

## **MVC Revision Checklist (and references to problem sheet questions)**

- Defn of a map. Linearity: defn and examples; ps1q1
- Derivative of a map (Jacobian matrix); ps1q3, ps1q3, ps1q8
- Directional derivatives: both ways of defining; ps1q3
- Chain rule applied to “functions of functions”; ps1q2, ps1q4
- Defn of inverse map & its derivation (derivative of inverse = inverse of derivative); ps3q1
- Inverse function theorem and application to existence solutions of systems of equations; p1q5, p1q8
- Implicit function theorem and application to existence of solutions of systems of equations; ps1q7

- Higher order derivatives; Taylor's theorem; ps1q6
- Summation convention (pairs of suffices imply summation); ps2q1
- Kronecker delta defn and rule of application; ps2q1, ps2q4, ps2q5, ps2q6, ps2q7, ps2q8
- Levi-civita tensor defn and rule of application to cross products; ps2q4, ps2q5, ps2q6, ps2q7, ps2q8
- Connection between products of  $e_{ijk}$  and products of  $\delta_{ij}$ ; ps2q5, ps2q7, ps2q8
- Defn of gradient and interpretations; ps2q3, ps2q4, ps2q6

- Defn of divergence and its application; ps2q3, ps2q4, ps2q5, ps2q6, ps2q7, ps2q8
- Defn of curl and its application; ps2q3, ps2q4, ps2q5, ps2q6, ps2q7, ps2q8
- The two Null identities; ps2q3, ps2q10
- Defn of the Laplacian; ps2q4, ps2q6, ps2q10, ps3q3, ps3q5
- Coordinate transformations, the defn of a curvilinear basis, scale factors, the right-hand rule for ordering of basis, invertibility of the map; ps3q2, ps3p4
- Transformation of the gradient: method and result; ps3q2, ps3p4
- Transformation of the divergence (awareness of how this is done, not to remember derivation or formulae); ps3q2, ps3p4

- Line integrals of scalar and vector fields in 3D space: definitions, parametrisation of curves; ps4q1, ps4q2, ps4q4, ps4q5, ps4q6
- Fundamental theorem of Calculus for line integrals: proof and consequences; ps4q7, ps4q8, ps5q2
- Surface integrals of scalar and vector fields: definitions, how to parametrise surfaces, notion of surface direction; ps4q3, ps4q5, ps4q6
- Stokes' theorem: definition, the RH-thumb rule for consistent orientation of surfaces and curves (awareness of method of proof, but not details); ps4q5, ps4q6, ps5q1
- Green's theorem in the plane: defn and application; ps4q7, ps5q2, ps5q3.
- Volume integrals and change of coordinates; ps5q4, ps5q5, ps5q6, ps5q8

- Divergence theorem: defn (awareness of proof, but not details) and application; ps5q4, ps5q5, ps5q6, ps5q8
- Green's Identities: defn and derivation from the divergence theorem; ps5q10.