# Motion and force in a gravitational field

Home Assignment Vectors, Energy and Momentum

Name: _____ (37 marks total)

1.   Rain drops falling vertically have a terminal velocity of 4.00 ms^{-1}. They reach a zone in the atmosphere where the wind is blowing horizontally at a constant 6.00 ms^{-1}. At what angle to the vertical do the drops now move? Include a labelled diagram with your answer. (2 marks)

2.   A bird is flying upwards at an angle of 35.0^0 to the horizontal at a velocity of 2.88 ms^{-1}. What are the vertical and horizontal components of the bird's velocity? (2 marks)

3.   A baseball travelling at a velocity of 8.00 ms^{-1} west is hit by the batsman and ends up moving north at a velocity of 9.00 ms^{-1}. What is the resultant change in velocity? (3 marks)

4.   A boat's speed in still water is 5.00 ms^{-1}. If the boat is to travel directly across a river whose current has a speed of 3.00 ms^{-1}, at what angle to the bank must the boat head? Draw a labelled diagram with your answer.   (2 marks)

5. Consider the diagram of forces shown on the right.
    Calculate the total force acting on the object. (5 marks)
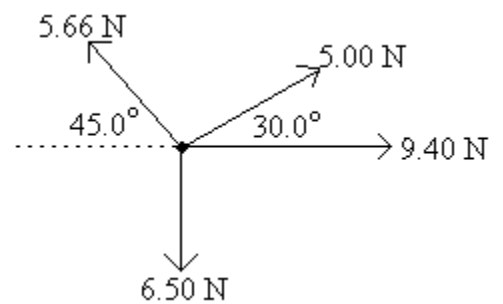
6. A plane whose airspeed is 55.0 ms^{-1} heads due north. But a 28.0 ms^{-1} northeast wind (i.e., coming from the northeast) suddenly begins to blow. What is the resulting velocity of the plane with respect to the ground? (5 marks)

7. A pitcher throws a baseball due south towards the batter at 20.0 ms^{-1}. The batter just touches the ball but causes it to continue in the same direction but at 15.0 ms^{-1} still sount. If the ball's change in velocity occurred in 0.200 s, what was the ball's acceleration? (3 marks)

8. As I watch out of my study window, I see Gipsy, my Persian cat, chasing a lizard (assume it has a mass of 0.144 kg). The Lizard is running at 3.15 ms^{-1} N when, coming to a wall, it spins around running straight under Gipsy and is now travelling at 3.80 ms^{-1} S. What was the change of momentum of the lizard? (3 marks)
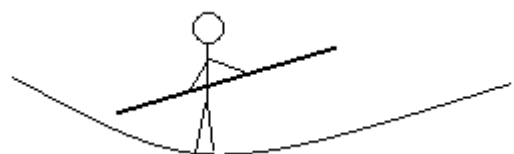
9. Tim is riding his bike (total mass of 70.0 kg) at 4.15 ms^{-1}.
   a. What is Tim's kinetic energy? (1 mark)

   b. How much work must Tim do to double his speed? (2 marks)

10. Free body diagrams are useful to show the forces acting.
    a. For the object shown, calculate the net force acting. (1 mark)

    b. Label all the forces
       acting in the following situation. (2 marks)

11. A 0.150 kg ball is thrown straight up into the air at 6.40 ms^{-1}.
   a. How much kinetic energy does the ball have as it leaves the person's hand? (1 marks)

   b. What is the maximum height the ball will reach assuming no air resistance? (3 marks)

   c. What is the potential energy when the ball is at its highest point? (1 marks)