Question 1.

- (a) What is a vector field?
- (b) Give a few examples that have real, or physical, meanings. For each, think about whether the divergence or curl represent anything particular.

Question 2.

- (a) What is a conservative vector field? Give at least two characterizations.
- (b) How can we determine whether \mathbf{F} is conservative?

Question 3.

- (a) How do you evaluate $\int_{\mathcal{C}} f(x, y, z) \, ds$?
- (b) How do you evaluate $\int_{\mathcal{C}} \mathbf{F}(x, y, z) \cdot d\mathbf{r}$?
- (c) In each case, what is C?
- (d) Can you think of any tricks that might help evaluate (a) or (b) in special cases?

Question 4.

Think of a few examples where $\int_{\mathcal{C}} f(x, y, z) \, ds$ or $\int_{\mathcal{C}} \mathbf{F}(x, y, z) \cdot d\mathbf{r}$ have a real or physical meaning.

Question 5.

- (a) How do you evaluate $\iint_S f(x, y, z) dS$?
- (b) How do you evaluate $\iint_{S} \mathbf{F}(x, y, z) \cdot d\mathbf{S}$?
- (c) In each case, what is S?
- (d) Can you think of any tricks that might help evaluate (a) or (b) in special cases?

Question 6.

Think of a few examples where $\iint_S f(x, y, z) \, dS$ or $\iint_S \mathbf{F}(x, y, z) \cdot d\mathbf{S}$ have a real or physical meaning.

Question 7.

State each of the following Theorems:

- (a) The fundamental theorem of calculus
- (b) The fundamental theorem for line integrals
- (c) Green's Theorem
- (d) Stokes' Theorem
- (e) The divergence theorem

Question 8.

Can you describe a common theme that links the 5 theorems in the previous question?

Question 9.

- (a) A question asks you to find $\int_{\mathcal{C}} \mathbf{F}(x, y, z) \cdot d\mathbf{r}$. If $\operatorname{curl}(\mathbf{F}) \neq \mathbf{0}$, can we use the fundamental theorem for line integrals?
- (b) A question asks you to find $\iint_{S} \mathbf{F}(x, y, z) \cdot d\mathbf{S}$. If div $(\mathbf{F}) \neq \mathbf{0}$, can we use Stokes' Theorem? If S is a closed surface, can we us the divergences theorem?