LESSON PLAN

Course: Grade 12 U Advanced Functions **Lesson : 3 - 1**

Unit/Chapter: Exponents & Logarithms **Topic: Exponent Laws**

□ ***note:*** **Exponent Laws Review**

Recall your five basic exponent laws:
multiplying powers with the same base – keep the base, add the exponents
dividing powers with the same base – keep the base, subtract the exponents
power of a power – keep the base, multiply the exponents
zero exponent – all bases raised to the exponent zero are equal to 1
negative exponent – the negative exponent signifies a position change from either numerator to denominator or vice versa
rational exponents – denominator tells type of root, numerator tells base to exponent
examples) Simplify.

$$\frac{\left(-2x^2\right)^3}{-4x^{-5}} = \frac{-8x^6}{-4x^{-5}} = 2x^{11}$$

$$\frac{\left(-3x^{-2}\right)^{-3}}{9x^{-2}} = \frac{\left(-3\right)^{-3} x^6}{9x^{-2}} = \frac{x^8}{-243}$$

$$\frac{2^{-2} - 3^{-1}}{4^{-1}} = \frac{\frac{1}{4} - \frac{1}{3}}{\frac{1}{4}} = \frac{\frac{3}{12} - \frac{4}{12}}{\frac{1}{4}} = \frac{-1}{12} \times 4 = -\frac{4}{12} = -\frac{1}{3}$$

$$\left(\frac{27}{64}\right)^{\frac{-2}{3}} = \left(\sqrt[3]{\frac{64}{27}}\right)^2 = \left(\frac{4}{3}\right)^2 = \frac{16}{9}$$

- ***homework assignment:*** **<u>FM11</u>** exercise 1.8 , 1.9, & 1.11 p. 17 – 24

EXERCISE 1.8

A 1. State the following as powers of 2.

(a) $2^5 \times 2^4$ (b) $2^7 \div 2^4$
(c) $2^3 \times 2^a$ (d) $2^b \div 2^4$
(e) $(2^5)^3$ (f) $(2^a)^3$

2. State the following as powers of 3.

(a) $3^4 \times 3^2$ (b) $3^5 \div 3^2$
(c) $3^a \times 3^2$ (d) $3^m \div 3^5$
(e) $(3^3)^3$ (f) $(3^2)^m$
(g) $(4^m)^n$ (h) $3^a \div 3$

B 3. Use the Laws of Exponents to express the following in another form, if possible.

(a) $(9 \times 13)^4$ (b) $(9x)^4$
(c) $\left(\frac{5}{6}\right)^{18}$ (d) $\left(\frac{x}{6}\right)^5$
(e) $7^8 \times 9^8$ (f) $(6 \times 72)^5$
(g) $2^6 \times 5^4$ (h) $(xy)^3$
(i) $\pi^2 \times \pi^3$ (j) $(\pi^2)^3$
(k) $\left(\frac{2}{3}\right)^{10}$ (l) $\left(\frac{x}{y}\right)^6$
(m) $\frac{(2.78)^{12}}{(2.78)^4}$ (n) $\frac{(-2)^{100}}{(-2)^{93}}$
(o) $\left(\frac{3}{a}\right)^2$ (p) $\frac{a^8}{b^8}$
(q) $4^9 \times 5^6$ (r) $(2x^2)^3$

4. Simplify the following expressions.

(a) $(-3x^8)^3$ (b) $(-3x^6)(4x^3)$
(c) $3^8 \times 3^6 \times 3^4$ (d) $a^m \times a^n \times a^p$
(e) $((2^3)^2)^4$ (f) $((a^m)^n)^p$
(g) $\frac{4^7 \times 4^3}{4^6}$ (h) $\frac{x^{m+n} \times x^{2m}}{x^n}$

5. Simplify the following.

(a) $\frac{7^{10} \times 7^{12} \times 7^6}{(7^3)^9}$ (b) $\frac{3^6 \times 3^5 \times 3^4}{3^8 \times 3^9}$
(c) $\frac{56^4}{14^4}$ (d) $\frac{2^{n+2} \times 4^{n+1}}{8^n}$
(e) $\frac{125^{16}}{5^{47}}$ (f) $\frac{a^{27} \times a^{18} \times a^4}{a^7 \times (a^3)^{14}}$

