1. Identify any intercepts and test for symmetry. Show your work. (8 points)

$$y = -x^2 - 3x$$

X - int

$y = 0 = -x^2 - 3x$

$0 = -x(x+3)$

$\boxed{x = 0, -3}$

y - int

$x = 0$, $y = -0^2 - 3 \cdot 0 = \boxed{0}$

Test for symmetry across y-axis

$f(-x) = -(-x)^2 - 3(-x) = -x^2 + 3x \neq f(x)$

Test for symmetry across x-axis

$-f(x) = -(-x^2 - 3x) = x^2 + 3x \neq f(x)$

Test for symmetry across the origin

$-f(-x) = -((-x)^2 - 3(-x)) = -(x^2 + 3x) = x^2 - 3x \neq f(x)$

$\boxed{\text{Therefore not symmetric}}$

2. Write the slope-intercept form of the equation of the line through the given point and perpendicular to the given line. Show your work. (8 points)

$$(-4, 2) \qquad 2x + 3y = -4$$

$2x + 3y = -4$

$3y = -2x - 4$

$y = -\frac{2}{3}x - \frac{4}{3}$

$m = -\frac{2}{3}$

$m_\perp = -\frac{1}{-\frac{2}{3}} = \frac{3}{2}$

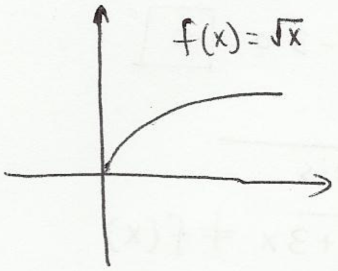
$(y-2) = \frac{3}{2}(x - (-4)) = \frac{3}{2}(x+4)$

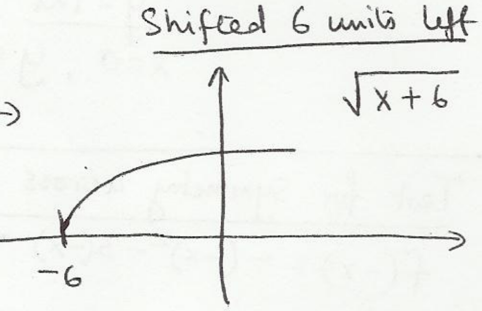
$y - 2 = \frac{3}{2}x + 6$

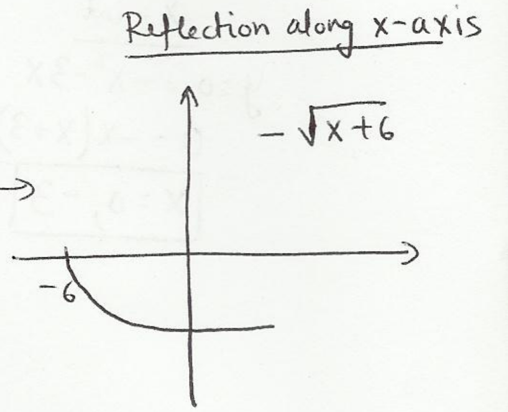
$\boxed{y = \frac{3}{2}x + 8}$

3. Write an equation for the function that is described by the given characteristics. Show your work in each step. (5 points)

The shape of $f(x) = \sqrt{x}$, but shifted six units to the left and reflected along the x-axis.







$$\therefore \boxed{g(x) = -\sqrt{x+6}}$$

4. Verify that f and g are inverse functions. Show your work. (5 points)

$$f(x) = 6x + 5 \qquad\qquad g(x) = \frac{x-5}{6}$$

$$f(g(x)) = \cancel{6}\left(\frac{x-5}{\cancel{6}}\right) + 5$$

$$= x - 5 + 5$$

$$= x$$

$$g(f(x)) = \frac{6x + \cancel{5} - \cancel{5}}{6} = \frac{6x}{6} = x$$

$\therefore$ f and g are inverse functions.

5. Identify the vertex, axis of symmetry of the following quadratic function. Then sketch the graph of the function. Show your work. (8 points)

$$f(x) = x^2 + 2x + 3$$

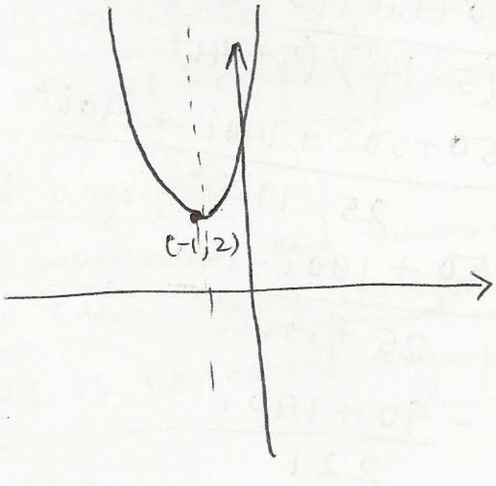
$= (x^2+2x+1) - 1 + 3$

$= (x+1)^2 + 2$

$\therefore$ $h = -1$, $k = 2$

$\therefore$ Vertex : $(-1, 2)$

Axis of symmetry $= \boxed{x = -1}$



6. Perform the operation and write the result in the standard form. Show your work. (8 points)

$$\frac{i}{2-3i}+\frac{3i}{4-i}$$

$$\frac{4i-i^2+6i-9i^2}{(2-3i)(4-i)}$$

$$=\frac{10i-10i^2}{8-12i-2i+3i^2}$$

$$=\frac{10+10i}{5-14i}$$

$$=\frac{(10+10i)(5+14i)}{(5-14i)(5+14i)}$$

$$=\frac{50+50i+140i+140i^2}{25-196i^2}$$

$$=\frac{50+190i-140}{25+196}$$

$$=\frac{-90+190i}{221}$$

$$=\boxed{\frac{-90}{221}+\frac{190}{221}i}$$

7. (a) State the domain of the function, (b) identify all intercepts, (c) find any vertical and horizontal asymptotes, and (d) plot additional points as needed to sketch the graph of the rational function. Show your work. (8 points)

$$f(x) = \frac{x^2}{x^2+9}$$

(a) Domain $= (-\infty, \infty)$

(b) <u>x - int</u>

$y = 0 \Rightarrow \frac{x^2}{x^2+9} = 0$

$\boxed{x = 0}$

<u>y-int</u>

$x = 0$, $f(0) = \frac{0^2}{0^2+9} = 0$

$\boxed{y = 0}$

(c) <u>Vertical asymptote</u>

$x^2 + 9 = 0 \Rightarrow$ No real values of x

$\therefore$ $\boxed{\text{No vertical asymptote}}$

<u>Horizontal asymptote</u>

Since the numerator and denominator have the same degree, therefore

$\boxed{y = 1 \text{ is horizontal asymptote}}$

(d)

x	$f(x)$
-2	$\frac{4}{13} = 0.307$
4	$\frac{16}{25} = 0.64$