

**Initial Self-Test**  
(optional; no grading)

**A. Vector Algebra**

**T.1.** Let  $\vec{A}$  and  $\vec{B}$  be vector functions of the Cartesian coordinates  $\{x, y, z\}$ . Express the following scalars:

- (i)  $\vec{\nabla} \cdot \vec{A}$ ,
- (ii)  $\vec{\nabla} \cdot (\vec{\nabla} \times \vec{A})$ ,
- (iii)  $\vec{A} \cdot \vec{B}$ ,
- (v)  $\vec{B} \cdot \vec{A}$ ,

and all Cartesian components of the following vectors:

- (i)  $\vec{\nabla} \times \vec{A}$ ,
- (ii)  $\vec{\nabla} \times (\vec{\nabla} \times \vec{A})$ ,
- (iii)  $(\vec{\nabla} \times \vec{\nabla}) \times \vec{A}$ ,
- (iv)  $\vec{\nabla} (\vec{\nabla} \cdot \vec{A})$ ,
- (v)  $(\vec{\nabla} \cdot \vec{\nabla}) \vec{A}$ ,
- (vi)  $\vec{A} \times \vec{B}$ ,
- (vii)  $\vec{B} \times \vec{A}$ ,

via the components of  $\vec{A}$  and  $\vec{B}$ , and compare the results, especially for apparently similar operations.

**T.2.** What is meant by  $\nabla^2 \vec{A}$ ? Is it equal to any of the expressions in T.1?

**T.3.** Express  $\vec{\nabla} \times (\vec{\nabla} \times \vec{A})$  via scalar products of  $\vec{\nabla}$  and  $\vec{A}$ .

**B. E&M Units**

**T.4.** Two electrons in vacuum are 1 cm apart. What is the force of their Coulomb repulsion in:

- (i) Gaussian units?
- (ii) SI units?

**T.5.** Express:

- (i) the current of 1 Ampere,
- (ii) the inductance of 1 Henry, and
- (iii) the resistance of 1 Ohm

in Gaussian units.