6. Simplify the following.

(a) $a^{2+p} + a^{2p} \times (-a)^7$
(b) $x^n \times (x^2)^{n+1} \times (x^3)^{n+2}$
(c) $\frac{(3^6)^n \times (81)^{2n}}{(3^n)^4}$ (d) $\frac{2^n \times 4^{n-1} \times 8^{3n-2}}{16^{2n-1}}$
(e) $\frac{32^n \times 16^{1-n} \times 8^{2n}}{(4^2)^{n+1}}$

7. Simplify if possible.

(a) $(x^5y^3)(x^2y^6)$ (b) x^8y^9
(c) $\left(\frac{1}{2}x^3\right)^2(x^8y^2)^4$ (d) $(-xy)^3(x^4y)^9$
(e) $\frac{2xy^4}{3x^3y^2} \times \frac{15x^2y^3}{12x^4y^2}$ (f) $\frac{a^2b^4}{a^3b^2} \times \left(\frac{a^4}{b^2}\right)^3$
(g) $\frac{(2x^2y^2)^5}{8x^4y^3(x^2y)^3}$ (h) $\left(\frac{x}{y}\right)^5\left(\frac{2}{x}\right)^4\left(\frac{y}{4}\right)^3$

CALCULATOR MATH

USING THE EXPONENTIAL KEY y^x

Some calculators have an exponential key y^x .

In order to calculate a^b, we press

C a y^x b =

Check the use of this key with the following examples.

3^2 C 3 y^x 2 =

5^3 C 5 y^x 3 =

2^5 C 2 y^x 5 =

EXERCISE

1. Simplify.

(a) 1.015^7 (b) 1.15^3
(c) 1.025^4 (d) 1.0375^6
(e) 1.01^{10} (f) 1.1^{10}

(a) $\left(\frac{2}{3}\right)^{-2}$ (b) $\frac{(-12)^0}{2^{-4}}$ (c) $\frac{2^{-8}+2^{-10}}{2^{-9}+2^{-7}}$

SOLUTION:

(a) $\left(\frac{2}{3}\right)^{-2} = \frac{1}{\left(\frac{2}{3}\right)^2}$
$= \frac{1}{\frac{4}{9}}$
$= \frac{9}{4}$

(b) $\frac{(-12)^0}{2^{-4}} = \frac{1}{2^{-4}}$
$= \frac{1}{\frac{1}{2^4}}$
$= 2^4$

(c) $\frac{2^{-8}+2^{-10}}{2^{-9}+2^{-7}} = \frac{2^{10}}{2^{10}} \times \frac{2^{-8}+2^{-10}}{2^{-9}+2^{-7}}$
$= \frac{2^{10}\times 2^{-8} + 2^{10}\times 2^{-10}}{2^{10}\times 2^{-9} + 2^{10}\times 2^{-7}}$
$= \frac{2^2+2^0}{2^1+2^3}$
$= \frac{4+1}{2+8}$
$= \frac{5}{10}$
$= \frac{1}{2}$

EXERCISE 1.9

A 1. State the value of each of the following.

(a) 6^0 (b) 9^{-1} (c) 2^{-3} (d) 3^{-2}
(e) $(-1)^{-1}$ (f) $(-\pi)^0$ (g) 10^{-4} (h) 837^{-1}

2. State the following using only positive exponents.

(a) x^{-8} (b) x^2y^{-2} (c) $a^{-3}b^{-4}$
(d) $a^3 \times a^{-5}$ (e) $\frac{1}{a^{-10}}$ (f) $\left(\frac{x}{y}\right)^3$

3. State the following with the variables in the numerator.

(a) $\frac{1}{x^3}$ (b) $2\frac{a}{b^4}$ (c) $\pi\frac{x^2}{y^{-1}}$

B 4. Evaluate.

(a) $2^{-1} \times 3^0 \times 4^2 \times 5^{-2}$ (b) $(2^3 \times 4^{-4})^{-2}$
(c) $(3^{-3} \times 5^2)^{-1}$ (d) $4^{10} \times 2^{-18}$
(e) $\frac{(27)^{-2}}{3^{-8}}$ (f) $\frac{(5^3+3^5)^0}{2^{-1}}$
(g) $\frac{3^{-12}+3^{-14}}{3^{-12}-3^{-14}}$ (h) $\frac{(7\times 5^{-1})^{-1}}{(2\times 3^{-1})^{-1}}$
(i) $\left(\frac{3^{-1}-4^{-1}}{2^{-1}-3^{-1}}\right)^{-1}$ (j) $[5^{-4} \times (25)^3]^2$
(k) $1 + \cfrac{1}{2^{-1} + \cfrac{1}{3^{-1} + \cfrac{1}{4^{-1}}}}$
(l) $\{1 - [(2+3^{-1})^{-1}]\}^{-1}$

