Difficulty guide for worksheet:	
C-level or B-level exam problem:	1, 2, 3, 5
A-level exam problem or challenge for extra study:	4
beyond the scope and/or removed from syllabus:	none

1. For each part, calculate $\displaystyle\int_{\mathcal{C}} f\,ds$ for the given function f and curve $\mathcal{C}$.

(a) $f(x,y) = xy$; $\mathcal{C}$ is the unit circle

(b) $f(x,y) = x^2 - 2y^2$; $\mathcal{C}$ is the line segment from the origin to the point $(\sqrt{8}, \sqrt{8})$

(c) $f(x,y) = x$; $\mathcal{C}$ is the curve $\boldsymbol{r}(t) = \langle t^3,\ 4t\rangle$ for $0 \le t \le 1$

(d) $f(x,y,z) = y - z$; $\mathcal{C}$ is one turn of the helix $\boldsymbol{r}(t) = \langle 3\cos(t), 3\sin(t), 4t\rangle$ starting from the point $(3,0,0)$

(e) $f(x,y,z) = xz$; $\mathcal{C}$ is the line segment from the origin to $(3,2,6)$ followed by the line segment from $(3,2,6)$ to $(7,9,10)$

2. For each part, calculate $\displaystyle\int_{\mathcal{C}} \boldsymbol{F}\cdot d\boldsymbol{r}$ for the given vector field $\boldsymbol{F}$ and curve $\mathcal{C}$.

(a) $\boldsymbol{F}(x,y) = \langle x, y\rangle$; $\mathcal{C}$ is the portion of the parabola $16y = x^2$ from $(4,1)$ to the origin.

(b) $\boldsymbol{F}(x,y) = \dfrac{\langle x, y\rangle}{(x^2+y^2)^{3/2}}$; $\mathcal{C}$ is the path $\boldsymbol{r}(t) = \langle t^2, 3t^2\rangle$ for $1 \le t \le 2$

(c) $\boldsymbol{F}(x,y,z) = \langle -y, x, z\rangle$; $\mathcal{C}$ is the helix $\boldsymbol{r}(t) = \left\langle 2\cos(t), 2\sin(t), \frac{t}{2\pi}\right\rangle$ for $0 \le t \le 2\pi$

(d) $\boldsymbol{F}(x,y,z) = \langle x+y, x-y, x\rangle$; $\mathcal{C}$ is the line segment from $(1,2,4)$ to $(3,8,13)$

(e) $\boldsymbol{F}(x,y) = \left\langle x^2, xy\right\rangle$; $\mathcal{C}$ is a quarter circle with radius 3 centered at the origin from $(0,3)$ to $(-3,0)$

3. Let $\mathcal{C}$ be the path $\boldsymbol{r}(t) = \langle \cos(t), \tan(t), t\rangle$ for $0 \le t \le \pi/4$. Calculate

$$\int_{\mathcal{C}} \left(z\,dx + x^2\,dy + y\,dz\right)$$

4. A particle travels in the force field $\boldsymbol{F}(x,y,z) = \langle e^z, e^{x-y}, e^y\rangle$ along the piecewise linear path starting from the origin, then to $(0,0,1)$, then to $(0,1,1)$, and ending at $(-1,1,1)$. Calculate the work done by the force field on the particle.

5. Let $\mathcal{C}$ be the curve $y = x^{4/3}$ in the xy-plane from $(1,1)$ to $(8,16)$. Let $\mathcal{R}$ be the sheet that consists of all points below the surface $z = x/y$ and above the curve $\mathcal{C}$. Calculate the area of $\mathcal{R}$.