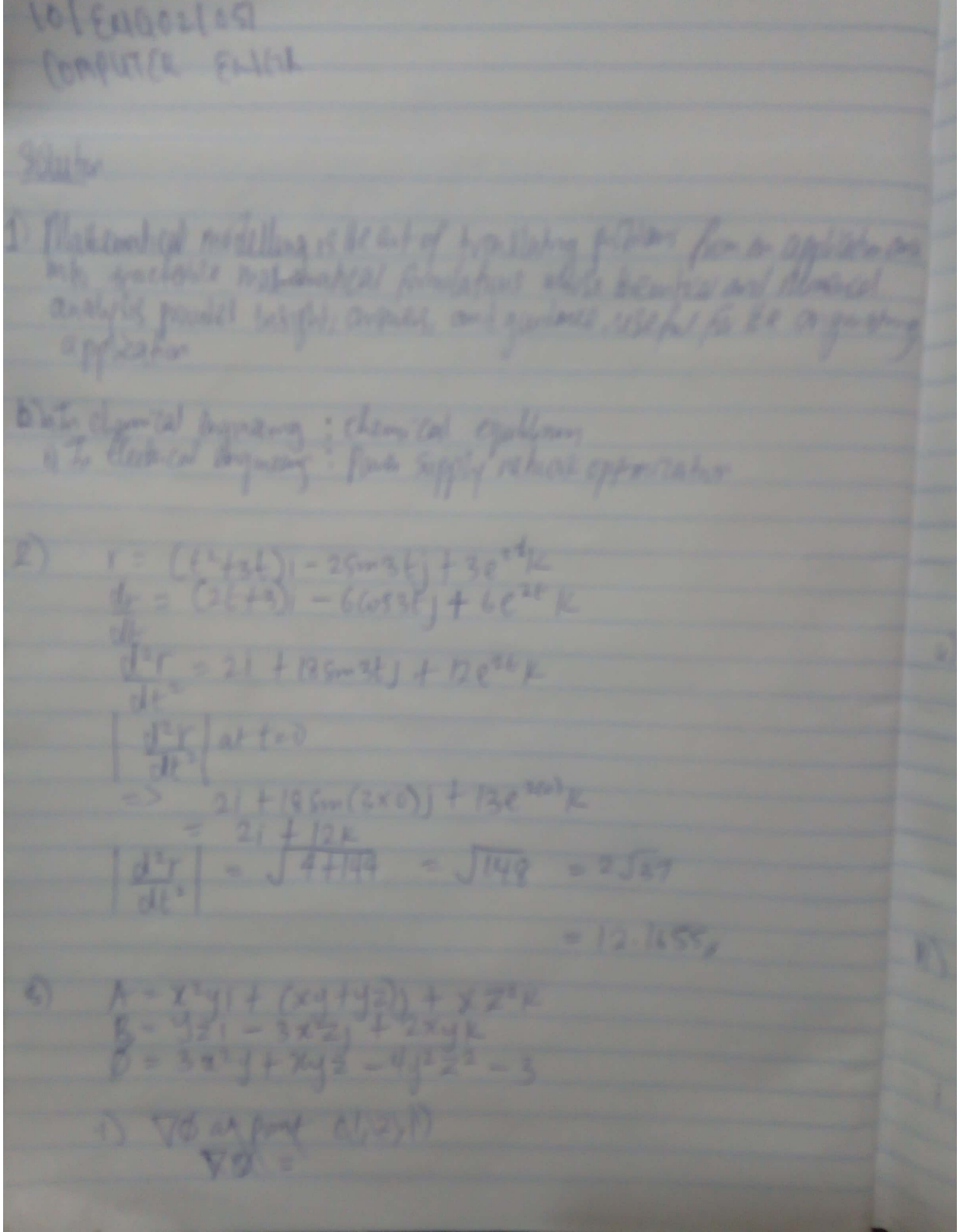

i) $\nabla\phi$ at point (1, 2, 1)

$$\nabla\phi = \frac{\partial\phi}{\partial x}i + \frac{\partial\phi}{\partial y}j + \frac{d\phi}{dz}k$$

$$\frac{d\phi}{dx} = 6xy + yz$$

$$\frac{d\phi}{dy} = 3x^2 + xz - 8yz^2$$

$$\frac{d\phi}{dz} = xy - 8y^2z$$

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

at point (1, 2, 1)

$$\nabla\phi = (12+2)i + (3+1-8(2)(2))j + (2-32)k$$

$$= 14i + (4-16)j + (-30)k$$

$$= 14i - 12j - 30k$$

$$\nabla\phi = 14i - 12j - 30k$$

ii) ∇A

$$\nabla A = \frac{d}{dx}i + \frac{d}{dy}j + \frac{d}{dz}k \cdot (x^2yi + (xy+yz)j + xz^2k)$$

$$\nabla \cdot A = \frac{d}{dx}(x^2y) + \frac{d}{dy}(xy+yz) + \frac{d}{dz}(xz^2)$$

$$\nabla \cdot A = 2xy + (x+z) + 0 + (2xz)$$

$$= 2(1)(2) + (1+1) + (2\times1\times1) = 4+2+2$$

$$\nabla \cdot A = 8_n$$

iii) $\nabla \times B = \begin{vmatrix} i & j & k \\ \partial/\partial x & d/dy & d/dz \\ yz & -3xz & 2xy \end{vmatrix}$

$$i\left(\frac{d}{dy}(2xy) + \frac{d}{dz}(3xz)\right) - j\left(\frac{d}{dx}(2xy) - \frac{d}{dz}(yz)\right)$$

$$k\left(\frac{d}{dx}(-3xz) - \frac{d}{dy}(yz)\right)$$

$i(2x+3x) - j(2y-y) + k(-3z-z)$

$i(5x) - j(y) + k(-4z)$

$5xi - yj - 4zk$

at point $(1,2,1)$

$\nabla \times B = 5i - 2j - 4k$

iv) grad div A $\quad \nabla \cdot \vec{A}$

$\text{Div } A = 2xy + (x+z) + 2zx$

$\nabla(\nabla \cdot A) = \frac{d(\nabla \cdot A)}{dx} i + \frac{d(\nabla \cdot A)}{dy} j + \frac{d(\nabla \cdot A)}{dz} k$

$\nabla(\nabla \cdot A) = i(2y+1+2z) + 2xj + (1+2x)k$

$= i(4+1+2) + 2j + 3k$

$= 7i + 2j + 3k$

v) $\nabla \times (\nabla \times \vec{A}) \quad \vec{A} = x^2y\,i + (xy+yz)j + xz^2k$

$$\nabla \times \vec{A} = \begin{vmatrix} i & j & k \\ d/dx & d/dy & d/dz \\ x^2y & (xy+yz) & (xz^2) \end{vmatrix}$$

$i(0-y) - j(z^2-0) + k(x^2+(y)) - yi - j(z^2) + k(x^2-y)$

$\nabla \times \vec{A} = -yi - j(z^2) + k(x^2-y)$

$$\nabla \times (\nabla \times \vec{A}) = \begin{vmatrix} i & j & k \\ d/dx & d/dy & d/dz \\ -y & -z^2 & x^2-y \end{vmatrix}$$

$= 1(1+2z) - j(0-2x) + k(1-0)$

$= (1+2z)i + 2xy + k$

$= (1+2(1))i + 2j + k$

$\nabla \times (\nabla \times \vec{A}) = 3i + 2j + k$