Class XI

ANSWER KEY

Computer Science

1. Numbers

Unsolved Questions

A. 1. b 2. c 3. a 4. c 5. d
6. b 7. c 8. a 9. c 10. a

B. 1. Digit, base 2. 2 3. 0,9 4. A, F 5. Divide, 2
6. 010010,010011 7. 1560 8. Gottfried Wilhelm Leibniz
9. 1 10. 1111

C. 1.

a. $(763)_{10}$

Divisor	Dividend	Remainder
2	763	
2	381	1
2	190	1
2	95	0
2	47	1
2	23	1
2	11	1
2	5	1
2	2	1
2	1	0
	0	1

$(763)_{10} = (1011111011)_2$

b. $(2154)_{10}$

Divisor	Dividend	Remainder
2	2154	
2	1077	0
2	538	1
2	269	0

2	134	1
2	67	0
2	33	1
2	16	1
2	8	0
2	4	0
2	2	0
2	1	0
	0	1

$(2154)_{10} = (100001101010)_2$

c. $(678.50)_{10}$

Integer part		
Divisor	**Dividend**	**Remainder**
2	678	
2	339	0
2	169	1
2	84	1
2	42	0
2	21	0
2	10	1
2	5	0
2	2	1
2	1	0
	0	1

Fractional part		
Multiplication	**Result**	**Integer part**
0.50 × 2	1.00	1

$= (1010100110.1)_2$

d. $(2351.75)_{10}$

Integer part		
Divisor	**Dividend**	**Remainder**
2	2351	
2	1175	1
2	587	1
2	293	1
2	146	1
2	73	0
2	36	1
2	18	0
2	9	0
2	4	1

2	2	0
	1	0

Fractional part		
Multiplication	**Result**	**Integer part**
0.75 × 2	1.50	1
0.50 × 2	1.00	1

= $(100100101111.11)_2$

e. $(436.35)_{10}$

Integer part		
Divisor	**Dividend**	**Remainder**
2	436	
2	218	0
2	109	0
2	54	1
2	27	0
2	13	0
2	6	1
2	3	0
2	1	1
	0	1

Fractional part		
Multiplication	**Result**	**Integer part**
0.35 x 2	0.70	0
0.70 x 2	1.40	1
0.40 x 2	0.80	0
0.80 x 2	1.60	1
0.60 x 2	1.20	1
0.20 x 2	0.40	0
0.40 x 2	0.80	0
0.80 x 2	1.60	1
0.60 x 2	1.20	1

= $(110110100.01011001100110011001101)_2$

2.

a. $(299)_{10}$

Divisor	Dividend	Remainder
8	299	
8	37	3
8	4	5
	0	4

= $(453)_8$

b. $(3846)_{10}$

Divisor	Dividend	Remainder
8	3846	
8	480	6
8	60	0
8	7	4
	0	7

$= (7406)_8$

c. $(178.48)_{10}$

Integer part		
Divisor	**Dividend**	**Remainder**
8	178	
8	22	2
8	2	6
	0	2

Fractional part		
Multiplication	**Result**	**Integer part**
0.48 × 8	3.84	3
0.84 × 8	6.72	6
0.72 × 8	5.76	5

$= (262.365)_8$

d. $(4367.5)_{10}$

Integer part		
Divisor	**Dividend**	**Remainder**
8	4367	
8	545	7
8	68	1
8	8	4
8	1	0
	0	1

Fractional part		
Multiplication	**Result**	**Integer part**
0.50 × 8	4.00	1

$= (10417.4)_8$

e. $(897.75)_{10}$

Integer part		
Divisor	**Dividend**	**Remainder**
8	897	

8	112	1
8	14	0
8	1	6
	0	1

Fractional part		
Multiplication	Result	Integer part
0.75 x 8	6.00	6

= $(1601.6)_8$

3.

a. $(488)_{10}$

Divisor	Dividend	Remainder
16	488	
16	30	8
16	1	E
	0	1

= $(1E8)_{16}$

b. $(3926)_{10}$

Divisor	Dividend	Remainder
16	3926	
16	245	6
16	15	5
	0	F

= $(F56)_{16}$

c. $(978.5)_{10}$

Integer part		
Divisor	Dividend	Remainder
16	978	
16	61	2
16	3	D
	0	3

Fractional part		
Multiplication	Result	Integer part
0.50 × 16	8.00	8

= $(3D2.8)_{16}$

d. $(6363.25)_{10}$

Integer part		
Divisor	Dividend	Remainder
16	6363	

16	397	B
16	24	D
16	1	8
	0	1

Fractional part		
Multiplication	Result	Integer part
0.25 × 16	4.00	4

$= (18DB.4)_{16}$

e. $(854.4)_{10}$

Integer part		
Divisor	Dividend	Remainder
16	854	
16	53	6
16	3	5
	0	3

Fractional part		
Multiplication	Result	Integer part
0.40 × 16	6.40	6
0.40 × 16	6.40	6
0.40 × 16	6.40	6

$= (356.666)_{16}$

4.

a. $(11101111)_2$

5	4	3	2	1	0	Place value
1	0	0	1	1	0	Digits

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

$= 32 + 0 + 0 + 4 + 2 + 0$

$= 38$

b. $(100110)_2$

7	6	5	4	3	2	1	0	Place value
1	1	1	0	1	1	1	1	Digits

$= 1 \times 2^7 + 1 \times 2^6 + 1 \times 2^5 + 0 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$

$= 128 + 64 + 32 + 0 + 8 + 4 + 2 + 1$

$= 239$

c. $(101010.11)_2$

5	4	3	2	1	0		-1	-2	Place value
1	0	1	0	1	0	.	1	1	Digits

$= 1 \times 2^5 + 0 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 0 \times 2^0 . 1 \times 2^{-1} + 1 \times 2^{-2}$

$= 32 + 0 + 8 + 0 + 2 + 0 . 0.50 + 0. 25$

$= (42.75)_{10}$

d. $(1111010.101)_2$

6	5	4	3	2	1	0		-1	-2	-3	Place value
1	1	1	1	0	1	0	.	1	0	1	Digits

$= 1 \times 2^6 + 1 \times 2^5 + 1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 0 \times 2^0. 1 \times 2^{-1} + 0 \times 2^{-2} + 1 \times 2^{-3}$

$= 64 + 32 + 16 + 8 + 0 + 2 + 0 . 0.50 + 0 + 0.125$

$= (122. 625)_{10}$

e. $(11001101010.01)_2$

10	9	8	7	6	5	4	3	2	1	0		-1	-2	Place value
1	1	0	0	1	1	0	1	0	1	0	.	0	1	Digits

$= 1 \times 2^{10} + 1 \times 2^9 + 0 \times 2^8 + 0 \times 2^7 + 1 \times 2^6 + 1 \times 2^5 + 0 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 0 \times 2^0. 0 \times 2^{-1} + 1 \times 2^{-2}$

