1. Consider the following 3 vectors given by $\vec{A} = 5\hat{i} - 2\hat{j}$; $\vec{B} = -4\hat{i} + 6\hat{j}$; $\vec{C} = -7\hat{i} + 8\hat{j}$.
What are the following quantities?
(Note: you must use vector notation in your answers where appropriate for credit)

(a) $\vec{A} + \vec{B} =$ _____

(b) $2\vec{B} - \vec{C} =$ _____

(c) $(\vec{B} - \vec{C}) \bullet \vec{A} =$ _____

(d) $\vec{A} \bullet \hat{i} =$ _____

(2) **[210]** An object is observed to move along the x with a position which is given by:

$$x = d + bt + ct^2$$

where b, c and d are constants.
(a) find the velocity of the object as a function of time.
(b) find the acceleration of the object.
(c) Suppose c=-5 m/s^2 , b=0.5 m/s and d=1 m. At t=2 s, provide numerical answer for (a) and (b) above with correct SI units.
(c:1) v=_____
(c:2) a=_____

(2) **[240]** An object is observed to move along the x with a position which is given by:

$$x = bt + ct^2 + dt^4$$

where b, c and d are constants.
(a) find the velocity of the object as a function of time.
(b) find the acceleration of the object as a function of time.
(c) Suppose $b = 1\frac{m}{s}; c = -5\frac{m}{s^2}; d = 0.5\frac{m}{s^4}$. At t=2s, provide numerical answer for (a) and (b) above with correct SI units.
(c:1) v=_____
(c:2) a=_____

[3] A ball is thrown from ground level with an initial velocity vector given by:

$$\vec{v}_0 = v_{0,x}\hat{i} + v_{0,y}\hat{j} = 7\hat{i} + 3\hat{j}\,\frac{m}{s} \quad .$$

(a) Find the maximum height to which the ball rises above the ground.
(b) Find the velocity vector at the instant the ball strikes the ground on the way down.
(c) Find the time that the ball is in the air.
(d) Find the **x-position** of the ball when the ball is at its maximum altitude.
(e) Find the range of the ball.

[4] A ball is thrown upward from ground level with an initial speed of 5 m/s. If the initial velocity makes an angle of 40^0 with respect to the x-axis (i.e., the ground), answer the following (using correct SI units).
(a) How far does the ball travel in the x-direction when it returns to the ground?
(b) How high did the ball go at its maximum altitude?
(c) How long was the ball in the air?
(d) What is the impact velocity **vector** (express using the unit vectors $\hat{i}$ and $\hat{j}$)?

[5] A ball is thrown off of the top of a 20 m building with an initial velocity of $\vec{v}=10\,\hat{x}+0\,\hat{y}\,\frac{m}{s}$.

(a) what is the time of flight of the ball?
(b) what is the distance in the x direction the ball travels?
(c) what is the impact velocity vector of the ball?

[6] 240 A particle is observed to move with a constant acceleration given by $\vec{a}=0\hat{x}-ct\hat{y}$ where the constant c has SI units of m/s^3.
(a) Find the velocity vector at a later time assuming that at t=0 the initial velocity vector is $\vec{v}_0=0\hat{x}+0\hat{y}$.
(b) Find the position vector at a later time assuming that at t=0, the velocity and position vectors are both zero.
Suppose another particle is seen to have a position vector given by:

$$\vec{R}(t)=(x_0+v_{0,x}t)\hat{x}+(y_0+v_{0,y}t-\frac{1}{2}gt^2-kt^3)\hat{y}$$.

The constant k has SI units of m/s^5.
(c) Find the velocity vector at a later time.
(d) Find the acceleration vector at some later time.

[6] 210 A particle is observed to move with a constant acceleration given by $\vec{a}=0\hat{x}-c\hat{y}$ where the constant c has SI units of m/s^2.
(a) Find the velocity vector at a later time assuming that at t=0 the initial velocity vector is $\vec{v}_0=0\hat{x}+0\hat{y}$.
(b) Find the position vector at a later time assuming that at t=0, the velocity and position vectors are both zero.
Suppose another particle is seen to have a position vector given by:

$$\vec{R}(t)=(x_0+v_{0,x}t)\hat{x}+(y_0+v_{0,y}t-\frac{1}{2}gt^2)\hat{y}$$.

(c) Find the velocity vector at a later time.
(d) Find the acceleration vector at some later time.

[7] A particle is observed to move with an acceleration given by:

$$\vec{a} = b\,\hat{x} + 0\,\hat{y}$$

where the constant b has SI units of $[b] = [\frac{m}{s^2}]$.

(a) Find the velocity **vector** at a later time assuming at t=0 the velocity is zero.
(b) Find the position **vector** at a later time assuming at t=0, the velocity and position are both zero.

Suppose another particle is seen to have a position vector given by:

$$\vec{R}(t) = (-bt)\,\hat{x} + (f t^2)\,\hat{y} \quad ,$$

Where the constants have SI units of $[b] = [\frac{m}{s}], [f] = [\frac{m}{s^2}]$. .

(c) Find the velocity **vector** at a later time.
(d) Find the acceleration **vector** at some later time.

[8] Consider the following vectors:

$$\vec{A} = 9\,\hat{x} + 2\,\hat{y} : \vec{B} = -5\,\hat{x} + 3\,\hat{y} : \vec{C} = 5\,\hat{x} - 3\,\hat{y}$$

(a) $\vec{A} + \vec{B} + \vec{C} =$ _____

(b) $\vec{A} \bullet \vec{B} =$ _____

(c) $|\vec{A} + \vec{B}| =$ _____

(d) $(\vec{A} + \vec{C}) \bullet \hat{y} =$ _____

(e) The angle that vector A makes with respect to the positive x-axis.

$\theta =$ _____