

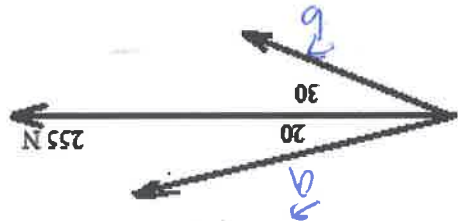
Sample Problems - These are meant to be representative of the level of difficulty of what might be on an exam - it's a small sample, not meant to be an all-inclusive list of problem types.

1. (1 pt each) Given vectors a and b , write the formulas for the following. Use

magnitudes and angles (not components)

a) $\text{comp}_a b = \frac{a \cdot b}{|a|}$
 b) $\text{proj}_a b = \frac{a \cdot b}{|a|^2} \cdot a$

2. A boat is pulled onto shore using 2 ropes as shown, at angles of 20 degrees and 30 degrees from the direction of pulling. If a force of 255 N is needed, find the magnitude of the force in each rope.



$|a| \approx 166 \text{ N}$
 $|b| \approx 114 \text{ N}$

3. Find the distance from the point $(2, 2, 3)$ to the plane $2x + y + 2z = 4$.

$\frac{8}{3}$

4. Find the equation of the plane through points $(3, 0, -1)$, $(-2, -2, 3)$ and $(7, 1, -4)$

$2x - y + 3z - 3 = 0$

5. For the quadric surface $z^2 + 1 = x^2 + y^2$

- hyperboloid, one sheet



a) Name the surface
 b) Draw the traces of the surface
 c) Sketch the surface in \mathbb{R}^3

6. a) Convert the point $(0, -1, \sqrt{3})$ from rectangular to cylindrical and spherical coordinates

$\text{Cyl: } (1, \frac{3\pi}{2}, \sqrt{3})$
 $\text{Sph: } (2, \frac{3\pi}{2}, \frac{\pi}{6})$

b) Find inequalities in spherical coordinates that describe the solid above the xy-plane that lies inside $z = \sqrt{9 - x^2 - y^2}$

$0 \leq \rho \leq 3, 0 \leq \theta \leq 2\pi, 0 \leq \phi \leq \frac{\pi}{2}$

7. Find parametric equations for the line tangent to the curve

$r(t) = (\sqrt{t}, \ln(t), -\frac{1}{t^2+1})$ at the point $(1, 0, -\frac{1}{2})$

$x = 1 + \frac{1}{2}t$
 $y = t$
 $z = -\frac{1}{2} + \frac{1}{2}t$

8. Evaluate the integral $\int_0^{\frac{\pi}{4}} (\sec t \tan t + t \cos 2t + \sin^2 2t \cos 2t) dt$

$(\frac{1}{2} - 1) + \frac{1}{8} + \frac{\pi}{8} + \frac{1}{6} + \frac{1}{2}$

There might be 6 "real" problems rather than 7, depending on the length of the problems.