

Rational Expressions and Functions - ANSWERS

RT.1 Exercises

1. reciprocal
3. scientific
5. false
7. false
9. false
11. true
13. false
15. a. - B.; b. - E.; c. - B.; d. - E.; e. - D.
17. $-\frac{1}{81}$
19. $\frac{1}{4}$
21. $-\frac{4}{9}$
23. 6
25. $-\frac{20y}{x^9}$
27. $\frac{15}{y^{7a}}$
29. $\frac{1}{x^{10n}}$
31. $-\frac{7b^2}{4a^{12}}$
33. $\frac{16p^{28}}{q^4}$
35. $\frac{x^6y^9}{5^3}$
37. $\frac{5^4x^8y^{16}}{2^8}$
39. $\frac{x^8}{5^8y^8}$
41. $\frac{2}{a^3}$
43. $\frac{8}{3pq^{10}}$
45. $-\frac{27a^9}{b^{21}}$
47. $\frac{1}{16^{xy}}$
49. 1
51. $-3x^{2a-1}$
53. $-\frac{5x^{2b}}{y^{2a}}$
55. $-1.32 \cdot 10^{-4}$
57. $7.056 \cdot 10^2$
59. 0.00005072
61. 0.00000000905
63. $3.38 \cdot 10^{-4}$
65. $1.6952 \cdot 10^{-13}$
67. $3 \cdot 10^5$
69. $2 \cdot 10^6$
71. $\sim 9.46 \cdot 10^{12}$ km
73. 8 light-years
75. ~ 7.9 billions in 2020; ~ 8.5 billions in 2025
77. Using the power rules and scientific notation, we obtain $1.6 \cdot 10^{441}$.

RT.2 Exercises

1. rational
3. common
5. reciprocal
7. true
9. false
11. $f(-1) = \frac{5}{4}$, $f(0) = \text{undefined}$, $f(2) = 5$
13. -2 ; $D = \mathbb{R} \setminus \{-2\}$; $D = (-\infty, -2) \cup (-2, \infty)$
15. $-\frac{7}{3}$; $D = \mathbb{R} \setminus \{-\frac{7}{3}\}$; $D = (-\infty, -\frac{7}{3}) \cup (-\frac{7}{3}, \infty)$
17. $-2, 2$; $D = \mathbb{R} \setminus \{-2, 2\}$; $D = (-\infty, -2) \cup (-2, 2) \cup (2, \infty)$
19. $0, 3$; $D = \mathbb{R} \setminus \{0, 3\}$; $D = (-\infty, 0) \cup (0, 3) \cup (3, \infty)$

$$21. \frac{3}{4}; D = \mathbb{R} \setminus \left\{\frac{3}{4}\right\}; D = \left(-\infty, \frac{3}{4}\right) \cup \left(\frac{3}{4}, \infty\right)$$

$$23. \text{b., d., and e. are equivalent to } -1$$

$$29. 1$$

$$37. -\frac{m+5}{4}$$

$$45. 10ab^2$$

$$53. (2a-1)(3a-8)$$

$$61. \frac{a^2+ab+b^2}{a-b}$$

$$69. \frac{15}{y^2}$$

$$75. f(x) \cdot g(x) = \frac{2(x-4)}{(x+1)^2}; f(x) \div g(x) = \frac{x-4}{2x^2}$$

