1. Section 14.1, Page 1017, questions 1-6.
1. (c) 2. (d) 3. (b) 4. (e) 5. (a) 6. (f)

2. Section 14.1, Page 1017, question 38.

$\mathbf{F}(x,y) = 3x^2y^2\mathbf{i} + 2x^3y\mathbf{j}$

$\frac{\partial}{\partial y}(3x^2y^2) = (3x^2)(2y) = 6x^2y$

$\frac{\partial}{\partial x}(2x^3y) = (y)(6x^2) = 6x^2y$

$\therefore \mathbf{F}$ is conservative.

$\int 3x^2y^2dx = x^3y^2 + g(y)$

$\int 2x^3ydy = x^3y^2 + h(x)$

By inspection, it is clear that the overall potential function is :

$\boxed{f(x,y) = x^3y^2 + K}$

3. Section 14.1, Page 1018, question 64.

$\mathbf{F}(x,y,z) = \ln(xyz)(\mathbf{i}+\mathbf{j}+\mathbf{k})$

$\text{div}\mathbf{F}(x,y,z) = \frac{\partial}{\partial x}\ln(xyz) + \frac{\partial}{\partial y}\ln(xyz) + \frac{\partial}{\partial z}\ln(xyz) = \frac{yz}{xyz} + \frac{xz}{xyz} + \frac{xy}{xyz} = \frac{xz+xy+yz}{xyz}$

$\text{div}\mathbf{F}(3,2,1) = \frac{(3)(1)+(3)(2)+(2)(1)}{(3)(2)(1)} = \boxed{\frac{11}{6}}$

4. (MAPLE) Section 14.2, Page 1030, question 28.

$Find : \int_C \mathbf{F} \bullet d\mathbf{r}$

$\mathbf{F}(x,y,z) = \frac{x\mathbf{i}+y\mathbf{j}+z\mathbf{k}}{\sqrt{x^2+y^2+z^2}}$

$\mathbf{F}(t) = \frac{t\mathbf{i}+t\mathbf{j}+e^t\mathbf{k}}{\sqrt{t^2+t^2+(e^t)^2}}$

$C : \mathbf{r}(t) = t\mathbf{i} + t\mathbf{j} + e^t\mathbf{k}, \quad 0 \le t \le 2$

$d\mathbf{r} = \mathbf{i} + \mathbf{j} + e^t\mathbf{k}$

$\int_C \mathbf{F} \bullet d\mathbf{r} = \int_0^2 \frac{t\mathbf{i}+t\mathbf{j}+e^t\mathbf{k}}{\sqrt{t^2+t^2+(e^t)^2}} \bullet (\mathbf{i}+\mathbf{j}+e^t\mathbf{k})dt = \int_0^2 \frac{t+t+e^{2t}}{\sqrt{t^2+t^2+(e^t)^2}}dt = \int_0^2 \frac{2t+e^{2t}}{\sqrt{2t^2+e^{2t}}}dt = \boxed{6.911899268}$

5. Section 14.2, Page 1030, question 38.

$Find: \int_C \mathbf{F} \bullet d\mathbf{r}$

$\mathbf{F}(x,y) = x^2 y\mathbf{i} + xy^{3/2}\mathbf{j}$

(a) $\mathbf{r}_1(t) = (t+1)\mathbf{i} + t^2\mathbf{j}, \ 0 \le t \le 2$

$\mathbf{r}_1'(t) = \mathbf{i} + 2t\mathbf{j}$

$\mathbf{F}(t) = (t+1)^2(t^2)\mathbf{i} + (t+1)(t^2)^{3/2}\mathbf{j} = (t^2+2t+1)(t^2)\mathbf{i} + (t+1)(t^3)\mathbf{j} = t^4 + 2t^3 + t^2\mathbf{i} + t^4 + t^3\mathbf{j}$

$\int_C \mathbf{F} \bullet d\mathbf{r} = \int_0^2 (t^4 + 2t^3 + t^2\mathbf{i} + t^4 + t^3\mathbf{j}) \bullet (\mathbf{i} + 2t\mathbf{j})dt = \int_0^2 t^4 + 2t^3 + t^2 + 2t^5 + 2t^4 dt = \int_0^2 2t^5 + 3t^4 + 2t^3 + t^2 dt =$

$[\frac{t^6}{3} + \frac{3t^5}{5} + \frac{t^4}{2} + \frac{t^3}{3}]_0^2 = \frac{2^6}{3} + \frac{3(2)^5}{5} + \frac{2^4}{2} + \frac{2^3}{3} - (\frac{0^6}{3} + \frac{3(0)^5}{5} + \frac{0^4}{2} + \frac{0^3}{3}) = \frac{64}{3} + \frac{96}{5} + 8 + \frac{8}{3} = \frac{320+288+120+40}{15} = \frac{768}{15} = \boxed{\frac{256}{5}}$

(b) $\mathbf{r}_2(t) = (1+2\cos t)\mathbf{i} + (4\cos^2 t)\mathbf{j}, \ 0 \le t \le \pi/2$

$\mathbf{r}_2'(t) = -2\sin t\mathbf{i} + -8\sin t\cos t\mathbf{j}$

$\mathbf{F}(t) = (1+2\cos t)^2(4\cos^2 t)\mathbf{i} + (1+2\cos t)(4\cos^2 t)^{3/2}\mathbf{j} = (1+4\cos t + 4\cos^2 t)(4\cos^2 t)\mathbf{i} + (1+2\cos t)(8\cos^3 t)\mathbf{j}$

$= 4\cos^2 t + 16\cos^3 t + 16\cos^4 t\mathbf{i} + 8\cos^3 t + 16\cos^4 t\mathbf{j}$

$\int_C \mathbf{F} \bullet d\mathbf{r} = \int_0^{\pi/2} (4\cos^2 t + 16\cos^3 t + 16\cos^4 t\mathbf{i} + 8\cos^3 t + 16\cos^4 t\mathbf{j}) \bullet (-2\sin t\mathbf{i} + -8\sin t\cos t\mathbf{j})dt =$

$\int_0^{\pi/2} -8\cos^2 t\sin t - 32\cos^3 t\sin t - 32\cos^4 t\sin t\mathbf{i} - 64\sin t\cos^4 t - 128\sin t\cos^5 t dt =$

$8[\frac{\cos^3 t}{3} + \cos^4 t + \frac{12\cos^5 t}{5} + \frac{8\cos^6 t}{3}]_0^{\pi/2} =$

$8[\frac{\cos^3(\pi/2)}{3} + \cos^4(\pi/2) + \frac{12\cos^5(\pi/2)}{5} + \frac{8\cos^6(\pi/2)}{3} - (\frac{\cos^3(0)}{3} + \cos^4(0) + \frac{12\cos^5(0)}{5} + \frac{8\cos^6(0)}{3})] =$

$-8[\frac{1}{3} + 1 + \frac{12}{5} + \frac{8}{3}] = -8[\frac{5+15+36+40}{15}] = -8[\frac{96}{15}] = -8[\frac{32}{5}] = \boxed{-\frac{256}{5}}$

Since both curves connect (1,0) and (3,4) using the same path, but go in opposite directions, the integrals are additive inverses of the other. In other words, one is the negative of the other.