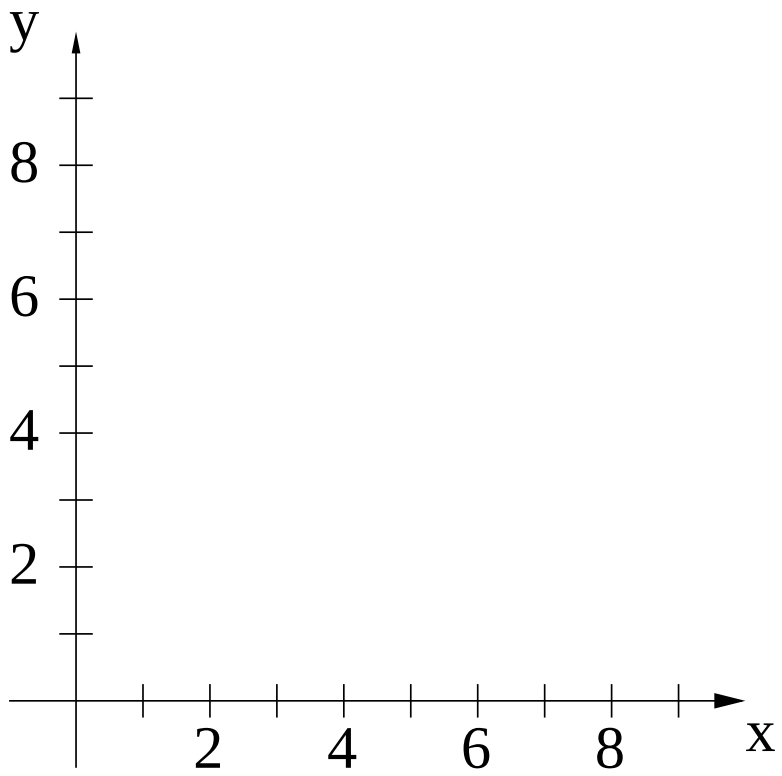
**Name:** _____

1. Consider the vector $\mathbf{v} = \langle 4, 7 \rangle$.

   (a) Sketch and label the *vector* $\mathbf{v} = \langle 4, 7 \rangle$, AND sketch and label the *point* $P = (4, 7)$.

   | 7 pts |
   |---|
   | |




   (b) On your sketch in (1a), draw a representation $\vec{AB}$ of the vector $\mathbf{v} = \langle 4, 7 \rangle$ whose tail is at the point $A = (1, 3)$. Label the coordinates of the tip at the point $B$.

   | 7 pts |
   |---|
   | |

   (c) What is the **exact** component of the vector $\mathbf{v} = \langle 4, 7 \rangle$ in the direction $\langle 5, 1 \rangle$? Illustrate with a sketch on the figure in (1a).

   | 7 pts |
   |---|
   | |

   (d) Notice in figure in (1a), we could put a $z$-axis coming directly up out of the paper to form a right-handed 3-D coordinate system. Using the right-hand rule, determine whether the vector $\langle 4, 7, 0 \rangle \times \langle 5, 1, 0 \rangle$ points in the direction of the positive $z$-axis, the negative $z$-axis, or neither.

   Circle one: **POSITIVE $z$-axis** **NEGATIVE $z$-axis** **NEITHER**

   | 7 pts |
   |---|
   | |

(e) Find a vector $\mathbf{w}$ in the same *direction* as $\mathbf{v} = <4, 7>$ but with *(exact) length 2.* | 7 pts |

2. Consider the two planes given by $x + y + z = 1$ and $x - 2y + 3z = 1$.

(a) State a normal vector to each plane. | 6 pts |

(b) What is the **exact** angle between the two planes? | 7 pts |

**(OVER)**

3. Consider the skew lines given by $x = y = z$ and $x + 1 = y/2 = z/3$.

   (a) State a direction vector for each line.

| 4 pts |
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| |

   (b) Find a vector that is perpendicular to both lines.

| 8 pts |
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| |

   (c) Find parametric equations for the line perpendicular to both of the given lines and passing through the point $(1, -1, 2)$.

| 4 pts |
| --- |
| |

4. Consider the equation $x^2 - y^2 + z^2 - 2x + 2y + 4z + 2 = 0$.

   (a) Reduce the equation to one of the standard forms for a quadric surface.

| 7 pts |
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| |

   (b) Classify the quadric surface, and graph it. Label the axes, and label the center point or vertex with its coordinates.

| 7 pts |
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5. Consider the point $(\rho, \theta, \phi) = (3, 0, \pi)$.

   (a) Plot the point. Remember to label the axes and show the scale.

| 7 pts |
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| |

   (b) Find the coordinates of the point in rectangular coordinates.

| 7 pts |
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| |

6. Sketch the solid given by $r^2 \leq z \leq 2 - r^2$, and describe it fully.

| 8 pts |
|---|
| |