5. Rewrite the following using only positive exponents. Simplify where possible.

(a) $(7x^2y^{-3})^3$ (b) $(3a^{-1}b^{-2})^{-5}$
(c) $(4ab^{-2}c^3d^{-4})^3$ (d) $\frac{a^{-3}b^2}{a^{-5}b^5}$
(e) $\frac{a^2x^3y^{-2}}{b^{-2}xy^{-6}}$ (f) $(a^2b^{-1}-1)^2$
(g) $a^4(a^2+a-5a^{-2})$ (h) $(x^2-1)(x^{-2}+2)$
(i) $(b^{-2})^{n-2} \div b^4$
(j) $(x^{-n}+y^{-m})(x^{-n}-y^{-m})$

CALCULATOR MATH

Some calculators carry digits beyond the display.

1. Perform the calculation
   $2 \div 3 \times 3 - 2$
   on a calculator.
   Can you explain your result?
2. Press **+/−**
   and explain your result.
3. Press
   × 1 0 y^x 1 0 =
4. Summarize the results of 1, 2, 3.

EXERCISE 1.11

A 1. State the following using radicals.

(a) $2^{\frac{1}{9}}$ (b) $37^{\frac{1}{2}}$ (c) $x^{\frac{1}{3}}$ (d) $2^{\frac{2}{3}}$

(e) $2^{\frac{3}{2}}$ (f) $3^{\frac{3}{4}}$ (g) $a^{\frac{2}{5}}$ (h) $x^{\frac{4}{7}}$

(i) $2^{-\frac{1}{2}}$ (j) $7^{-\frac{1}{5}}$ (k) $a^{-\frac{3}{2}}$ (l) $9^{\frac{2}{11}}$

2. State the following using exponents.

(a) $\sqrt{3}$ (b) $\sqrt{19}$ (c) $\sqrt[7]{23}$ (d) $\sqrt[4]{x}$

(e) $(\sqrt[3]{7})^2$ (f) $\sqrt[3]{7^2}$ (g) $(\sqrt[5]{6})^4$ (h) $(\sqrt[3]{13})^5$

(i) $\sqrt[5]{a^2}$ (j) $(\sqrt[6]{a})^5$ (k) $\frac{1}{\sqrt{5}}$ (l) $\frac{1}{(\sqrt[4]{7})^3}$

3. Evaluate.

(a) $25^{\frac{1}{2}}$ (b) $64^{\frac{1}{3}}$ (c) $9^{\frac{3}{2}}$ (d) $1^{\frac{9}{7}}$

(e) $36^{-\frac{1}{2}}$ (f) $98^{\frac{2}{3}}$ (g) $9^{0.5}$ (h) $8^{-\frac{1}{3}}$

(i) $(-8)^{\frac{2}{3}}$ (j) $4^{-\frac{3}{2}}$ (k) $(-8)^{\frac{1}{3}}$ (l) $(-32)^{\frac{2}{5}}$

B 4. Evaluate.

(a) $32^{\frac{4}{5}}$ (b) $8^{2\frac{1}{3}}$

(c) $100\,000^{\frac{2}{5}}$ (d) $64^{-\frac{1}{3}}$

(e) $81^{\frac{3}{4}}$ (f) $625^{-\frac{3}{4}}$

(g) $128^{\frac{8}{7}}$ (h) $3^{\frac{2}{7}} \times 3^{\frac{5}{7}}$

(i) $(6^{0.4})^5$ (j) $(49^6)^{\frac{1}{4}}$

(k) $2^{\frac{1}{5}} \times 4^{\frac{2}{5}}$ (l) $9^{\frac{3}{2}} \div 36^{-\frac{1}{2}}$

(m) $\left(\frac{8}{27}\right)^{\frac{1}{3}}$ (n) $\left(\frac{49}{144}\right)^{-\frac{1}{2}}$

(o) $\left(\frac{25}{64}\right)^{\frac{3}{2}}$ (p) $\frac{64^{\frac{2}{3}}}{216^{-\frac{1}{3}}}$

(q) $(0.16)^{\frac{1}{2}}(0.008)^{\frac{1}{3}}$ (r) $3^{\frac{1}{2}} \times 9^{\frac{1}{4}}$

(s) $256^{0.375}$ (t) $0^{1.356}$

(u) $[(\sqrt{343})^{\frac{1}{9}}]^6$ (v) $\frac{(0.09)^{-\frac{1}{2}}}{(0.125)^{-\frac{2}{3}}}$

(w) $(81^{-1})^{-\frac{1}{4}}$ (x) $\frac{(0.81)^{\frac{1}{2}} \times 6^{-3}}{(0.027)^{\frac{2}{3}}}$

5. Simplify.

(a) $2^{\frac{1}{2}} \times 2^{\frac{1}{3}}$ (b) $3^{\frac{2}{9}} \times 9^{\frac{1}{3}}$

(c) $(x^{\frac{2}{3}}y^{\frac{1}{6}})^3$ (d) $(a^{\frac{1}{4}}b^{\frac{1}{3}})^{12}$

(e) $(a^3b^6c^9)^{\frac{1}{3}}$ (f) $(x^{\frac{2}{3}} + 3x^{\frac{1}{3}})x^{\frac{1}{3}}$

(g) $(16x^8y^2)^{\frac{1}{4}}$ (h) $(64x^9y^{-3})^{\frac{2}{3}}$

(i) $(20x^2y^3z^{-1})^{\frac{3}{2}}$ (j) $\left(\frac{a^3b^{-4}}{x^{-1}y^2}\right)^2 \times \frac{x^{-1}b^{-1}}{a^{\frac{3}{2}}y^{\frac{4}{5}}}$

(k) $\sqrt[4]{\frac{y^{\frac{1}{2}}\sqrt{xy}}{x^{\frac{2}{3}}}}$ (l) $\sqrt[4]{a^{2n+1}} \times \sqrt[4]{a^{-1}}$

C 6. Find a rational approximation of each of the following to the nearest thousandth.

(a) $2^{0.4}$ (b) $3^{-1.6}$

(c) $5^{2.8}$ (d) $3^{\frac{2}{3}}$

(e) $6^{-\frac{3}{5}}$ (f) $10^{\frac{5}{7}}$

7. Determine which is the larger of each of the following pairs of numbers to the nearest thousandth.

(a) $5^{\frac{1}{3}}, 3^{\frac{1}{2}}$ (b) $7^{\frac{1}{4}}, 4^{\frac{1}{3}}$

(c) $3^{\frac{3}{2}}, 9^{\frac{2}{3}}$ (d) $6^{-\frac{1}{2}}, 14^{-\frac{1}{3}}$

MIND BENDER

Each letter represents a number. Solve the following cryptograms.

1.
```
  FORTY
    TEN
+   TEN
  SIXTY
```

2.
```
   SLED
+ SNOW
   RIDE
```

3.
```
   SLED
- SNOW
    BOB
```

EXERCISE 1.4

1. (a) $\{x \in R \mid -2 < x \leq 3\}$ (b) $\{x \in R \mid -1 \leq x \leq 1\}$
   (c) $\{x \in R \mid -3 < x < 1\}$ (d) $\{x \in R \mid x > -1\}$
2. (a) $\{x \in R \mid -3 < x < 3, x \neq 0\}$ (b) $\{x \in R \mid -3 \leq x \leq 3, x \neq 0\}$
   (c) $\{x \in R \mid x \leq 2\}$ (d) $\{x \in R \mid x \neq -1\}$

EXERCISE 1.5

1. (a) closure (+) (b) neutral element (×) (c) commutative (×) (d) associative (+)
   (e) commutative (+) (f) inverse element (−) (g) closure (×) (h) distributive
2. (a) trichotomy (b) symmetric
   (c) completeness (d) transitive property of order
   (e) transitive property of order (f) transitive — axiom of equality
   (g) symmetric — axiom of equality or commutative (h) symmetric — axiom of equality or commutative
3. (a) $a < b$ (b) $a = a$ (c) $a > b$ (d) $3a + 3b = 3(a + b)$
   (e) $x + 3 = 2x + 1$ (f) $a + b > a - b$ (g) $-1 < 3c$ (h) $0.25 = \frac{1}{4}$
4. (a) $y = 0$ (b) $y < 0$ (c) $y > 0$ (d) $y = 0$
   (e) $y > 0$ (f) $y = 0$ and $y = 1$
5. Answers vary

EXERCISE 1.6

1. (a) 2^4 (b) 2 (c) 2^5 (d) 2^{15} (e) 2^9 (f) 2^{10}
   (g) 2^7 (h) 2^5 (i) 2^{12}
2. (a) 3^3 (b) 3^5 (c) 3^6 (d) 3^9 (e) 3^4 (f) 3^9
   (g) 3^7 (h) 3^7 (i) 3^{12}
3. (a) 5^2 (b) 5^3 (c) 5^4 (d) 5^4 (e) 5^4 (f) 5^6
   (g) 5^5 (h) 5^2 (i) 5^{12}
4. (a) 72 (b) 54 (c) 48 (d) 36 (e) 216 (f) 36
   (g) 10 (h) 6 (i) 27
5. (a) 9 (b) -27 (c) 81 (d) -81 (e) -729 (f) 10
   (g) 4 (h) 18 (i) -9
6. (a) -24 (b) 576 (c) 13 (d) 20 (e) 36 (f) 16
   (g) 1 (h) 35 (i) 36
7. (a) 1.1025 (b) 1.4641 (c) 4.913 (d) 1.5625 (e) 1.003 003 001
   (f) 3.8416 (g) 2.488 32 (h) 1.061 363 55 (i) 3.051 757 81

EXERCISE 1.7

1. (a) \$2123.04 (b) \$3184.56 (c) \$6700.48 2. (a) \$5450 (b) \$1638.04 (c) \$10 305.16

EXERCISE 1.8

1. (a) 2^9 (b) 2^3 (c) $2^{(3+a)}$ (d) $2^{(b-4)}$ (e) 2^{15} (f) 2^{3a}
2. (a) 3^6 (b) 3^3 (c) $3^{(a+2)}$ (d) $3^{(m-5)}$ (e) 3^9 (f) 3^{2m}
   (g) 3^{mn} (h) $3^{(a-1)}$
3. (a) $9^4 \times 13^4$ (b) 9^4x^4 (c) $\frac{5^{18}}{6^{18}}$ (d) $\frac{x^5}{6^5}$ (e) 63^8 (f) $6^5 \times 72^5$
   (g) — (h) x^3y^3 (i) π^5 (j) π^6 (k) $\frac{2^{10}}{3^{10}}$ (l) $\frac{x^6}{y^6}$
   (m) $(2.78)^8$ (n) $(-2)^7$ (o) $\frac{9}{a^2}$ (p) $\left(\frac{a}{b}\right)^8$ (q) — (r) $8x^6$
4. (a) $-27x^{24}$ (b) $-12x^9$ (c) 3^{18} (d) a^{m+n+p} (e) 2^{24} (f) a^{mnp}
   (g) 4^4 (h) x^{3m}
5. (a) 7 (b) $\frac{1}{9}$ (c) 256 (d) 16 (e) 5 (f) 1
6. (a) $a^{2+p} - a^{2p+7}$ (b) x^{6n+8} (c) 3^{10n} (d) 2^{4n-4} (e) 2^{3n}
7. (a) x^7y^9 (b) — (c) $\frac{1}{4}x^{38}y^8$ (d) $-x^{39}y^{12}$ (e) $\frac{5y^3}{6x^4}$ (f) $\frac{a^{11}}{b^4}$
   (g) $4y^4$ (h) $\frac{x}{4y^2}$

EXERCISE 1.9

1. (a) 1 (b) $\frac{1}{9}$ (c) $\frac{1}{8}$ (d) $\frac{1}{9}$ (e) -1 (f) 1
   (g) $\frac{1}{10\,000}$ (h) $\frac{1}{837}$
2. (a) $\frac{1}{x^8}$ (b) $\frac{x^2}{y^2}$ (c) $\frac{1}{a^3b^4}$ (d) $\frac{1}{a^2}$ (e) a^{10} (f) $\left(\frac{y}{x}\right)^3$
3. (a) x^{-3} (b) $2ab^{-4}$ (c) πx^2y
4. (a) $\frac{8}{25}$ (b) 1024 (c) $\frac{27}{25}$ (d) 4 (e) 9 (f) 2
   (g) $\frac{5}{4}$ (h) $\frac{10}{21}$ (i) 2 (j) 625 (k) $\frac{45}{19}$ (l) $\frac{7}{4}$
5. (a) $\frac{343x^6}{y^9}$ (b) $\frac{a^5b^{10}}{243}$ (c) $\frac{64a^3c^9}{b^6d^{12}}$ (d) $\frac{a^2}{b^3}$ (e) $a^2b^2x^2y^4$
   (f) $\frac{a^4}{b^2} - 2\frac{a^2}{b} + 1$ (g) $a^6 + a^5 - 5a^2$ (h) $2x^2 - \frac{1}{x^2} - 1$ (i) $\frac{1}{b^{2n}}$ (j) $\frac{1}{x^{2n}} - \frac{1}{y^{2m}}$

EXERCISE 1.10

1. (a) \$9658.92 (b) \$18 655.38 (c) \$7875.66 (d) \$3655.96 (e) \$3867.65
   (f) \$457.17 (g) \$6143.17
2. \$5499.49 3. \$4319.78 4. \$5131.58

EXERCISE 1.11

1. (a) $\sqrt[9]{2}$ (b) $\sqrt{37}$ (c) $\sqrt[3]{x}$ (d) $\sqrt[3]{4}$ (e) $\sqrt{8} = 2\sqrt{2}$
   (f) $\sqrt[4]{27}$ (g) $\sqrt[5]{a^2}$ or $(\sqrt[5]{a})^2$ (h) $\sqrt[7]{x^4}$ or $(\sqrt[7]{x})^4$ (i) $\frac{1}{\sqrt{2}}$ (j) $\frac{1}{\sqrt[5]{7}}$
   (k) $\frac{1}{\sqrt{a^3}}$ (l) $\sqrt[11]{81}$
2. (a) $3^{\frac{1}{2}}$ (b) $19^{\frac{1}{2}}$ (c) $23^{\frac{1}{7}}$ (d) $x^{\frac{1}{4}}$ (e) $7^{\frac{2}{3}}$ (f) $7^{\frac{2}{3}}$
   (g) $6^{\frac{4}{5}}$ (h) $13^{\frac{2}{3}}$ (i) $a^{\frac{2}{5}}$ (j) $a^{\frac{5}{6}}$ (k) $5^{-\frac{1}{2}}$ (l) $7^{-\frac{3}{4}}$
3. (a) 5 (b) 4 (c) 27 (d) 1 (e) $\frac{1}{6}$ (f) 21.2561
   (g) 3 (h) $\frac{1}{2}$ (i) 4 (j) $\frac{1}{8}$ (k) -2 (l) 4
4. (a) 16 (b) 128 (c) 100 (d) $\frac{1}{4}$ (e) 27 (f) $\frac{1}{125}$
   (g) 256 (h) 3 (i) 36 (j) 343 (k) 2 (l) 162
   (m) $\frac{2}{3}$ (n) $\frac{12}{7}$ (o) $\frac{125}{512}$ (p) 96 (q) 0.08 (r) 3
   (s) 8 (t) 0 (u) 7 (v) $\frac{5}{6}$ (w) 3 (x) $\frac{5}{108}$
5. (a) $2^{\frac{5}{6}}$ (b) $3^{\frac{8}{3}}$ (c) $x^2y^{\frac{1}{2}}$ (d) a^3b^4 (e) ab^2c^3
   (f) $x + 3x^{\frac{2}{3}}$ (g) $2x^2y^{\frac{1}{2}}$ (h) $\frac{16x^6}{y^2}$ (i) $\frac{40\sqrt{5}\,x^3y^{\frac{9}{2}}}{z^{\frac{3}{2}}}$ (j) $\frac{a^{\frac{9}{2}}x}{b^9y^{\frac{24}{5}}}$
   (k) $\frac{y^{\frac{1}{4}}}{x^{\frac{1}{24}}}$ (l) $a^{\frac{0}{2}}$
6. (a) 1.319 507 91 (b) 0.172 427 286 (c) 90.597 458 (d) 2.080 083 82
   (e) 0.341 278 752 (f) 5.179 474 68
7. (a) $3^{\frac{1}{2}}$ (b) $7^{\frac{1}{4}}$ (c) $3^{\frac{3}{2}}$ (d) $14^{-\frac{1}{3}}$

EXERCISE 1.12

1. (a) 5 (b) 3 (c) 6 (d) 2 (e) 4 (f) 2
   (g) 3 (h) 3 (i) 4 (j) 2
2. (a) 4 (b) 3 (c) 3 (d) 16 (e) 2 (f) 4
   (g) 6 (h) 2 (i) $x \in N$ (j) $x \in N$, x even
3. (a) 2 (b) -7 (c) 5
   (d) $x = 0, \pm 2, \pm 4, \pm 6, \ldots$ (e) 2 (f) 1
   (g) 1 (h) $x \in I$ (i) 4
   (j) $-\frac{5}{2}$
4. (a) $\frac{3}{2}$ (b) $-\frac{1}{3}$ (c) $\frac{2}{3}$ (d) $-\frac{1}{4}$ (e) $\frac{1}{4}$ (f) -2
   (g) 16 (h) -1 (i) 4 (j) -2 (k) 0 (l) 4