Dipl.-Ing. R. Hannemann SS 2001

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

Exercise 1.

(a) $\int x \,\mathrm{d}x = \frac{1}{2}x^2$

(b) $\int x^2 \,\mathrm{d}x = \frac{1}{3}x^3$

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

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

(e) $\int (x+y) \,\mathrm{d}x = \frac{1}{2}x^2 + xy$

(f) $\int (x+y) \,\mathrm{d}y = xy + \frac{1}{2}y^2$

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

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

Exercise 2.

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

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

(c) $\frac{\mathrm{d}}{\mathrm{d}x}cx^5 = 5cx^4$ with c constant

(d) $\frac{\mathrm{d}}{\mathrm{d}x}\frac{1}{x} = -\frac{1}{x^2}$

(e) $\frac{\mathrm{d}}{\mathrm{d}x}c = 0$ with c constant

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

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

(h) $\frac{\mathrm{d}}{\mathrm{d}x}\sqrt{x} = \frac{1}{2\sqrt{x}}$

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

Exercise 3.

(a) $\underline{\mathbf{A}} = R^2 \cos\varphi \underline{\mathbf{e}}_R$

(b) $\underline{\mathbf{A}} = z(r\underline{\mathbf{e}}_r + z\underline{\mathbf{e}}_z)$

Exercise 4.

(a) $\underline{\mathbf{A}} = R\cos^2\vartheta \underline{\mathbf{e}}_R - R\cos\vartheta\sin\varphi \underline{\mathbf{e}}_\vartheta - R\sin\vartheta \underline{\mathbf{e}}_\varphi$

(b) $\underline{\mathbf{A}} = -r\underline{\mathbf{e}}_\varphi + z\underline{\mathbf{e}}_z$

Exercise 5.

(a) $\underline{\mathbf{A}} = (x^2+y^2+z^2)\underline{\mathbf{e}}_x + (x^2+y^2)\underline{\mathbf{e}}_y$

(b) $\underline{\mathbf{A}} = R^2[(\sin\vartheta\cos\varphi + \sin^3\vartheta\sin\varphi)\underline{\mathbf{e}}_R + (\cos\vartheta\cos\varphi + \sin^2\vartheta\cos\vartheta\sin\varphi)\underline{\mathbf{e}}_\vartheta + (-\sin\varphi + \sin^2\vartheta\cos\varphi)\underline{\mathbf{e}}_\varphi]$

(c) $\underline{\mathbf{A}} = [(r^2+z^2)\cos\varphi + r^2\sin\varphi]\underline{\mathbf{e}}_r - [(r^2+z^2)\sin\varphi - r^2\cos\varphi]\underline{\mathbf{e}}_\varphi$

(d) $\nabla\cdot\underline{\mathbf{A}} = 2x + 2y$

(e) $\nabla\cdot\underline{\mathbf{A}} = 2R\sin\vartheta\cos\varphi + 2R\sin\vartheta\sin\varphi$

(f) $\nabla\cdot\underline{\mathbf{A}} = 2r\cos\varphi + 2r\sin\varphi$

(g) $\nabla(\underline{\mathbf{e}}_x\cdot\underline{\mathbf{A}}) = 2x\underline{\mathbf{e}}_x + 2y\underline{\mathbf{e}}_y + 2z\underline{\mathbf{e}}_z$

(h) $\nabla(\underline{\mathbf{e}}_x\cdot\underline{\mathbf{A}}) = 2R\underline{\mathbf{e}}_R$

(i) $\nabla(\underline{\mathbf{e}}_x\cdot\underline{\mathbf{A}}) = 2r\underline{\mathbf{e}}_r + 2z\underline{\mathbf{e}}_z$

(j) $\nabla\times\underline{\mathbf{A}} = 2z\underline{\mathbf{e}}_y + (2x-2y)\underline{\mathbf{e}}_z$

(k) $\nabla\times\underline{\mathbf{A}} = 2R[\sin\vartheta\cos\vartheta\cos\varphi\underline{\mathbf{e}}_R + (\sin\varphi - \sin^2\vartheta\cos\varphi)\underline{\mathbf{e}}_\vartheta + \cos\vartheta\cos\varphi\underline{\mathbf{e}}_\varphi$

(l) $\nabla\times\underline{\mathbf{A}} = 2z\sin\varphi\underline{\mathbf{e}}_r + 2z\cos\varphi\underline{\mathbf{e}}_\varphi + (2r\cos\varphi - 2r\sin\varphi)\underline{\mathbf{e}}_z$