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 $y = x^2 - x - 2$ and $y = -2x + 10$.
                 Find the area of that region.

2.   Let R be the region, in the first quadrant, bounded by the curves $y = 3x^2$,
                 $y = -x + 14$ 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 $x = -3$

3. (12 pts)   The polar curves $r^2 = 4\cos 2q$ and $r = \sqrt{2}$ have four distinct intersection points. Find
   polar coordinates for two of the intersections points.

4. (12 pts)   Consider the four-petal rose given by $r = 3\cos 2q$. Find the area in one of the petals.
                 It may help to know the following:

                 $$\int \cos^2 u \ du = \tfrac{1}{2}u + \tfrac{1}{4}\sin 2u + c \qquad\qquad \int \sin^2 u \, du = \tfrac{1}{2}u - \tfrac{1}{4}\sin 2u + c$$

5. (12 pts)   Setup, but do **not** evaluate, an integral to find the length of the curve $y = \sqrt{x-1}$ 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 $y = \dfrac{x}{2} + \dfrac{1}{x}$ from $x = 1$ to $x = 4$ about the y-axis.

7. (12 pts)   Consider a vertical plate in tank filled with water
                 (density $r = 62.4$) – see figure to the right.
                 Calculate the fluid force against the face of the
                 vertical plate.
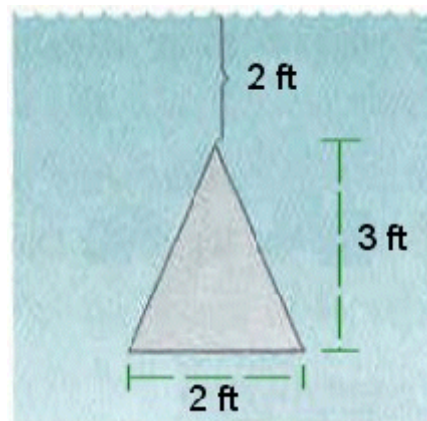
8. (12 pts)   Find the x-coordinate of the centroid of the planar
                 region in the first quadrant bounded by the curves
                 $y = 1 + 3x$ and $y = -3x + 7$ and the y-axis.