Rational Expressions and Functions - ANSWERS

RT1 Exercises

1. true **3.** true **5.** true **7.** false

9. false **11.** false **13.** $\frac{1}{64}$ **15.** $\frac{1}{512}$

17. $-\frac{125}{81}$ **19.** $\frac{3}{8}$ **21.** $-\frac{14}{x^{11}}$ **23.** $-\frac{36}{x^{12n}}$

25. $-\frac{4}{x^3}$ **27.** $3n^4m^2$ **29.** $\frac{3x^2}{2y^2}$ **31.** $-\frac{b^{15}}{27a^6}$

33. $\frac{27}{8x^9y^3}$ **35.** $\frac{x^{10}y^5}{5^{10}}$ **37.** $\frac{64}{x^{24}y^{12}}$ **39.** $\frac{4k^5}{m^2}$

41. $-\frac{5^3y^3}{x^{30}}$ **43.** $\frac{1}{3^8x^8y^8}$ **45.** $\frac{1}{5^{a^2}}$ **47.** $3n^x$

49. x^{b+5} **51.** $2.6 \cdot 10^{10}$ **53.** $1.05 \cdot 10^{-8}$ **55.** 670,000,000

57. 2,000,000,000,000 **59.** $1048576 = 1.05 \cdot 10^6$ **61.** $1.3338 \cdot 10^{-10}$

63. $5 \cdot 10^{-5}$ **65.** $2.5 \cdot 10^7$ **67.** $1.25 \cdot 10^3$ **69.** 18,108.11 \$/person

71. $1.59 \cdot 10^7$ ft³/min; $2.2896 \cdot 10^{10}$ ft³/day **73.** 81 times

RT2 Exercises

1. false **3.** true **5.** $f(-1) = \frac{1}{3},\ f(0) = 0,\ f(2) = undefined$

7. $f(-1) = \frac{1}{2},\ f(0) = \frac{1}{3},\ f(2) = undefined$ **9.** $6;\ D = \mathbb{R} \setminus \{6\};\ D = (-\infty, 6) \cup (6, \infty)$

11. $\frac{4}{5};\ D = \mathbb{R} \setminus \left\{\frac{4}{5}\right\};\ D = \left(-\infty, \frac{4}{5}\right) \cup \left(\frac{4}{5}, \infty\right)$ **13.** none; $D = \mathbb{R}$; $D = (-\infty, \infty)$

15. $-7, -5;\ D = \mathbb{R} \setminus \{-7, -5\};\ D = (-\infty, -7) \cup (-7, -5) \cup (-5, \infty)$

17. **b.**, **d.**, and **e.** are equivalent to -1 **19.** $\frac{8a^2}{b^2}$ **21.** -1

23. 1 **25.** $\frac{4x-5}{7}$ **27.** $\frac{y-3}{y+3}$ **29.** $\frac{6}{7}$

31. $-\frac{m+5}{4}$ **33.** $\frac{t+5}{t-5}$ **35.** $\frac{x-8}{x+4}$ **37.** $\frac{x^2+xy+y^2}{x+y}$

39. $10ab^2$ **41.** $\frac{3}{2y^4}$ **43.** $\frac{10}{9a^2}$ **45.** $-\frac{y+5}{2y}$

47. $-8y(y+2)$ **49.** $\frac{x^2-16}{x(x+3)}$ **51.** $\frac{1}{b(b-1)}$ **53.** $\frac{x(3x+2)}{(3x+1)(3x-2)}$

55. $\frac{a^2+ab+b^2}{a-b}$ **57.** $\frac{x^2+4x+16}{(x+4)^2}$ **59.** $\frac{1}{2x+3y}$ **61.** $-\frac{7x+3}{7}$

63. $\frac{15}{y^2}$ **65.** $\frac{2b}{a+2b}$ **67.** $\frac{x-6}{x+5}$

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

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

RT3 Exercises

1. **a.** 18; **b.** 18 **3.** 36; $\frac{41}{36}$ **5.** 240; $\frac{221}{240}$ **7.** $72a^5b^4$

9. $x(x+2)(x-2)$ **11.** $(x-1)^2$ **13.** $y(x+y)(x-y)$ **15.** $(x+1)^2(x-5)$

17. $(x-3)^2(2x+1)(x-1)$ **19.** $6x^3(x+2)^2(x-2)$

21. true; $\frac{1}{3-x}$ is opposite to $\frac{1}{x-3}$ **23.** false; $\frac{3}{4}+\frac{x}{5}=\frac{3\cdot5+4x}{20}=\frac{4x+15}{20}$

25. $\frac{8}{a+1}$ **27.** $\frac{3n-3}{n-2}$ **29.** $\frac{1}{a+7}$ **31.** a^2+ab+b^2

33. $\frac{2x^2-x+14}{(x+3)(x-4)}$ **35.** $\frac{x+y}{x-y}$ **37.** $\frac{y-34}{20(y+2)}$ **39.** $\frac{4y+17}{y^2-4}$

41. $\frac{2x^2+21x}{(x-4)(x-2)(x+3)}$ **43.** $\frac{3y^2+7y+14}{(2y-5)(y+2)(y-1)}$ **45.** $\frac{2x^2-13x+7}{(x+3)(x-3)(x-1)}$ **47.** $\frac{-y}{(y+3)(y-1)}$

