

Answer the problems on separate paper. You do not need to rewrite the problem statements on your answer sheets. Work carefully. Do your own work. **Show all relevant supporting steps!**

1. (12 pts) Sketch the region bounded between the curves  $y = -x^2 - x + 7$  and  $y = -3x - 8$ . Find the area of that region.
2. Let  $R$  be the region, in the first quadrant, bounded by the curves  $y = x^2 + 2x + 2$ ,  $y = 4x + 10$  and by the  $y$ -axis. Set up, but do **not** evaluate, an integral to compute the volume of the solid of revolution generated by revolving the region  $R$  about the indicated axis of rotation:
  - a. (10 pts) the  $x$ -axis
  - b. (10 pts) the line  $x = 6$
3. (12 pts) Find polar coordinates for each of the intersections points of the polar curves  $r = 2 \cos \theta$  and  $r = 2 - 2 \cos \theta$ .
4. (12 pts) Consider the lemniscate given by  $r^2 = 8 \cos 2\theta$ . Find the total area enclosed by the lemniscate.
5. (12 pts) Find the length of the curve  $y = 8(x - 1)^{3/2}$  from  $x = 2$  to  $x = 5$ .
6. (12 pts) Setup, but do **not** evaluate, an integral to find the surface area generated by revolving the curve  $y = x^2/4 + 2/x^2$  from  $x = 1$  to  $x = 4$  about the  $y$ -axis.
7. (12 pts) Consider a vertical plate in tank filled with water (density  $\rho = 62.4$ ) – see figure to the right. Calculate the fluid force against the face of the vertical plate.
8. (12 pts) Find the  $x$ -coordinate of the centroid of the homogenous planar region in the first quadrant bounded by the curves  $y = 2 + 3x$  and  $y = 18 - 5x$  and the  $y$ -axis.