$= 1024 + 512 + 0 + 0 + 64 + 32 + 0 + 8 + 0 + 2 + 0 . 0 + 0.25$

$= (1642.25)_{10}$

5.

a. $(2571)_8$

3	2	1	0	Place value
2	5	7	1	Digits

$= 2 \times 8^3 + 5 \times 8^2 + 7 \times 8^1 + 1 \times 8^0$

$= 2 \times 512 + 5 \times 64 + 7 \times 8 + 1 \times 1$

$= 1024 + 320 + 56 + 1$

$= (1401)_{10}$

b. $(3773)_8$

3	2	1	0	Place value
3	7	7	3	Digits

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

$= 3 \times 512 + 7 \times 64 + 7 \times 8 + 3 \times 1$

$= 1536 + 448 + 56 + 3$

$= (2043)_{10}$

c. $(1655.25)_8$

3	2	1	0		-1	-2	Place value
1	6	5	5	.	2	5	Digits

$= 1 \times 8^3 + 6 \times 8^2 + 5 \times 8^1 + 5 \times 8^0. 2 \times 8^{-1} + 5 \times 8^{-2}$

$= 1 \times 512 + 6 \times 64 + 5 \times 8 + 5 \times 1 . 2 \times 0.125 + 5 \times 0.015$

$= 512 + 384 + 40 + 5 . 0.25 + 0.075$

$= (941.325)_{10}$

d. $(2511.4)_8$

3	2	1	0		-1	Place value
2	5	1	1	.	4	Digits

$= 2 \times 8^3 + 5 \times 8^2 + 1 \times 8^1 + 1 \times 8^0. 4 \times 8^{-1}$

$= 2 \times 512 + 5 \times 64 + 1 \times 8 + 1 \times 1. 4 \times 0.125$

$= 1024 + 320 + 8 + 1 + 0.5$

$= (1353.5)_{10}$

e. $(4471.2)_8$

3	2	1	0		-1	Place value
4	4	7	1	.	2	Digits

$= 4 \times 8^3 + 4 \times 8^2 + 7 \times 8^1 + 1 \times 8^0 + 2 \times 8^{-1}$

$= 4 \times 512 + 4 \times 64 + 7 \times 8 + 1 \times 1 + 2 \times 0.125$

$= 2048 + 256 + 56 + 1 + 0.25$

$= (2361.25)_{10}$

6.

a. $(2DC1)_{16}$

3	2	1	0	Place value
2	13	12	1	Digits

$= 2 \times 16^3 + 13 \times 16^2 + 12 \times 16^1 + 1 \times 16^0$

$= 2 \times 4096 + 13 \times 256 + 12 \times 16 + 1 \times 1$

$= 8192 + 3328 + 192 + 1$

$= (11713)_{10}$

b. $(EC98)_{16}$

3	2	1	0	Place value
14	12	9	8	Digits

$= 14 \times 16^3 + 12 \times 16^2 + 9 \times 16^1 + 8 \times 16^0$

$= 14 \times 4096 + 12 \times 256 + 9 \times 16 + 8 \times 1$

$= 57344 + 3072 + 144 + 8$

$= (60568)_{10}$

c. $(5E67.8)_{16}$

3	2	1	0		-1	Place value
5	14	6	7	.	8	Digits

$= 5 \times 16^3 + 14 \times 16^2 + 6 \times 16^1 + 7 \times 16^0 + 8 \times 16^{-1}$

$= 5 \times 4096 + 14 \times 256 + 6 \times 16 + 7 \times 1 + 8 \times 0.0625$

$= 20480 + 3584 + 96 + 7 + 0.5$

$= (24167.5)_{10}$

d. $(E22B.C)_{16}$

3	2	1	0		-1	Place value
14	2	2	11	.	12	Digits

$= 14 \times 16^3 + 2 \times 16^2 + 2 \times 16^1 + 11 \times 16^0 + 12 \times 16^{-1}$

$= 14 \times 4096 + 2 \times 256 + 2 \times 16 + 11 \times 1 + 0.75$

$= 57344 + 512 + 32 + 11 + 0.75$

$= (57899.75)_{10}$

e. $(4F71.2)_{16}$

3	2	1	0		-1	**Place value**
4	15	7	1	.	2	**Digits**

$= 4 \times 16^3 + 15 \times 16^2 + 7 \times 16^1 + 1 \times 16^0 + 2 \times 16^{-1}$

$= 4 \times 4096 + 15 \times 256 + 7 \times 16 + 1 \times 1 + 2/16$

$= 16384 + 3840 + 112 + 1 + 0.125$

$= (20337.125)_{10}$

7.

a. $(10011110)_2$

On grouping 3 bits from LSB 10 011 110

Adding 0 before 10 we get 010 011 110

010	011	110
2	3	6

$= (236)_8$

b. $(111011101)_2$

On grouping 3 bits from LSB 111 011 101

111	011	101
7	3	5

$= (735)_8$

c. $(1001010.11)_2$

On grouping 3 bits from LSB 001 001 010 . 110

001	001	010	.	110
1	1	2		6

$= (112.6)_8$

d. $(1110010.001)_2$

On grouping 3 bits from LSB 001 001 010 . 110

001	001	010	.	110
1	1	2		6

$= (112.6)_8$

e. $(1100110100.1)_2$

001 100 110 100. 100

001	100	110	100	.	100
1	4	6	4		4

$= (1464.4)_8$

8.

a. $(1100110100.1)_2$

Making group of 4 bits 0001 0011 1100

8	4	2	1	Hexa
0	0	0	1	0 × 8 + 0 × 4 + 0 × 2 + 1 × 1 = 1
0	0	1	1	0 × 8 + 0 × 4 + 1 × 2 + 1 × 1 = 3
1	1	0	0	1 × 8 + 1 × 4 + 0 × 2 + 0 × 1 = 12

$= (13C)_{16}$

b. $(1100110100.1)_2$

Making group of 4 bits 0001 0011 1100

8	4	2	1	Hexa
0	1	1	1	0 × 8 + 1 × 4 + 1 × 2 + 1 × 1 = 7
0	1	1	1	0 × 8 + 1 × 4 + 1 × 2 + 1 × 1 = 7
0	0	1	1	0 × 8 + 0 × 4 + 1 × 2 + 1 × 1 = 3

$= (\quad)_{16}$

c. $(10010101.101)_2$

1001 0101. 1010

8	4	2	1	Hexa
1	0	0	1	1 × 8 + 0 × 4 + 0 × 2 + 1 × 1 = 9
0	1	0	1	0 × 8 + 1 × 4 + 0 × 2 + 1 × 1 = 5
1	0	1	0	1 × 8 + 0 × 4 + 1 × 2 + 0 × 1 = 10

$= (95.A)_{16}$

d. $(11110010.001)_2$

1111 0010. 0010

8	4	2	1	Hexa
1	1	1	1	1 × 8 + 1 × 4 + 1× 2 + 1 × 1 = 15
0	0	1	0	0 × 8 + 0 × 4 + 1 × 2 + 0 × 1 = 2
0	0	1	0	0 × 8 + 0 × 4 + 1 × 2 + 0 × 1 = 2

