**1**  **a**  $= (x-4)^2 - 16 + 18$
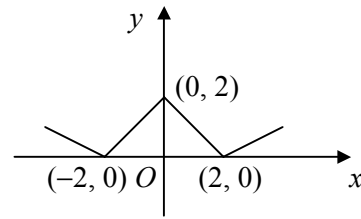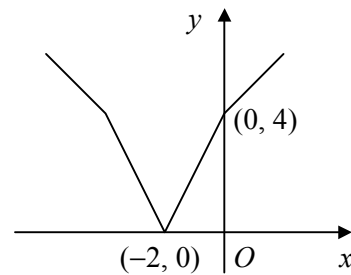$= (x-4)^2 + 2$

  **b**  vertex $= (4, 2)$
$\therefore$ dist. $= \sqrt{4^2 + 2^2}$
$= \sqrt{20} = 2\sqrt{5}$

  **c**  translation by 4 units in +ve *x*-direction
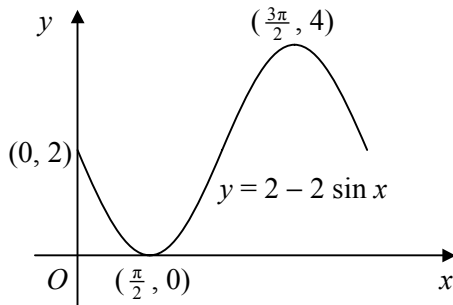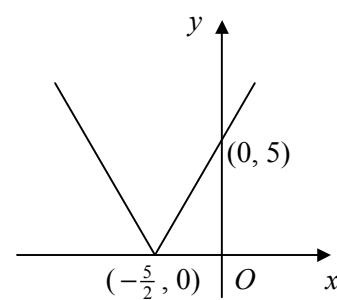translation by 2 units in +ve *y*-direction
(either first)

**2**  **a**

  **b**

**3**



**4**  **a**

  **b**  $f(-4) = |-3| = 3$
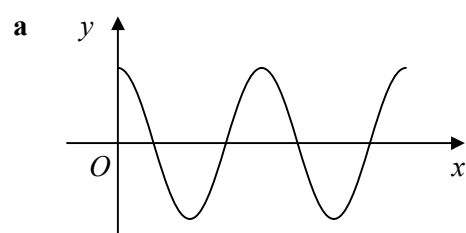$ff(-4) = f(3) = |11| = 11$

  **c**  $-\frac{5}{2}$

**5**  **a**  $(0, 2)$  $\therefore a = 2$
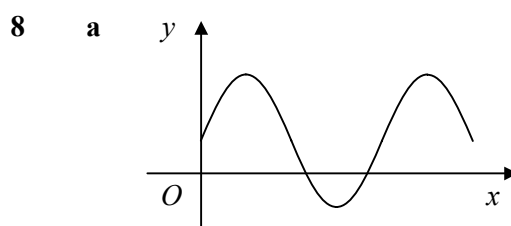$(90, 7)$  $\therefore 7 = 2 + b$  $\therefore b = 5$
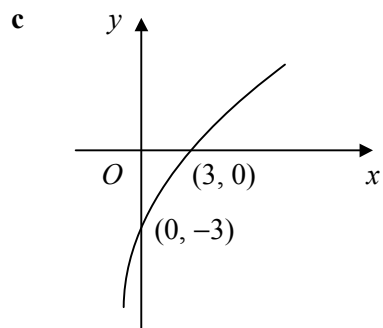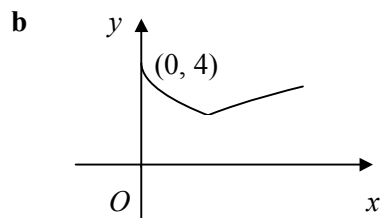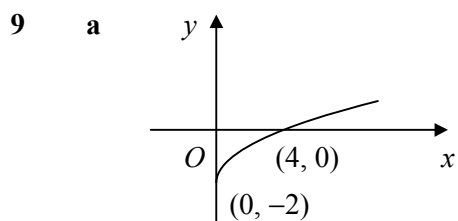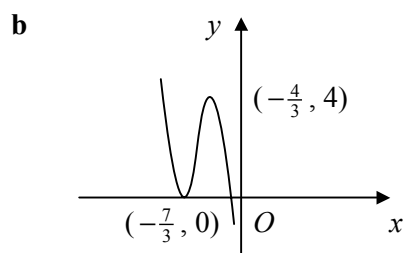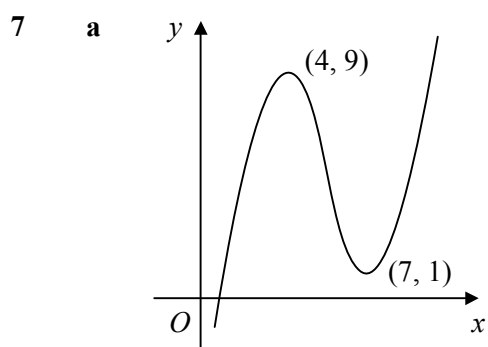
  **b**  $2 + 5\sin x = 0$
$\sin x = -0.4$
$x = 180 + 23.6, 360 - 23.6$
$x = 203.6°, 336.4°$ (1dp)

**6**  **a**

  **b**  $(45, 0), (135, 0), (225, 0), (315, 0)$

  **c**  $(0, 3), (90, -3), (180, 3), (270, -3), (360, 3)$

**7  a**



Graph through origin region with maximum $(4, 9)$ and minimum $(7, 1)$.

**b**



Points $(-\frac{4}{3}, 4)$ and $(-\frac{7}{3}, 0)$.

**8  a**



**b**  $(30°, 1.5), (90°, -0.5), (150°, 1.5)$

**c**  $\frac{1}{2} + \sin 3x = 0$

$\sin 3x = -\frac{1}{2}$

$3x = 180 + 30,\ 360 - 30$
$\quad = 210,\ 330$

$x = 70°,\ 110°$

**9  a**



Points $(4, 0)$ and $(0, -2)$.

**b**



Point $(0, 4)$.

**c**



Points $(3, 0)$ and $(0, -3)$.

**10**



Points $(\frac{\pi}{6}, 4)$, $\frac{2\pi}{3}$, $\frac{5\pi}{3}$, $(\frac{7\pi}{6}, -4)$.
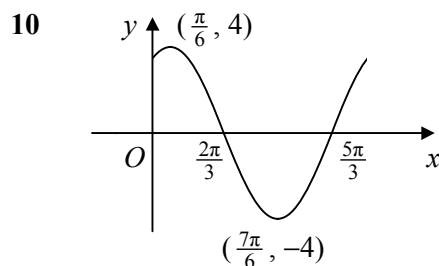
**11  a**  $y = \frac{3x - 5}{x - 2}$

swap  $x = \frac{3y - 5}{y - 2}$

$xy - 2x = 3y - 5$
$y(x - 3) = 2x - 5$
$y = \frac{2x - 5}{x - 3}$

$f^{-1}(x) = \frac{2x - 5}{x - 3},\ x \in \mathbb{R},\ x \neq 3$

**b**  $f(x) = 4 \Rightarrow x = f^{-1}(4) = 3$

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

$\therefore\ a = 3,\ b = 1$

**d**  translation by 2 in the positive *x*-direction
and translation by 3 in the positive *y*-direction
(either first)