

MATHEMATICS FOR 8<sup>TH</sup> CLASS (UNIT 3)

ASAN Math For Class 8<sup>th</sup>

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UNIT 3

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EXERCISE 3.1

1. Write the following binary numbers in words.

(i)  $(1011)_2$

Digits	1	0	1	1
Place value	Eight	Four	Two	Unit

= 1 eight, 0 four, 1 two and 1 unit

(ii)  $(11110)_2$

Digits	1	1	1	1	0
Place value	Sixteen	Eight	Four	Two	Units

= 1 sixteen, 1 eight, 1 four, 1 two, and unit 1

(iii)  $(100011)_2$

Digits	1	0	0	0	1	1
Place value	Thirty two	Sixteen	Eight	Four	Two	Unit

= 1 thirty two, 0 sixteen, 0 eight, 0 four, 1 two, and 1 unit

(iv)  $(100110)_2$

Digits	1	1	0	0	1	1	0
Place value	Sixty four	Thirty two	Sixteen	Eight	Four	Two	Unit

= 1 sixty four, 1 thirty two, 0 sixteen, 0 eight, 1 four, 1 two, 0 unit

2. Write the following numbers in binary digits.

(i) 1 sixteen, 0 eight, 0 four, 1 two, 1 unit

=  $(10011)_2$

Digits	1	0	0	1	1
Place value	Sixteen	Eight	Four	Two	Units

(ii) 1 thirty two, 1 eight, 1 four, 1 two

=  $(101110)_2$

Digits	Thirty two	Sixteen	Eight	Four	Two	Unit
Place Value	1	0	1	1	1	0



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- (iii) 1 sixty four, 1 thirty two, 1 sixteen, 1 unit  
=  $(1110001)_2$

Digits	Sixty four	Thirty two	Sixteen	Eighteen	Four	Two	Unit
Place value	1	1	1	0	0	0	1

3. Write the following base five numbers in words.

- (i)  $(124)_5$

Digits	1	2	4
Place value	Twenty five	Five	Unit

1 twenty five, 2 five, 4 unit

- (ii)  $(2233)_5$

Digits	2	2	3	3
Place value	One twenty five	Twenty five	Five	Unit

2 one twenty five, 2 twenty five, 3 five, 3 unit

- (iii)  $(10411)_5$

Digits	1	0	4	1	1
Place value	Six twenty five	One twenty five	Twenty five	Five	Unit

1 six twenty five, 0 one twenty five, 4 twenty five, 1 five, 1 unit

- (iv)  $(4003)_5$

Digits	4	0	0	3
Place value	One twenty five	Twenty five	Five	Unit

4 one twenty five, 0 twenty five, 0 five, 3 unit

4. Write the following numbers in base five digits.

- (i) 3 twenty five, 2 five, 1 unit

$$= (321)_5$$

- (ii) 1 one hundred twenty five, 4 twenty five, 3 fives

$$= (1430)_5$$

- (iii) 2 six hundred twenty five, 1 twenty five, 2 fives, 1 unit

$$= (20121)_5$$



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5. Write the following octal numbers in words.

(i)  $(34)_8$

Digits	3	4
Place value	Eight	Unit

(ii)  $(650)_8$

Digits	6	5	0
Place value	Sixty four	Eight	Unit

(iii)  $(1155)_8$

Digits	1	1	5	5
Place value	Five hundred twelve	Sixty four	Eight	Unit

(iv)  $(6002)_8$

Digits	6	0	0	2
Place value	Five hundred twelve	Sixty four	Eight	Unit

6. Write the following numbers in base eight digits.

(i) 6 sixty fours, 4 units

$$= (504)_8$$

(ii) 6 five hundred twelve, 4 sixty fours, 3 eight, 7 units

$$(6437)_8$$

(iii) 1 five hundred twelve, 5 eights, 6 units

$$= (1056)_8$$

7. Write place value of each digit in the following numbers.

(i)  $(1203)_{10}$

Digits	1	2	0	3
Place value	Thousand	Hundred	ten	Unit

(ii)  $(52341)_{10}$

Digits	5	2	3	4	1
Place value	Ten thousand	Thousand	Hundred	Ten	Unit

(iii)  $(10101)_2$

Digits	1	0	1	0	1
Place value	Sixteen	Eight	Four	two	Unit

(iv)  $(100111)_2$

Digits	1	0	0	1	1	1
Place value	Thirty two	Sixteen	Eight	Four	Two	Unit



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(v)  $(1001101)_2$

Digits	1	0	0	1	1	0	1
Place value	Sixty four	Thirty two	Sixteen	Eight	Four	Two	Unit

(vi)  $(4103)_5$

Digits	4	1	0	3
Place value	One twenty five	Twenty five	Five	Unit

(vii)  $(12204)_5$

Digits	1	2	2	0	4
Place value	Six hundred Twenty five	One hundred Twenty five	Twenty five	Five	Unit

(viii)  $(40341)_5$

Digits	4	0	3	4	1
Place value	Six hundred Twenty five	One hundred Twenty five	Twenty five	Five	Unit

(ix)  $(513)_8$

Digits	5	1	3
Place value	Sixty four	Eight	Unit

(x)  $(6701)_8$

Digits	6	7	0	1
Place value	Five hundred twelve	Sixty four	Eight	Unit

(xi)  $(1254)_8$

Digits	1	2	5	4
Place value	Five hundred twelve	Sixty four	Eight	Unit

(xii)  $(2043)_8$

Digits	2	0	4	3
Place value	Five hundred twelve	Sixty four	Eight	Unit

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**EXERCISE 3.2**

1. Convert the following decimal number into an equivalent number with base.

(i) 9

2	9
2	8 - 1
2	2 - 0
	1 - 0

$(1001)_2$

(iii) 37

2	37
2	18 - 1
2	9 - 0
2	4 - 1
2	2 - 0
	1 - 0

$(100101)_2$

(v) 111

2	111
2	55 - 1
2	27 - 1
2	13 - 1
2	6 - 1
2	3 - 0
	1 - 1

$(1101111)_2$

(vi) 1578

2	1578
---	------

(ii) 20

2	20
2	10 - 0
2	5 - 0
2	2 - 1
	1 - 0

$(10100)_2$

(iv) 60

2	60
2	30 - 0
2	15 - 0
2	7 - 0
2	3 - 1
	1 - 1

$(11100)_2$

(vi) 864

2	864
2	432 - 0
2	216 - 0
2	108 - 0
2	54 - 0
2	27 - 0
2	13 - 1
2	6 - 1
2	3 - 0
	1 - 1

