



Further Math with Ali Hashir

Rational Functions

Further Pure Mathematics 1 – Chapter 2 • Answers

Final answers only. Full step-by-step working, including every sketch, is in the companion *Worked Solutions* booklet.

QUESTIONS 1–5 • Reading asymptotes off the algebra

- 1 (a) $x = 4, y = 0$ (b) $x = 5, y = 2$ (c) $x = -3, x = 3, y = 0$
 2 (a) 2 (b) 0 (c) 1
 3 (a) $a = 5, b = 9$ (b) $x = 2$ and $y = x + 5$
 4 (a) $x = -3, x = 2, y = 3$ (b) discriminant $= -23 < 0$; $(0, -\frac{1}{3})$
 5 (a) $x = 1, x = 3, y = 0$ (b) $(2, -1)$ (c) see the sketch

QUESTIONS 6–10 • Ranges, related graphs and inequalities

- 6 $x < -\frac{7}{2}$ or $x > -2$
 7 (a)–(c) see the sketches. Asymptotes of $y = f(x)$: $x = -1, y = 1$; intersections $(3, 0)$ and $(0, -3)$. $y = f(|x|)$ has no vertical asymptote because $|x| + 1 \geq 1$ for every real x .
 8 (a) $p = 7, q = 16$; asymptotes $x = 3$ and $y = x + 7$ (b) shown (c) $(-1, 2)$ and $(7, 18)$
 9 $-2 < x < 1$ or $x > 2$
 10 (a) $x = -2, x = 2, y = 0$ (b) shown (c) $(-1, 0)$ and $(0, -\frac{1}{4})$ (d) $-2 < x < -1$ or $x > 2$

QUESTIONS 11–15 • Examination-standard problems

- 11 (a) $a = 3, b = -6$ (b) $x = 2$ (c) $(0, 3)$ and $(4, 11)$
 12 (a) $x < -1$ or $x \geq 2$ (b) $x = -1, y = 1, y = -1$ (c) see the sketch
 13 (a) $y = 1$ (b) shown (c) $(-1, -1)$ and $(1, 3)$ (d) $(-2 \pm \sqrt{3}, 0)$ and $(0, 1)$
 (e) $-1 < k < 1$ or $1 < k < 3$
 14 (a) $x = -2, y = 1$ (b) $(1, 0), (-3, 0), (0, -\frac{3}{4})$ (c) turning point $(-5, \frac{4}{3})$
 (d) see the sketch

- 15** (a) $x = 1$, $y = x + 1$ (b) shown (c) $(-1, -2)$ and $(3, 6)$ (d) $(0, -3)$
(e) see the sketch (f) $-3 - 2\sqrt{3} < x < -3 + 2\sqrt{3}$

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