MA2VC, Vector Calculus, Assignment 2

due: 12pm on the 18th of Nov 2011 (late assignments will not be accepted)

1a) (3 marks) Calculate the derivative $\frac{df}{dt}$ of the scalar field, $f(\mathbf{r}) = e^{xyz}$, along the path $\mathbf{r}(t) = t\hat{\mathbf{i}} + t\hat{\mathbf{j}} + t^2\hat{\mathbf{k}}$.
1b) (2 marks) Calculate the change in the scalar field, Δf, in going from $t = 1$ to $t = 1.01$, and then estimate it using the derivative $\frac{df}{dt}$.

2a) (4 marks) Calculate the vector field, $\mathbf{F}(\mathbf{r}) = \nabla\phi(\mathbf{r})$, for the potential $\phi(\mathbf{r}) = 1/r$.
2b) (1 mark) Determine the line integral $\int \mathbf{F} \cdot d\mathbf{r}$ from (1,1,0) to (2,2,0) using the change in the potential.
2c) (4 marks) Explicitly calculate $\int \mathbf{F} \cdot d\mathbf{r}$ along the straight path from (1,1,0) to (2,2,0).
2d) (6 marks) Explicitly calculate $\int \mathbf{F} \cdot d\mathbf{r}$ along the 2 straight-line segments from (1,1,0) to (1,2,0) to (2,2,0).