

Test 1A – MA 225 – Spring 2015

February 13, 2015

---

---

Name: \_\_\_\_\_ BU ID: \_\_\_\_\_

Discussion section (circle one):

A2: W 12-1, A3: W 3-4, A4: W 4-5, A5: Th 830-930, A6: Th 930-1030

---

---

Instructions: Please write clearly and **show all work**. **If an answer is not justified, no points will be awarded**. Points may be deducted for messy, unclear, or poorly explained work. Books, notes, and calculators are NOT permitted during this exam.

---

---

Do not write in the following box.

| Problem                 | Possible | Score |
|-------------------------|----------|-------|
| Name, BU ID, discussion | 2        |       |
| 1                       | 20       |       |
| 2                       | 20       |       |
| 3                       | 18       |       |
| 4                       | 20       |       |
| 5                       | 20       |       |
| Total                   | 100      |       |

---

**Question 1 [20 points]** Let

$$\mathbf{u} = \langle 2, -1, 3 \rangle, \quad \mathbf{v} = \langle 4, 5, 0 \rangle, \quad \mathbf{w} = \langle 1, -1, -4 \rangle$$

be vectors in  $\mathbb{R}^3$ . For each of the following, if the quantity makes sense, compute it. If it does not make sense, explain why.

(i)  $(2\mathbf{u}) \cdot \mathbf{v}$

(ii)  $(\mathbf{u} - \mathbf{v}) \times \mathbf{w}$

(iii)  $\mathbf{u} \times (\mathbf{v} \cdot \mathbf{w})$

(iv)  $|\mathbf{w}|$



---

**Question 3 [18 points]**

- (i) Give a geometric description of the set of points  $(x, y, z)$  that satisfy

$$x^2 + y^2 + z^2 - 4x + 6z \geq 10.$$

- (ii) Write down an equation describing the plane that is parallel to the  $xz$ -plane and that contains the point  $(-3, 2, -8)$ .

- (iii) Describe the set of all vectors whose projection onto the unit coordinate vector  $\mathbf{k}$  is zero, and draw a picture of the collection of all such vectors.

---

**Question 4 [20 points]**

(i) Find an equation of the line containing the points  $(0, 2, 3)$  and  $(1, -4, 2)$ .

(ii) Sketch the curve described by the following function and describe in words all key aspects of your picture.

$$\mathbf{r}(t) = \langle 2 \cos 3t, e^t, 2 \sin 3t \rangle, \quad -\infty < t < \infty$$

---

**Question 5 [20 points]**

- (i) A fish in the water is climbing at an angle of 60 degrees above the horizontal with a heading to the southeast. If its speed is 2 mi/hr, find the three components of its velocity vector.

- (ii) Suppose a projectile begins at the point  $(0, 3, 4)$  with an initial velocity vector of  $\langle 1, 2, 3 \rangle$ . If its acceleration is given by

$$\mathbf{a}(t) = \langle t, e^{-t}, 2 \rangle,$$

find the velocity and position vectors for  $t \geq 0$ .