$= (F2.2)_{16}$

e. $(10110100.1)_2$

1011 0100. 1000

8	4	2	1	Hexa
1	0	1	1	1 × 8 + 0 × 4 + 1× 2 + 1 × 1 = 11
0	1	0	0	0 × 8 + 1 × 4 + 0 × 2 + 0 × 1 = 4
1	0	0	0	1 × 8 + 0 × 4 + 0 × 2 + 0 × 1 = 8

$= (B4.8)_{16}$

9. a. $(4573)_8$

4	5	7	3
100	101	111	011

$= (100101111011)_2$

b. $(1771)_8$

1	7	7	1
1	111	111	001

$= (001111111001)_2$

c. $(655.25)_8$

6	5	5	2	5
110	101	101	010	101

$= (110101101.010101)_2$

d. $(536.4)_8$

5	3	6	.	4
101	011	110		100

$= (0101011110.1)_2$

e. $(4245.2)_8$

4	2	4	5	.	2
100	010	100	101		010

$= (100010100101.01)_2$

10. a. $(DEC)_{16}$

D(13)	E(14)	C(12)
1101	1110	1100

$= (110111101100)_2$

b. $(FF98)_{16}$

F(15)	F(15)	9	8
1111	1111	1001	1000

$= (1111111110011000)_2$

c. $(5E.8)_{16}$

5	E(14)	.	8
0101	1110		1000

$= (11011110.1)_2$

d. $(D2B.C)_{16}$

D(13)	2	B(11)	.	C(12)
1101	0010	1011		1100

$= (0110100101011.11)_2$

e. $(4F71.2)_{16}$

4	F(15)	7	1	.	2
0100	1111	0111	0001		0010

$= (0100111101110001.001)_2$

11.

a. $(101010)_2 + (1101)_2$

	+1				
1	0	1	0	1	0
+		1	1	0	1
1	**1**	**0**	**1**	**1**	**1**

$= (01000100000)_2$

b. $(111101010)_2 + (110110)_2$

+1	+1	+1	+1	+1	+1	+1		
1	1	1	1	0	1	0	1	0
+			1	1	0	1	1	0
0	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**

$= (01000100000)_2$

c. $(110111.01)_2 + (111.11)_2$

		+1	+1	+1	+1		+1	
1	1	0	1	1	1	.	0	1
+			1	1	1	.	1	1
1	**1**	**1**	**1**	**1**	**1**	**.**	**0**	**0**

$= (0111111.00)_2$

d. $(1101101.11)_2 + (101.11)_2$

		+1	+1	+1	+1	+1		+1	
1	1	0	1	1	0	1	.	1	1
+				1	0	1	.	1	1
1	**1**	**1**	**0**	**0**	**1**	**1**	**.**	**0**	**0**

$= (0111001110)_2$

e. $(110111111)_2 + (10111111)_2$

	+1	+1	+1	+1	+1	+1	+1	+1		
	1	1	0	1	1	1	1	1	1	
	+	1	0	1	1	1	1	1	1	
0	**1**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**0**

$= (01001111110)_2$

12.

a. $(354)_8 + (205)_8$

		+1	
	3	5	4
+	2	0	5
	5	**6**	**1**

$= (561)_8$

b. $(1266)_8 + (505)_8$

		+1		
	1	2	6	6
+		5	0	5
	1	**7**	**7**	**3**

$= (\quad)_8$

c. $(1057.6)_8 + (2341.5)_8$

		+1	+1	+1		
	1	0	5	7	.	6
+	2	3	4	1	.	5
	3	**4**	**2**	**1**	**.**	**3**

$= (3421.3)_8$

d. $(1057.6)_8 + (2341.5)_8$

		+1	+1	+1		
	1	0	5	7	.	6
+	2	3	4	1	.	5
	3	**4**	**2**	**1**	**.**	**3**

$= (3421.3)_8$

e. $(12347)_8 + (422)_8$

	+1	+1	+1	
1	2	3	4	7
+		4	2	2
1	**2**	**7**	**7**	**1**

$= (12771)_8$

13.

a. $(A67)_{16} + (2175)_{16}$

		A (10)	6	7
+	2	1	7	5
	2	**B**	**D**	**C**

$= (2BDC)_{16}$

b. $(B23C)_{16} + (D16)_{16}$

	+1	+1		
	B (11)	2	3	C (12)
+	D (13)		1	6
	B	**F**	**5**	**2**

$= (BF52)_{16}$

c. $(A67)_{16} + (2175)_{16}$

	+1	+1			
	A (10)	9	.	C (12)	D (13)
+		5	.	E (14)	E (14)
	A	**F**	**.**	**B**	**B**

$= (AF.BB)_{16}$

d. $(678.9)_{16} + (ABC.D)_{16}$

+1	+1				
	6	7	8	.	9
+	A (10)	B (11)	C (12)	.	D (13)
1	**1**	**3**	**5**	**.**	**6**

$= (1135.6)_{16}$

e. $(C24F)_{16} + (19DE)_{16}$

	+1	+1		
	C (12)	2	4	F (15)
+	1	9	D (13)	E (14)
	D	**C**	**2**	**D**

$= (\quad)_{16}$

14.

a. $(101010)_2 - (1101)_2$

			+1	+1	+1	
	1	0	1	0	1	0
+			1	1	0	1
	0	**1**	**1**	**1**	**0**	**1**

$= (11101)_{16}$

(using 1's complement method)

Minuend 101010 has 6 digits and subtrahend has 4 digits.

Adding preceding 0's we get 001101.

1's complement of 00101 is 110010.
Adding 101010 and 110010 we get

+1				+1		
	1	0	1	0	1	0
+	1	1	0	0	1	0
1	0	1	1	1	1	0
					+	1
	0	**1**	**1**	**1**	**0**	**1**

using 2's complement method
101010 has 6 bits and 1101 has 4 bits.
Adding prefix 0 we get 00101.
1's complement of 001101 is 110010.
2's complement is 110010 + 1 = 0110011
Adding 101010 and 0110011 we get

	+1		+1		+1	
	1	0	1	0	1	0
+	1	1	0	0	1	1
1	**0**	**1**	**1**	**1**	**0**	**1**

Discarding MSB 1 we get 011101

b. $(111101010)_2 - (110110)_2$

			+1	+1	+1				
	1	1	1	1	0	1	0	1	0
+				1	1	0	1	1	0
	1	**1**	**0**	**1**	**1**	**0**	**1**	**0**	**0**

using 1's complement method
Minuend has 9 bits and subtrahend has 6 bits.
Adding preceding 0 we get 000110110.
1's complement of 000110110 is 111001001.
Adding 111101010 and 111001001 we get.

			+1	+1	+1				
	1	1	1	1	0	1	0	1	0
+	1	1	1	0	0	1	0	0	1
1	1	1	0	1	1	0	0	1	1
								+	1
	1	**1**	**0**	**1**	**1**	**0**	**1**	**0**	**0**

using 2's complement method

111101010 has 9 bits and 110110 has 6 bits.