$$77. f(x) \cdot g(x) = -(x-3)^2; f(x) \div g(x) = -\frac{(x-4)^2}{(x+3)^2}$$

$$31. \frac{4x-5}{7}$$

$$39. \frac{t+5}{t-5}$$

$$47. \frac{3}{2y^4}$$

$$55. \frac{x^2-16}{x(x+3)}$$

$$63. \frac{x^2+4x+16}{(x+4)^2}$$

$$71. \frac{2b}{a+2b}$$

$$25. \frac{8a^2}{b^2}$$

$$33. \frac{y-3}{y+3}$$

$$41. \frac{x-8}{x+4}$$

$$49. \frac{10}{9a^2}$$

$$57. \frac{1}{b(b-1)}$$

$$65. \frac{1}{2x+3y}$$

$$73. \frac{x-6}{x+5}$$

$$27. -1$$

$$35. \frac{6}{7}$$

$$43. \frac{x^2+xy+y^2}{x+y}$$

$$51. -\frac{y+5}{2y}$$

$$59. \frac{x(3x+2)}{(3x+1)(3x-2)}$$

$$67. -\frac{7x+3}{7}$$

RT.3 Exercises

1. denominator

3. different

5. rational

7. a. $x^2 - 25$; b. $x^2 - 25$

9. 150; $\frac{17}{150}$

11. 120; $\frac{19}{60}$

13. $90x^3y^3$

15. $50x^2(x-1)$

17. $(y+5)(y-5)$

19. $5(a-3)^2$

21. $(n-5)(n-3)(n-2)$

23. $(2x+1)(2x-1)$

25. false; $\frac{1}{2x} + \frac{1}{3x} = \frac{3+2}{6x} = \frac{5}{6x}$

27. false; $\frac{1}{x} + \frac{1}{y} = \frac{y+x}{xy}$

29. 1

31. $\frac{3a+6}{a-3}$

33. $x+y$

35. $\frac{1}{y-1}$

37. $\frac{-h}{x(x+h)}$

39. $\frac{x^2+2x+5}{(3x+1)(x-3)}$

41. $\frac{2(x-7)}{15(x+5)}$

43. $\frac{2(2x-1)}{x-1}$

45. $\frac{3y-10}{(y-5)(y+4)}$

47. $\frac{3x-4}{(x-2)(x-1)}$

49. $\frac{11y-3}{(y+3)^2(y-3)}$

51. $\frac{-x}{x-2}$

53. $\frac{-(3x^2+3x+4)}{(x+1)(x-1)}$

55. $\frac{1}{x+1}$

57. $\frac{6+x^2}{3x^3}$

59. $\frac{x-14}{(x+1)(x-4)}$

61. $\frac{-(2x^2+5x-2)}{(x+2)(x+1)}$

63. $(f+g)(x) = \frac{x^2+x+8}{(x+2)(x-3)}$; $(f-g)(x) = \frac{x^2-7x-8}{(x+2)(x-3)}$

$$65. (f + g)(x) = \frac{3x^2 - 2x + 3}{(x-1)^2(x+3)}; (f - g)(x) = \frac{3x^2 - 4x - 3}{(x-1)^2(x+3)}$$

67. 30

$$69. \frac{100(S_1 - S_0)}{S_0}$$

RT.4 Exercises

1. complex

3. reciprocal

5. $\frac{5}{16}$

7. $-\frac{111}{160}$

9. xy^2

11. $\frac{a-1}{4a+1}$

13. $\frac{-9(x-4)}{2(x+3)}$

15. $\frac{2y-x}{2y+x}$

17. $\frac{a^2(b-3)}{b^2(a-1)}$

19. $\frac{-(2x+y)}{x}$

21. $\frac{n-3}{n}$

23. $\frac{1}{a(a-h)}$

25. $\frac{4}{5}$

27. $\frac{a+b}{ab}$

29. $\frac{(x-3)(x+1)}{x^2+x-1}$

31. $\frac{-ab(a-b)}{a^2-ab+b^2}$

33. The expressions $\frac{x^{-1}+y^{-1}}{x^{-2}+y^{-2}}$ and $\frac{x^2+y^2}{x+y}$ are **not** equivalent, as if we assume for example that $x = y = 2$, the first expression results in 4 while the second results in 2. Notice that the powers with negative exponents can't be 'shifted to a different level' due to the addition in the numerator and denominator. Only powers that are factors of the numerator or denominator can be 'shifted to a different level' to change the sign of their exponents.