$(1101100000)_2$

(viii) 1300

2	1300
	650 - 1



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2	394 - 1
2	197 - 0
2	98 - 1
2	49 - 0
2	24 - 1
2	12 - 0
2	6 - 0
2	3 - 0
	1 - 1

$(11000101010)_2$

2	325 - 0
2	162 - 1
2	81 - 0
2	40 - 1
2	20 - 0
2	10 - 0
2	5 - 0
2	2 - 1
	1 - 0

$(10100010100)_2$

2. *Convert the following numbers of binary system into decimal system.*

(i)  $(10)_2$   
 $= (1 \times 2^1) + (0 \times 2^0)$   
 $= 1 \times 2 + (0 \times 1)$   
 $= 2 + 0$   
 $= 2$

(ii)  $(111)_2$   
 $= (1 \times 2^2) + (1 \times 2^1) + (0 \times 2^0)$   
 $= (1 \times 4) + (1 \times 2) + (1 \times 1)$   
 $= 4 + 2 + 1$   
 $= 7$

(iii)  $(100101)_2$   
 $= (1 \times 2^5) + (0 \times 2^4) + (0 \times 2^3) + (1 \times 2^2) + (0 \times 2^1) + (1 \times 2^0)$   
 $= (1 \times 32) + (0 \times 16) + (0 \times 8) + (1 \times 4) + (0 \times 2) + (1 \times 1)$   
 $= 32 + 0 + 0 + 4 + 0 + 1$   
 $= 37$

(iv)  $(1110011)_2$   
 $= (1 \times 2^6) + (1 \times 2^5) + (1 \times 2^4) + (0 \times 2^3) + (0 \times 2^2)$   
 $\quad \quad \quad + (1 \times 2^1) + (1 \times 2^0)$   
 $= (1 \times 64) + (1 \times 32) + (1 \times 16) + (0 \times 4) + (1 \times 2) + (1 \times 1)$   
 $= 64 + 32 + 16 + 0 + 2 + 1$   
 $= 115$

(v)  $(1010101001)_2$   
 $= (1 \times 2^9) + (0 \times 2^8) + (1 \times 2^7) + (0 \times 2^6) + (1 \times 2^5) + (0 \times 2^4)$   
 $\quad \quad \quad + (1 \times 2^3) + (0 \times 2^2) + (0 \times 2^1) + (1 \times 2^0)$   
 $= (1 \times 512) + (0 \times 256) + (1 \times 128) + (0 \times 64) + (1 \times 32)$   
 $\quad \quad \quad + (0 \times 16) + (1 \times 8) + (0 \times 4) + (0 \times 2) + (1 \times 1)$

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$$= 512 + 0 + 128 + 0 + 32 + 0 + 8 + 0 + 0 + 1$$

$$= 681$$

(vi)  $(100110101)_2$

$$= (1 \times 2^8) + (0 \times 2^7) + (0 \times 2^6) + (1 \times 2^5) + (1 \times 2^4)$$

$$+ (0 \times 2^3) + (1 \times 2^2) + (0 \times 2^1) + (1 \times 2^0)$$

$$= (1 \times 256) + (0 \times 128) + (0 \times 64) + (1 \times 32) + (1 \times 16)$$

$$+ (0 \times 8) + (1 \times 4) + (0 \times 2) + (1 \times 1)$$

$$= 256 + 0 + 0 + 32 + 16 + 0 + 4 + 0 + 1$$

$$= 309$$

3. *Convert the following decimal numbers into equivalent numbers of base five system.*

(i) 8

5	8
	1 - 3

$$= (13)_5$$

(ii) 18

5	18
	3 - 3

$$= (33)_5$$

(iii) 32

5	32
	6 - 2

$$= (62)_5$$

(ii) 65

5	65
5	13 - 0
	2 - 3

$$= (230)_5$$

(vi) 123

5	123
5	24 - 3
	4 - 4

$$= (443)_5$$

(vi) 306

5	306
5	61 - 1
5	12 - 1
	2 - 2

$$= (2211)_5$$

(vii) 729

5	729
5	145 - 4
5	29 - 0
5	5 - 4
	1 - 0

$$= (10404)_5$$

(viii) 1999

5	1999
5	399 - 4
5	79 - 4
5	15 - 4
	3 - 0

$$= (30444)_5$$



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(ix) 2104

5	2104
5	420 - 4
5	84 - 0
5	16 - 4
	3 - 1

$$= (31404)_5$$

(xi) 26921

5	26921
5	5384 - 1
5	1076 - 4
5	215 - 1
5	43 - 0
5	8 - 3
	3 - 3

$$= (3330141)_5$$

(x) 5000

5	5000
5	1000 - 0
5	200 - 0
5	40 - 0
5	8 - 0
	1 - 3

$$= (130000)_5$$

(xii) 60917

5	60917
5	12183 - 2
5	2436 - 3
5	487 - 1
5	97 - 2
5	19 - 2
	3 - 4

$$= (3422132)_5$$

**4. Convert the following numbers into decimal system.**

(i)  $(43)_5$

$$\begin{aligned} &= (4 \times 5^1) + (3 \times 5^0) \\ &= (4 \times 5) + (3 \times 1) \\ &= 20 + 3 \\ &= 23 \end{aligned}$$

(ii)  $(214)_5$

$$\begin{aligned} &= (2 \times 5^2) + (1 \times 5^1) + (4 \times 5^0) \\ &= (2 \times 25) + (1 \times 5) + (4 \times 1) \\ &= 50 + 5 + 4 \\ &= 59 \end{aligned}$$

(iii)  $(2431)_5$

$$\begin{aligned} &= (2 \times 5^3) + (4 \times 5^2) + (3 \times 5^1) + (1 \times 5^0) \\ &= (2 \times 125) + (4 \times 25) + (3 \times 5) + (1 \times 1) \\ &= 250 + 100 + 15 + 1 \\ &= 366 \end{aligned}$$

(iv)  $(31224)_5$

$$\begin{aligned} &= (3 \times 5^4) + (1 \times 5^3) + (2 \times 5^2) + (2 \times 5^1) + (4 \times 5^0) \\ &= (3 \times 625) + (1 \times 125) + (2 \times 25) + (2 \times 5) + (4 \times 1) \\ &= 1875 + 125 + 50 + 10 + 4 \\ &= 2064 \end{aligned}$$



