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3.3 Graphing quadratic functions

Useful forms of equations for quadratics:

$f(x) = ax^2 + bx + c$, with y-intercept c, axis of symmetry $x = -\dfrac{b}{2a}$, zeros $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$g(x) = a(x - p)(x - q)$, with x-intercepts p, q and axis of symmetry $x = \dfrac{p + q}{2}$

$h(x) = a(x - h)^2 + k$, with vertex (h, k)

1. Given $f(x) = (x - 1)(x - 5)$

   (a) Write down the two solutions to $f(x) = 0$. Mark them as the x-intercepts on the axes below.

   (b) Expand the function to standard form, $f(x) = ax^2 + bx + c$ where $a, b, c \in \mathbb{R}$.

   (c) Write down the value of $f(0)$. Mark it as the y-intercept on the graph.

   (d) Sketch the function, labeling the vertex as an ordered pair. Show the axis of symmetry as a dotted line and label it with its equation.
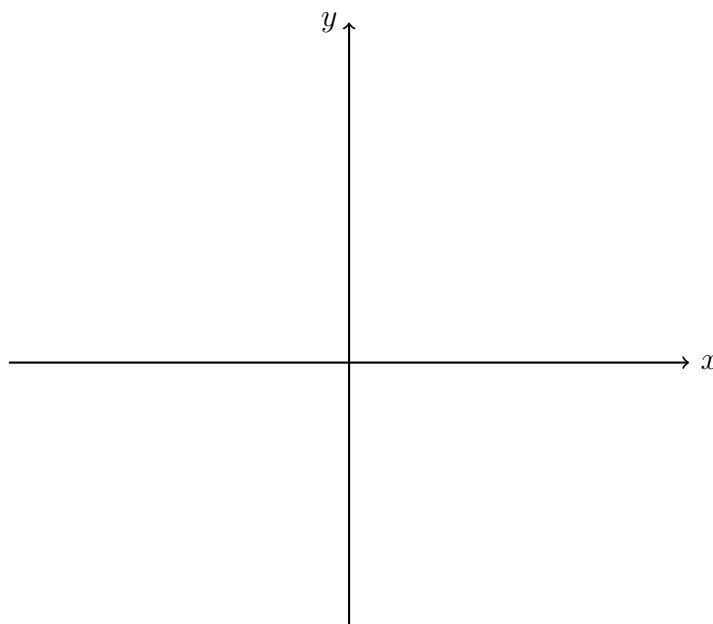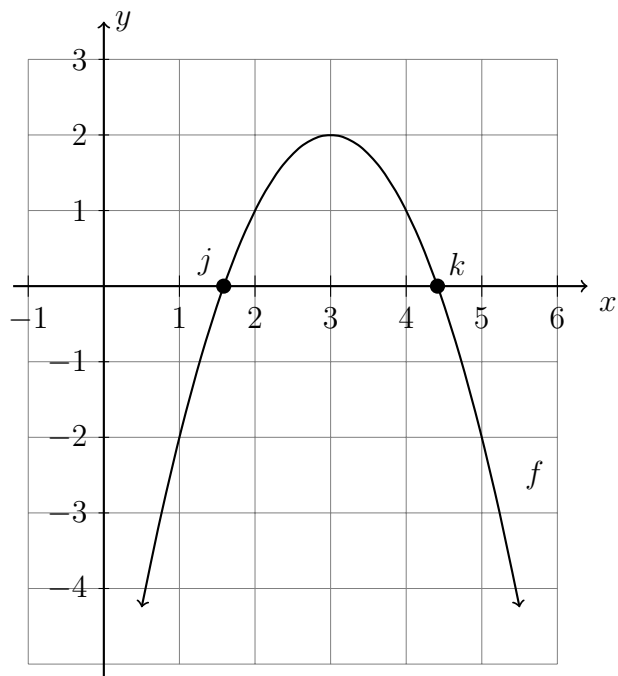
2. The function $f(x) = -x^2 + 6x - 7$ is shown on the graph.

