## Vectors Review (courtesy of Ms. Wimbs)

- 1. If  $\vec{u}=4\vec{i}-\vec{j}+\vec{k}$  and  $\vec{v}=\vec{i}+3\vec{j}-2\vec{k}$  , simplify  $3\vec{u}-2\vec{v}$
- 2. Determine the resultant
  - a) 42 km/h north and 10 km/h N30°E
  - b) A river current of 3 knots N, a boat with speed 10 knots N10°W, and a passenger walking directly across the deck of the boat with a speed of 2 knots.
- 3. A pilot flies on a heading of N40°W with an airspeed of 240 km/h. Her actual ground velocity is 250 km/h at a bearing of N48°W. Calculate the speed and direction of the wind.
- 4. If  $\vec{a} = [-2,3,-1]$  and  $\vec{b} = [4,-5,8]$ , find  $\vec{a} \cdot \vec{b}$  and  $\vec{a} \times \vec{b}$
- 5. Determine the projection and its magnitude, of  $\vec{a}$  onto  $\vec{b}$ , if  $\vec{a} = [2, -3, 8]$  and  $\vec{b} = [-7, -1, 6]$ .
- 6. A force  $\vec{F} = [2,8,15]$ , in newtons, is applied to lift a box with displacement  $\vec{s} = [0,2,9]$ . Calculate
- a) the work against gravity
- b) the work in the direction of travel
- A force of 75 N is applied to a wrench in a counterclockwise direction at 60° to the handle, 12 cm from the centre of the bolt.
- a) Calculate the magnitude of the torque.
- b) In what direction does the bolt move?
- 8. A line passes through the points P(2, 3, -1) and Q(4, -2, 5). Determine vector, parametric and scalar equations for this line.
- 9. Write a vector equation and scalar equation of a plane that is perpendicular to [x,y,z] = [5,3,-1] + t[-1,7,2] and contains the point (1, 2, 5).
- 10. Determine the intersection of the line [x,y,z] = [-2,4,13] + t[1,2,-3] and the plane [x,y,z] = [2,1,-1] + s[3,-1,-1] + u[1,4,2].
- 11. Determine the line of intersection of this system of equations.

x + 3y + 3z = 8x - y + 3z = 42x + 6y + 6z = 16

## Practice Questions - Limits, Derivatives

- 1. Find each limit.
- a)  $\lim_{x \to -1} \frac{2x^2 + 5x + 3}{x + 1}$  b)  $\lim_{x \to 9} \frac{x 9}{\sqrt{x} 3}$
- 2. Determine the derivative of  $f(x) = \frac{3}{x+2}$  from first principles.
- 3. Find  $\frac{dy}{dx}$ . Write your answer in simplified factored form.

a) 
$$y = \ln(2x^2 - 4x + 5)$$
 b)  $y = 4^x \sin^2(x^3)$ 

c) 
$$y = \frac{xe^{x} - 5}{x+1}$$
 d)  $y = e^{2\cos \pi x}$ 

- 4. Find the equation of the tangent line to the curve  $y = x + \frac{1}{x^2}$  that is parallel to the line x + y + 3 = 0.
- 5. An object moves in a straight line, and its position, s (in metres) after t seconds is  $s(t) = 8 7t + t^2$ .
  - a) Find the average velocity between t = 3 and t = 4.
  - b) Find the velocity when t = 3.
  - c) When is the object speeding up?
  - d) When is the object approaching the point where s(t) = 0?
- 6. A supermarket is designed to have a rectangular floor area of 3750 m<sup>2</sup>, with three walls made of cement blocks and one wall made of glass. In order to conform to the building code, the length of the glass wall must not exceed 60 m but must not be less than 30 m. The cost per linear metre of constructing a glass wall is twice that of constructing a cement wall. Find the dimensions of the floor area that will minimize the cost of building the walls.