Math 10C, August-2021.
HOMEWORK ASSIGNMENT

During the course, the HW assignment may be slightly changed. ***Please, watch the current assignment***.

1. **2.1**: 1, 7,8, 9, 11, 13, 15, 21, 25, 29.

   2.2: 63, 65, 66, 67, 71, 75, 77, 83, 9192, 99, 101.

   A1. In **all** problems below regions in $\mathbb{R}^3$ (not in $\mathbb{R}^2$ or $\mathbb{R}$) are specified. Describe each region in words.

   (a) $x^2 + y^2 + z^2 \geq 16.$
   (b) $x^2 + y^2 \geq 16$
   (c) $x^2 + y^2 + z^2 = 0.$
   (d) $x = -3.$
   (e) $3 < y < 5.$
   (f) $3 \leq y \leq 5.$
   (g) $x^2 + 4x + y^2 - 10x + z^2 \geq 1.$

   2.3: 123, 125, 127, 135, 137, 138, 141, 143, 144, 145, 147, 149, 155, 157, 161, 167, 169.

   A2. Which of these two pairs of vectors are orthogonal?

$$(a)\ (3,2,1) \quad , \quad (1,2,-5).$$
$$(b)\ (3,2,1) \quad , \quad (1,2,-7).$$

   A3. Which of these two pairs of lines are orthogonal? (*Hint*: You may solve it in mind.)

$$(a)\ 2x + 3y \ = \ 5, \ \ 3x - 2y = 7.$$
$$(b)\ 5x + 2y \ = \ 5, \ \ 3x - 2y = 7.$$

   2.4: 183, 185, 187, 189, 193, 197, 199, 201, 209, 213, 215, 217.

2. **2.5**: 243, 245, 247, 249, 251, 253, 255, 257, 259, 269, 271, 273, 274, 275, 277, 281, 283.

   3.1: 1, 2, 5, 19, 23.

   A4. Let a vector $\mathbf{a} = (1,2,3)$, a vector function $\mathbf{r}(t)$ satisfies equations $|\mathbf{r}(t)| = 16$, and $\mathbf{r}(t) \cdot \mathbf{a} = 0$. Specify, as much as it is possible, the curve. (In other words, where is it located?)

   3.2: 41, 43, 47, 55, 57, 59, 63, 83, 84, 85, 93.

   A5. Consider a curve $\mathbf{r}(t) = (t, \cos(\pi t), t^2)$.

a) Make sure that the point $(1, -1, 1)$ belongs to the curve.

b) Write an equation of the line tangent to the curve at the point mentioned. (*Advice*: To avoid confusion, for the parameter in the equation of the line, use a symbol different from t; say, s.

c) Now forget about the curve, and find the point at which the tangent line you found intersects the plane $x + y + z = 7$. (*Advice*: First, find the value of parameter s (in the equation of the line you found) for which the corresponding point indeed lies on the plane mentioned.

A6. Consider point $(1, 2, 4)$ and the plane whose equation is $x + y + 2z = 20$. Find the distance between the point and the plane. (*Advice*: We discussed two methods of solving such a problem. Both are not bad; so, select which you like more. (Frankly, I prefer "dropping a perpendicular on the plane", but this does not mean that you should follow it.))

3.4: 155, 157, 159, 161.

A7. A ball was thrown at an angle of 30^o with an initial speed of 10 f/sec.

a) Find a position vector function $\mathbf{r}(t)$.

b) Find the maximal height the ball will attain. (*Hint*: That is, the maximal value of $y(t)$.)

c) Find the time at which the ball will fall on the ground. (*Hint*: That is, the time at which $y(t) = 0$.)

d) Find the position of the ball at the end of the first second.

3. **4.1**: 1, 3, 6, 15, 17, 20, 23, 28, 31, 32, 42, 43, 48, 49.

4.3: 113, 114, 115, 117, 119, 121, 123, 135, 136, 137, 138.

4.4: 163, 165, 167, 171, 174, 175, 179, 183, 185.

4.5 215, 216, 217, 221, 223, 231, 233, 243, 245.

4.6: 261, 263, 267, 281, 283, 285, 287, 291, 297, 298, 299, 300, 301, 302, 303, 304, 305.

A8. Let $f(x, y) = x^3 + xy^2 - 100$.

a) Find the gradient of f at point $P(1, -2)$.

b) Find the directional derivative of f at the direction of vector $\mathbf{v} = (2, 1)$.

c) Find the direction at which $f(x, y)$ starting from point P increases fastest (most rapidly)? What is the corresponding maximum increase rate?

d) Find the direction at which $f(x, y)$ starting from point P decreases fastest (most rapidly)? What is the corresponding maximum decrease rate? (*Hint*: The answer should be positive (just a decrease rate)).

e) Compare the answer in Problem b) and the second answer in Problem c). Which is greater? Why?

A9. Consider planes whose equations are $2x - y + 2z = 5$ and $3x - y + 3z = 7$, respectively.

a) To which plane (or both) does the point $P(1, -1, 1)$ belong?

b) Write parametric equations of the line at which these two planes intersect. (Hint: You can set $z = t$, $x = x(t)$, and $y = y(t)$.)

c) Find the directional vector of this line.

d) Does the point P you considered in a) belong to the line you found?

e) Rewrite the equations for the line for the case where point P plays the role of an "initial" point.

f) Write the equations for a plane that orthogonal to the intersection line and goes through point P.

g) Draw (imagine) a picture.

Due to August 27.

4. **4.7**: 310, 311, 313, 315, 317, 318, 319, 321, 323, 331, 340.

   4.8: 358, 359, 365, 369, 371, 373. 376.

   Due to .

5. **5.1**: 11, 13, 15, 17, 19, 25, 26, 31, 36.

   5.2: 60, 63, 67, 69, 80-83, 85.

   A10. Let a set D be a triangle with vertices $(0, 1), (2, 1), (0, 2)$. Find

$$\iint_D xe^y dA.$$