49. $\frac{-(14y^2+3y-3)}{(2y+1)(2y-1)}$ **51.** $\frac{x^2+6}{3x^3}$ **53.** $\frac{x-14}{(x+1)(x-4)}$ **55.** $\frac{-(2x^2+5x-2)}{(x+2)(x+1)}$

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

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

61. every 12th day **63.** $\frac{100(P_1-P_0)}{P_0}$

RT4 Exercises

1. $\frac{5}{16}$ **3.** $-\frac{111}{160}$ **5.** xy^2 **7.** $\frac{a-1}{4a+1}$

9. $\frac{-9(x-4)}{2(x+3)}$ **11.** $\frac{2y-x}{2y+x}$ **13.** $\frac{a^2(b-3)}{b^2(a-1)}$ **15.** $\frac{-(2x+y)}{x}$

17. $\frac{n-3}{n}$ **19.** $\frac{1}{a(a-h)}$ **21.** $\frac{4}{5}$ **23.** $\frac{a+b}{ab}$

25. $\frac{x^2-2x-3}{x^2+x-1}$ **27.** $\frac{-ab(a-b)}{a^2-ab+b^2}$

29. The expressions $\frac{x^{-2}+y^{-2}}{x^{-1}+y^{-1}}$ and $\frac{x+y}{x^2+y^2}$ are **not** equivalent, as if we assume for example that $x = 1$ and $y = 2$, the first expression results in $\frac{5}{6}$ while the second results in $\frac{3}{5}$. 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.

31. $\frac{x+1}{3x}$ **33.** $\frac{n}{n+1}$ **35.** $\frac{-2(2a+h)}{a^2(a+h)^2}$ **37.** $\frac{1}{(a-2)(a+h-2)}$

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

RT5 Exercises

1. $\mathbb{R}$ **3.** $\mathbb{R} \setminus \{-4,9\}$ **5.** $\mathbb{R} \setminus \{-5,5,7\}$ **7.** $x = \frac{17}{2}$

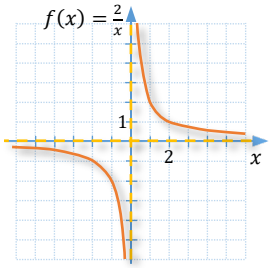
9. $x \in \{-8,-1\}$ **11.** $r = 2$ **13.** $r = 30$ **15.** $y = 3$

17. $x = -5$ **19.** $x \in \{-3,1\}$ **21.** $y = -3$ **23.** $k = \frac{5}{4}$

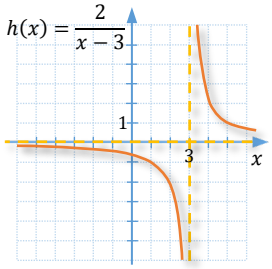
25. $y = 4$ **27.** $x = \frac{1}{5}$ **29.** $x = \frac{31}{5}$ **31.** $x = -2$

33. $x = 2$ **35.** $x \in \left\{-\frac{1}{3}, 5\right\}$ **37.** $x \in \left\{-\frac{5}{2}, 3\right\}$ **39.** $x \in \{-2,6\}$

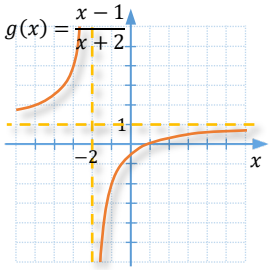
41. $D = \mathbb{R} \setminus \{0\}$; range $= \mathbb{R} \setminus \{0\}$;
VA: $x = 0$; HA: $y = 0$



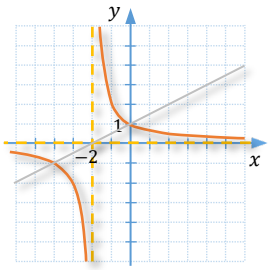
43. $D = \mathbb{R} \setminus \{3\}$; range $= \mathbb{R} \setminus \{0\}$;
VA: $x = 3$; HA: $y = 0$



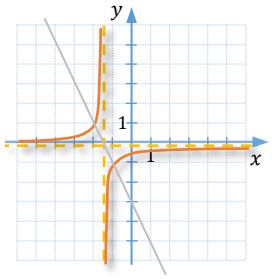
45. $D = \mathbb{R} \setminus \{-2\}$; range $= \mathbb{R} \setminus \{1\}$;
VA: $x = -2$; HA: $y = 1$



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



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



51. $x \in \{-1\}$

53. **a.** $D(10) = 0.9$ If a smoker is 10 times more likely to die of lung cancer than a non-smoker, then 90% of deaths are caused by smoking.

b. $x = 2$

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

RT6 Exercises

1. $q = 15$

3. factor k from the left

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

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

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

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

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

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

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

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

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

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

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

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

29. 121.275 N

31. 77 km

33. ~1142 zebras

35. ~155 white-tailed eagles

37. $PR = 6; PS = 3; SR = 4.2$

39. ~17.8 km/h

41. 4 km/h

43. 50 km/h

45. 1275 km

47. 2 km

49. $\frac{4(x+y)}{xy}$

51. 15 hr

53. 24 hr

55. 2450 people

57. 20 km

59. 12 hours

61. 1.4 m

63. 2651 km

65. ~1802 N