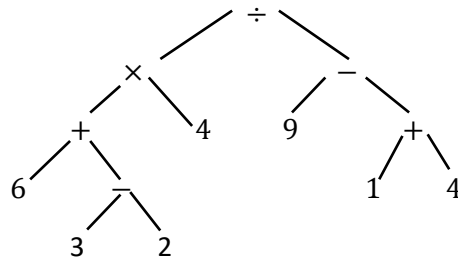


**Question 1**

a) (i) 7

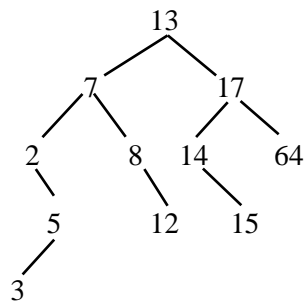
(ii)  $((6 + (3 - 2)) \times 4) \div (9 - (1 + 4))$

(iii) Binary tree



(iv) Postorder search: 6 3 2 - + 4 × 9 1 4 + - ÷

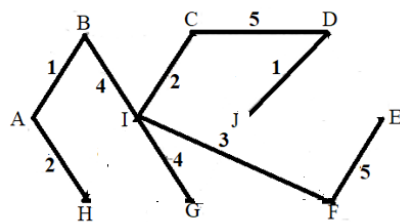
b) (i) 13 7 8 2 17 5 12 14 15 64 3



(ii)  $\frac{34}{11}$

(iii) Preorder search: 13 7 2 5 3 8 12 17 14 15 64

c)

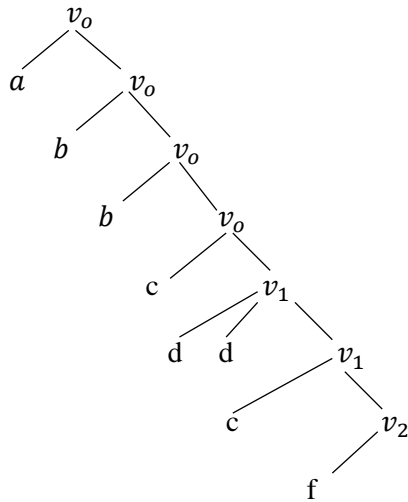


Minimum total weight  
= 27

## Question 2

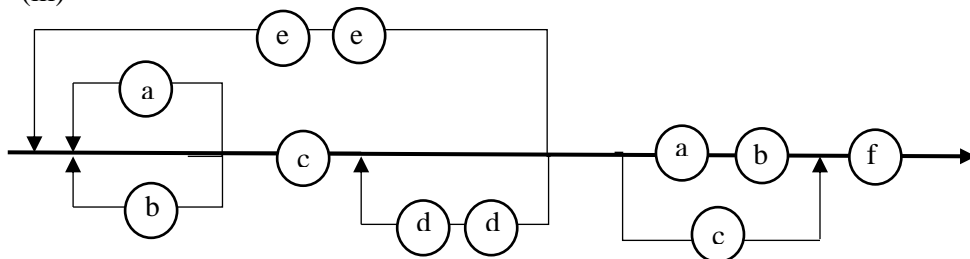
- a) (i)  $\langle v_o \rangle ::= a\langle v_o \rangle \mid b\langle v_o \rangle \mid c\langle v_1 \rangle$   
 $\langle v_1 \rangle ::= dd\langle v_1 \rangle \mid ee\langle v_o \rangle \mid ab\langle v_2 \rangle \mid c\langle v_2 \rangle$   
 $\langle v_2 \rangle ::= f$

(ii)



*abbcddcf* is a syntactically correct sentence.

(iii)



- (iv) Regular expression =  $(a \vee b)^* c (dd)^* [(ee(a \vee b)^* c (dd)^*)^* (ab \vee c) f$

- (b) (i) State transition table of  $f_{1100}$

	$f_{1100}$
$S_0$	$S_5$
$S_1$	$S_5$
$S_2$	$S_4$
$S_3$	$S_5$
$S_4$	$S_5$
$S_5$	$S_5$

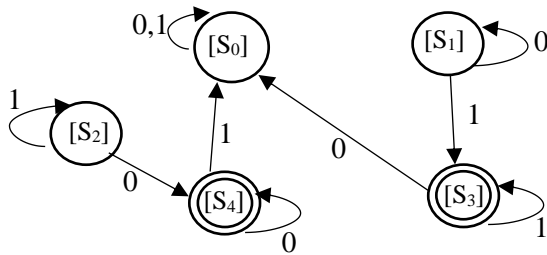
- (ii)

	$S_0$	$S_5$	$S_1$	$S_2$	$S_3$	$S_4$
0	$S_0$	$S_5$	$S_1$	$S_4$	$S_5$	$S_4$
1	$S_5$	$S_5$	$S_3$	$S_2$	$S_3$	$S_5$

- (iii)

	0	1
$[S_0]$	$[S_0]$	$[S_0]$
$[S_1]$	$[S_1]$	$[S_3]$
$[S_2]$	$[S_4]$	$[S_2]$
$[S_3]$	$[S_0]$	$[S_3]$
$[S_4]$	$[S_4]$	$[S_0]$

- (iv)



- (v) Not accepted by  $M$  and  $M/R$ .

**Question 3**

a)  $\therefore *$  is not a valid binary operation defined on the set of integers  $\mathbb{Z}$ .

b) (i)  $a * b = 9$

(ii)  $b * a = 11$

(iii)  $(b * a) * b = 36$

(iv)  $b * (a * b) = 18$

Not commutative and not associative.

c) (i)  $x = a$

$y = d$

(ii) Identity element is  $b$ .

(iii) Inverse of  $a$  is  $a$

Inverse of  $b$  is  $b$

Inverse of  $c$  is  $c$

Inverse of  $d$  is  $d$

#### Question 4

a) (i)

w	e(w)
000	00000
001	00110
010	01001
011	01111
100	10011
101	10101
110	11010
111	11100

(ii) The minimum distance = 2.

(iii)

Coset leader	Syndrome
00000	00
00001	01
00010	10
10000	11

(iv) (1)  $d(11101) = 111$

(2)  $d(01010) = 110$

b) (i)

Letter, $(x_i)$	A	B	C	E	L	P	W
Probability, $P(x_i)$	0.11	0.09	0.12	0.20	0.30	0.13	0.05
Codeword, $C_i$	101	0100	100	11	00	011	0101

C A P A B L E

(ii) Average code length,  $L(C) = 2.64$  bits

Entropy  $H(x) = 2.6143$

Efficiency = 0.9903

The efficiency of this code is 99.03%