$f(x) = -4x + x^2 - 3$

$f(x) = ax^2 + bx + c$

$a = 1 \quad b = -4 \quad c = -3$

opens up
minimum

min = -7

D $\Rightarrow$ $\mathbb{R}$

R $\Rightarrow$ $y \geq -7$

Axis of symmetry

$$x = \frac{-b}{2a} = \frac{-(-4)}{2(1)} = \frac{4}{2} = 2$$

$x = 2$

Vertex $(2, -7)$

$$f(x) = -4x + x^2 - 3$$
$$= -4(2) + (2)^2 - 3$$
$$= -8 + 4 - 3$$
$$= -7$$

$$f(x) = -\frac{1}{2}x^2 + 3 - 2x$$

$a = -\frac{1}{2}$ $b = -2$ $c = 3$

Axis of symmetry

$$x = \frac{-b}{2a} = \frac{-(-2)}{2\left(-\frac{1}{2}\right)} = \frac{2}{-1} = -2$$

$\boxed{x = -2}$

Vertex $(-2, 5)$

$$f(x) = -\frac{1}{2}x^2 + 3 - 2x$$

$$= -\frac{1}{2}(-2)^2 + 3 - 2(-2)$$

$$= -\frac{1}{2}(4) + 3 - 2(-2)$$

$$= -2 + 3 + 4 = 5$$

$$f(x) = -\frac{1}{2}x^2 + 3 - 2x$$

$a = -\frac{1}{2}$ $b = -2$ $c = 3$

opens down maximum

max value $y = 5$

Domain $\Rightarrow \mathbb{R}$

Range $\Rightarrow y \leq 5$

$$f(x) = -3 + 5x^2 - 10x$$

$f(x) = ax^2 + bx + c$

$a = 5 \quad b = -10 \quad c = -3$

Find Axis of symmetry

$$X = \frac{-b}{2a} = \frac{-(-10)}{2(5)} = \frac{10}{10} = 1$$

$X = 1$

$$f(x) = -3 + 5x^2 - 10x$$

Vertex

$(1, -8)$

$$= -3 + 5(1)^2 - 10(1)$$
$$= -3 + 5(1) - 10(1)$$
$$= -3 + 5 - 10$$
$$= -8$$

$a = 5 \quad b = -10 \quad c = -3$

Opens up

minimum

$y = -8$

Domain $\rightarrow \mathbb{R}$

Range $\rightarrow y \geq -8$