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 $\mathcal{C}$?

(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 $\text{curl}(\mathbf{F}) \neq \mathbf{0}$, 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 $\text{div}(\mathbf{F}) \neq \mathbf{0}$, can we use Stokes' Theorem? If S is a closed surface, can we us the divergences theorem?