

Physics 225

Fall 2014

Problem Set # 4

- 1) Mitch is out in the backwoods scaring up some dinner with his bow and arrows. He shoots an arrow horizontally 1.25 m above the ground. He completely misses the rabbit he was shooting at and the arrow plunges into the ground 150 m away. Calculate the initial velocity of the arrow.
- 2) Sideshow Bob is launched from a cannon at an angle of 30° with a velocity of 50 m/s. (a) What is Bob's velocity at the highest point in its trajectory? (b) How long does it take to get to this point? (c) How far does Bob travel horizontally right before he hits the ground? (d) What is the y-component of Bob's velocity when its velocity vector is pointing downward at an angle of 45° below the horizontal?
- 3) Skid is going to attempt a field goal by kicking the football from a point 40 yards out from the goal. The ball must clear the crossbar that is 3 m off of the ground. Skid kicks the ball with a velocity of 20 m/s at an angle of 45° (a) Does the ball clear the crossbar? (b) Is the ball rising or falling as it approaches the crossbar? Show your work for all.
- 4) A stone is thrown upward from the top of a 20 m high cliff at an angle of 25° . The stone has an initial velocity of 15 m/s. Make the BASE of the cliff the origin. (a) Write out the position, velocity, and acceleration vectors for the stone. (b) What is the magnitude of the velocity of the stone 3 s after it is launched?
- 5) A baseball is hit at angle into the air. When the ball is at a height of 9.1 m, it has a velocity according to $\mathbf{v} = (7.6 \text{ m/s})\mathbf{i} + (6.1 \text{ m/s})\mathbf{j}$. What is the magnitude and direction of the initial velocity of the baseball?
- 6) A projectile is launched with a speed of v_0 at an angle of θ_0 with respect to the horizontal. Derive an expression for the maximum height it reaches above its starting point in terms of g , θ_0 , v_0 .
- 7) A baseball is thrown with an initial speed of 25 m/s at an angle of 40° with the horizontal. At the same moment that the ball is launched, a player is 45 m away from the thrower. At what speed and which direction should the player run in order to catch the ball at the same level at which it was released?
- 8) Calculate the angle of launch for an object so that maximum height of the object is equal to its horizontal range.
- 9) Skid wants to fly his plane from Champaign, IL to Chicago, IL. Champaign is directly south of Chicago. Relative to the air, Skid's plane can fly at 100 mph. The wind is blowing due east at 40 mph. (a) In what direction should Skid fly in order to travel directly to Chicago? (b) What will his speed be relative to the ground?

1) 297 m/s

2) a) 43.3 m/s b) 2.55 s
c) 221 m

4) b) 26.8 m/s

5) 16.6 m/s, 62.6°

6) $H = \frac{v_0^2 \sin^2 \theta}{2g}$

7) 5.53 /s, away

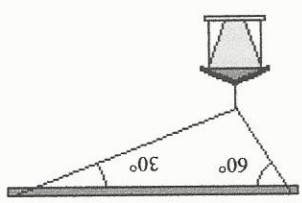
8) 76°

9) a) 23.6° west of north

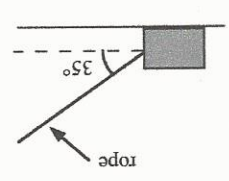
Physics 225

Fall 2014

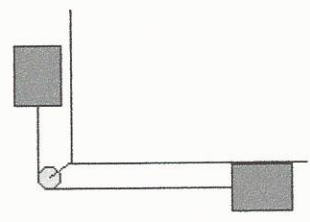
Problem Set # 5



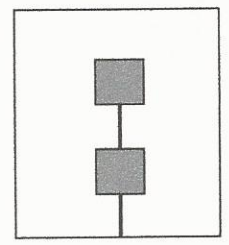
1) Grezy-X has a 150 N bird-feeder in his backyard. It is suspended by two ropes tied to a third as shown in the diagram. Calculate the tension in each of the three ropes.



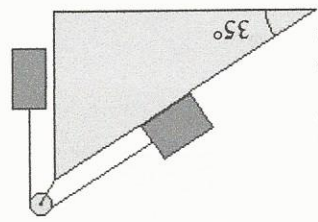
2) A block of mass 25 kg is being dragged across a frictionless surface by a rope with an unknown tension. See diagram. The block starts from rest and travels 30 m in 6 s. Calculate the tension in the rope.



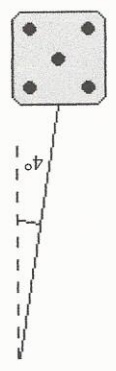
3) A mass, $m_1 = 5$ kg, resting on a frictionless horizontal table is connected to a cable that passes over a pulley which is then attached to a second hanging mass, $m_2 = 10$ kg. See diagram. Calculate the tension in the cable.



4) Two blocks are fastened to the ceiling of an elevator. See diagram. Each block has a mass of 10 kg. The elevator accelerates upward at 2 m/s^2 . Find the tension in each rope.



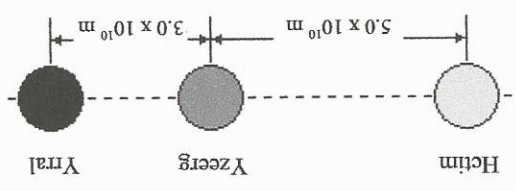
5) A mass, $m_1 = 5$ kg, resting on a frictionless ramp is connected to a cable that passes over a pulley which is then attached to a second hanging mass, $m_2 = 10$ kg. See diagram. How long will it take the boxes to move 3 m if they are released from rest?



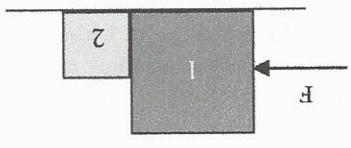
6) Skid has fuzzy dice hanging from the rearview mirror of his Pinto. See diagram. When Skid's car accelerates to the right the string holding up one of the dice makes an angle of 4° with the vertical. Calculate the acceleration of the Pinto.

7) A block is at the base of a 5 m long ramp of angle 35° . If the block is initially given a velocity of 12 m/s up the ramp, how far from the ramp will the block land?

8) Three planets, Hctim of mass 4.88×10^{24} kg, Yzerg of mass 3.18×10^{23} kg, and Yrtal of mass 5.98×10^{24} kg in the solar system Strageb are in harmonic convergence (i.e. they are perfectly aligned). See diagram. At the exact time that they are aligned, calculate the net force acting on planet Yzerg.



9) Two blocks are in contact on a frictionless surface as shown. Block # 1 has a mass of 5 kg and Block # 2 has a mass of 2 kg. A force of 14 N is applied to the right on Block # 1. (a) Calculate the contact force between two blocks. (b) If the force is applied to the left on Block # 2, will the contact force be the same or different. Explain your answer.



10) An object of 4 kg has two forces acting on it: $F_1 = 3i - 2j + 18k$, $F_2 = 13i - 10j + 10k$. If the object is started from rest and the forces are applied over a period of 3 s, find using complete unit vector notation (a) the acceleration of the object and (b) the velocity of the object at the end of the 3 s interval.

- 1) 130 N, 75 N, 150 N
- 2) 51.0 N
- 3) 32.7 N
- 4) 236 N, 118 N
- 5) 1.13 s
- 6) 0.685 m/s^2
- 7) 11.44 m
- 8) $9.96 \times 10^{16} \text{ N}$
- 9) a) 4 N
- 10) a) $a = 4i - 3j + 7k$
- b) $v = 12i - 9j + 21k$