Adding prefix 0 we get 000110110.

1's complement of 000110110 is 111001001.

2's complement is 111001001 + 1 =

Adding 111101010 and 111001010 we get.

	+1	+1	+1	+1	+1				
	1	1	1	1	0	1	0	1	0
+	1	1	1	0	0	1	0	1	0
1	**1**	**1**	**0**	**1**	**1**	**0**	**1**	**0**	**0**

Discarding MSB 1 we get 110110100.

c. $(110111.01)_2 - (111.11)_2$

			+1	+1	+1			
1	1	0	1	1	1	.	0	1
		-	1	1	1	.	1	1
1	**0**	**1**	**1**	**1**	**1**	**.**	**1**	**0**

Using 1's complement method

Minuend has 8 bits and subtrahend has 5 bits.

Adding preceding 0 we get 000111.11.

1's complement of 000111.11 is 111000.00.

Adding 110111.01 and 111000.00 we get.

	1	1	0	1	1	1	.	0	1
+	1	1	1	0	0	0	.	0	1
	1	**0**	**1**	**1**	**1**	**1**	**.**	**1**	**0**

Discarding MSB 1 we get 101111.10.

d. $(1101101.11)_2 - (1001.01)_2$

1	1	0	1	1	0	1	.	1	1
		-	1	0	0	1	.	0	1
1	**1**	**0**	**0**	**1**	**0**	**0**	**.**	**1**	**0**

Using 1's complement method

Minuend has 9 bits and subtrahend has 6 bits.

Adding preceding 0 we get 0001001.01.

1's complement of 0001001.01 is 1110110.10.

Adding 1101101.11 and 1110110.10 we get.

	+1	+1	+1	+1	+1	+1	+1			
	1	1	0	1	1	0	1	.	1	1
+	1	1	1	0	1	1	0	.	1	0
	1	1	1	0	0	1	0	.	0	1
									+	1
1	**1**	**1**	**0**	**0**	**1**	**0**	**0**	**.**	**1**	**0**

Using 2's complement method
1101101.11 has 9 bits and 1001.01has 6 bits.
Adding prefix 0 we get 0001001.01.
1's complement of 0001001.01 is 1110110.10.
2's complement is 1110110.10 + 1 = 1110110.11
Adding 1101101.11 and 1110110.11 we get.

	+1	+1	+1	+1	+1	+1	+1		+1	
	1	1	0	1	1	0	1	.	1	1
+	1	1	1	0	1	1	0	.	1	1
	1	**1**	**1**	**0**	**1**	**0**	**0**	**.**	**1**	**0**

e. $(110111)_2$ - $(1001.01)_2$

	+1	+1	+1					
	0	0	1	1	0	1	1	1
-	1	0	1	1	1	1	1	1
	1	**0**	**0**	**0**	**1**	**0**	**0**	**0**

Using 1's complement method
1's complement of 10111111 is 01000000.
Adding 110111 and 01000000 we get.

			1	1	0	1	1	1
+	0	1	0	0	0	0	0	0
	0	**1**	**1**	**1**	**0**	**1**	**1**	**1**

1's complement of 01110111 is 10001000.
= $(10001000)_2$
Using 2's complement method
1's complement of 10111111 is 01000000.
2's complement is 01000000 + 1 = 01000001.
Adding 110111 and 01000001 we get.

		+1	+1	+1			
		1	0	1	1	1	1
+	0	1	0	0	0	0	0
0	**1**	**1**	**1**	**1**	**0**	**0**	**0**

1s complement of 01111000 is 10000111.

2s complement of 10000111 is 010001000.

$= (10001000)_2$

15. **Borrow Method**

a. $(4541)_8 - (205)_8$

			+8	
	4	5	4	1
-		2	0	5
	4	**3**	**3**	**4**

7's complement

4541 has 4 digits and 205 has 3 digits.

So, adding 0 it becomes 0205.

7's complement of 0205 is 7572.

Adding 4541 and 7572 we get.

			+8	
	4	5	4	1
+	7	5	7	2
1	4	3	3	3
			+	1
	4	**3**	**3**	**4**

8's complement

7's complement of 0205 is 7572.

8's complement is 7573.

Adding 4541 and 7573 we get

+1	+1			
	4	5	4	1
+	7	5	7	3
1	**4**	**3**	**3**	**4**

Discarding MSB 1 we get 4334.

$= (4334)_8$

b. $(12.66)_8$ - $(5.75)_8$

		+8		+8	
	1	2	.	6	6
-		5	.	7	5
		4	**.**	**7**	**1**

= $(4.71)_8$

7's complement

12.66 has 4 digits and 5.75 has 3 digits.

So, adding 0 it becomes 05.75.

7's complement of 05.75 is 72.02.

Adding 12.66 and 72.02 we get.

+1		+1			
	1	2	.	6	6
+	7	2	.	0	2
1	0	4	.	7	0
				+	1
	0	**4**	**.**	**7**	**1**

= $(4.71)_8$

8's complement

7's complement of 05.75 is 72.02.

8's complement is 72.03.

Adding 12.66 and 72.03 we get.

				+1	
	1	2	.	6	6
+	7	2	.	0	3
1	**0**	**4**	**.**	**7**	**1**

Discarding MSB 1 we get 4.71.

= $(4.71)_8$

c. $(1057.6)_8$ - $(2341.5)_8$

	1	0	5	7	.	6
-	2	3	4	1	.	5
					.	

= ($)_8$

7's complement

7's complement of 2341.5 is 5436.2.

Adding 1057.6 and 5436.2 we get.

	+1	+1	+1			
	1	0	5	7	.	6
+	5	4	3	6	.	5
	6	**5**	**1**	**6**	**.**	**0**

= $(-1261.7)_8$

8's complement method

7's complement of 2341.5 is 5436.2.

8's complement of 5436.2 is 5436.3

Adding 1057.6 and 5436.3 we get

	1	0	5	7	.	6
+	5	4	3	6	.	3
	6	**5**	**1**	**6**	**.**	**1**

7's complement of 6516.1 is 1261.6

8's complement of 1261.6 is 1261.7

= $(-1261.7)_8$

d. $(3445)_8 - (5625)_8$

		+1		
	3	4	4	5
+	2	1	5	2
	5	**6**	**1**	**7**

7's complement of 5617 is 2160.

= $(-2160)_8$

8's complement method

7's complement of 5625 is 2152.

8's complement of 2152 is 2153

Adding 3445 and 2153 we get.

		+1	+1	
	3	4	4	5
+	2	1	5	3
	5	**6**	**2**	**0**

7's complement of 5620 is 2157

8's complement of 2157 is 2158

e. $(123.74)_8$ - $(46.5)_8$

1	2	3	.	7	4
-	4	6	.	5	0
	5	**5**	**.**	**2**	**4**

7's complement

123.74 has 5 digits and 46.50 has 4 digits.