35. $\frac{x+1}{3x}$

37. $\frac{n}{n+1}$

39. $\frac{-2(2a-h)}{a^2(a+h)^2}$

41. $\frac{1}{(a-2)(a+h-2)}$

43. $\frac{-3x-2}{x-2}$

RT.5 Exercises

1. rational

3. equations

5. domain

7. numerator

9. \mathbb{R}

11. $\mathbb{R} \setminus \{-4, 11\}$

13. $\mathbb{R} \setminus \{-5, 5, 7\}$

15. $x = \frac{17}{2}$

17. $x \in \{-8, -1\}$

19. $r = 2$

21. $r = 30$

23. $y = 3$

25. $x = -5$

27. $x \in \{-3, 1\}$

29. $y = -3$

31. $k = \frac{5}{4}$

33. $y = 4$

35. $x = \frac{1}{5}$

37. $x = \frac{31}{5}$

39. $x = -2$

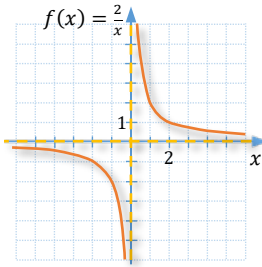
41. $x = 2$

43. $x \in \left\{-\frac{1}{3}, 5\right\}$

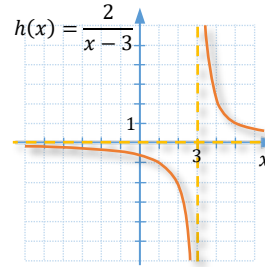
45. $x \in \left\{-\frac{5}{2}, 3\right\}$

47. $x \in \{-2, 6\}$

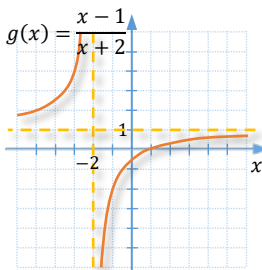
49. $D = \mathbb{R} \setminus \{0\}$; range = $\mathbb{R} \setminus \{0\}$;
VA: $x = 0$; HA: $y = 0$



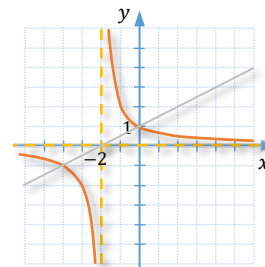
51. $D = \mathbb{R} \setminus \{3\}$; range = $\mathbb{R} \setminus \{0\}$;
VA: $x = 3$; HA: $y = 0$



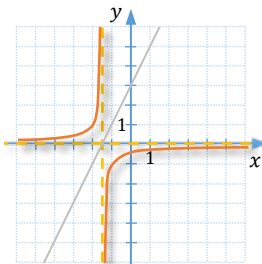
53. $D = \mathbb{R} \setminus \{-2\}$; range = $\mathbb{R} \setminus \{1\}$;
VA: $x = -2$; HA: $y = 1$



55. $g(x) = \frac{2}{x+2}$
VA: $x = -2$; HA: $y = 0$



57. $g(x) = \frac{-1}{2x+3}$
VA: $x = -\frac{3}{2}$; HA: $y = 0$



59. $x \in \left\{-1, \frac{1}{2}\right\}$

61. a. $p(10) = 0.9$ b. $x = 5$

c. Yes. The incidence rate is 0 if a smoker is as likely to die of lung cancer as a nonsmoker.

d. No, as this would mean that nonsmokers do not die of lung cancer.

RT.6 Exercises

1. numerator

3. row; column

5. motion

7. 24

9. factorization of r

10. multiplication by $a - b$

11. $a = \frac{F}{m}$

13. $d_1 = \frac{W_1 d_2}{W_2}$

15. $t = \frac{2s}{v_1 + v_2}$

17. $R = \frac{r_1 r_2}{r_1 + r_2}$

19. $q = \frac{fp}{p-f}$

21. $v = \frac{PVt}{Tp}$

23. $b = \frac{2A}{h} - a$ or $b = \frac{2A-ah}{h}$

25. $s = \frac{Rg}{g-R}$

27. $n = \frac{IE}{E-Ir}$

29. $r = \frac{Re}{E-e}$

31. $R = \frac{V}{\pi h^2} + \frac{h}{3}$ or $R = \frac{3V+\pi h^3}{3\pi h^2}$

33. $h = \frac{2R^2g}{V^2} - R$ or $h = \frac{2R^2g-V^2R}{V^2}$

35. 12.8 kg

37. 21.54 mi

39. ~210 deer

41. ~176 bald eagles

43. $y = 2$; $AC = 8$; $PR = 6$; $QR = \frac{15}{4}$

45. 19.8 km/h

47. 3 mph

49. 35 mph

51. 1020 mi

53. 2.4 mi

55. $2\left(\frac{1}{x} + \frac{1}{y}\right)$

57. 20 hr

59. 49.5 hr

61. 2250 people

63. 30 mi