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$$\begin{aligned}
 \text{(v)} \quad (100232)_5 &= (1 \times 5^4) + (0 \times 5^4) + (0 \times 5^3) + (2 \times 5^2) + (3 \times 5^1) + (2 \times 5^0) \\
 &= (1 \times 3125) + (0 \times 625) + (0 \times 125) + (2 \times 25) + (3 \times 5) \\
 &\quad + (2 \times 1) \\
 &= 3125 + 0 + 0 + 50 + 15 + 2 = 3192
 \end{aligned}$$

$$\begin{aligned}
 \text{(vi)} \quad (203404)_5 &= (2 \times 5^5) + (0 \times 5^4) + (3 \times 5^3) + (4 \times 5^2) + (0 \times 5^1) + (4 \times 5^0) \\
 &= (2 \times 3125) + (0 \times 625) + (3 \times 125) + (4 \times 25) + (0 \times 5) \\
 &\quad + (4 \times 1) \\
 &= 6250 + 0 + 375 + 100 + 0 + 4 = 6729
 \end{aligned}$$

$$\begin{aligned}
 \text{(vii)} \quad (102030)_5 &= (1 \times 5^5) + (0 \times 5^4) + (2 \times 5^3) + (0 \times 5^2) + (3 \times 5^1) + (0 \times 5^0) \\
 &= (1 \times 3125) + (0 \times 625) + (2 \times 125) + (0 \times 25) + (3 \times 5) \\
 &\quad + (0 \times 1) \\
 &= 3125 + 0 + 250 + 0 + 15 + 0 = 3390
 \end{aligned}$$

$$\begin{aligned}
 \text{(viii)} \quad (44444)_5 &= (4 \times 5^4) + (4 \times 5^3) + (4 \times 5^2) + (4 \times 5^1) + (4 \times 5^0) \\
 &= (4 \times 625) + (4 \times 125) + (4 \times 25) + (4 \times 5) + (4 \times 1) \\
 &= 2500 + 500 + 100 + 20 + 4 = 3124
 \end{aligned}$$

$$\begin{aligned}
 \text{(ix)} \quad (112233)_5 &= (1 \times 5^5) + (1 \times 5^4) + (2 \times 5^3) + (2 \times 5^2) + (3 \times 5^1) + (3 \times 5^0) \\
 &= (1 \times 3125) + (1 \times 625) + (2 \times 125) + (2 \times 25) + (3 \times 5) \\
 &\quad + (3 \times 1) \\
 &= 3125 + 625 + 250 + 50 + 15 + 3 = 4068
 \end{aligned}$$

5. *Convert the following decimal numbers into equivalent numbers of base eight system.*

$$\begin{array}{r}
 \text{(i)} \quad 8 \quad \begin{array}{|l} 8 \\ \hline 1-0 \end{array} \\
 \hline
 = (10)_8
 \end{array}$$

$$\begin{array}{r}
 \text{(ii)} \quad 22 \quad \begin{array}{|l} 22 \\ \hline 2-6 \end{array} \\
 \hline
 = (26)_8
 \end{array}$$



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(iii) 37

$$\begin{array}{r|l} 8 & 37 \\ \hline & 4 - 5 \end{array}$$

$$= (45)_8$$

(v) 132

$$\begin{array}{r|l} 8 & 132 \\ \hline 8 & 16 - 4 \\ \hline & 2 - 0 \end{array}$$

$$= (204)_8$$

(vii) 624

$$\begin{array}{r|l} 8 & 624 \\ \hline 8 & 78 - 0 \\ \hline 8 & 9 - 6 \\ \hline & 1 - 1 \end{array}$$

$$= (1160)_8$$

(ix) 2013

$$\begin{array}{r|l} 8 & 2013 \\ \hline 8 & 251 - 5 \\ \hline 8 & 31 - 3 \\ \hline & 3 - 7 \end{array}$$

$$= (3735)_8$$

(xi) 27823

$$\begin{array}{r|l} 8 & 27823 \\ \hline 8 & 3477 - 7 \\ \hline 8 & 434 - 5 \\ \hline 8 & 54 - 2 \\ \hline & 6 - 6 \end{array}$$

$$= (66257)_8$$

(iv) 69

$$\begin{array}{r|l} 8 & 69 \\ \hline 8 & 8 - 5 \\ \hline & 1 - 0 \end{array}$$

$$= (105)_8$$

(vi) 700

$$\begin{array}{r|l} 8 & 700 \\ \hline 8 & 87 - 4 \\ \hline 8 & 10 - 7 \\ \hline & 1 - 2 \end{array}$$

$$= (1274)_8$$

(viii) 1789

$$\begin{array}{r|l} 8 & 1789 \\ \hline 8 & 223 - 5 \\ \hline 8 & 27 - 7 \\ \hline & 3 - 3 \end{array}$$

$$= (3375)_8$$

(x) 4760

$$\begin{array}{r|l} 8 & 4760 \\ \hline 8 & 595 - 0 \\ \hline 8 & 74 - 3 \\ \hline 8 & 9 - 2 \\ \hline & 1 - 1 \end{array}$$

$$= (11230)_8$$

(xii) 61092

$$\begin{array}{r|l} 8 & 61092 \\ \hline 8 & 7636 - 4 \\ \hline 8 & 954 - 4 \\ \hline 8 & 119 - 2 \\ \hline 8 & 14 - 7 \\ \hline & 1 - 6 \end{array}$$

$$= (167244)_8$$



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**6. Convert the following octal numbers into decimal system.**

