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Exercises for EFT 1, Sheet 2
Exercises for Math. Foundations of EFT, Sheet 2

Exercise 1.

(a) $\int x \, \mathrm{d}x$

(b) $\int x^2 \, \mathrm{d}x$

(c) $\int \frac{1}{x} \, \mathrm{d}x$

(d) $\int \mathrm{e}^x \, \mathrm{d}x$

(e) $\int (x + y) \, \mathrm{d}x$

(f) $\int (x + y) \, \mathrm{d}y$

(g) $\int \sin x \, \mathrm{d}x$

(h) $\int \cos x \, \mathrm{d}x$

Exercise 2.

(a) $\frac{\mathrm{d}}{\mathrm{d}x} x$

(b) $\frac{\mathrm{d}}{\mathrm{d}x} x^2$

(c) $\frac{\mathrm{d}}{\mathrm{d}x} c x^5$ with c constant

(d) $\frac{\mathrm{d}}{\mathrm{d}x} \frac{1}{x}$

(e) $\frac{\mathrm{d}}{\mathrm{d}x} c$ with c constant

(f) $\frac{\mathrm{d}}{\mathrm{d}x} \sin x$

(g) $\frac{\mathrm{d}}{\mathrm{d}x} \cos x$

(h) $\frac{\mathrm{d}}{\mathrm{d}x} \sqrt{x}$

(i) $\frac{\mathrm{d}}{\mathrm{d}x} \mathrm{e}^x$

Exercise 3. Transform the vector

$$\underline{\mathbf{A}} = xz\underline{\mathbf{e}}_x + yz\underline{\mathbf{e}}_y + z^2\underline{\mathbf{e}}_z$$

(a) into spherical coordinates and components,

(b) into cylindrical coordinates and components.

Exercise 4. Transform the vector

$$\underline{\mathbf{A}} = y\underline{\mathbf{e}}_x - x\underline{\mathbf{e}}_y + z\underline{\mathbf{e}}_z$$

(a) into spherical coordinates and components,

(b) into cylindrical coordinates and components.

Exercise 5. Given is the vector field

$$\underline{\mathbf{A}} = R^2\underline{\mathbf{e}}_x + r^2\underline{\mathbf{e}}_y.$$

(a) Express $\underline{\mathbf{A}}$ in cartesian coordinates and components.

(b) Express $\underline{\mathbf{A}}$ in spherical coordinates and components.

(c) Express $\underline{\mathbf{A}}$ in cylindrical coordinates and components.

(d) Determine $\nabla \cdot \underline{\mathbf{A}}$ in cartesian coordinates.

(e) Determine $\nabla \cdot \underline{\mathbf{A}}$ in spherical coordinates.

(f) Determine $\nabla \cdot \underline{\mathbf{A}}$ in cylindrical coordinates.

(g) Determine $\nabla(\underline{\mathbf{e}}_x \cdot \underline{\mathbf{A}})$ in cartesian coordinates.

(h) Determine $\nabla(\underline{\mathbf{e}}_x \cdot \underline{\mathbf{A}})$ in spherical coordinates.

(i) Determine $\nabla(\underline{\mathbf{e}}_x \cdot \underline{\mathbf{A}})$ in cylindrical coordinates.

(j) Determine $\nabla \times \underline{\mathbf{A}}$ in cartesian coordinates.

(k) Determine $\nabla \times \underline{\mathbf{A}}$ in spherical coordinates.

(l) Determine $\nabla \times \underline{\mathbf{A}}$ in cylindrical coordinates.