

Show all work and use pencil only. Write your solutions up neatly on separate sheets of the engineering paper (use the blank side only) and staple this sheet on top. **Do not do your work on this sheet of paper.**

Five (5) points will be deducted if your overall presentation is not neat, clear, and concise. Each problem is worth 4 points.

1. Two trains leave the railroad station at 12:15pm. The first train travels along a straight track at 83 mph. The second train travels at 68 mph along another straight track that makes an angle of  $123.5^\circ$  with the first track. At what time are the trains 525 miles apart? Round your answer to the nearest minute.

2. Suppose that  $\mathbf{u} = \langle u_1, u_2 \rangle$  and  $\mathbf{v} = \langle v_1, v_2 \rangle$  are vectors such that  $|\mathbf{u} + \mathbf{v}|^2 = |\mathbf{u}|^2 + |\mathbf{v}|^2$ . Prove that  $\mathbf{u}$  and  $\mathbf{v}$  are orthogonal.

3. Analytically find the exact cube roots of the following complex number. No decimals. Use radians and be clear.

$$-4\sqrt{2}(1-i)$$

4. Convert  $y^2 - 8x - 16 = 0$  to polar form. Write  $r$  in terms of  $\theta$  and simplify as much as possible.

5. Sketch the curve represented by the parametric equations (indicate the direction of the curve). Then, without using inverse trig functions, eliminate the parameter and write the corresponding rectangular equation whose graph represents the curve.

$$x = \cos t$$

$$y = 2 \sin 2t$$