So, adding 0 it becomes 046.50

7's complement of 046.50 is 731.27.

Adding 123.74 and 731.27 we get.

			+1			
	1	2	3	.	7	4
+	7	3	1	.	2	7
1	0	5	5	.	2	3
					+	1
		5	**5**	**.**	**2**	**4**

= $(55.24)_8$

8's complement method

7's complement of 046.50 is 731.27.

8`s complement of 731.27 is 731.28.

Adding 123.74 and 731.28 we get.

			+1			+1
	1	2	3	.	7	4
+	7	3	1	.	2	8
1	**0**	**5**	**5**	**.**	**2**	**4**

= $(55.24)_8$

Discarding MSB 1 we get 55.24

= $(55.24)_8$

16.

a. $(B78)_8$ - $(8AB)_8$

	+16	+16	
	B (11)	7	8
-	8	A (10)	B (11)
	2	**C**	**D**

15's complement

15's complement of 8AB is 754

Adding B78 and 754 we get

	B	7	8
+	7	5	4
	2	C	D
		+	1
	2	**C**	**D**

= $(2CD)_{16}$

16's complement

15's complement of 8AB is 754

16`s complement of 754 is 755

Adding B78 and 755 we get.

	B	7	8
+	7	5	5
1	**2**	**C**	**D**

Remove leftmost 1 we get 2CD.

= $(2CD)_{16}$

b. $(B23C)_{16}$ - $(DF6)_{16}$

	+16	+16		
	B (11)	2	3	C (12)
-		D (13)	F (15)	6
	A	**4**	**4**	**6**

= $(A446)_{16}$

15's complement

15's complement of 0DF6 is F209

Adding B23C and F209 we get

	+16	+16		
	B (11)	2	3	C (12)
+	F (15)	2	0	9
1	A	4	4	5
			+	1
	A	**4**	**4**	**6**

= $(A446)_{16}$

16's complement

15's complement of 0DF6 is F209

16`s complement of F209 is F20A

Adding B23C with F20A we get

			+1	
	B (11)	2	3	C (12)
-	F (15)	2	0	A (10)
1	**A**	**4**	**4**	**6**

Remove leftmost 1 we get A446.

= $(A446)_{16}$

c. $(A9.CD)_{16}$ - $(5.EE)_{16}$

A (10)	9	.	C (12)	D (13)
+	5	.	E (14)	E (14)
A	**3**	**.**	**D**	**F**

= $(A3.DF)_{16}$

15 's complement

15's complement of 05.EE is FA.11

Adding A9.CD and FA.11 we get

	A (10)	9	.	C (12)	D (13)
+	5 (15)	A (10)	.	1	1
1	A	3	.	D	F
				+	1
	A	**3**	**.**	**D**	**F**

= $(A3.DF)_{16}$

16 's complement

15's complement of 05.EE is FA.11

16`s complement of FA.11 is FA.12.

Adding A9.CD and FA.12 we get

	A (10)	9	.	C (12)	D (13)
+	5 (15)	A (10)	.	1	2
1	**A**	**3**	**.**	**D**	**F**

Remove leftmost 1 we get A3.DF

= $(A3.DF)_{16}$

d. $(678.9)_{16}$ - $(AFC.D)_{16}$

6	7	8	.	9
A	F	C	.	D
			.	

15 ’s complement

15’s complement of AFC.D is 503.2

Adding 678.9 and 503.2 we get

6	7	8	.	9
5	0	3	.	2
B	**7**	**B**	**.**	**B**

15’s complement of B7B.B IS 484.4

= $(-484.4_{)16}$

16’s complement

15’s complement of AFC.D is 503.2

16`s complement of 503.2 IS 503.3

Adding 678.9 and 503.3 we get

6	7	8	.	9
5	0	3	.	3
B	**7**	**B**	**.**	**C**

15’s complement of B7B.C IS 484.3

16's complement of 484.3 IS 484.4.

= $(-484.4)_{16}$

e. $(C44)_{16}$ - $(19BB)_{16}$

C	4	4		
1	9	B		B

15 ’s complement

15’s complement of 19BB IS E644

Adding C44 and E644 we get

	C	4	4	
+	E	6	4	4
	F	**2**	**8**	**8**

15's complement of F288 is D77

$= (-D77)_{16}$

16's complement

15's complement of 19BB is E644

16's complement of E644 is E645.

Adding C44 and E645 we get

	C	4	4	
+	E	6	4	5
	F	**2**	**8**	**9**

15's complement of F289 is D76.

16`s complement of D76 is D77.

$= (-D77)_{16}$

2. Propositional Logic, Hardware Implementation, Arithmetic Operations

Unsolved Questions

A.

1. b	2. d	3. 4	4. a	5. b
6. c	7. b	8. a	9. b	10. b

B.

1. A'.B'+A.B
2. XNOR gate
3. A'.B + A.B'
4. fundamental gates
5. odd
6. XOR gate
7. AND
8. all
9. converse
10. c

C. 1. i. The difference between simple proposition and compound proposition is as follows

Simple proposition	compound proposition
It contains a single atomic statement.	It contains two or more simple propositions joined by special symbols called connectives.

ii. The difference between conjunction and disjunction are as follows:

Conjunction	Disjunction
It is a binary connective as it joins two or more simple propositions.	It is also a binary connective.
It results in true if all proposition variables are true.	It results in true if any one proposition is true.
If any variable is false, the resulting output is false.	The output is false only when both propositions are false.
Conjunction is represented by dot (.) or ($\wedge$).	Disjunction is represented by (+) or ($\vee$).

iii. The difference between conditional and bi-conditional are as follows:

Conditional	Bi-conditional
It is represented by the symbol '$\rightarrow$'.	It is represented by $\leftrightarrow$ symbol.
It implies results in false if the first proposition (if) is true but the second one (then) is false.	It is true when both propositions have the same value and false if they have different values.

iv. The difference between AND gate and OR gate are as follows:

AND gate	OR gate
The AND gate is the logical gate which always gives single output for two and more than two inputs signals.	A logical gate that results in inclusive disjunction is called an OR gate
It produces a high output (1) only when all inputs are high (1).	It produces high output (1) when any one input is high (1).
AND operation is represented by a dot (.).	OR operation is represented by plus (+).

v. The difference between half adder and full adder are as follows:

Half adder	Full adder
The half adder is a combinational circuit that is designed to perform the addition of two bits and produce the two binary outputs as sum (S) and carry (C) bits.	The full adder is a combinational circuit that is designed to perform the addition of three bits and produce the two binary outputs as sum (S) and carry (C) bits.

2. i. $Q \rightarrow P \wedge R$

ii. $P \wedge Q$

iii. $Q \leftrightarrow P$

iv. $\sim P \vee \sim Q$

v. $P \rightarrow R$

3. i. It is not raining heavily or there is no prediction for cyclone.

ii. It is not raining heavily or there is no prediction for cyclone and there will be no damage of life and property.

iii. It is not raining heavily if and only if there is no prediction for cyclone.

iv. It is not raining heavily and there is no prediction for cyclone and there will be no damage of life and property.

v. If there is a prediction for cyclone, then there will be no damage of life and property.