(i)  $(63)_8$

$$= (6 \times 8^1) + (3 \times 8^0)$$

$$= (6 \times 8) + (3 \times 1)$$

$$= 48 + 3$$

$$= 51$$

(ii)  $(217)_8$

$$= (2 \times 8^2) + (1 \times 8^1) + (7 \times 8^0)$$

$$= (2 \times 64) + (1 \times 8) + (7 \times 1)$$

$$= 128 + 8 + 7$$

$$= 143$$

(iii)  $(2435)_8$

$$= (2 \times 8^3) + (4 \times 8^2) + (3 \times 8^1) + (5 \times 8^0)$$

$$= (2 \times 512) + (4 \times 64) + (3 \times 8) + (5 \times 1)$$

$$= 1024 + 256 + 24 + 5 = 1309$$

(iv)  $(31264)_8$

$$= (3 \times 8^4) + (1 \times 8^3) + (2 \times 8^2) + (6 \times 8^1) + (4 \times 8^0)$$

$$= (3 \times 4096) + (1 \times 512) + (2 \times 64) + (6 \times 8) + (4 \times 1)$$

$$= 12288 + 512 + 128 + 48 + 4 = 12980$$

(v)  $(10237)_8$

$$= (1 \times 8^4) + (0 \times 8^3) + (2 \times 8^2) + (3 \times 8^1) + (7 \times 8^0)$$

$$= (1 \times 4096) + (0 \times 512) + (2 \times 64) + (3 \times 8) + (7 \times 1)$$

$$= 4096 + 0 + 128 + 24 + 7 = 4255$$

(vi)  $(20544)_8$

$$= (2 \times 8^4) + (0 \times 8^3) + (5 \times 8^2) + (4 \times 8^1) + (4 \times 8^0)$$

$$= (2 \times 4096) + (0 \times 512) + (5 \times 64) + (4 \times 8) + (4 \times 1)$$

$$= 8192 + 0 + 320 + 32 + 4 = 8548$$

(vii)  $(100230)_8$

$$= (1 \times 8^5) + (0 \times 8^4) + (0 \times 8^3) + (2 \times 8^2) + (3 \times 8^1) + (0 \times 8^0)$$

$$= (1 \times 32768) + (0 \times 4096) + (0 \times 512) + (2 \times 64)$$

$$+ (3 \times 8) + (0 \times 1)$$

$$= 32768 + 0 + 0 + 128 + 24 + 0 = 32920$$

(viii)  $(55555)_8$

$$= (5 \times 8^4) + (5 \times 8^3) + (5 \times 8^2) + (5 \times 8^1) + (5 \times 8^0)$$

$$= (5 \times 4096) + (5 \times 512) + (5 \times 64) + (5 \times 8) + (5 \times 1)$$

$$= 20480 + 2560 + 320 + 40 + 5 = 23405$$



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$$\begin{aligned} \text{(ix)} \quad (7777)_8 &= (7 \times 8^3) + (7 \times 8^2) + (7 \times 8^1) + (7 \times 8^0) \\ &= (7 \times 512) + (7 \times 64) + (7 \times 8) + (7 \times 1) \\ &= 3584 + 448 + 56 + 7 = 4095 \end{aligned}$$

**EXERCISE 3.3**

1. Simplify the following.

$$\text{(i)} \quad (111)_2 + (101)_2$$

$$\begin{array}{r} (111)_2 \\ + (101)_2 \\ \hline \end{array}$$

$$(1100)_2$$

$$\text{(ii)} \quad (1011)_2 + (1010)_2$$

$$\begin{array}{r} (1011)_2 \\ + (1010)_2 \\ \hline \end{array}$$

$$(10101)_2$$

$$\text{(iii)} \quad (111100111)_2 + (1001101110)_2$$

$$\begin{array}{r} (111100111)_2 \\ + (1001101110)_2 \\ \hline \end{array}$$

$$(10001010101)_2$$

$$\text{(iv)} \quad (110110110110)_2 + (10110111011)_2$$

$$\begin{array}{r} (110110110110)_2 \\ + (10110111011)_2 \\ \hline \end{array}$$

$$(1001101110001)_2$$

$$\text{(v)} \quad (101001100010)_2 + (1111011110)_2$$

$$\begin{array}{r} (101001100010)_2 \\ + (1111011110)_2 \\ \hline \end{array}$$

$$(111001000000)_2$$



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2. *Simplify the following.*

(i)  $(111)_2 - (110)_2$

$$\begin{array}{r} (111)_2 \\ - (110)_2 \\ \hline \end{array}$$

$$(001)_2$$

(ii)  $(1101)_2 - (111)_2$

$$\begin{array}{r} (1101)_2 \\ - (111)_2 \\ \hline \end{array}$$

$$(110)_2$$

(iii)  $(1101000)_2 - (111011)_2$

$$\begin{array}{r} (1101000)_2 \\ - (111011)_2 \\ \hline \end{array}$$

$$(101101)_2$$

(iv)  $(101100110)_2 - (10101101)_2$

$$\begin{array}{r} (101100110)_2 \\ - (10101101)_2 \\ \hline \end{array}$$

$$(10111001)_2$$

(v)  $(1000000)_2 - (111111)_2$

$$\begin{array}{r} (1000000)_2 \\ - (111111)_2 \\ \hline \end{array}$$

$$(000001)_2$$

3. *Simplify the following.*

(i)  $(1011)_2 + (1101)_2 + (1110)_2$

$$\begin{array}{r} (1011)_2 \\ + (1101)_2 \\ \hline \end{array}$$

$$\begin{array}{r} (11000)_2 \\ + (1110)_2 \\ \hline \end{array}$$

$$(100110)_2$$



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(ii)  $(1101)_2 - (10101)_2 + (100101)_2$

$$\begin{array}{r} (100101)_2 \\ + (1101)_2 \\ \hline (110010)_2 \\ - (10101)_2 \\ \hline (11101)_2 \end{array}$$

(iii)  $(110101)_2 - \{(1010)_2 + (1110)_2\}$

$$\begin{array}{r} (1010)_2 \\ + (1110)_2 \\ \hline (11000)_2 \end{array} \quad \begin{array}{r} (110101)_2 \\ - (11000)_2 \\ \hline (11101)_2 \end{array}$$

$$(110101)_2 - (11000)_2$$

(iv)  $(100000)_2 - \{(11101)_2 - (10011)_2\}$

$$\begin{array}{r} (11101)_2 \\ - (10011)_2 \\ \hline (01010)_2 \end{array} \quad \begin{array}{r} (100000)_2 \\ - (01010)_2 \\ \hline (10110)_2 \end{array}$$

$$(100000)_2 - (01010)_2 = (10110)_2$$

4. Evaluate the following binary numbers.

(i)  $(111)_2 \times (11)_2$

$$\begin{array}{r} (111)_2 \\ \times (11)_2 \\ \hline (111)_2 \\ (1110)_2 \\ \hline (10101)_2 \end{array}$$

