Difficulty guide for worksheet:	
C-level or B-level exam problem:	1a, 1b, 1c, 1e, 2a, 3, 4, 5
A-level exam problem or challenge for extra study:	1d, 1f, 2b, 6
beyond the scope and/or removed from syllabus:	none

1. Find the volume of each region or type of solid.

(a) the region bounded by the paraboloid $z = x^2 + y^2$ and the cone $z = 2 - \sqrt{x^2 + y^2}$

(b) the region below the surface $z = xy + 10$ and above the annular region $\mathcal{R} = \{(x, y) : 4 \leq x^2 + y^2 \leq 16\}$

(c) the region inside both the cone $\varphi = \frac{\pi}{6}$ and the sphere $\rho = 4$

(d) a spherical cap of radius R and height H

(e) the solid obtained from a sphere centered at the origin with radius 2 after a cylindrical hole of radius 1 is drilled through the center of the sphere perpendicular to its base

(f) the solid bounded by the cylinder $x^2 + y^2 = 1$, the xy-plane, and the plane $z = x + y$

2. Let $\mathcal{D}_1$ be the disk in the xy-plane centered at the origin with radius 2. Let $\mathcal{D}_2$ be the disk in the xy-plane centered at $(2, 0)$ with radius 2. Suppose $g(x, y)$ is continuous for all x and y. Write an iterated integral in polar coordinates for $\iint_{\mathcal{R}} g(x, y)\, dA$, where $\mathcal{R}$ is...

(a) ...the region outside $\mathcal{D}_1$ and inside $\mathcal{D}_2$.

(b) ...the region inside both $\mathcal{D}_1$ and $\mathcal{D}_2$.

3. Calculate $\int_0^5 \int_0^y x\, dxdy$ by changing to polar coordinates.

4. Calculate $\int_0^3 \int_{-\sqrt{9-y^2}}^{\sqrt{9-y^2}} \int_0^{9-3\sqrt{x^2+y^2}} dzdxdy$ by changing to cylindrical coordinates.

5. Let $\mathcal{W}$ be the solid region bounded above by the plane $z = 5$ and bounded below by the cone $z^2 = x^2 + y^2$. Use spherical coordinates to calculate $\iiint_{\mathcal{W}} \sqrt{x^2 + y^2 + z^2}\, dV$.

6. Let $\mathcal{W}$ be the region within the cylinder $x^2 + y^2 = 2$ between the xy-plane and the cone $z = \sqrt{x^2 + y^2}$. Calculate the integral of $f(x, y) = x^2 + y^2$ over $\mathcal{W}$ using...

(a) ...rectangular coordinates.

(b) ...cylindrical coordinates.

(c) ...spherical coordinates.

Which of these do you think is easiest?