INSTRUCTIONS: Solve 6 of the 7 problems; choose one problem to skip and put a big **X** in the corresponding box below. If you do not indicate which problem you are choosing to skip, I will assume that I should skip problem 7, which may hurt your grade. Show your work: even correct answers may receive little or no credit if a method of solution is not shown. You do not need to simplify your solutions. Graphing calculators, notes, cell phones, and other materials are not permitted.

Name:							
1	2	3	4	5	6	7	Total

Theorems

Green's (general): $\oint_C P dx + Q dy = \iint_R \frac{\partial Q}{\partial x} - \frac{\partial P}{\partial y}\, dA$

Green's (circulation): $\oint_C \mathbf{F} \cdot d\mathbf{r} = \iint_R \frac{\partial g}{\partial x} - \frac{\partial f}{\partial y}\, dA$

Green's (flux): $\oint_C \mathbf{F} \cdot \mathbf{n}\, ds = \iint_R \frac{\partial f}{\partial x} + \frac{\partial g}{\partial y}\, dA$

Stokes': $\oint \mathbf{F} \cdot d\mathbf{r} = \iint_S (\nabla \times \mathbf{F}) \cdot \mathbf{n}\, dS$

Divergence: $\iint_S \mathbf{F} \cdot \mathbf{n}\, dS = \iiint_D \nabla \cdot \mathbf{F}\, dV$

Test for conservative v.f.: $\mathbf{F}$ is conservative if and only if curl$\mathbf{F} = 0$

Fundamental theorem of line integrals: if $\mathbf{F}$ is conservative, then $\int_C \mathbf{F} \cdot d\mathbf{r} = \varphi(B) - \varphi(A)$

Definitions

Curl (3-d): $\text{curl}\mathbf{F} = \nabla \times \mathbf{F} = \left\langle \frac{\partial h}{\partial y} - \frac{\partial g}{\partial z}, \frac{\partial f}{\partial z} - \frac{\partial h}{\partial x}, \frac{\partial g}{\partial x} - \frac{\partial f}{\partial y} \right\rangle$

Curl (2-d): $\text{curl}\mathbf{F} = \frac{\partial g}{\partial x} - \frac{\partial f}{\partial y}$

Divergence (3-d): $\text{div}\mathbf{F} = \nabla \cdot \mathbf{F} = \frac{\partial f}{\partial x} + \frac{\partial g}{\partial y} + \frac{\partial h}{\partial z}$

Divergence (2-d): $\text{div}\mathbf{F} = \nabla \cdot \mathbf{F} = \frac{\partial f}{\partial x} + \frac{\partial g}{\partial y}$

Line integrals

Scalar: $$\int_C f\ ds = \int_a^b f(\mathbf{r}(t))\left|\mathbf{r}'(t)\right| dt$$

Circulation/work: $$\int_C \mathbf{F}\cdot d\mathbf{r} = \int_C f dx + g dy = \int_a^b \mathbf{F}(\mathbf{r}(t))\cdot\mathbf{r}'(t)\ dt$$

Flux: $$\int_C \mathbf{F}\cdot\mathbf{n}\ ds = \int_C f dy - g dx = \int_a^b \left[f(\mathbf{r}(t))y'(t) - g(\mathbf{r}(t))x'(t)\right]\ dt$$

Surface integrals

Scalar: $$\iint_S f\ dS = \iint_R f(\mathbf{r}(u,v))\left|\mathbf{t}_u \times \mathbf{t}_v\right|\ dA$$

Scalar for $z = z(x,y)$: $$\iint_S f\ dS = \iint_R f(x,y,z(x,y))\sqrt{z_x^2 + z_y^2 + 1}\ dA$$

Flux: $$\iint_S \mathbf{F}\cdot\mathbf{n}\ dS = \iint_R \mathbf{F}\cdot(\mathbf{t}_u \times \mathbf{t}_v)\ dA$$

Flux for $z = z(x,y)$: $$\iint_S \mathbf{F}\cdot\mathbf{n}\ dS = \iint_R \mathbf{F}\cdot\langle -z_x, -z_y, 1\rangle\ dA = \iint_R (-f z_x - g z_y + h)\ dA$$

Integration formulas from Ch. 13

Applications	Translations		Differentials
$A = \iint_R dA$	Rectangular → Cylindrical	Rectangular → Spherical	$dV = \ldots$
$V = \iint_R f(x,y)\ dA$	$x = r\cos\theta$	$x = \rho\sin\varphi\cos\theta$	$dx\ dy\ dz$
$m = \iint_R f(x,y)\ dA$	$y = r\sin\theta$	$y = \rho\sin\varphi\sin\theta$	$r\ dz\ dr\ d\theta$
$V = \iiint_S dV$	$z = z$	$z = \rho\cos\varphi$	$\rho^2\sin\varphi\ d\rho\ d\varphi\ d\theta$
$m = \iiint_S f(x,y,z)\ dV$	$x^2 + y^2 = r^2$	$x^2 + y^2 + z^2 = \rho^2$	