(ii)  $(10101)_2 \times (1010)_2$

$$\begin{array}{r} (10101)_2 \\ \times (1010)_2 \\ \hline (00000)_2 \\ (101010)_2 \\ (0000000)_2 \\ (10101000)_2 \\ 101010000 \\ \hline (11010010)_2 \end{array}$$



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(iii)  $(11011)_2 \times (10110)_2$

$$\begin{array}{r} (11011)_2 \\ \times (10110)_2 \\ \hline (00000)_2 \\ (110110)_2 \\ (1101100)_2 \\ (00000000)_2 \\ (110110000)_2 \\ \hline \end{array}$$

$(1001010010)_2$

(v)  $(1010101010)_2 \times (10101)_2$

$$\begin{array}{r} (1010101010)_2 \\ \times (10101)_2 \\ \hline (1010101010)_2 \\ (000000000000)_2 \\ (101010101000)_2 \\ (00000000000000)_2 \\ (10101010100000)_2 \\ \hline \end{array}$$

$(1101111110010)_2$

(vi)  $(101100101)_2 \times (11010)_2$

$$\begin{array}{r} (101100101)_2 \\ \times (11010)_2 \\ \hline (0000000000)_2 \\ (1011001010)_2 \\ (000000000000)_2 \\ \hline \end{array}$$

(iv)  $(1001)_2 \times (1011010)_2$

$$\begin{array}{r} (1011010)_2 \\ \times (1001)_2 \\ \hline (1011010)_2 \\ (00000000)_2 \\ (0000000000)_2 \\ (1011010000)_2 \\ \hline (1100101010)_2 \end{array}$$



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EXERCISE 12.1

$$(101100101000)_2$$

$$(1011001010000)_2$$

$$(1001000100010)_2$$

$$(vii) (101)_2 \times (11)_2 \times (111)_2$$

$$(101)_2$$

$$\times (110)_2$$

$$(101)_2$$

$$(1010)_2$$

$$(10100)_2$$

$$\times (111)_2$$

$$(10100)_2$$

$$(101000)_2$$

$$(1010000)_2$$

$$(10001100)_2$$

$$(viii) \{(110)_2 \times (1101)_2\} \times (11)_2$$

$$(1101)_2$$

$$\times (110)_2$$

$$(0000)_2$$

$$(11010)_2$$

$$(110100)_2$$

$$(1001110)_2$$

$$\times (11)_2$$



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Number Systems

$$\begin{array}{r} (1001110)_2 \\ (10011100)_2 \\ \hline \end{array}$$

$$(10001100)_2$$

**EXERCISE 3.4**

1. Evaluate the following.

(1)  $(32)_5 + (12)_5$

$$\begin{array}{r} (32)_5 \\ + (12)_5 \\ \hline \end{array}$$

$$(44)_5$$

(3)  $(333)_5 + (222)_5$

$$\begin{array}{r} (333)_5 \\ + (222)_5 \\ \hline \end{array}$$

$$(1110)_5$$

(5)  $(10223)_5 + (31244)_5$

$$\begin{array}{r} (10223)_5 \\ + (31244)_5 \\ \hline \end{array}$$

$$(42022)_5$$

(7)  $(3024)_5 + (2432)_5 + (2203)_5$

$$\begin{array}{r} (3024)_5 \\ + (2432)_5 \\ \hline \end{array}$$

$$(11011)_5$$

$$+ (2203)_5$$

$$(13214)_5$$

(2)  $(34)_5 + (43)_5$

$$\begin{array}{r} (34)_5 \\ + (43)_5 \\ \hline \end{array}$$

$$(132)_5$$

(4)  $(1234)_5 + (4443)_5$

$$\begin{array}{r} (1234)_5 \\ + (4443)_5 \\ \hline \end{array}$$

$$(11232)_5$$

(6)  $(432434)_5 + (243434)_5$

$$\begin{array}{r} (432434)_5 \\ + (243434)_5 \\ \hline \end{array}$$

$$(1231423)_5$$

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Number Systems

$$(8) \quad (34)_5 - (23)_5$$

$$(34)_5$$

$$- (23)_5$$

$$\hline$$

$$(11)_5$$

$$(10) \quad (342)_5 - (234)_5$$

$$(342)_5$$

$$- (234)_5$$

$$\hline$$

$$(103)_5$$

$$(12) \quad (22222)_5 - (4444)_5$$

$$(22222)_5$$

$$- (4444)_5$$

$$\hline$$

$$(12223)_5$$

$$(14) \quad (40404)_5 - (3030)_5$$

$$(40404)_5$$

$$- (3030)_5$$

$$\hline$$

$$(32324)_5$$

$$(9) \quad (33)_5 - (24)_5$$

$$(33)_5$$

$$- (24)_5$$

$$\hline$$

$$(04)_5$$

$$(11) \quad (1000)_5 - (333)_5$$

$$(1000)_5$$

$$- (333)_5$$

$$\hline$$

$$(112)_5$$

$$(13) \quad (323232)_5 - (133333)_5$$

$$(323232)_5$$

$$- (133333)_5$$

$$\hline$$

$$(134344)_5$$

$$(15) \quad (123)_5 + \{(4302)_5 - (1234)_5\}$$

$$(4302)_5$$

$$- (1234)_5$$

$$\hline$$

$$(3013)_5$$

$$+ (123)_5$$

$$\hline$$

$$(3141)_5$$

$$(16) \quad \{(2001)_5 - (1233)_5\} - (14)_5$$

$$(2001)_5$$

$$- (1233)_5$$

$$\hline$$

$$(213)_5$$

$$- (14)_5$$

$$\hline$$

$$(144)_5$$



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$$(17) \quad (11111)_5 - \{(4030)_5 - (1222)_5\}$$

$$\begin{array}{r} (4030)_5 \\ - (1222)_5 \\ \hline (2303)_5 \\ \hline (11111)_5 \\ - (2303)_5 \\ \hline (3303)_5 \end{array}$$

$$(18) \quad (23)_5 \times (34)_5$$

$$\begin{array}{r} (23)_5 \\ \times (34)_5 \\ \hline (202)_5 \\ (1240)_5 \\ \hline (1442)_5 \end{array}$$

$$(20) \quad (222)_5 \times (432)_5$$

$$\begin{array}{r} (222)_5 \\ \times (432)_5 \\ \hline (444)_5 \\ (12210)_5 \\ (144300)_5 \\ \hline (213004)_5 \end{array}$$

$$(22) \quad (40343)_5 \times (3424)_5$$

$$\begin{array}{r} (40343)_5 \\ \times (3424)_5 \\ \hline (313032)_5 \end{array}$$

$$(19) \quad (310)_5 \times (24)_5$$

$$\begin{array}{r} (302)_5 \\ \times (24)_5 \\ \hline (2213)_5 \\ (11040)_5 \\ \hline (133303)_5 \end{array}$$

$$(21) \quad (3022)_5 \times (1443)_5$$

$$\begin{array}{r} (3022)_5 \\ \times (1443)_5 \\ \hline (14121)_5 \\ (221430)_5 \\ (2214300)_5 \\ (3022000)_5 \\ \hline (11032401)_5 \end{array}$$