4. i. converse: If you will crack IIT, then you work hard.
Inverse: If you not work hard then you will not crack IIT.
Contrapositive: If you will not crack IIT, then you not work hard.

ii. converse: If it is rose, then the flower has a beautiful smell.
Inverse: If the flower has not a beautiful smell, then it is not rose.
Contrapositive: If it is not rose, then the flower has not a beautiful smell.

iii. converse: If I will wear my red gown, then I am invited to a party.
Inverse: If I am not invited to a party, then I will not wear my red gown.
Contrapositive: If I will not wear my red gown, then I am not invited to a party

iv. converse: If we will celebrate, then India wins World Cup cricket.
Inverse: If India not wins World Cup cricket, then we will not celebrate.
Contrapositive: If we will not celebrate, then India not wins World Cup cricket.

v. converse: If it is a palindrome, then a number is equal to its reverse.
Inverse: If a number is not equal to its reverse, then it is not a palindrome.
Contrapositive: If it is not a palindrome, then a number is not equal to its reverse.

3. Introduction to Object-Oriented Programming Using Java

Unsolved Questions

A. 1. a 2. a 3. a 4. d 5. d

B. 1. Encapsulation 2. main() 3. object-oriented programming
4. exception 5. many forms

C. 1. Some of the characteristics of object-oriented programming (OOP) languages are as follows:
- It follows a bottom-up approach.
- More emphasis is given on data rather than procedure.
- Programs are divided into objects.
- Data cannot be accessed by external functions.
- Functions are ways used by objects to communicate with each other.
- Most important characteristics is that new data and function can be added as and when required without making severe changes in program. This is because it uses the concept of reusability where coding is written once and can be used multiple times using different objects.

2. The five main objectives kept in mind while developing the Java language are as follows:
- Coding should be simple and object-oriented.
- It must be dynamic and secure.
- It must be architecture-neutral and handy.
- The program code should execute with high performance.
- It should be platform independent and threaded.

3. Sun Microsystems, Inc. developed Java in the year 1991 with the help of James Gosling and Patrick Naughton. It was first released in 1995. In the beginning, it was called OAK (as there was an Oak tree

outside the office of the developers). Later, it was renamed as Java (derived from Java Coffee – a type found in Indonesia). Java used the principle of WORA i.e., Write Once, Run Anywhere. Thus, it provides a free execution in any platform such as Windows, Linux, etc.

4. The main features of BlueJ are as follows:
   - Bluej has a simpler and smaller interface than other specialised environments like NetBeans and Eclipse.
   - Since Bluej is a Windows-based environment, it is very easy to interact with objects.
   - BlueJ can run on Windows, Mac OS X, Linux and other platforms.
   - BlueJ provides a menu-driven window approach.
   - Projects from non-BlueJ environments can be exported and imported.

4. Objects

Unsolved Questions

A. 1. b 2. c 3. b 4. c

B. 1. objects 2. runtime exceptions 3. object
4. derived

C. 1. Some features of JVM are as follows:
   - It allows Java code to execute on any computers, mobiles, etc. Also, it can run on any operating system. It follows the principle of "Write Once, Run Anywhere".
   - It manages and optimises the program so that memory usage can be minimized.

2. When Java source code is compiled by the Java compiler (JAVAC), the resultant code is called Java bytecode.

3. The steps to use a Scanner class are as follows:

   Step 1: Import the package in the beginning of the program code. There are two ways to import:
   - import java.util.*;
   - import java.util.Scanner;

   Step 2: Then we have to create the object of the Scanner class. The method to create the object:
   Scanner sc = new Scanner(System.in);

   where sc is the name of the object of Scanner class.

   Step 3: Use Scanner class methods as per your data type to read input from user.

   Say to read whole number from user, we have to use sc.nextInt();

   Similarly, to read character from user, we have to use sc.next().charAt(0);

4. A method throws many types of exceptions during the execution of the program. The throws keyword handles all these types of exceptions. This is used to help the programmers with prior knowledge about what types of exceptions are to be handled.

5. Primitive Values, Wrapper Classes, Types and Casting

Unsolved Questions

A. 1. a 2. b 3. c 4. d 5. c

B. 1. Boolean 2. = 3. Dynamic Initialization
4. Braces () 5. dot operator(.) 6. escape sequence
7. 4 8. 16-bit 9. Pure Arithmetic Expression
10. Explicit

C. 1. In implicit type conversion, the resultant data types are automatically chosen by the compiler. It is a process of widening.

2. An arithmetic expression an expression that contains variables, constants and arithmetic operators. It is used for calculations.

   There are two types of arithmetic expressions which are Pure Arithmetic Expression and Mixed Arithmetic Expression.

3. The use of the given escape sequences are as follows:

Escape Sequence	Required for
\’	Inserts a single quote character.
\”	Inserts a double quote character.
\\	Insert a backslash character.
\0	Used for assigning a null to a String variable.

4. The rules that we must follow at the time of naming a variable are as follows:
   - A variable name should start with a letter.
   - A variable name may contain any number of letters, digits and underscore.
   - The name should have a meaning related to the program.
   - There should not be any space between the name of the variable.
   - Variable names cannot be a reverse word.

6. Variables and Expressions

Unsolved Questions

A. 1. a 2. c 3. a 4. b 5. a
6. b 7. b 8. b 9. a 10. b

B. 1. Relational Operators
2. Ternary operator
3. nested Conditional Assignment Operator
4. ==
5. compound assignment operators
6. P = (a/b*b) + (b/a*a)
7. Binary 8. 384 9. True 10. Bitwise XOR(∧)

C. 1. 12-0
2. True
3. A
4. 6
   2
5. 112 : k
6. 4
7. T = Math.sqrt(a*a) +(b*b*b*b) + (c*c*c*c*c*c) – (a*b)
8. System.out.print(x%2==0)? (x >0) "EVEN POSITIVE NUMBER": "EVEN NEGATIVE NUMBER":"ODD"
9. 19
10. true
11. 65
12. a. d = 10 + 3*(11-77)
       = 10+3*(-66)
       = 10-198
       = -188

    b. a += ++a /++b;
       a = a+ ++a/++b
       = 10 + 11/5
       = 10 + 2
       = 12

    c. c -= b++ + b++ - c-- - --c;
       c = c - b++ + b++ - c-- - c--
       = 77 - 4 + 5 - 77 - 76
       = 77 - 157 + 5

= 5 - 80
= -75

d. a *= ++c;
a = a* ++c
= 10*78
= 780

e. d = a * (a++ - ++b) / 3;
d = 10 * (10 - 5)/3
= 10 * 5/3
= 10 * 1
= 10

7. Statements and Scope

Unsolved Questions

A.

1. c	2. a	3. c	4. b	5. b
6. d	7. c	8. a	9. c	10. d
11. a	12. c	13.	14. b	

B.

