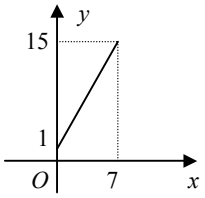
1 **a** 4 **b** 2 **c** 11 **d** -2 **e** -4 **f** -2
g $\frac{2}{5}$ **h** -3 **i** $\frac{5}{4}$ **j** -8 **k** -4 **l** $\frac{12}{13}$

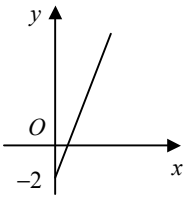
2 **a** $= \sin \pi$ $= 0$ **b** $= \ln 2$ $= 0.693$ **c** $= 5$ **d** $= \sin \frac{2\pi}{3}$ $= \frac{\sqrt{3}}{2}$ or 0.866 **e** $= 3 + 2e^{-1}$ $= 3.74$ **f** $= \ln \frac{9}{2}$ $= 1.50$
g $= 3 + 2e^{1.8}$ $= 15.1$ **h** $= \ln 1$ $= 0$ **i** $= \sin(0.6 + \frac{\pi}{3})$ $= 0.997$ **j** $= 3 + 2e^{\frac{1}{3}}$ $= 5.79$ **k** $= \sin(\frac{\pi}{3} - 2)$ $= -0.815$ **l** $= \ln \frac{23}{4}$ $= 1.75$

3 **a**



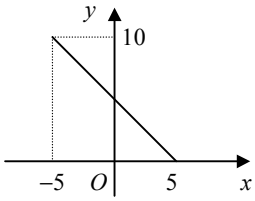
range: $1 \le f(x) \le 15$

b



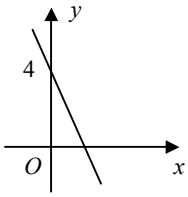
range: $f(x) \ge -2$

c



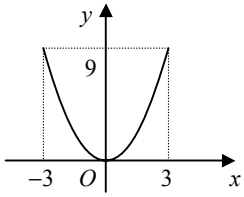
range: $0 \le f(x) \le 10$

d



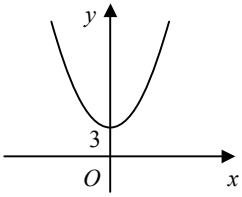
range: $f(x) \in \mathbb{R}$

e



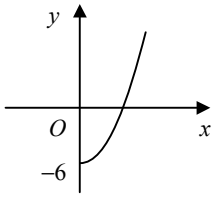
range: $0 \le f(x) < 9$

f



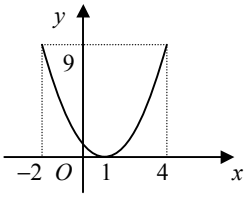
range: $f(x) \ge 3$

g



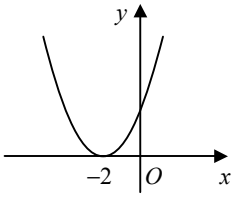
range: $f(x) \ge -6$

h



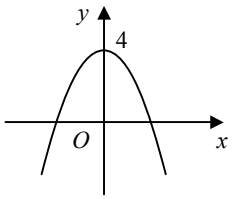
range: $0 \le f(x) \le 9$

i



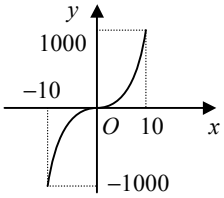
range: $f(x) \ge 0$

j



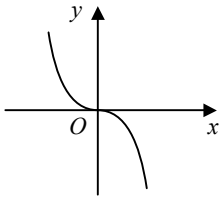
range: $f(x) \le 4$

k



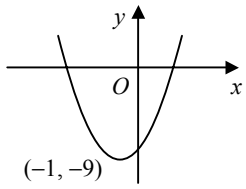
range: $-1000 < f(x) \le 1000$

l



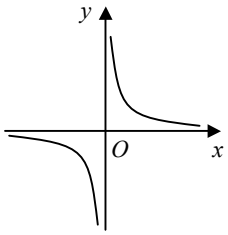
range: $f(x) \in \mathbb{R}$

4 **a** $f(x) = (x + 1)^2 - 9$ $\therefore$ $(-1, -9)$



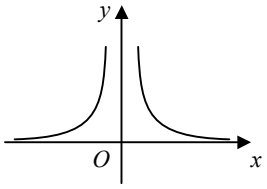
range:
$f(x) \geq -9$

b



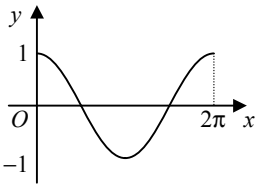
range:
$f(x) \in \mathbb{R}$, $f(x) \neq 0$

c



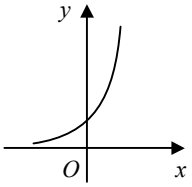
range:
$f(x) > 0$

d



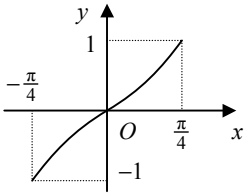
range:
$-1 \leq f(x) \leq 1$

e



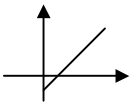
range:
$f(x) > 0$

f

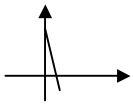


range:
$-1 \leq f(x) \leq 1$

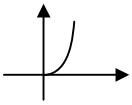
5 **a** $f(0) = -1$, $f(7) = 6$
$\therefore$ $0 \leq x < 7$



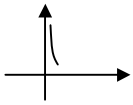
b $f(0) = 4$
$\therefore$ $x \geq 0$



c $f(0) = 0$, $f(5) = 125$
$\therefore$ $0 \leq x \leq 5$



d $f(\frac{1}{2}) = 2$, $f(\frac{1}{10}) = 10$
$\therefore$ $\frac{1}{10} < x < \frac{1}{2}$



6 **a** $4x + 3 = 9$
$x = \frac{3}{2}$

b $x^2 - 7 = 18$
$x^2 = 25$
$x = \pm 5$

c $\frac{9}{x+2} = 6$
$6x + 12 = 9$
$x = -\frac{1}{2}$

d $4x + 3 = \frac{9}{x+2}$
$(4x + 3)(x + 2) = 9$
$4x^2 + 11x - 3 = 0$
$(4x - 1)(x + 3) = 0$
$x = -3, \frac{1}{4}$

e $x^2 - 7 - \frac{x+2}{9} = -\frac{19}{3}$
$9x^2 - 63 - x - 2 = -57$
$9x^2 - x - 8 = 0$
$(9x + 8)(x - 1) = 0$
$x = -\frac{8}{9}, 1$

f $4x + 3 + x^2 - 7 = 0$
$x^2 + 4x - 4 = 0$
$x = \frac{-4 \pm \sqrt{16+16}}{2}$
$x = -2 \pm 2\sqrt{2}$
or -4.83, 0.828 (3sf)

7 **a** $f(x) = (x + 2)^2 - 4 + 11 = (x + 2)^2 + 7$ range: $f(x) \geq 7$

b $f(x) = (x - 1)^2 - 1 - 6 = (x - 1)^2 - 7$ range: $f(x) \geq -7$

c $f(x) = (2x + 3)^2 - 9 + 3 = (2x + 3)^2 - 6$ range: $f(x) \geq -6$

d $f(x) = (3x - 1)^2 - 1 + 16 = (3x - 1)^2 + 15$ range: $f(x) \geq 15$

e $f(x) = 15 - [x^2 + 4x] = 15 - [(x + 2)^2 - 4] = 19 - (x + 2)^2$ range: $f(x) \leq 19$