parts to the exam. **ANSWER ALL QUESTIONS FROM PART A AND B. Answer one out of two from Part C.**

3. Questions from part A are 2 marks each(Total 20%). Questions from part B and C are 10 marks each(Total 80%)

4. The last page of the exam is a formula sheet. Feel free to tear it off.

5. Please use **THREE** significant figures in all calculations.

6. **Relax!** Good luck!

A	1	2	3	4	5	6	7	8	9	Total

Part A- 2 marks each(Total-20%)

1. The area 35.0 cm^2 in SI unit is:
   a. 3.50 m^2
   b. 35000 m^2
   c. .035 m^2
   d. .0035 m^2

2. Consider a projectile launched near the surface of the earth . Which of the following is true?

   a. The vertical component of its velocity is constant
   b. The horizontal component of its velocity is increasing
   c. The vertical component of its acceleration is increasing
   d. The horizontal component of its acceleration is increasing
   e. The horizontal component of its velocity is constant

3. If $\vec{A} = 4.0\hat{x} + 6.0\hat{y}$ and $\vec{B} = 2.0\hat{x} + 4.0\hat{y}$ the magnitude of the vector $\vec{A} - 2\vec{B}$
   a. 4
   b. 2
   c. $\sqrt{2}$
   d. 16

4. A mass is being lifted upwards with a constant acceleration by a rope. It is true that the tension in the string is:
   a. equal to the weight of the mass
   b. greater than the weight of the mass
   c. less than the weight of the mass
   d. zero

5. A satellite of mass M travels in a circular orbit of radius R about the earth. If the mass of the satelite is doubled, but the velocity stays constant, the new orbital radius will be

   a. 4R
   b. R/2
   c. unchanged
   d. 2R

6. Linear momentum is conserved in a two body collision only if:
   a. both bodies come to rest
   b. the net external force acting on the two body system is zero
   c. the collision is perfectly elastic
   d. the kinetic energy of the system is conserved

7. A box slides down a ramp at constant speed, acted upon by gravity and contact with the ramp. Which of the folowing statements is true?
   a. Friction acting on the block is negligible
   b. Mechanical energy is conserved in this system
   c. Mechanical energy is not conserved in this system
   d. The weight of the box equals the frictional force

8. Two identical sized blocks are pulled along a rough surface as shown.
   Which of the following statements is NOT TRUE?

a. The coefficient of kinetic friction is the same in each case.
b. A force of the same magnitude is needed to keep each block moving.
c. A force of the same magnitude is needed to start each block moving.
d. The force of kinetic friction is greater in magnitude for the block on the left.
e. The normal force exerted on the blocks by the surface is the same for both blocks.

9. A train moving at high speed collides with a solid wall and stops. If the time during which the collision occurs is increased the force exerted on the train is:
   a. increased
   b. decreased
   c. unchanged
   d. there is insufficient information given

10. An object moves in uniform circular motion. It is true that the centripetal force:
   a. does work on the object
   b. does no work on the object
   c. is directed outward from the center
   d. changes the speed of the object

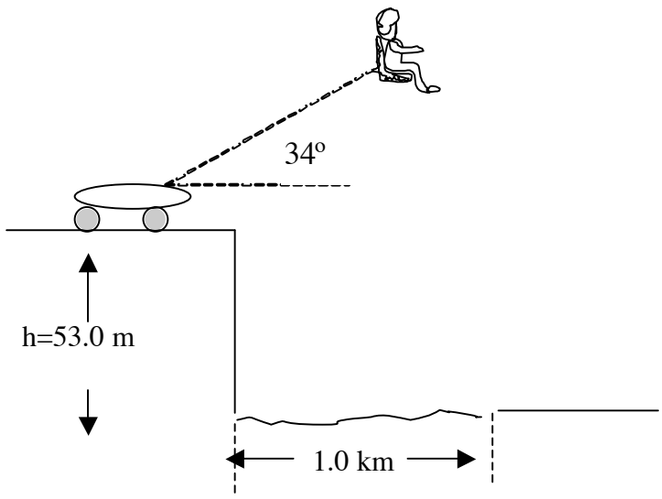
Part B – ATTEMPT All QUESTIONS
All questions are of equal value-Total Value 70%

Note: The last page of the exam is a formula sheet. Feel free to tear it off.

1. A toy rocket is traveling to the right at 15.0 m/s when it undergoes a constant acceleration 3.00 m/s^2 to the left.
    a. How long does it take before the rocket stops moving to the right?
    b. What distance does the rocket travel before it stops moving to the right?
    c. What distance does the rocket travel in 7.00 s?