1. break
2. Top – down approach
3. 15
4. basic_sal>=2000?tax=5.0/100.0*basic_sal:tax=2.5/100.0*basic_sal
5. nested if statement
6. Switch Case
7. multidirectional
8. at least once
9. continue statement
10. Math.sqrt()
11. ...
12. floating-point format
13. -4.0
14. Void
15. delay

C. 1.

```
switch(ch) {
Case 1:
System.out.println("One");
break;
case 2:
System.out.println("Two");
break;
case 3:
System.out.println("Three");
break;
```

```
default:
System.out.println("Wrong Choice");
```

2. Science stream
   With Computer
3.
4.
5.
6. 1
   2
   5
   10
7. GCD of given numbers is: 2GCD of given numbers is: 2GCD of given numbers is: 2GCD of given numbers is: 2

D. 1. /*Java Program to check whether a number is even or odd*/

```
import java.util.Scanner;
public class Main
{
  public static void main(String args[])
  {
    Scanner input = new Scanner(System.in);
    int num;  //Declare a variable
    System.out.println("Enter a number:");
    num = input.nextInt();
    if ( num % 2 == 0 )
        System.out.println("The entered number is even");
     else
        System.out.println("The entered number is odd");
  }
}
```

8. Methods and Constructors

Unsolved Questions

A. 1. a 2. c 3. d 4. b 5. b
6. b 7. b 8. c 9. a 10. b

B. 1. Constructor 2. Static members methods 3. Instance Variable
4. Data Members 5. External Wrapper, Internal Wrapper
6. ... 7. New 8. static data member
9. Dynamic Binding 10. Impure Methods

C. 1. The differences between Method Header and Method Signature are as follows:

Method Header	Method Signature
The first line of any method definition is known as the method header.	The name of the method along with its parameter list in the method header is called the method signature.
It consists of the access specifier, return data type, method name and the parameter list.	It is the identification of the method in the programming code, which also specifies the different parameters used in that method, which are known as arguments.

2. The advantages of using a method are as follows:
   - They reduce the size of the coding.
   - They reduce the burden of debugging the programming code, as finding and correcting the errors become easier for the developers.
   - They also occupy less space in memory and the execution becomes faster.
3. The general syntax of declaring a method is given below:

```
<access specifier> <return-type> <name-of-method> <parameter-list>
{
Job done by the method;
}
```

4. The differences between Return Type and Return Statement are as follows:

Return Type	Return Statement
If the function is returning a value, then the data type of the value is mentioned here, in this part of the method definition.	This statement is used when the function is returning some value.
The different data types written here are byte, short, int, long, float, double, char or Boolean.	The returned value may be of any data type, even non-primitive data types.

5. a. **Method Header:** void input(int), boolean check_armstrong(), void display(), public static void main()
   b. **Access Specifiers:** all are public (as nothing is mentioned).
   c. **Return Type and Return Statement:** Boolean is the return type and return true and return false are its return statements. Other methods do not return any value. So, no return statements and void is the return type.

d. **Method name:** input(), check_armstrong(), display(), main()

e. **Parameter list:** num is the parameter in input(num) and the remaining methods do not have a parameter.

6. The two characteristics of Return Statement are as follows:
   1. It is the last statement in the method, after which the method is terminated.
   2. Only one value can be returned at a time.
7.

9. Strings

Unsolved Questions

A. 1. c 2. a 3. b 4. b 5. c 6. d

B. 1. java.lang 2. 0 3. int countTokens() 4. Boolean
5. Smaller, larger

C. 1. The String class is used to create and manipulate strings.

2. The StringBuffer class is used to create sufficient space in the memory to store a String. This space in memory can be changed as required. If the string is less than the size defined, the extra space will contain an extra value.

3. The StringTokenizer is a class defined under java.util package. It is used to split a String into tokens. As you know that tokens are separated by delimiters. Whitespace, newline, carriage return are the default delimiters, though other characters can be included. The methods of the StringTokenizer class do not distinguish among identifiers, numbers and quoted texts.

10. Arrays

Unsolved Questions

A. 1. a 2. c 3. b 4. c 5. c

B. 1. 0 2. Linear search 3. Merging
4. new and comma 5. Scanner

C. 1. A double-dimensional array or 2D array is a type of array which is used when we need to refer to data, stored in a tabular form. In this tabular format, data are stored in horizontal and vertical form and are known as rows and columns respectively.

2. Sorting is the process of arranging the elements either in ascending or descending order. Once sorted, we can see that the elements of the array are placed in such an order, that they lie from either small to big or from big to small.
3. In the bubble sort technique, each element is compared to its adjacent elements and arranged accordingly in ascending or descending order. If it is to be sorted in ascending order, then it is to be checked whether the previous element is larger than the next element. If it is so, then the elements in these positions are swapped, i.e., interchanged, and so on. This process continues till the entire list of elements is sorted.
4. In this process, the second element is checked with the first element and if the element is found to be smaller than the previous one, in the case of ascending sort, the first element is shifted by one index to the right and the second element is placed in the front. Similarly, the third element is checked with the previous elements and as long as the condition is satisfied the numbers are shifted, then the element in the third position is placed. This procedure continues until the last iteration is executed.

11. Basic Input/Output

Unsolved Questions

A.

1. d	2. a	3. d	4. c	5. a
6. b	7. a	8. b	9. d	10. b

B.

1. nextLong()	2. countTokens()	3. ascending, descending
4. nextToken(String delim)	5.	6. true
7. Byte stream	8. readFloat(float)	9. 16-bit Unicode
10.		

C.

1.
- **nextToken():** It returns the next token/word from the StringTokenizer object.
- **hasMoreTokens():** It returns true if there is a token left in the StringTokenizer object, else it returns false.
- **countTokens():** It returns the total number of tokens in the object.

2. To write data to a binary file, the following steps are to be performed:

Step 1: Create an object of the FileOutputStream class and connect it with the physical file on the disk. To open in append mode true parameter is used. If no parameter is specified then it will overwrite its previous content.

```
FileOutputStream <fileobject> = new FileOutputStream("File name",
true);
```

Step 2: Connect the FileOutputStream's object with the DataOutputStream's object to call the required methods for writing data of different primitive types.

```
DataOutputStream <dataobject> = new DataOutputStream(fileobject);
```

Step 3: Write data to the file using different write methods for different data types.

```
dataobject.writexxx(variable);
```

Step 4: Close all the stream objects by using the close() method.

```
fileobject.close();
```

3. To read data from a Binary file, the following steps are to be followed:

Step 1: Create object of FileInputStream and connect it with the physical file on the disk.

```
FileInputStream <fileobject> = new FileInputStream("File name");
```

Step 2: Connect the FileInputStream object with the DataInputStream objects to call the required methods for reading data of different primitive types.

```
DataInputStream <dataobject> = new DataInputStream(fileobject);
```

Step 3: Read data from the file using different read methods for different data types inside a try-catch block. When the end of file is met an EOFException is generated which is handled by the catch block.

```
dataobject.readxxx(variable);
```

4. The overloaded constructors of the StringTokenizer class are given in the following table:

Constructor	Purpose
StringTokenizer(String str)	It creates StringTokenizer object with a specified string considering only the default delimiters.
StringTokenizer(String str, String delimiter)	It creates StringTokenizer with a specified string and a String of delimiter list.

