

No calculators, books or notes are allowed on the exam. All electronic devices must be turned off and put away. **You must show all your work** in the blue book in order to receive full credit. A correct answer with no work may not necessarily score any points. Please box your answers and cross out any work you do not want graded. Make sure to sign your blue book. With your signature, you are pledging that you have neither given nor received assistance on the exam. Any violations will be reported to the appropriate dean, and will result in an F for the course.

1. (5 points) Find the length (magnitude) of

$$\langle 2, 4, -\sqrt{5} \rangle$$

2. (8 points) Are  $P : (1, 2, 3)$ ,  $Q : (2, -3, 6)$  and  $R : (3, -1, 9)$  collinear? Show work!

3. (8 points) Let  $\mathbf{u} = \langle 4, 3 \rangle$  and  $\mathbf{v} = \langle 1, 1 \rangle$ . Write  $\mathbf{u} = \mathbf{p} + \mathbf{n}$  where  $\mathbf{p}$  is parallel to  $\mathbf{v}$  and  $\mathbf{n}$  is orthogonal (perpendicular) to  $\mathbf{v}$ .

4. (5 points)  $P$  is the point  $(2, -5)$  and  $l$  is the line  $y = 3x$ . What is the distance between  $P$  and  $l$ ?

5. (8 points)  $P : (1, -4)$   $Q : (2, 7)$   $R : (-2, 2)$ . What is the cosine of  $\widehat{PQR}$ ?

6. (8 points) Find the area of the triangle with vertices  $O : (0, 0, 0)$   $P : (1, 2, 3)$  and  $Q : (6, 2, 4)$

7. (10 points) Do the lines

$$\mathbf{r}(t) = \langle 2 + 2t, 8 + t \rangle \text{ and}$$

$$\mathbf{R}(s) = \langle 6 + s, 10 - 2s \rangle$$

intersect? If so, where?

8. (8 points) Find  $\int_1^4 \langle \sqrt{t}, t^{-3}, -2t^2 \rangle dt$

9. (8 points) If  $\mathbf{r}$  is  $\langle 3 \cos t, 4 \sin t \rangle$ , what is  $\mathbf{v}$ ?  $\mathbf{a}$ ?

10. (10 points) Arc length of  $\left\langle \frac{t^2}{2}, \frac{(2t+1)^{\frac{2}{3}}}{3} \right\rangle$  for  $0 \leq t \leq 2$

11. (8 points) Find the intersection of planes  $Q : x + 2y - z = 1$  and  $R : x + y + z = 1$

12. (5 points) Sketch  $z^2 + 4y^2 - x^2 = 1$

13. (4 points) Find the level curves of

$$z = \sqrt{x^2 + 4y^2} \quad -8 \leq x, y \leq 8$$

14. (5 points) Let  $h(w, x, y, z) = \frac{wz}{xy}$ .

Find  $\frac{\partial h}{\partial w}$  and  $\frac{\partial h}{\partial x}$