Please show all work and **box your final answers**. If you need more room, you may use the backs of the pages. Calculators are not allowed and cellphones should be put away. Good luck!

1. (4 points) Find the x- and y-intercepts of the graph of the equation

$$y^2 - 2xy + 4x = 1.$$

x-INT: $0^2 - 2x(0) + 4x = 1$

$x = \frac{1}{4}$

$\boxed{\text{x-INT } \left(\frac{1}{4}, 0\right)}$

y-INT: $y^2 + 2(0)y + 4(0) = 1$

$y^2 = 1$

$y = \pm 1$

$\boxed{\text{y-INT } (0, -1), (0, 1)}$

2. (4 points) Give an equation for the circle with center $(5, -1)$ and radius 2.

$$\boxed{(x-5)^2 + (y+1)^2 = 2^2}$$

3. (6 points) Find the center and radius of the circle with the equation

$$x^2 + y^2 + 4x - 6y = 23.$$

$$x^2 + 4x + \left(\frac{4}{2}\right)^2 + y^2 - 6y + \left(\frac{-6}{2}\right)^2 = 23 + \left(\frac{4}{2}\right)^2 + \left(\frac{-6}{2}\right)^2$$

$$\underbrace{x^2 + 4x + 4} + \underbrace{y^2 - 6y + 9} = 23 + 4 + 9$$

$$(x+2)^2 + (y-3)^2 = 36$$

$$\boxed{\begin{array}{l} \text{CENTER: } (-2, 3) \\ \text{RADIUS: } \sqrt{36} = 6 \end{array}}$$

4. (4 points) Find the slope of the line that passes through the points $(-1, 2)$ and $(4, -3)$.

$$(x_1, y_1) \quad (x_2, y_2)$$

$$\text{SLOPE } m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-3 - 2}{4 - (-1)} = \frac{-5}{5} = \boxed{-1}$$

5. Give an equation for the line that passes through the point $(3, -1)$ and is...

(a) (4 points) horizontal.

$$\boxed{y = -1}$$

(b) (4 points) vertical.

$$\boxed{x = 3}$$

(c) (4 points) perpendicular to the line $2x + 5y + 8 = 0$.

$$5y = -2x - 8$$

$$y = -\frac{2}{5}x - \frac{8}{5}$$

$$\uparrow$$

$$\text{SLOPE } -\frac{2}{5}$$

$$\text{PERPINDICULAR SLOPE} = -\left(-\frac{2}{5}\right)^{-1} = \frac{5}{2}$$

$$\text{Point Slope Formula: } y - y_1 = m(x - x_1) \longrightarrow \boxed{y - (-1) = \frac{5}{2}(x - 3)}$$

$$\text{OR}$$

$$\boxed{y = \frac{5}{2}x - \frac{17}{2}}$$

6. (8 points) Find the domain of the function

$$g(x) = \frac{\sqrt{2+x}}{x^2 - 3x}.$$

·) $2 + x \geq 0$

   $x \geq -2$ *

·) $x^2 - 3x \neq 0$

   $x(x-3) \neq 0$

   $x \neq 0$ *

   $x \neq 3$ *

$$\boxed{[-2,0) \cup (0,3) \cup (3, \infty)}$$

7. (8 points) Let $f(x) = \frac{2x}{x-1}$. Find and simplify the difference quotient $\frac{f(a+h) - f(a)}{h}$.

$$\frac{\dfrac{2(a+h)}{a+h-1} - \dfrac{2a}{a-1}}{h} = \frac{1}{h}\left[\frac{2(a+h)(a-1) - 2a(a+h-1)}{(a+h-1)(a-1)}\right]$$

$$= \frac{2a^2 - 2a + 2ah - 2h - 2a^2 - 2ah + 2a}{h(a+h-1)(a-1)}$$

$$= \frac{-2h}{h(a+h-1)(a-1)} = \boxed{\frac{-2}{(a+h-1)(a-1)}}$$

8. (8 points) Graph the following piecewise defined function on the axes below.

$$f(x) = \begin{cases} x+7 & \text{if } x \leq -2 \\ x^2 & \text{if } -2 < x \leq 1 \\ 2 & \text{if } 1 < x \end{cases}$$
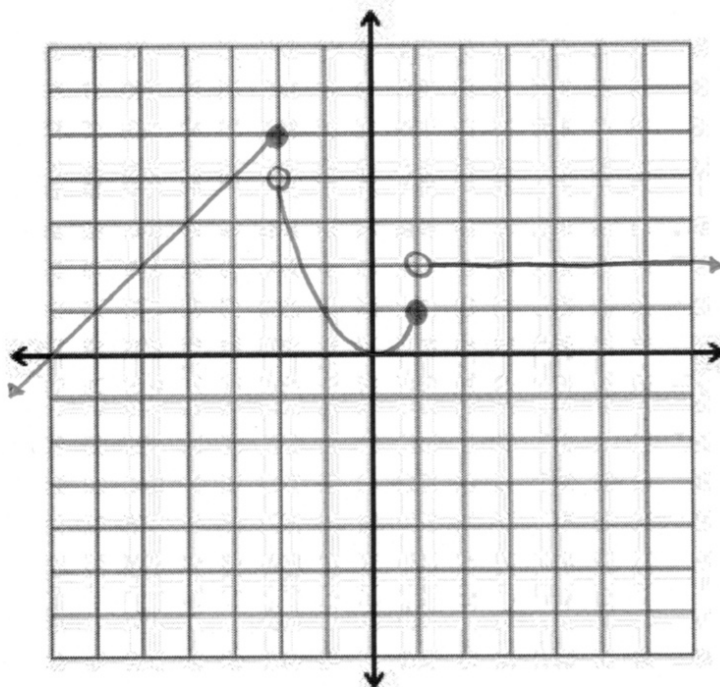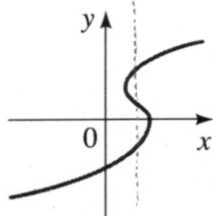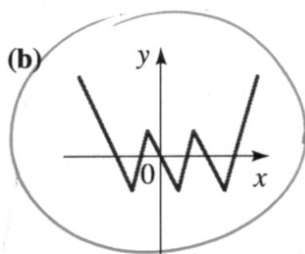

Figure 1: $y = f(x)$

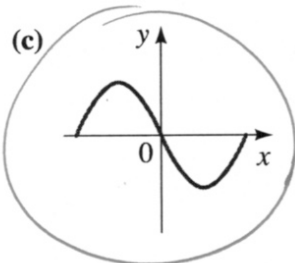9. (4 points) Circle the curves below that are the graph of a function of x.

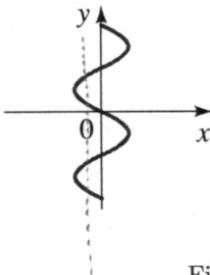(a) $\&$ (d) FAIL THE VERTICAL LINE TEST.

Figure 2: