

# Preliminaries

## Arithmetic

---

### Questions:

1) Calculate the following expressions:

$6+1$

$6-1$

$-6-1$

$-6+1$

$-5-13+9$

$5+7-23+1$

$5-8-12+17$

2) Calculate the following expressions:

a.  $2 \cdot 5$

$-2 \cdot (-5)$

$-2 \cdot 5$

b.  $2 \cdot (-5)$

$-2 \cdot 0$

$(-2) \cdot (-3) \cdot (-4)$

c.  $(-2) \cdot 3 \cdot (-4)$

3) Calculate the following expressions:

d.  $8:4$

$-50:-10$

$-15:3$

e.  $(-25):(-5)$

$(-30):(3)$

$(0):(5)$

f.  $\frac{32}{-4}$

4) Calculate the following expressions:

g.  $2^2$

$2^4$

$2^6$

h.  $-2^4$

$(-2)^4$

$(-2^4)$

i.  $-2^3$

5) Calculate the following expressions:

j.  $\sqrt{64}$                        $\sqrt[3]{64}$                        $\sqrt[5]{32}$

k.  $\sqrt{-16}$                        $\sqrt[4]{64}$                        $\sqrt[4]{-64}$

l.  $-3^4 + \sqrt[3]{-8}$

6) Calculate the following expressions:

m.  $\sqrt{169}$                        $-4^2$                        $(-3)^3$

n.  $\sqrt[3]{-27}$                        $\sqrt[4]{625}$                        $\sqrt[4]{-16}$

o.  $\sqrt[5]{-32}$

7) Calculate the following expressions:

p.  $\sqrt{196} + 5 \cdot 2^2 - 20 : 2$                        $(-2)^4 : 2 - 10 \cdot (-2)^3$

q.  $-3^2 - 4[5 + 4 \cdot (7 - 2)] + \sqrt{900}$                        $\sqrt{64} : (-4 + 2) - 4^2 \cdot (-3^2 + 10)$

r.  $\sqrt{144} - 20 : 4 + 3 \cdot (-2)^2$                        $3 + 4 \cdot [-3 + 4 \cdot (-2)] + \sqrt{10 + 6}$

$(-3)^4 : (-9) - 5 \cdot (-2)^3$

**Final Answers:**

- |                |        |        |                |        |                |
|----------------|--------|--------|----------------|--------|----------------|
| 1) a. 7        | b. 5   | c. -7  | d. -5          | e. -9  | f. -10         |
| g. 2           |        |        |                |        |                |
| 2) a. 10       | b. 10  | c. -10 | d. -10         | e. 0   | f. -24         |
| g. 24          |        |        |                |        |                |
| 3) a. 2        | b. 5   | c. -5  | d. 5           | e. -10 | f. 0           |
| g. -8          |        |        |                |        |                |
| 4) a. 4        | b. 16  | c. 64  | d. -16         | e. 16  | f. -16         |
| g. -8          |        |        |                |        |                |
| 5) a. 8        | b. 4   | c. 2   | d. no solution |        | e. 2.828       |
| f. no solution | g. -83 |        |                |        |                |
| 6) a. 13       | b. -16 | c. -27 | d. -3          | e. 5   | f. no solution |
| g. -2          |        |        |                |        |                |
| 7) a. 24       | b. 88  | c. -79 | d. -20         | e. 19  | f. -37         |
| g. 31          |        |        |                |        |                |

## Fractions

---

### Questions:

1) Write the following improper fractions as mixed numbers:

s.  $\frac{3}{2}$        $\frac{8}{5}$        $\frac{13}{2}$        $\frac{18}{4}$

2) Write the following mixed numbers as improper fractions:

t.  $2\frac{3}{8} =$        $12\frac{2}{5} =$        $6\frac{1}{2}$        $8\frac{1}{4}$

3) Which fraction is bigger?

u.  $\frac{5}{7}$  or  $\frac{3}{7}$        $\frac{3}{5}$  or  $\frac{3}{7}$        $\frac{3}{4}$  or  $\frac{4}{5}$

4) Convert the following decimals to fractions:

v. 0.3      0.02      1.012      2.75

5) Convert the following fractions to decimals:

w.  $\frac{1}{10}$        $\frac{1}{100}$        $\frac{3}{1000}$        $\frac{12}{1000}$

6) Convert the following fractions to decimals:

x.  $1\frac{12}{1000}$        $\frac{3}{50}$        $\frac{7}{20}$        $\frac{12}{25}$

7) Convert the following percentages to fractions:

y. 50%      25%      75%      15%

8) Convert the following fractions to percentages:

z.  $\frac{4}{10}$        $\frac{5}{20}$

9) Calculate the following expressions:

aa.  $\frac{1}{4} + \frac{3}{4}$        $\frac{5}{2} + \frac{7}{4}$        $\frac{3}{2} + \frac{1}{4} - \frac{5}{8}$        $\frac{2}{3} + \frac{5}{9} - \frac{1}{6}$

10) Calculate the following expressions:

bb.  $\frac{3}{4} - \frac{5}{6} + \frac{7}{5}$        $1\frac{1}{8} - \frac{11}{12}$        $1\frac{1}{9} - \frac{23}{27} + 2$        $1\frac{2}{21} - \frac{3}{14} - 3$

11) Calculate the following expressions:

cc.  $\frac{2}{3} \cdot \frac{2}{5}$        $4 \cdot \frac{2}{5}$        $2\frac{1}{3} \cdot 1\frac{1}{4}$        $3\frac{1}{3} \cdot 2\frac{2}{5}$

12) Calculate the following expressions:

dd.  $\frac{2}{3} : \frac{5}{6}$        $\frac{2}{5} : 4$        $6 : \frac{3}{4}$        $2\frac{2}{3} : 1\frac{1}{5}$

13) Calculate the following expressions:

ee.  $\frac{5}{9} : 3\frac{1}{3}$        $\left(\frac{3}{4}\right)^3$        $\frac{3^3}{4}$        $\frac{9}{20} \cdot 1\frac{1}{3} + 1\frac{1}{4} : \frac{1}{2}$

14) Calculate the following expressions:

ff.  $\frac{4}{3} \cdot \frac{2}{7}$        $5\frac{1}{3} : \frac{1}{6}$        $\frac{6}{2} \cdot \frac{2}{3} \cdot \frac{9}{4}$        $3\frac{1}{2} \cdot 4\frac{2}{5}$

15) Calculate the following expressions:

gg.  $\frac{5}{6} : 3$        $3\frac{3}{4} : 5\frac{5}{8}$        $8 \cdot \frac{3}{2} : \frac{12}{20}$

**Final Answers:**

- |                         |                    |                     |                     |
|-------------------------|--------------------|---------------------|---------------------|
| 1) a. $1\frac{1}{2}$    | b. $1\frac{3}{5}$  | c. $6\frac{1}{2}$   | d. $4\frac{1}{2}$   |
| 2) a. $\frac{19}{8}$    | b. $\frac{62}{5}$  | c. $\frac{13}{2}$   | d. $\frac{33}{4}$   |
| 3) a. $\frac{5}{7}$     | b. $\frac{3}{5}$   | c. $\frac{4}{5}$    |                     |
| 4) a. $\frac{3}{10}$    | b. $\frac{1}{50}$  | c. $1\frac{3}{250}$ | d. $2\frac{3}{4}$   |
| 5) a. 0.1               | b. 0.01            | c. 0.003            | d. 0.012            |
| 6) a. 1.012             | b. 0.06            | c. 0.35             | d. 0.48             |
| 7) a. $\frac{1}{2}$     | b. $\frac{1}{4}$   | c. $\frac{3}{4}$    | d. $\frac{3}{20}$   |
| 8) a. 40%               | b. 25%             |                     |                     |
| 9) a. 1                 | b. $4\frac{1}{4}$  | c. $1\frac{1}{8}$   | d. $1\frac{1}{18}$  |
| 10) a. $1\frac{19}{60}$ | b. $\frac{5}{24}$  | c. $2\frac{7}{27}$  | d. $-2\frac{6}{42}$ |
| 11) a. $\frac{4}{15}$   | b. $1\frac{3}{5}$  | c. $2\frac{11}{12}$ | d. 8                |
| 12) a. $\frac{4}{5}$    | b. $\frac{1}{10}$  | c. 8                | d. $2\frac{2}{9}$   |
| 13) a. $\frac{1}{6}$    | b. $\frac{27}{64}$ | c. $6\frac{3}{4}$   | d. $3\frac{1}{10}$  |
| 14) a. $\frac{8}{21}$   | b. 32              | c. $1\frac{4}{5}$   | d. $15\frac{2}{5}$  |
| 15) a. $\frac{5}{18}$   | b. $\frac{2}{3}$   | c. 20               |                     |

## Algebraic Expressions

### Questions:

- 1) Evaluate the following algebraic expressions using substitution.
- a.  $(x+y)^3$ ,  $x=5, y=-4$   $a^5 - 3a^4 - a^3 + 7$ ,  $a=-1$
- b.  $16m^2 - 9n^2$ ,  $m=\frac{1}{2}, n=-\frac{1}{3}$   $\frac{4a^2 - 3b}{c}$ ,  $a=-1, b=2, c=-4$
- 2) Evaluate the following algebraic expressions using substitution.
- a.  $\frac{(a-2c)^4}{a} - a^2$ ,  $a=2, c=-2$   $a^2 + 2ab + b^2$ ,  $a=3, b=-5$
- b.  $(x-3)^2 + 3x^2b$ ,  $x=5, b=-1$   $-x^3 - 2xy + y^4$ ,  $x=-2, y=-1$
- 3) Combine [collect] like terms.
- a.  $5x + 3x - 12x$   $a^5 + a^5$
- b.  $7m + 11 - 9m - 2$   $1 + b^2 - 2b - 3 - 2b^2$
- 4) Evaluate the following algebraic expressions using substitution.
- a.  $4ab - 3a^2b + 3b^2a - 5ab$   $x^2y - xy + 3y^2x + 9xy - 5xy^2$
- b.  $10m^2n - \{3mn^2 - [m^2n - 2m]5\}$   $8a^2 + 10a - 5a^2 - 11a + a^2$
- c.  $5a^2b - 8ab^2 + 20a^2b - 14ab^2$
- 5) Expand the brackets:
- a.  $2(x+4)$   $x(x+5)$
- b.  $7(a-3)$   $-2(b-2x)$
- 6) Expand the brackets:
- a.  $x(x^2 + 3x - 2)$   $\frac{2}{3}(6x - 3y)$
- b.  $-(5y - 7)$   $(3x + 2y)5$



---

**Special Binomial Products**

---

**Questions:**

1) Expand the following Square Binomials:

a.  $(x+2)^2$       b.  $(a+3)^2$       c.  $(b+1)^2$       d.  $\left(c+\frac{1}{4}\right)^2$

2) Expand the following Square Binomials:

a.  $(2m+5)^2$       b.  $(5y+4t)^2$       c.  $(x^2y+11)^2$

3) Expand each of the following as a Difference of Squares:

a.  $(x-7)(x+7)$       b.  $(9-x)(9+x)$       c.  $(3x-4)(3x+4)$

4) Simplify the following by taking out a Common Factor.

a.  $2x-4$       b.  $3x-6$       c.  $80-4x$       d.  $64+8a$

5) Simplify the following by taking out a Common Factor:

a.  $x^2+3x$       b.  $x^3-x$       c.  $x^5-2x^2$       d.  $4x^3+12x^2$

6) Factorize the following as Square Binomials:

a.  $x^2+6x+9$       b.  $9a^2+12a+4$   
c.  $12x^2+60x+75$       d.  $x^2-16x+64$

7) Factorize the following as Special Binomial Products:

[Difference of Squares or Square Binomials]

a.  $a^2-10a+25$       b.  $2x^2-36x+162$   
c.  $x^2-16$       d.  $a^2-9$

8) Simply the following by using Special Binomial Products:

[Difference of Squares or Square Binomials]

a.  $81-x^2$       b.  $100x^2-49$       c.  $49x-x^3$   
d.  $x^3-x$       e.  $m^2-9$



**Final Answers:**

- 1) a.  $x^2 + 4x + 4$                       b.  $a^2 + 6a + 9$                       c.  $b^2 + 2b + 1$   
d.  $c^2 + \frac{1}{2}c + \frac{1}{16}$
- 2) a.  $4m^2 + 20m + 25$                       b.  $25y^2 + 40yt + 16t^2$   
c.  $x^4y^2 + 22x^2y + 121$
- 3) a.  $x^2 - 49$                       b.  $81 - x^2$                       c.  $9x^2 - 16$
- 4) a.  $2(x - 2)$                       b.  $3(x - 2)$                       c.  $4(20 - x)$                       d.  $8(8 + a)$
- 5) a.  $x(x + 3)$                       b.  $x(x^2 - 1)$                       c.  $x^2(x^3 - 2)$                       d.  $4x^2(x + 3)$
- 6) a.  $(x + 3)^2$                       b.  $(3a + 2)^2$                       c.  $3(2x + 5)^2$                       d.  $(x - 8)^2$
- 7) a.  $(a - 5)^2$                       b.  $2(x - 9)^2$                       c.  $(a + 3)(a - 3)$                       d.  $(x + 4)(x - 4)$
- 8) a.  $(9 + x)(9 - x)$                       b.  $(10x + 7)(10x - 7)$                       c.  $x(7 + x)(7 - x)$   
d.  $x(x + 1)(x - 1)$                       e.  $(m + 3)(m - 3)$

