18.02 Problem Set 10

Due Thursday 11/15/07, 12:45 pm.

Part A (10 points)

Hand in the underlined problems only; the others are for more practice.

Lecture 27. Thu Nov. 8 **Exam 3 covering lectures 18–26.**

Lecture 28. Fri Nov. 9 Triple integrals in rectangular and cylindrical coordinates.
Read: 12.8 to p. 841; Notes I.3; 14.6 (esp. Examples 1, 2, 3); 14.7 pp. 988–989.
Work: 12.8/ 5, 23; 14.6/ 41; 14.7/ 9, 19; 5A/ 1, 2abcd, 3, 4, 5, 6, 7.

Lecture 29. Tue Nov. 13 Spherical coordinates. Gravitational attraction.
Read: Notes I.4, CV.4, G; 14.7 pp. 990–992.
Work: 12.8/ 9, 11, 15, 27, 55; 5B/ 1abc, 2, 3, 4abc; 5C/ 2, 3, 4.

Part B (16 points)

Directions: Attempt to solve *each part* of each problem yourself. If you collaborate, solutions must be written up independently. It is illegal to consult materials from previous semesters. With each problem is the day it can be done.

Write the names of all the people you consulted or with whom you collaborated and the resources you used.

Problem 1. (immediately, 4 points)

Find the flux of the vector field $\vec{F} = \frac{x}{r^2}\hat{\imath} + \frac{y}{r^2}\hat{\jmath}$ outwards through any circle centered at $(1,0)$ of radius $a \neq 1$. Consider the cases $a > 1$ and $a < 1$ separately. Explain your answers with diagrams.

Optional: use the applet on the course web page to get a better understanding of what happens when a changes from a value lower than 1 to a value greater than 1.

Problem 2. (Friday, 4 points)

Do 14.6/39. (Suggestion: use the order $dx\,dy\,dz$. The numerical answer is in the back of the text. Feel free to check your work using it.)

Problem 3. (Tuesday, 4 points)

The *average value* of $f(x,y,z)$ over a region D in space is

$$\frac{1}{V(D)}\iiint_D f(x,y,z)\,dV, \quad V(D) = \text{ volume of } D$$

Set up the integral *both* in cylindrical and spherical coordinates for the average distance from a point in the solid sphere of radius a to a point on the surface, and evaluate both integrals. Put the point on the surface at the origin and make it the South Pole of the sphere.

Problem 4. (Tuesday, 4 points) Notes 5C/5.