1. The dot product of two vectors is always orthogonal (perpendicular) to the plane through the two vectors.
   a. True
   b. False

2. The vectors \( \mathbf{a} \) and \( \mathbf{b} \) lie flat on the page and point in the directions indicated below:

   \[ \mathbf{a} \quad \mathbf{b} \]

   Which of the following is true?
   a. \( \mathbf{a} \cdot \mathbf{b} = 0 \)
   b. \( \mathbf{a} \times \mathbf{b} = 0 \)
   c. \( \mathbf{a} \cdot \mathbf{b} < 0 \)
   d. \( \mathbf{a} \cdot \mathbf{b} > 0 \)
   e. None of these

3. Given points \( P(2, -1, 3) \), \( Q(4, 1, -1) \) and \( R(-3, 0, 5) \), find the area of triangle \( PQR \).
   a. \( \frac{\sqrt{139}}{2} \)
   b. \( 4\sqrt{29} \)
   c. \( 2\sqrt{29} \)
   d. \( \frac{\sqrt{149}}{2} \)
   e. None of these

4. What is the volume of the parallelepiped with sides: \( \mathbf{a} = \mathbf{i} - 3\mathbf{j} + \mathbf{k}, \quad \mathbf{b} = 2\mathbf{j} - \mathbf{k}, \quad \mathbf{c} = \mathbf{i} + \mathbf{j} - 2\mathbf{k} \)
   a. 2
   b. 4
   c. 6
   d. 7
   e. None of these
5. If \( \mathbf{a} \) and \( \mathbf{b} \) are vectors such that \( \mathbf{a} \cdot \mathbf{b} = 0 \) and \( \mathbf{a} \times \mathbf{b} = \mathbf{0} \) then
   a. \( \mathbf{a} = \mathbf{0} \) and \( \mathbf{b} = \mathbf{0} \)
   b. only \( \mathbf{a} = \mathbf{0} \)
   c. only \( \mathbf{b} = \mathbf{0} \)
   d. at least one of \( \mathbf{a} \) and \( \mathbf{b} \) is \( \mathbf{0} \)

6. Which of the following DOESN’T make sense?
   a. \( \mathbf{a} \times (\mathbf{b} \times \mathbf{c}) \)
   b. \( \mathbf{a} \times (\mathbf{b} \cdot \mathbf{c}) \)
   c. \( \mathbf{a} \cdot (\mathbf{b} \times \mathbf{c}) \)
   d. \( \mathbf{a} \times ((\mathbf{b} \cdot \mathbf{c})\mathbf{d}) \)
   e. all are okay

7. A direction vector for the line \( \frac{x - 4}{-2} = \frac{y + 3}{5} = z - 1 \) is
   a. \( \mathbf{d} = (-2, 5, 1) \)
   b. \( \mathbf{d} = (4, -3, 1) \)
   c. \( \mathbf{d} = (-2, 5, 0) \)
   d. \( \mathbf{d} = (2, -5, -1) \)
   e. None of the above

8. Find the distance from the point \( P(2, -1, 4) \) to the line \( \ell : x = 1 + 3t, \ y = 4 - 2t, \ z = -2 + t \)
   a. \( \frac{10}{\sqrt{14}} \)
   b. \( \frac{\sqrt{110}}{\sqrt{14}} \)
   c. \( \frac{5}{\sqrt{14}} \)
   d. \( \frac{\sqrt{507}}{\sqrt{14}} \)
   e. None of the above
9. Symmetric equations for the line that passes through \(P(2, -1, 4)\) and is parallel to the line \(\mathbf{r}(t) = (3, 7, 2) + t(3, 4, -6)\) are:
   a. \(\frac{x+2}{3} = \frac{y-1}{4} = \frac{z+4}{-6}\)
   b. \(\frac{x-2}{3} = \frac{y+1}{4} = \frac{z-4}{-6}\)
   c. \(\frac{x-3}{3} = \frac{y-7}{4} = \frac{z-2}{-6}\)
   d. \(x = 2 + 3t, y = -1 + 4t, z = 4 - 6t\)
   e. None of the above

10. The lines \(\ell_1 : x = -2 + 4t, y = 3 - 2t, z = 3 + 6t\) and \(\ell_2 : x = 6 - 2s, y = -1 + s, z = 3 - 3s\) are
    a. Have a unique point of intersection
    b. Coincident
    c. Parallel but not coincident
    d. Skew
    e. None of the above

11. The lines \(\ell_1 : \frac{x+2}{4} = \frac{y-3}{-2} = \frac{z-3}{6}\) and \(\ell_2 : x = 1 + 3s, y = -1 + 2s, z = 4 + s\) are
    a. Have a unique point of intersection
    b. Coincident
    c. Parallel but not coincident
    d. Skew
    e. None of the above

12. The lines \(\ell_1 : \mathbf{r}(t) = (3i + 4j + 7k) + t(-i + 3j + 2k)\) and \(\ell_2 : \mathbf{R}(u) = (i - j + 4k) + u(3i + 2j + k)\) are
    a. Have a unique point of intersection
    b. Coincident
    c. Parallel but not coincident
    d. Skew
    e. None of the above

13. One of the problems 10 – 12 above has a unique point of intersection. That point of intersection is:
    a. \((2, 1, 9)\)
    b. \((1, -1, 0)\)
    c. \((4, 1, 5)\)
    d. \((4, -1, 9)\)
    e. None of the above
14. The cosine of the angle between the lines \( \ell_1 : \frac{x+2}{3} = \frac{y-2}{-2} = \frac{z+1}{-2} \) and \( \ell_2 : x = 2 - 3s, y = -4 + s, z = 1 + 4s \) is

a. \( -\frac{19}{\sqrt{26}\sqrt{17}} \)
b. \( \frac{1}{\sqrt{26}\sqrt{17}} \)
c. \( \frac{19}{\sqrt{26}\sqrt{17}} \)
d. \( \frac{15}{\sqrt{26}\sqrt{17}} \)
e. None of these

15. – 20. Choose A
Written Homework 2: (15 points) Print these three pages, work the following problems then scan and upload your answers to CASA under the Assignments tab. Choose whw 2.

1. Section 12.4 #12