## Rational Expressions

### Questions:

1) In problems 1-3 reduce the rational expressions to lowest terms.

$$1. \frac{x^2 + 4x}{2x^2 - 5x}$$

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

$$3. \frac{x^2 - 2x - 8}{x^2 - 4}$$

2) In problems 1-4 perform the indicated operation and reduce the answer to lowest terms.

$$1. \frac{x^2 + x - 2}{x^2 - x - 6} \cdot \frac{x^2 + 2x - 15}{x^2 + 3x - 4}$$

$$2. \frac{x^2 - 9}{x^2 + 4x - 21} \div \frac{x^2 + 6x - 27}{x^2 + 14x + 45}$$

$$3. \frac{x^2 - 4x + 3}{x^2 + 4x - 5} \div \frac{x^2 + 6x - 27}{x^2 + 14x + 45}$$

$$4. \frac{\frac{3}{x^2 - 4}}{\frac{x + 5}{x^2 + 8x - 20}}$$

### Final Answers:

$$1) \quad 1. \frac{x+4}{2x-5}$$

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

$$3. \frac{x-4}{x-2}$$

$$2) \quad 1. \frac{x+5}{x+4}$$

$$2. \frac{x+2}{x-1}$$

$$3. 1$$

$$4. \frac{3(x+10)}{(x+2)(x+5)}$$

---

**Complex Numbers**

---

**Questions:**

1) Evaluate each of the following and write your answers in standard form.

1.  $(4+i)+(3-2i)$

2.  $(-2+3i)-(4-5i)$

3.  $3(2+i)-5(6+2i)$

4.  $i(4+i)+3i(-5+2i)$

5.  $2i(3+i)+4(2-3i)$

2) Perform the following multiplications and write your answers in standard form.

1.  $(4+i)\cdot(3-2i)$

2.  $(-2+3i)\cdot(4-5i)$

3.  $(-4-2i)\cdot(-2+3i)$

4.  $(2-4i)\cdot(1-3i)$

5.  $(4-2i)\cdot(4+2i)$

3) Compute the following powers [exponents] and write your answer in standard form.

1.  $i^8$

2.  $i^{15}$

3.  $(-i)^6$

4.  $(-i)^9$

5.  $(2i+3)^2$

6.  $(i^5 - i^{13})^2$

4) Perform the following divisions and write your answers in standard form.

1.  $\frac{5}{2+i}$

2.  $\frac{2+3i}{5-2i}$

3.  $\frac{6-i}{-4i}$

4.  $\frac{4+2i}{4-2i}$

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

5) Write with  $i$ , ( $i = \sqrt{-1}$ ):

1.  $\sqrt{-4}$

2.  $\sqrt{-9}$

3.  $\sqrt{-5}$

6) Solve the following equations:

1.  $x^2 + 36 = 0$

2.  $x^2 - 2x + 5 = 0$

3.  $t^2 - 4t + 5 = 0$

4.  $4z^2 + 12z + 25 = 0$

5.  $4z^2 + 16z + 25 = 0$

6.  $(1+i)z^2 + 2z + 1 - i = 0$

**Final Answers:**

- 1) 1.  $7-i$                       2.  $-6+8i$                       3.  $-24-7i$                       4.  $-7-11i$   
     5.  $6-6i$
- 2) 1.  $14-5i$                       2.  $7+22i$                       3.  $14-8i$                       4.  $-10-10i$   
     5. 20
- 3) 1. 1                      2.  $-i$                       3. -1                      4.  $-i$                       5.  $5+12i$                       6. 0
- 4) 1.  $2-i$                       2.  $\frac{4}{29} + \frac{19}{29}i$                       3.  $\frac{1}{4} + \frac{3}{2}i$                       4.  $\frac{3}{5} + \frac{4}{5}i$   
     5.  $-\frac{19}{169} - \frac{22}{169}i$
- 5) 1.  $2i$                       2.  $3i$                       3.  $\sqrt{5} \cdot i$
- 6) 1.  $\pm 6i$                       2.  $1 \pm 2i$                       3.  $2 \pm i$                       4.  $-\frac{3}{2} \pm 2i$                       5.  $-2 \pm \frac{3}{2}i$                       6.  $i, -1$