2. Bond....James Bond is out in his specially equipped BMW when he is attacked by "Bad Guys". Traveling at 220 km/h James realizes that he is about to plunge over a cliff so he presses the Big Red Button and ejects. The seat is propelled upward at an angle of 34 degrees to the horizontal and a speed of 197 km/h , relative to the car. If the cliff is 53 m high:
   a. How long is James in the air?
   b. If the river is 1.00 km wide does James land in the water or in the trees on the other side??

(Choose the *x*-axis and the *y*-axis as the horizontal and vertical axis respectively)



3.

a. A ball is thrown straight upwards from a cliff with a speed of 19.6 m/s and hits the ground 7.00 s later. How high is the cliff?

b. Bonnie boater attempts to cross the Gander River river by pointing her boat straight across the river, as shown. Her boat can travel at 2.00 m/s in still water. Bonnie paddles hard for 1.00 minutes and to her surprise ends up 31.0 m downstream on the other side of the river.

   i. Draw the vector diagram showing how the velocity vectors of the boat and the river **<u>add</u>** to give the velocity of the boat relative to the shore. Label the velocites

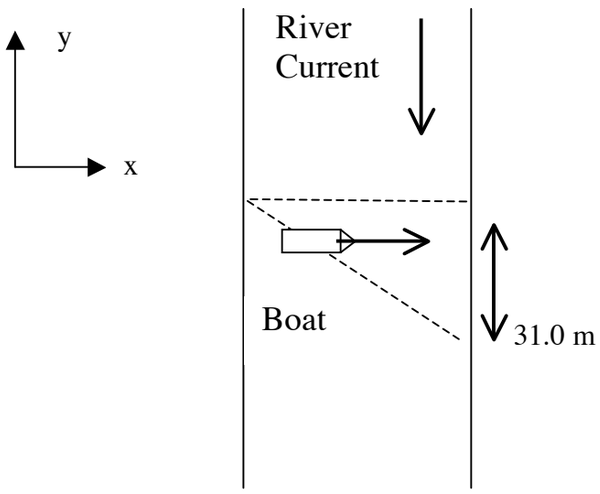
   V_B- velocity of boat to water

   V_R- velocity of river (ie. water to shore)

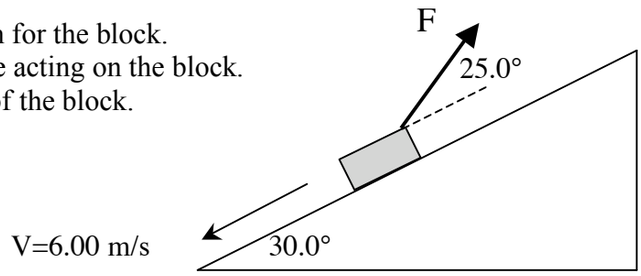
   V_{BS}- velocity of boat to shore

   ii. Determine the speed of the river.

   iii. Determine the velocity (magnitude and direction) of the boat relative to the shore



4. A 25.0 kg block is sliding down a 30.0 degree incline with an initial velocity 6.00 m/s. The coefficient of kinetic friction between the block and the incline is 0.250. A force of F=102 N is being applied to the block as shown at an angle of 25.0 degrees to the direction of the incline.
    a. Draw the free-body diagram for the block.
    b. Determine the frictional force acting on the block.
    c. Determine the acceleration of the block.

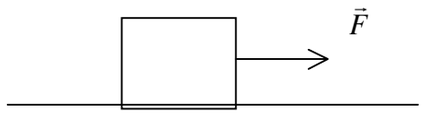


5.

a. State the Work-Energy theorem. Define any terms that you use.

b. A 5.00 kg block is pulled, from rest, across a rough surface by a 20.0 N force applied parallel to the surface. After moving 2.0 m the speed of the block is 3.5 m/s. Determine:

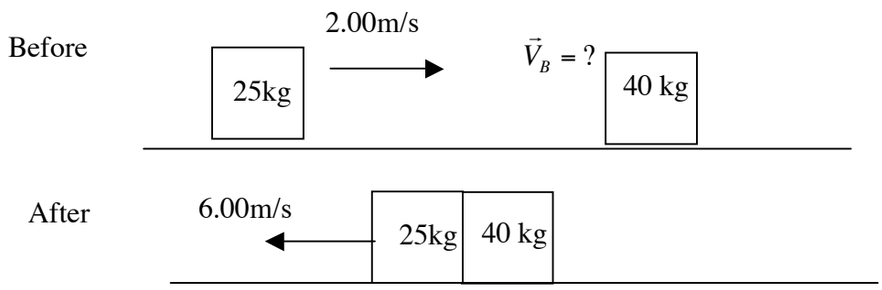
i. the work done by the 20.0 N force
ii. the work done by the normal force
iii. the work done by friction(Note: you do not know μ_k)



6.

a. In a car crash, the modern car is designed to crumple. Briefly explain in terms of Impulse-Momentum theory why this is so.

