

Directions: Do not simplify unless indicated. No calculators are permitted. Show all work as appropriate for the methods taught in this course. Partial credit will be given for any work, words or ideas which are relevant to the problem.

Please put problem 1 on answer sheet 1

1. Given the following data:

$$\begin{aligned} P &= (1, 2, 3) \\ Q &= (4, 10, 2) \\ \bar{a} &= 1\hat{i} + 2\hat{j} - 2\hat{k} \\ \bar{b} &= -3\hat{i} + 2\hat{j} + 1\hat{k} \end{aligned}$$

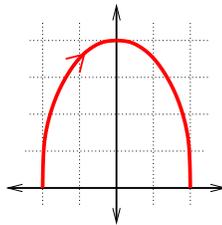
- (a) Find a vector perpendicular to both \overrightarrow{PQ} and \bar{a} . [10 pts]
 (b) Find the projection of \bar{b} onto \bar{a} . [5 pts]
 (c) Find the unit vector in the direction of \overrightarrow{PQ} . [5 pts]

Please put problem 2 on answer sheet 2

2. (a) Find the distance between the point $(3, 2, 1)$ and the plane $2x - 3y + 10z = 20$. Simplify. [12 pts]
 (b) Find the symmetric equation for the line through the points $(2, -1, 4)$ and $(0, 1, 4)$. [8 pts]

Please put problem 3 on answer sheet 3

3. (a) Find the point where the line through $(0, 2, 1)$ and $(3, 4, 5)$ passes through the plane $z = 0$. [6 pts]
 (b) Sketch the VVF $\bar{r}(t) = 2t\hat{i} + (2 - 4t)\hat{j} + t\hat{k}$ for $0 \leq t \leq 2$. Indicate direction. [6 pts]
 (c) Give a parametrization of the oriented semi-ellipse shown here. [8 pts]



Please put problem 4 on answer sheet 4

4. (a) Assuming a and b are positive constants calculate the curvature of the ellipse $\bar{r}(t) = a \cos t \hat{i} + b \sin t \hat{j}$ at $t = \frac{\pi}{2}$. [10 pts]
 (b) Calculate the length of the curve $\bar{r}(t) = 2t\hat{i} + t^2\hat{j} + \ln t\hat{k}$ for $1 \leq t \leq 2$. Simplify. [10 pts]

Please put problem 5 on answer sheet 5

5. (a) Find the position vector satisfying $\bar{a}(t) = 2\hat{i} + 2\hat{j}$, $\bar{v}(0) = 1\hat{i} - 2\hat{j}$ and $\bar{r}(1) = 3\hat{i} + 5\hat{j}$. [13 pts]
 (b) Sketch the plane $x + 2y + 3z = 12$. Label the three intercepts with their coordinates. [7 pts]