CLASS TEST

Sl. : 01_IG_CE_H+E_080523

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CPMT-PERT

CIVIL ENGINEERING

Date of Test : 08/05/2023

ANSWER KEY

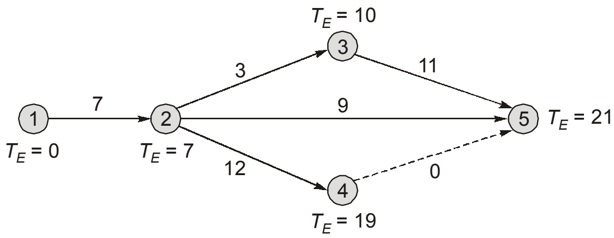
1.	(a)	7.	(c)	13.	(a)	19.	(a)	25.	(a)
2.	(a)	8.	(d)	14.	(a)	20.	(c)	26.	(b)
3.	(c)	9.	(c)	15.	(d)	21.	(b)	27.	(c)
4.	(d)	10.	(d)	16.	(a)	22.	(c)	28.	(c)
5.	(b)	11.	(d)	17.	(b)	23.	(c)	29.	(a)
6.	(a)	12.	(a)	18.	(c)	24.	(b)	30.	(d)

DETAILED EXPLANATIONS

1. (a)
Only D is predecessor to activity F

2. (a)

Activity	1-2	2-3	2-4	3-5	2-5
Expected time (in days)	7	3	12	11	9



3. (c)

$$\text{Cost slope} = \frac{8600 - 6000}{8 - 3} = 520$$

For duration of 5 days

$$\text{Direct cost} = 6000 + 520\,(8 - 5) = ₹7560$$

6. (a)
In bar charts, inter dependences between various activities is not shown.

7. (c)
Correct sequence of analysing a project will be as follows:
1. Work break down structure.
2. Network diagram.
3. Resource allocation and scheduling.
4. Project completion time.
5. Time cost study.

8. (d)
Project duration will be $4T$ as there are four activities are in series but over all project duration will be $4T \pm 3\sigma$.

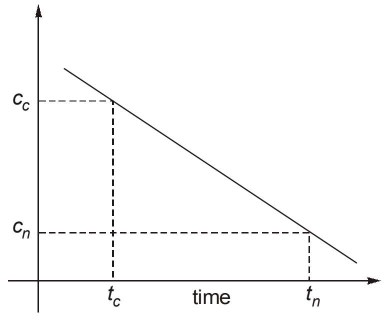
$$\sigma \text{ for entire project} = \sqrt{K^2 + K^2 + K^2 + K^2}$$

$$\Rightarrow \quad \sigma = 2K$$

$$\therefore \quad \text{Over all project duration} = 4T \pm 6K$$

9. (c)

$$\text{Cost slope} = \frac{c_c - c_n}{t_n - t_c}$$



10. (d)

$$\text{FDB} = 1 - \left(\frac{C_s}{C_i}\right)^{1/n}$$

$$= 1 - \left(\frac{2000}{16000}\right)^{1/3} = 0.5$$

11. (d)

Cost of machine = ₹100000

Rate of interest, i = 10% = 0.1

$$\text{Capital recovery factor (CRF)} = \frac{i(1+i)^n}{(1+i)^n - 1}$$

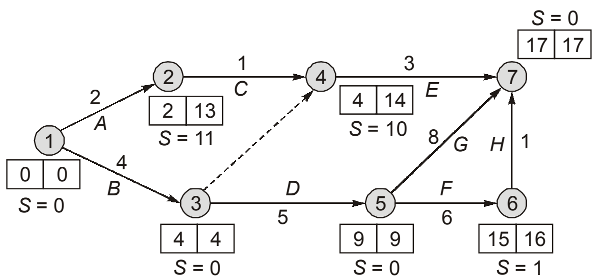
$$\Rightarrow \quad \text{CRF} = \frac{0.1(1+0.1)^{20}}{(1+0.1)^{20} - 1} = 0.11746$$

∴ The annual equipment cost = 100000 × 0.11746

= ₹11746

12. (a)

For given network diagram,



Project completion time = 17 weeks

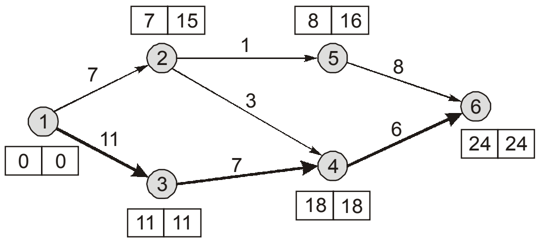
Critical path = 1-3-5-7

Slack of event 4 = 10 weeks

Total float of activity 6 – 7 = 1 week

13. (a)

Activity	Expected time (days) $t_E = \frac{t_o + t_p + 4t_m}{6}$	Variance $\sigma^2 = \left(\frac{t_p - t_o}{6}\right)^2$
1-2	7	2.78
1-3	11	2.78
2-4	3	0.11
2-5	1	0
3-4	7	1
4-6	6	1
5-6	8	1

