1) Mathematical modelling is the process of setting up a model, solving it mathematically and interpreting the result in physical or in order terms.

b) i, Law of conservation of mass (Balanced law)

ii, Forming a differential equation from an existing algebraic equation of the system.

2. $r = (t^2+3t)i - 2\sin 3t\, j + 3e^{2t} k$

i, $\frac{dr}{dt} = 2i + 18\sin 3t + 6e^{2t} k$

ii, $\frac{d^2r}{dt^2} = 2i + 18\sin 3t\, j + 12e^{2t} k$

iii, $\left.\frac{d^2r}{dt}\right|_{t=0} = 2i + 18(\sin 3(0))j + 12e^{2(0)}k$

$= 2i + 12k$

iv, $\left|\frac{d^2r}{dt^2}\right| = \sqrt{(2)^2+(12)^2} = \sqrt{4+144} = \sqrt{148}$

3. $A = x^2y\, i + (xy+yz)j + xz^2 k$

$B = yz\, i - 3xz\, j + 2xy\, k$

at point $(1,2,1)$

$\phi = 3x^2y + xyz - 4y^2z^2 - 3$

i, $\nabla\phi = \frac{d\phi}{dx} + \frac{d\phi}{dy} j + \frac{d\phi}{dz} k$

$\nabla\phi = (6xy+yz)i + (3x^2+xz-8yz^2)j + (xy-8y^2z)k$

at $x=1$, $y=2$, $z=1$,