

**1**

Calculate the work done by the force:

$$\mathbf{F} = x\mathbf{i} - y\mathbf{j} + (x + y + z)\mathbf{k}$$

Along the curve:

$$y = 3x^2 \quad \text{from } (0, 0, 0) \rightarrow (2, 12, 0)$$

## 2

Determine if the following vector field is conservative:

$$\mathbf{F} = (e^x \sin y - yz)\mathbf{i} + (e^x \cos y - xz)\mathbf{j} + (z - xy)\mathbf{k}$$

### 3

(i) Find the potential function  $f$  of:

$$\mathbf{F} = (2xy + \cos 2y)\mathbf{i} + (x^2 - 2x \sin 2y)\mathbf{j}$$

(ii) What is the gradient field of  $f$ ?

**4**

Calculate:

$$\int_C (x^3 y^2) \, dx + (y^3 z) \, dy + \left(\frac{zxy}{4}\right) dz \quad C : (0, 0, 0) \rightarrow (2, 2, 2)$$

## 5 Useful Formulae

### 5.1 Green's Theorem

$$\oint_C P \, dx + Q \, dy = \iint_D \left( \frac{\partial Q}{\partial x} - \frac{\partial P}{\partial y} \right) dA$$

### 5.2 Calculating Parameterised Vector Line Integrals

$$\int \mathbf{F} \cdot d\mathbf{s} = \int \mathbf{F}(\mathbf{r}) \cdot \|\mathbf{r}'(t)\| \, dt$$

### 5.3 Curl

$$\nabla \times \mathbf{F} \quad (\text{vector field}) \qquad \nabla^2 f \quad (\text{scalar field})$$

### 5.4