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Number Systems

$$(1312410)_5$$

$$(31303200)_5$$

$$(222134000)_5$$

$$(311123142)_5$$

**EXERCISE 3.5**

**I. Evaluate the following.**

(1)  $(35)_8 + (42)_8$

$$(35)_8$$

$$+ (42)_8$$

$$(77)_5$$

(3)  $(555)_8 + (444)_8$

$$(555)_8$$

$$+ (444)_8$$

$$(1221)_8$$

(5)  $(10223)_5 + (31244)_5$

$$(10223)_5$$

$$+ (31244)_5$$

$$(42022)_5$$

(7)  $(5074)_8 + (2642)_8 + (1153)_8$

$$(5074)_8$$

$$+ (2642)_8$$

$$(7736)_8$$

$$+ (1153)_8$$

$$(11111)_8$$

(2)  $(76)_8 + (34)_8$

$$(76)_8$$

$$+ (34)_8$$

$$(132)_8$$

(4)  $(1524)_8 + (4662)_8$

$$(1524)_8$$

$$+ (4662)_8$$

$$(6406)_8$$

(6)  $(765432)_8 + (234567)_5$

$$(765432)_8$$

$$+ (234567)_8$$

$$(1222221)_8$$



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Number Systems

$$(8) \quad (75)_8 - (66)_8$$

$$\quad (75)_8$$

$$\quad - (66)_8$$

$$\quad (07)_8$$

$$(10) \quad (475)_8 - (277)_8$$

$$\quad (475)_8$$

$$\quad - (277)_8$$

$$\quad (176)_8$$

$$(12) \quad (33333)_8 - (5555)_8$$

$$\quad (33333)_8$$

$$\quad - (5555)_8$$

$$\quad (25556)_8$$

$$(14) \quad (60606)_8 - (4040)_8$$

$$\quad (60606)_8$$

$$\quad - (4040)_8$$

$$\quad (54546)_8$$

$$(9) \quad (55)_8 - (26)_8$$

$$\quad (55)_8$$

$$\quad - (26)_8$$

$$\quad (27)_8$$

$$(11) \quad (1000)_8 - (444)_8$$

$$\quad (1000)_8$$

$$\quad - (444)_8$$

$$\quad (334)_8$$

$$(13) \quad (545454)_8 - (244422)_8$$

$$\quad (545454)_8$$

$$\quad - (244422)_8$$

$$\quad (301032)_8$$

$$(15) \quad (153)_8 + \{(6304)_8 - (2534)_8\}$$

$$\quad (6304)_8$$

$$\quad - (2534)_8$$

$$\quad (3550)_8$$

$$\quad + (153)_8$$

$$\quad (3723)_8$$

$$(16) \quad \{(7007)_8 - (4244)_8\} - (30)_8$$

$$\quad (7007)_8$$

$$\quad - (4244)_8$$

$$\quad (2543)_8$$

$$\quad - (30)_8$$

$$\quad (2513)_8$$

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Number Systems

$$\begin{array}{r}
 (17) \quad (11111)_8 - \{(2070)_8 - (1666)_8\} \\
 \quad \quad (2070)_8 \\
 \quad \quad - (1666)_8 \\
 \quad \quad \hline
 \quad \quad (3776)_8 \\
 \quad (11111)_8 \\
 \quad - (3776)_8 \\
 \quad \hline
 \quad (5113)_8
 \end{array}$$

$$\begin{array}{r}
 (18) \quad (43)_8 \times (56)_8 \\
 \quad \quad (43)_8 \\
 \quad \quad \times (56)_8 \\
 \quad \quad \hline
 \quad \quad (322)_8 \\
 \quad (2570)_8 \\
 \quad \hline
 \quad (3112)_8
 \end{array}$$

$$\begin{array}{r}
 (20) \quad (555)_8 \times (314)_8 \\
 \quad \quad (555)_8 \\
 \quad \quad \times (314)_8 \\
 \quad \quad \hline
 \quad \quad (2664)_8 \\
 \quad (5550)_8 \\
 \quad (210700)_8 \\
 \quad \hline
 \quad (221334)_8
 \end{array}$$

$$\begin{array}{r}
 (22) \quad (40573)_8 \times (5403)_8 \\
 \quad \quad (40573)_8 \\
 \quad \quad \times (5403)_8 \\
 \quad \quad \hline
 \quad \quad (142161)_8
 \end{array}$$

$$\begin{array}{r}
 (19) \quad (307)_8 \times (63)_8 \\
 \quad \quad (307)_8 \\
 \quad \quad \times (63)_8 \\
 \quad \quad \hline
 \quad \quad (1125)_8 \\
 \quad (22520)_8 \\
 \quad \hline
 \quad (23645)_8
 \end{array}$$

$$\begin{array}{r}
 (21) \quad (3077)_5 \times (1446)_5 \\
 \quad \quad (3077)_8 \\
 \quad \quad (1446)_8 \\
 \quad \quad \hline
 \quad \quad (22572)_8 \\
 \quad (144040)_8 \\
 \quad (1440400)_8 \\
 \quad (3077000)_8 \\
 \quad \hline
 \quad (4726232)_8
 \end{array}$$

$$\begin{array}{r}
 (23) \quad (127)_8 \times (21)_8 \times (44)_8 \\
 \quad \quad (127)_8 \\
 \quad \quad \times (21)_8 \\
 \quad \quad \hline
 \quad \quad (127)_8
 \end{array}$$



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Number Systems

$$\begin{array}{r}
 (000000)_8 \\
 (20275400)_8 \\
 (243547000)_8 \\
 \hline
 (264206561)_8
 \end{array}
 \begin{array}{r}
 (2560)_8 \\
 \hline
 (2707)_8 \\
 \times (44)_8 \\
 \hline
 (147774)_8
 \end{array}$$

