Math 53 Homework 2

Due Wednesday 2/3/16 in section

(The problems in parentheses are for extra practice and optional. Only turn in the underlined problems.)

Monday 1/25 – Polar coordinates continued

- **Read:** section 10.4.
- **Work:** 10.4: (5), 7, 23[1], (31), 35, (41), (45), 47.
- **Bonus problem** (extra credit, hard): p. 692 problem 4. (Hint: look at 10.3 #77).[2]

Wednesday 1/27 – Vectors, dot product

- **Read:** sections 12.1, 12.2, 12.3.
- **Work:** 12.1: (7), (9), (13), 15, (23), (29), 37, 45.[3]

  12.2: (3), (5), (17), (19), (25), (29), 33, (35), (43), 45, 51.[4]

Friday 1/29 – Dot product continued; determinant

- **Read:** section 12.3.
- **Work:** 12.3: (1), (11), (17), 23[5], 25, (27).

  12.3: (38), (39), (41), (49), 55, 60, 63, (64).[6]

  Problem 1 below.

Problem 1. The eight vertices of a cube centered at $(0, 0, 0)$ of side length 2 are at $(\pm 1, \pm 1, \pm 1)$.

a) Find the four vertices of the cube, starting with $(1, 1, 1)$, that form a regular tetrahedron. Confirm your answer by finding the length of an edge and explaining why all edges have the same length.

(Recall: a tetrahedron is a solid with four triangular faces, like a pyramid with a triangular base; it is *regular* if all faces are equilateral triangles. Draw pictures and look at cubical objects in order to figure out how equilateral triangles fit on a cube).

b) Use dot product to find the angle between two adjacent edges (edges sharing a common vertex) of the regular tetrahedron; and the angle between two opposite edges (edges that lie on skew lines; even though they don't intersect, you can still compute the angle made by their directions). Explain your answers using symmetry.

c) A methane molecule CH_4 consists of a hydrogen atom at each of the vertices of a regular tetrahedron and a carbon atom at the center. Find the "bond angle", i.e. the angle made by vectors from the carbon atom to two hydrogen atoms (use a calculator; round your answer).

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[1] **6th and 7th eds:** do the 8th ed problem: $r = 4\sin\theta$, $r = 2$.

[2] **6th ed:** p. 672 problem 4; look at 10.3 # 83. **7th ed:** p. 688 problem 4; look at 10.3 # 77.

[3] **6th ed:** 12.1: (5), (7), (11), 13, (21), (27), 31, 39. **7th ed:** 12.1: (5), (7), (11), 13, (21), (27), 33, 41.

[4] **6th ed:** 12.2: (3), (5), (15), (17), (23), (25), 29, (31), (37), 39, 45. **7th ed:** same as 8th ed.

[5] **6th and 7th ed:** do the 8th ed problem: (a) $\mathbf{a} = \langle 9, 3\rangle$, $\mathbf{b} = \langle -2, 6\rangle$. (b) $\mathbf{a} = \langle 4, 5, -2\rangle$, $\mathbf{b} = \langle 3, -1, 5\rangle$. (c) $\mathbf{a} = -8\hat{\imath} + 12\hat{\jmath} + 4\hat{k}$, $\mathbf{b} = 6\hat{\imath} - 9\hat{\jmath} - 3\hat{k}$. (d) $\mathbf{a} = 3\hat{\imath} - \hat{\jmath} + 3\hat{k}$, $\mathbf{b} = 5\hat{\imath} + 9\hat{\jmath} - 2\hat{k}$.

[6] **6th ed:** 12.3: (34), (35), (37), (45), 51, 56, 59, (60). **7th ed:** same as 8th ed.