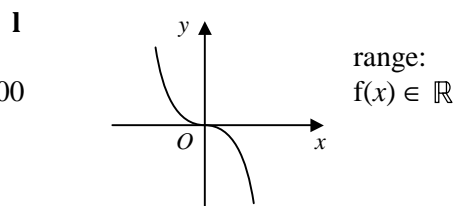
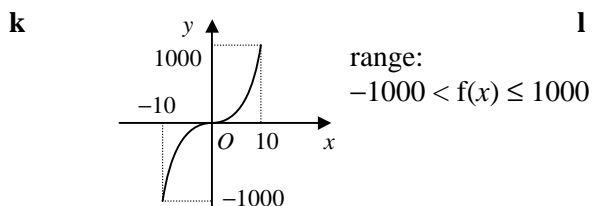
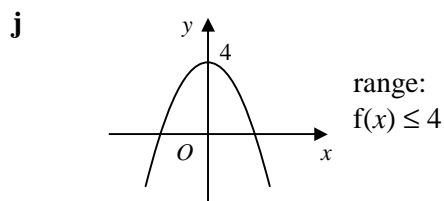
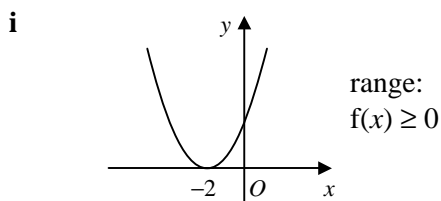
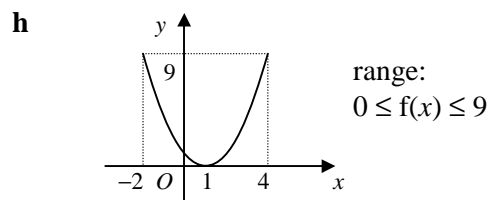
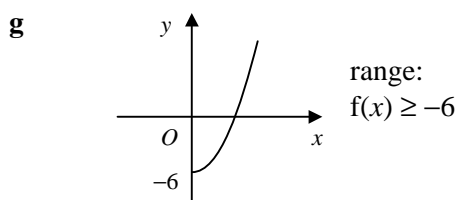
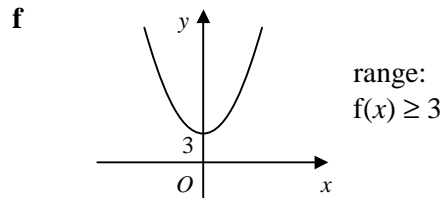
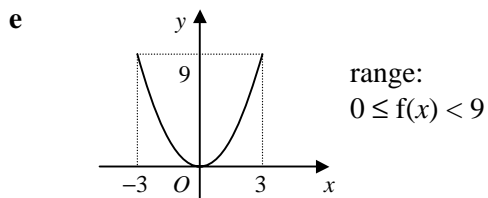
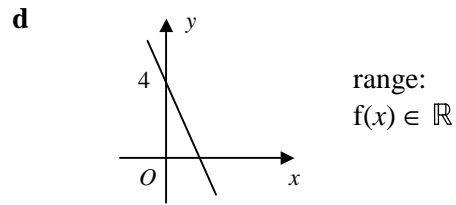
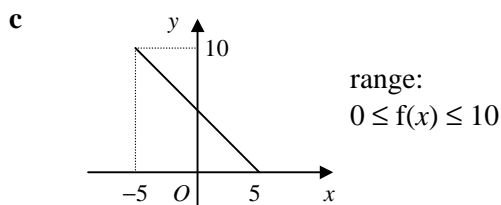
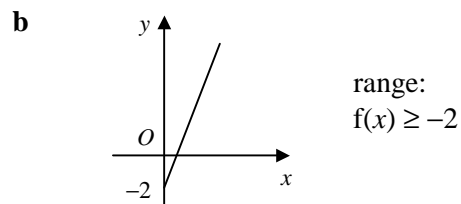
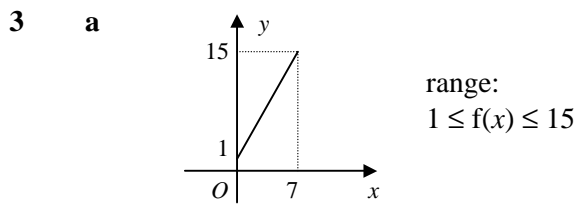
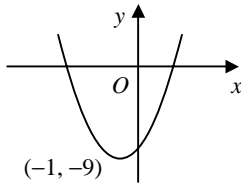


1    a 4            b 2            c 11            d -2            e -4            f -2  
       g  $\frac{2}{5}$         h -3            i  $\frac{5}{4}$             j -8            k -4            l  $\frac{12}{13}$

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

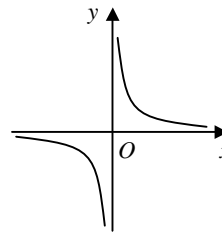


4 a  $f(x) = (x + 1)^2 - 9 \therefore (-1, -9)$



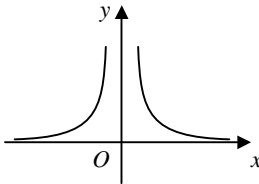
range:  
 $f(x) \geq -9$

b



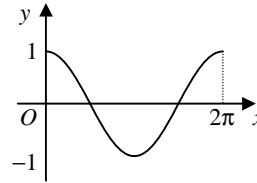
range:  
 $f(x) \in \mathbb{R}, f(x) \neq 0$

c



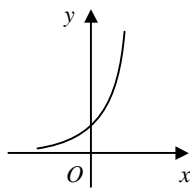
range:  
 $f(x) > 0$

d



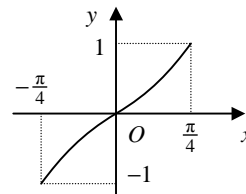
range:  
 $-1 \leq f(x) \leq 1$

e



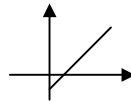
range:  
 $f(x) > 0$

f



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

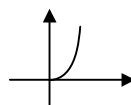
5 a  $f(0) = -1, f(7) = 6$   
 $\therefore 0 \leq x < 7$



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:  $f(x) \leq 19$