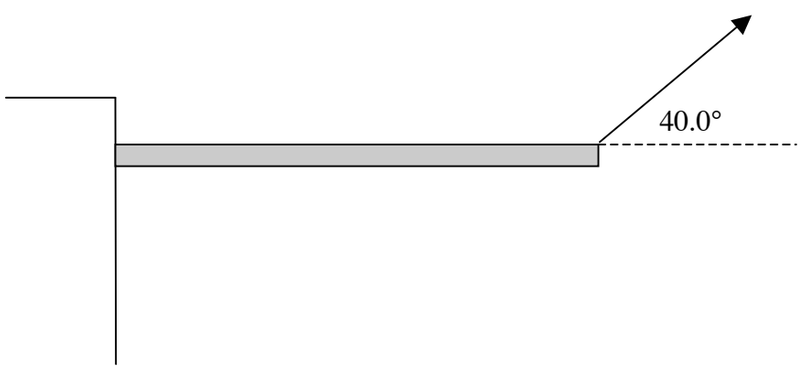
b. Block A, of mass 25.0 kg, is traveling to the right with speed 2.00 m/s. It collides with block B, of mass 40.0 kg, traveling with speed v_B. They stick together after the collision and the surface on which they slide is frictionless. If the final velocity of both blocks together after the collision is 6.00 m/s to the left, find the initial velocity of the second block, v_B.



7.

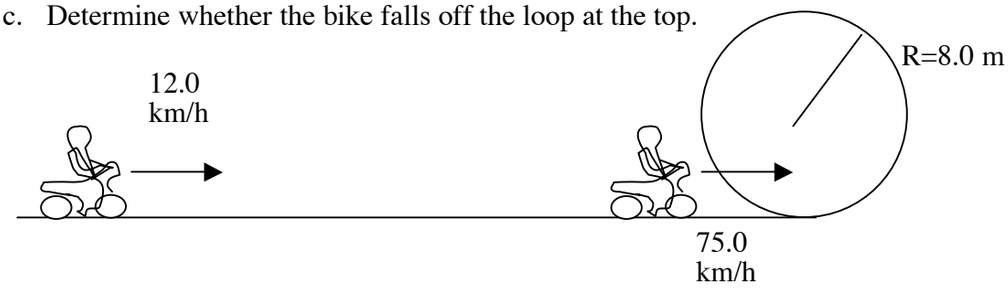
a. State the two conditions for static equilibrium

b. A uniform metal pole of mass 15.0 kg and length 5.00 m is bolted horizontally to a vertical wall. A cable is tied at the far end of the pole and exerts a force at an angle 40.0° above the horizontal.
    i. What is the tension in the cable?
    ii. A cat of mass 8.00 kg walks out onto the pole from the wall. If the cable can withstand a maximum tension of 200.0 N, how far out can the cat walk before the cable breaks?

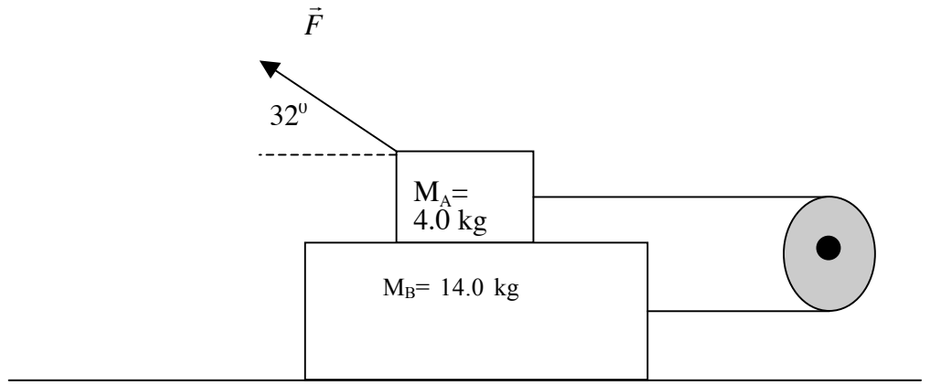


PART C DO one of questions 8 and 9 (Value 10%)

8. A stuntman on a motorcycle attempts to do an inside loop. He accelerates his bike from 12.0 km/h to a top speed of 75.0 km/h and then coast into the loop. The bike and stuntman have a combined mass of 284 kg. The radius of the loop is 8.0 m
    a. How much work is done is by the bikes motor in accelerating the bike?
    b. If a constant frictional force of 320.0 N acts on the bike as it travels the loop, what is the speed of the bike at the top of the loop?
    c. Determine whether the bike falls off the loop at the top.