**EXERCISE 3.6**

*Evaluate questions from 1 to 5.*

(1)  $(101010)_2 + (2340)_5 + (67)_8$

$$\begin{aligned}
 (101010)_2 &= (1 \times 2^5) + (0 \times 2^4) + (1 \times 2^3) + (0 \times 2^2) \\
 &\quad + (1 \times 2^1) + (0 \times 2^0) \\
 &= (1 \times 32) + (0 \times 16) + (1 \times 8) + (0 \times 4) + (1 \times 2) \\
 &\quad + (0 \times 1) \\
 &= 32 + 0 + 8 + 0 + 2 + 0 \\
 &= 42 \quad \text{(i)}
 \end{aligned}$$

$$\begin{aligned}
 (2340)_5 &= (2 \times 5^3) + (3 \times 5^2) + (4 \times 5^1) + (0 \times 5^0) \\
 &= (2 \times 125) + (3 \times 25) + (4 \times 5) + (0 \times 1) \\
 &= 250 + 75 + 20 + 0 \\
 &= 345 \quad \text{(ii)}
 \end{aligned}$$

$$\begin{aligned}
 (67)_8 &= (6 \times 8^1) + (7 \times 8^0) \\
 &= (6 \times 8) + (7 \times 1) \\
 &= 48 + 7 = 55 \quad \text{(iii)}
 \end{aligned}$$

Adding i + ii + iii we get

$$\begin{aligned}
 (101010)_2 + (2340)_5 + (67)_8 \\
 = 42 + 345 + 55 = 442
 \end{aligned}$$

(2)  $(2321)_5 - (1100110)_2 + (55)_8$

$$\begin{aligned}
 (2321)_5 &= (2 \times 5^3) + (3 \times 5^2) + (2 \times 5^1) + (1 \times 5^0) \\
 &= (2 \times 125) + (3 \times 25) + (2 \times 5) + (1 \times 1) \\
 &= 250 + 75 + 10 + 1 \\
 &= 336 \quad \text{(i)}
 \end{aligned}$$

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Number Systems

$$\begin{aligned}(1100110)_2 &= (1 \times 2^6) + (1 \times 2^5) + (0 \times 2^4) + (0 \times 2^3) \\ &\quad + (1 \times 2^2) + (1 \times 2^1) + (0 \times 2^0) \\ &= (1 \times 64) + (1 \times 32) + (0 \times 16) + (0 \times 8) \\ &\quad + (1 \times 4) + (1 \times 2) + (0 \times 1) \\ &= 64 + 32 + 0 + 0 + 4 + 2 + 0 \\ &= 102\end{aligned}\quad \text{(ii)}$$

$$\begin{aligned}(55)_8 &= (5 \times 8^1) + (5 \times 8^0) \\ &= (5 \times 8) + (5 \times 1) \\ &= 40 + 5 = 45\end{aligned}\quad \text{(iii)}$$

$$\begin{aligned}(2321)_5 &= (1100110)_2 + (55)_8 \\ &= 336 - 102 + 45 = 279\end{aligned}$$

$$\begin{aligned}(3) \quad (650)_8 \times (333)_5 \times (1001)_2 \\ (650)_8 &= (6 \times 8^2) + (5 \times 8^1) + (0 \times 8^0) \\ &= (6 \times 64) + (5 \times 8) + (0 \times 1) \\ &= 384 + 40 + 0 = 424\end{aligned}\quad \text{(i)}$$

$$\begin{aligned}(333)_5 &= (3 \times 5^2) + (3 \times 5^1) + (3 \times 5^0) \\ &= (3 \times 25) + (3 \times 5) + (3 \times 1) \\ &= 75 + 15 + 3 = 93\end{aligned}\quad \text{(ii)}$$

$$\begin{aligned}(1001)_2 &= (1 \times 2^3) + (0 \times 2^2) + (0 \times 2^1) + (1 \times 2^0) \\ &= (1 \times 8) + (0 \times 4) + (0 \times 2) + (1 \times 1) \\ &= 8 + 0 + 0 + 1 = 9\end{aligned}\quad \text{(iii)}$$

$$(650)_8 \times (333)_5 \times (1001)_2 = 424 \times 93 \times 9 = 354888$$

$$\begin{aligned}(4) \quad 809 - \{(111001)_2 - (3240)_5 + (1041)_8\} \\ (111001)_2 &= (1 \times 2^5) + (1 \times 2^4) + (1 \times 2^3) + (0 \times 2^2) \\ &\quad + (0 \times 2^1) + (1 \times 2^0) \\ &= (1 \times 32) + (1 \times 16) + (1 \times 8) + (0 \times 4) \\ &\quad + (0 \times 2) + (1 \times 1) \\ &= 32 + 16 + 8 + 0 + 0 + 1 = 57\end{aligned}\quad \text{(i)}$$

$$\begin{aligned}(3240)_5 &= (3 \times 5^3) + (2 \times 5^2) + (4 \times 5^1) + (0 \times 5^0) \\ &= (3 \times 125) + (2 \times 25) + (4 \times 5) + (0 \times 1) \\ &= 375 + 50 + 20 + 0 = 445\end{aligned}\quad \text{(ii)}$$



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$$\begin{aligned}(1041)_8 &= (1 \times 8^3) + (0 \times 8^2) + (4 \times 8^1) + (1 \times 8^0) \\ &= (1 \times 512) + (0 \times 64) + (4 \times 8) + (1 \times 1) \\ &= 512 + 0 + 32 + 1 = 545\end{aligned}\quad \text{(iii)}$$

$$809 - \{(111001)_2 - (3240)_5 + (1041)_8\}$$

By putting values

$$\begin{aligned}&= 809 - \{57 - 445 + 545\} \\ &= 809 - 157 = 652\end{aligned}$$

$$(5) \quad 90 + \{(1110)_2 \times (234)_5 - (472)_8\}$$

$$\begin{aligned}(1110)_2 &= (1 \times 2^3) + (1 \times 2^2) + (1 \times 2^1) + (1 \times 2^0) \\ &= (1 \times 8) + (1 \times 4) + (1 \times 2) + (0 \times 1) \\ &= 8 + 4 + 2 + 0 = 14\end{aligned}\quad \text{(i)}$$

$$\begin{aligned}(234)_5 &= (2 \times 5^2) + (3 \times 5^1) + (4 \times 5^0) \\ &= (2 \times 25) + (3 \times 5) + (4 \times 1) \\ &= 50 + 15 + 4 = 69\end{aligned}\quad \text{(ii)}$$

$$\begin{aligned}(472)_8 &= (4 \times 8^2) + (7 \times 8^1) + (2 \times 8^0) \\ &= (4 \times 64) + (7 \times 8) + (2 \times 1) \\ &= 256 + 56 + 2 = 314\end{aligned}\quad \text{(iii)}$$

$$\begin{aligned}&90 + \{(1110)_2 \times (234)_5 - (472)_8\} \\ &= 90 + \{14 \times 69 - 314\} \quad \text{By putting values} \\ &= 90 + 652 = 742\end{aligned}$$