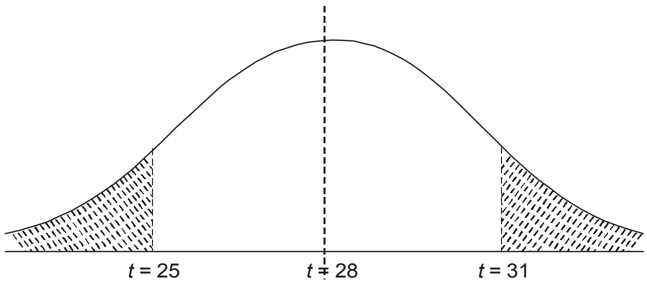


Expected time = 24 days

Critical path = 1–3–4–6

Variance for critical path = 2.78 + 1 + 1 = 4.78

14. (a)



For given project,

Standard deviation $\sigma = \sqrt{9} = 3$ days

Probability factor for $T_S = 25$, $Z = \frac{25-28}{3} = -1$

Probability of completion within 25 days

= 100 – 84 = 16%

For probability of completion after 31 days

Probability factor, $Z = \frac{31-28}{3} = 1$

Probability of completion = 100 – 84 = 16%

Total probability = 16 + 16 = 32%

15. (d)

During crashing of an activity, the duration of activity is reduced due to which:

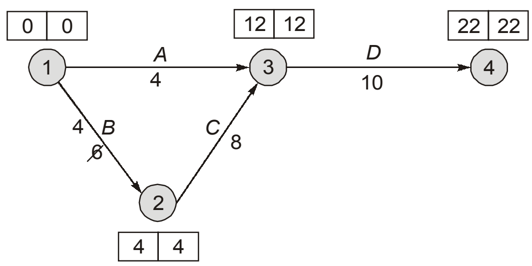
1. Indirect cost decreases.
2. Direct cost increases.

16. (a)

Activity	Crash limit (days)	Cost Slope (₹/day)
A	4 – 3 = 1	(105 – 80) / (4 – 3) = 25
B	6 – 4 = 2	(250 – 180) / (6 – 4) = 35
C	8 – 5 = 3	(320 – 200) / (8 – 5) = 40
D	10 – 6 = 4	(530 – 350) / (10 – 6) = 45

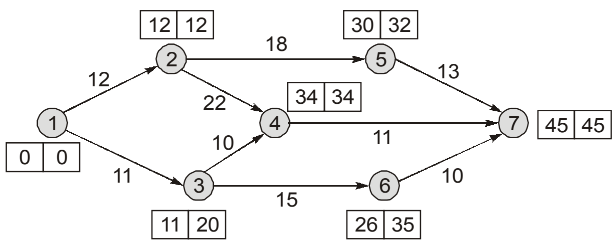
Activity	*A*	*B*	*C*	*D*
Critical	–	✓	✓	✓

Since the critical activity *B* has the lowest crash cost per day, it should be crashed first.
Hence, crash activity *B* by 2 days



Critical path is still *B-C-D*
Project completion time = 22 days
Project cost = 810 + (2) (35) = ₹ 880

17. (b)
Network diagram,



For activity 3-4,

$$\text{EST} = 11$$
$$\text{EFT} = 11 + 10 = 21$$
$$\text{LFT} = 34$$
$$\text{Total float} = 34 - 21 = 13 \text{ days}$$

For activity 3-6,

$$\text{EST} = 11$$
$$\text{EFT} = 11 + 15 = 26$$
$$\text{LFT} = 35$$
$$\text{Total float} = 35 - 26 = 9 \text{ days}$$
$$\text{Sum of total float} = 13 + 9 = 22 \text{ days}$$

18. (c)

For the given project, available paths are:

Available paths

(i) 1 – 2 – 3 – 5 – 6 ⇒ Time duration = 18 days

(ii) 1 – 2 – 4 – 5 – 6 ⇒ Time duration = 18 days

So both paths are critical.

Combination of activities to crash the path, and their respectively cost slopes are given below:

(i) only *A* → ₹ 600/day

(ii) only *F* → ₹ 700/day

(iii) *B* and *C* → 200 + 300 = ₹ 500/day

(iv) *B* and *E* → 200 + 200 = ₹ 400/day

(v) *D* and *C* → 300 + 300 = ₹ 600/day

(vi) *D* and *E* → 300 + 200 = ₹ 500/day

So we will crash that combination of activity for which slope is minimum i.e. *B* and *E*.