9. Consider a system of two masses, M_A=4.00 kg and M_B=14.0 kg attached by a rope which passes over a smooth pulley. Block A rests on block B. The surface between the two blocks is rough and has a coefficient of kinetic friction of 0.25. The surface on which block B rests is frictionless. A force of 38.0 N is applied acting 32 degrees above the horizontal, as shown.
    a. Draw a free body diagram for each block
    b. Choose an appropriate coordinate system and determine the tension in the string and the acceleration of the system.



Physics 1020 Sample Final Exam Answers

Fall 2006

Part A: Multiple choice

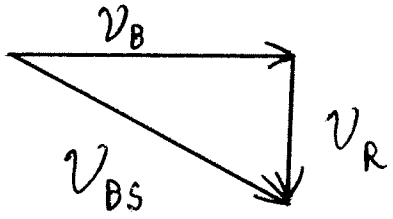
1. d
2. e
3. b
4. b
5. c
6. b
7. c
8. d
9. b
10. b

Part B:

1. a. $t = 5.00$ s
   b. $d = 37.5$ m
   c. $d_{total} = 43.5$ m

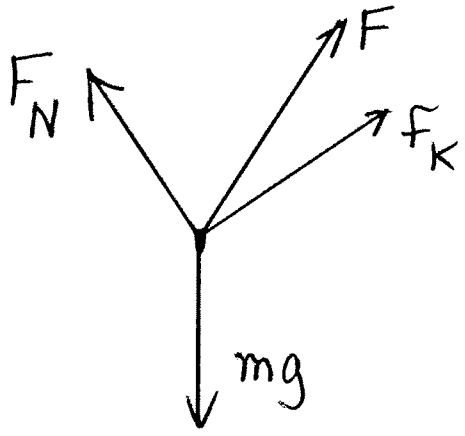
2. a. $t = 7.65$ s
   b. $\Delta x = 815$ m, so James lands in the water

3. a. $h = 103$ m
   b. i.



   ii. $v_R = 0.517$ m/s in the negative y direction
   iii. $v_{BS} = 2.07$ m/s, 14.5° downstream

4. a.



b. $f_k = 42.3$ N
c. $a = -0.486$ m/s^2 (i.e. 0.486 m/s^2 up the incline)

5. a. Two possible answers:
The net work done on an object equals the change in its kinetic energy:

$$W_{net} = \Delta KE$$

Or: The work done by the non-conservative forces equals the change in the total mechanical energy:

$$W_{NC} = \Delta E$$

b. i. $W_F = 40.0$ J
ii. $W_N = 0$ J
iii. $W_f = -9.38$ J

6. a. The impulse of the force is the force multiplied by the time. If the car crumples, the time of the collision is made longer, which makes the force of the impact less.

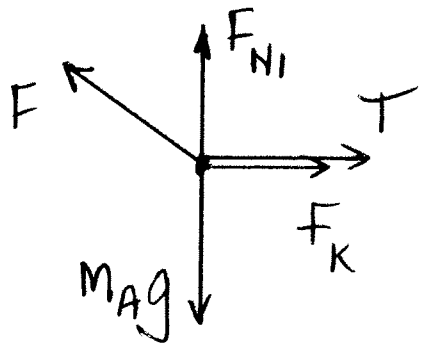
b. $v_{Bi} = -11.0$ m/s (i.e. 11.0 m/s to the left)

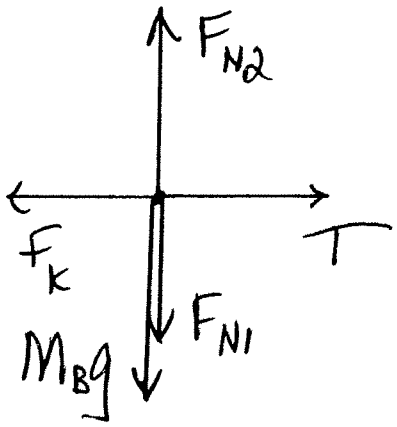
7. a. The net force is zero: $\Sigma F = 0$.
The net torque is zero: $\Sigma \tau = 0$.
b. $T = 114$ N
$d = 3.50$ m

Part C:

8. a. $W = 60{,}000$ J
b. $v = 7.96$ m/s (or 7.88 m/s if velocity is rounded off)
c. $v_{min} = 8.86$ m/s, so bike does fall

9. a.





b. $T = 22.4$ N, $a = 1.26$ m/s^2