6. *convert the following numbers into base five and eight systems.*

$$\begin{aligned}(i) \quad (110011)_2 &= (1 \times 2^5) + (1 \times 2^4) + (0 \times 2^3) + (0 \times 2^2) \\ &\quad + (1 \times 2^1) + (1 \times 2^0) \\ &= (1 \times 32) + (1 \times 16) + (0 \times 8) + (0 \times 4) \\ &\quad + (1 \times 2) + (1 \times 1) \\ &= 32 + 16 + 0 + 2 + 1 = 51\end{aligned}$$

Base five system

5	51
5	10 - 1
	2 - 0

Base eight system

8	51
	6 - 3

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$$= (201)_5$$

$$= (163)_8$$

$$51 = (201)_5 = (63)_8$$

$$\begin{aligned} \text{(ii)} \quad (100110110)_2 &= (1 \times 2^8) + (0 \times 2^7) + (0 \times 2^6) + (1 \times 2^5) \\ &\quad + (1 \times 2^4) + (0 \times 2^3) + (1 \times 2^2) + (1 \times 2^1) \\ &\quad + (0 \times 2^0) \\ &= (1 \times 256) + (0 \times 128) + (0 \times 64) + (1 \times 32) \\ &\quad + (1 \times 16) + (0 \times 8) + (1 \times 4) + (1 \times 2) \\ &\quad + (0 \times 1) \\ &= 256 + 0 + 0 + 32 + 16 + 0 + 4 + 2 + 0 \\ &= 310 \end{aligned}$$

Base five system

5	310
5	62 - 0
5	12 - 2
	2 - 2

$$= (2220)_5$$

Base eight system

8	310
8	38 - 6
	4 - 6

$$= (466)_8$$

$$310 = (2220)_5 = (466)_8$$

7. *Convert the following numbers into binary as well as octal number system.*

$$\begin{aligned} \text{(i)} \quad (324)_5 &= (3 \times 5^2) + (2 \times 5^1) + (4 \times 5^0) \\ &= (3 \times 25) + (2 \times 25) + (4 \times 1) \\ &= 75 + 10 + 4 = 89 \end{aligned}$$

Binary system

2	89
2	44 - 1
2	22 - 0
2	11 - 0
2	5 - 1
2	2 - 1
	1 - 0

$$= (1011001)_2$$

Base octal system

8	89
8	11 - 1
	1 - 3

$$= (131)_8$$

$$89 = (1011001)_2 = (131)_8$$



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$$\begin{aligned} \text{(ii)} \quad (4030)_5 &= (4 \times 5^3) + (0 \times 5^2) + (3 \times 5^1) + (0 \times 5^0) \\ &= (4 \times 125) + (0 \times 25) + (3 \times 5) + (0 \times 1) \\ &= 500 + 0 + 15 + 0 = 515 \end{aligned}$$

Binary system

2	515
2	257 - 1
2	128 - 1
2	64 - 0
2	32 - 0
2	16 - 0
2	8 - 0
2	4 - 0
2	2 - 0
	1 - 0

$$= (1000000011)_2$$

Base eight system

8	515
8	64 - 3
8	8 - 0
	1 - 0

$$= (1003)_8$$

$$515 = (1000000011)_5 = (1003)_8$$

8. *Convert the following number into binary as well as base five system.*

$$\begin{aligned} \text{(i)} \quad (734)_8 &= (7 \times 8^2) + (3 \times 8^1) + (4 \times 8^0) \\ &= (7 \times 64) + (3 \times 8) + (4 \times 1) \\ &= 448 + 24 + 4 = 476 \end{aligned}$$

Binary system

2	476
2	238 - 0
2	119 - 0
2	59 - 1
2	29 - 1
2	14 - 1
2	7 - 0
2	3 - 1
	1 - 1

$$= (111011100)_2$$

Base five system

5	476
5	95 - 1
5	19 - 0
	3 - 4

$$= (3401)_5$$

$$476 = (111011100)_2 = (3401)_5$$

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$$\begin{aligned} \text{(ii)} \quad (1052)_8 &= (1 \times 8^3) + (0 \times 8^2) + (5 \times 8^1) + (2 \times 8^0) \\ &= (1 \times 512) + (0 \times 64) + (5 \times 8) + (2 \times 1) \\ &= 512 + 0 + 40 + 2 = 554 \end{aligned}$$

Binary system

2	554
2	277 - 0
2	138 - 1
2	69 - 0
2	34 - 1
2	17 - 0
2	8 - 1
2	4 - 0
2	2 - 0
	1 - 0

$$= (1000101010)_2$$

Base five system

5	554
5	110 - 4
5	22 - 0
	4 - 2

$$(4204)_5$$

$$554 = (1000101010)_2 = (4204)_5$$

**REVIEW EXERCISE 3**

*Under line the base answer in the following.*

- (i) Base ten system of number is also called \_\_\_\_\_,  
 (a) ☒ decimal (b) octal  
 (c) binary (d) denary
- (ii) Digits used in base 2 are:  
 (a) 0, 2 (b) 0, 1, 2 (c) ☒ 0, 1 (d) 1, 2
- (iii)  $3 \times 10^2 + 3 \times 10^1 + 5 \times 10^0 =$   
 (a) 285 (b) ☒ 235 (c) 532 (d) 253
- (iv)  $(4)_5 + (3)_5 =$   
 (a)  $(7)_5$  (b)  $(10)_5$  (c)  $(11)_5$  (d) ☒  $(12)_5$
- (v)  $(12)_8 - (4)_8 =$   
 (a) ☒  $(6)_8$  (b)  $(5)_8$  (c)  $(7)_8$  (d)  $(8)_8$