5. The difference between text file and binary file are as follows:

- **Text Files:** The files that store data in the form of human-readable text are known as text files. These files contain data as a sequence of characters in the form of ASCII or UNICODE characters. A text file is identified by .txt extension. In this type of file, each line is terminated by an End of Line (EOL) character.
- **Binary Files:** Binary files are not in human-readable form. These are machine-readable files. It stores data in the form of 0s and 1s. There is no need to put a comma, space, or end-of-line character in binary files.

12. Recursion

Unsolved Questions

A. 1. d 2. d 3. a 4. 5. c

B. 1.

r

C. 1. A

13. Implementation of Algorithms to Solve Problems

Unsolved Questions

A. 1. d 2. c 3. a 4. b 5. d

B. 1. Flowchart 2. Time 3. efficient 4. finite

C. 1. a. **Algorithm:** An algorithm is a set of well-defined finite steps or rules to be followed that will give us our desired result.

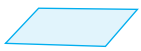
b. **Pseudocode:** Pseudocode is a representation of an algorithm in any standard human-readable language and mathematical notations.

c. **Flowchart:** A flowchart is a pictorial representation of an algorithm using standard symbols.

2. a.  : The oval-shaped start/stop symbol is used to represent the beginning and end of a flowchart.

b.  : The rectangle-shaped process box is used to represent internal operations like arithmetic and assignment operations inside the process or memory.

c.  : The diamond-shaped decision box is used to check the condition. It has one input and two outputs representing the actions to be taken for two outcomes true and false.

d.  : The parallelogram-shaped input/output box represents an input operation like accepting data from the keyboard or an output operation like displaying the result on a monitor or printing it.

e.  : The off page connectors are used to join symbols on another page. These connectors are also used in pairs.

3. One similarity between a flowchart and a pseudocode is that, they are only used for planning and documentation.

One difference between a flowchart and a pseudocode is that a pseudocode is written in any human-readable language and mathematical notations while a flowchart is a graphical representation of algorithm and pseudocode.

4. a. **Best case complexity:** For any input of size 'n' the function takes the minimum time or the minimum number of steps for execution. It defines the lower bound of an algorithm.

   b. **Worst case complexity:** For any input of size 'n', the function takes the maximum time or the maximum number of steps required for execution. It defines the upper bound of an algorithm.

   c. **Average case complexity:** In the average case analysis, we take all possible inputs combination and calculate their individual computation time and then calculate the average of all the data. So, this calculates the average time taken by the algorithm for execution.

16. Trends in Computing and Ethical Issues

Unsolved Questions

A.

1. a	2. b	3. c	4. b	5. b
6. b	7. a	8. c	9. d	10. c

B.

1. spam
2. Commercial Software
3. Business Software Alliance
4. Cyber crime
5. malicious
6. Copyleft
7. Open-Source Initiative
8. execute
9. Trojan horse
10. Cloud Computing

C.

1. Intellectual Property refers to the ideas and innovations that are the creation of an individual mind or a group of minds.
2. The three types of Intellectual Property Rights are as follows:
   i. Patents
   ii. Trademarks
   iii. Copyrights
3. **Patents:** This property right gives the owner of the innovation the sole right to produce, use or sell the item at least for the first 5 year, before others could start manufacturing it. This right is also valid for computer software.
4. Software Piracy as the name itself suggests is illegal and refers to the unlawful act using copying or distributing software.

   No, it is illegal.
5. The four applications of artificial intelligence are as follows:

- Face detection and recognition technology like the FaceID used for unlocking smartphones use AI.
- Text editors like the INK can instantly rephrase any content with a mouse click. INK makes work faster and easier for writers, bloggers, content writers, etc.
- Social media platforms like Facebook, Twitter, and Instagram use AI to personalise a person's feeds, based on his area of interest and even recommend similar content for browsing.
- Several companies use chat bots for conversing with their customers. These chat bots are designed to converse as efficiently as their human counterparts (the customer care representatives) using natural language processing.

6. Some of the measures that can be taken to control Software Piracy are as follows:
   - We should always purchase legal software and that too from reputed vendors or directly from a computer website.
   - While buying, we should always check for the license documentation, original disc, etc.
   - We should never copy the software and give it to our employees or friends for use. We should also encourage others to buy original software.
   - Check for the serial number that has been provided and any difference should be avoided.
   - As soon as the software is purchased, we should register the software so that others will not be able to use the same serial number.
7. The two applications of IoT are as follows:
   - **Smart cities:** IoT applications are implemented in smart cities for intelligent traffic management, improved health diagnosis and services, smart water supply, scheduling waste collection depending on the fill level of the bins, automated meter reading of water, electricity and gas of the consumers, smart parking facility, automated smart lighting controls and many more such applications.
   - **Healthcare:** Physical fitness devices and activity trackers like smartwatches and monitors easily provide their users with data pertaining to their blood pressure, heart rate, and activity of users and also update them on a daily basis. They can even send messages to family members or even contact appointed doctors in case of emergencies.
8. A few Netiquettes we must observe while using the Internet are as follows:
   - We should always remember that the privacy of a person is of utmost importance. So, we should respect it.
   - We should not use abusive language while sending any email or using social media.
   - We should not post any rude or nasty messages about others online.
   - Sending any spam messages to others is not acceptable.

- Emoticons may be used in an appropriate manner and carefully so that it does not deliver the wrong messages across to the receiver.
- We should try to reply to the messages of others whenever possible.
- The use of words such as “Please” or “Thank you” is to be done whenever solicited.
- We should avoid any form of sarcastic jokes/comments while posting on social media which may hurt the feelings of anyone.
- We should not post any misinformation.
- We should always take care to avoid sharing other person’s personal or professional information.

9. Two types of Cybercrime that are frequently heard of these days are:
   - **Spam:** Spams are unsolicited mails sent mainly with the idea of online business schemes or commercial advertisements, which are sent in bulk to many recipients at once. They contain many fraudulent schemes which appear to be lucrative choices for the users but which on opening may encounter malware such as worms, Trojan Horse, spyware, etc. This would obviously be a threat to our computer systems as well as our user accounts held online. So, it is very essential for the user to be aware of such spam e-mails.
   - **Phishing:** Phishing refers to cybercrimes where spam email messages are sent to different people to get personal information like usernames, passwords, card details, etc. In this case, the sender pretends to be a genuine official/company whose mails look authentic enough to trick recipients into giving their sensitive personal information.
10. Two applications of Virtual Reality are as follows:
    - Virtual reality is extensively used in the field of entertainment like gaming and movies.
    - VR medical training helps medical students practice surgical operations in a virtual environment.