   (a) Write down its vertex as an ordered pair.
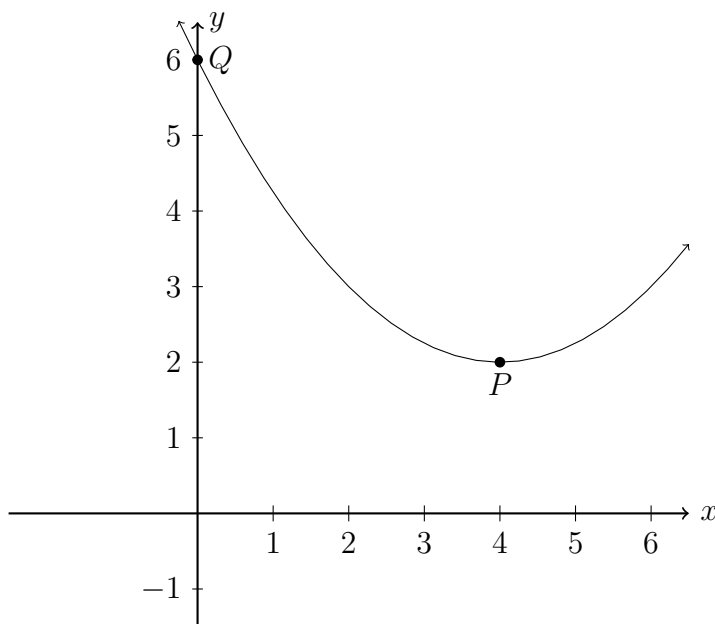
   (b) Write down the domain and range of f.

   (c) Draw on the graph the function $g(x) = x - 3$.

   (d) Write down the two ordered pairs that satisfy both f and g.

   (e) Find the exact values of j and k, the x-intercepts of f. (as an expression with radicals, not a decimal)

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3. Let f be a quadratic function. Part of the graph of f is shown below. The vertex is at $P(4, 2)$ and the y-intercept is at $Q(0, 6)$.

(a) Write down the equation of the axis of symmetry.

(b) Write down the domain and range of f.

(c) The function f can be written in the form $f(x) = a(x - h)^2 + k$.
Write down the value of h and of k.

(d) Find a.

4. Consider the function $f(x) = ax^2 + bx + c$. The graph of $y = f(x)$ is shown in the diagram. The vertex of the graph has coordinates $(0.5, -12.5)$. The graph intersects the x-axis at the two points, $(-2, 0)$ and $(p, 0)$.

diagram not to scale
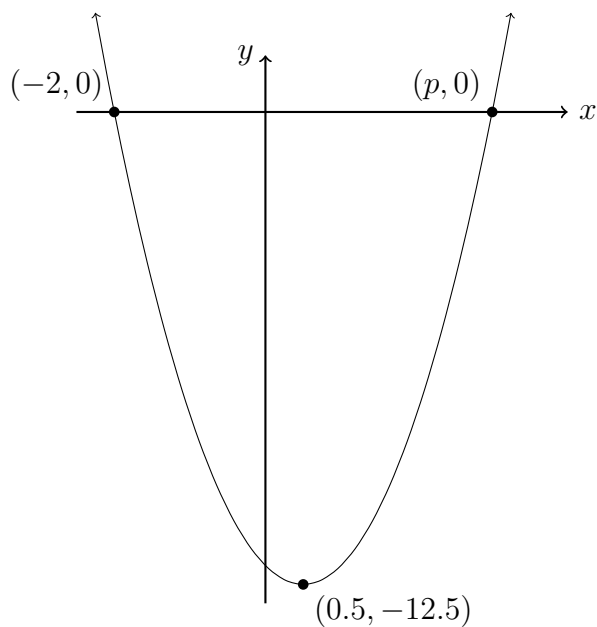
(a) Find the value of p.

(b) Find the value of:

    i. a.

    ii. b.

    iii. c.

(c) Write down the equation of the axis of symmetry.

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5. Consider the function $f(x) = x^2 + 2x - 3$.

  (a) Sketch the graph of f, for $-4 \le x \le 2$. Label the vertex and the intercepts.

  (b) This function can also be written in the form $f(x) = (x - p)^2 - 4$.
      Write down the value of p.

  (c) The graph of f has two solutions for $f(x) = 0$. Write down the solutions (or roots, zeros) of the function.

  (d) Hence, write down the function in factored form, $f(x) = (x - a)(x - b)$.