19. (a)

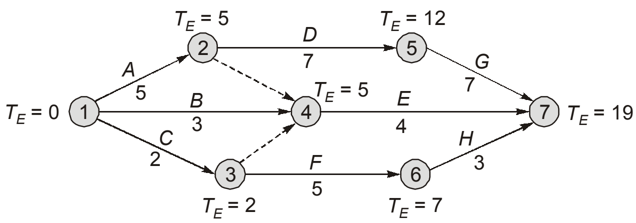
Path available	Duration (days)	Standard deviation (days)
1 – 2 – 4 – 6	5 + 8 + 17 = 30	
1 – 2 – 4 – 5 – 6	5 + 8 + 5 + 18 = 36	2.345
1 – 2 – 5 – 6	5 + 13 + 18 = 36	2.69
1 – 3 – 5 – 6	4 + 11 + 18 = 33	

So, number of critical path = 2

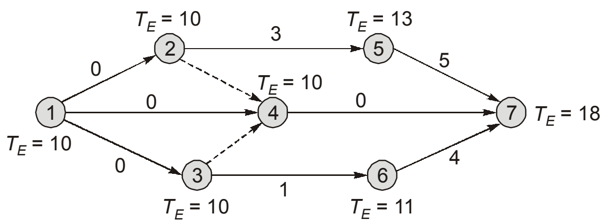
Path with more uncertainty = 1 – 2 – 5 – 6

20. (c)

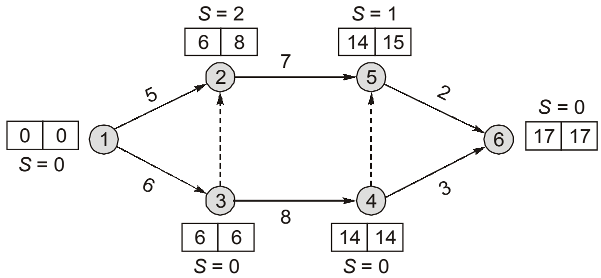
For given network diagram



After updating

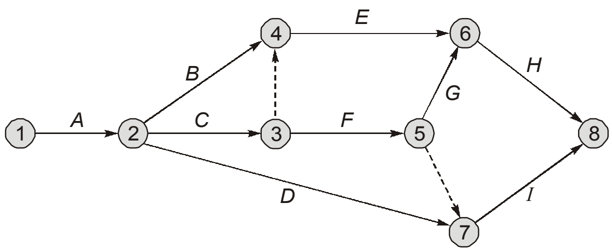


21. (b)



Sum of slacks = 2 + 1 = 3 days

22. (c)



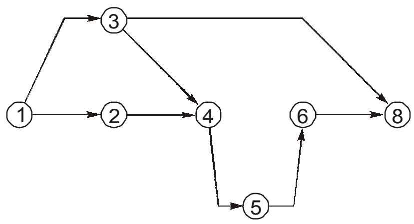
23. (c)

There is an extra dummy between events (7) and (8).

There are two arrows joining events (2) and (4).

There is extra dummy connecting nodes (4) and (6).

The correct diagram will be



So there are two errors.

24. (b)

$$\text{Expected time} = \frac{t_0 + t_p + 4t_m}{6} = \frac{12 + 25 + 20 \times 4}{6}$$

$$= \frac{117}{6} \text{ minutes}$$

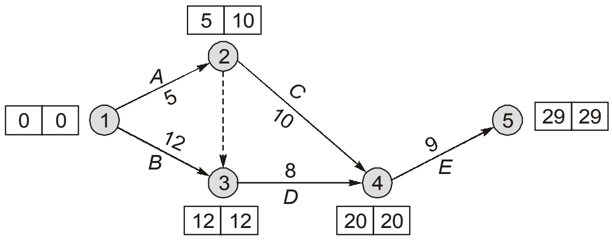
$$\text{Standard deviation, } \sigma = \frac{t_p - t_0}{6} = \frac{25 - 12}{6} = \frac{13}{6} \text{ minutes}$$

$$\text{Minimum time alloted, } t_{min} = t_E - 3\sigma$$

$$= \frac{117}{6} - \frac{3 \times 13}{6} = 13 \text{ minutes}$$

25. (a)

For given relationship



26. (b)

Let N be the number of unit

At breakdown point,

$$\text{Fixed cost + Variable cost} = \text{Total cost}$$

$$\Rightarrow \quad 1000000 + 100 \times N = 5000000$$

$$\therefore \quad N = 40000 \text{ units}$$

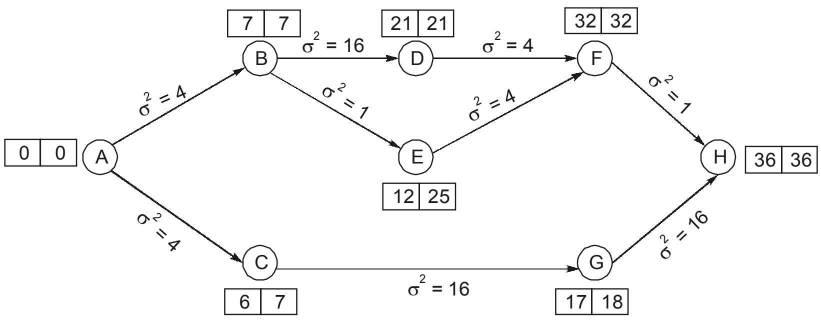
Suppose the selling price per unit be ₹ x

$$\text{Now,} \quad \text{Margin of safety} = \frac{\text{Total sales – Sales at BEP}}{\text{Total sales}}$$

$$\Rightarrow \quad \frac{10}{100} = \frac{5000000 - 40000 \times x}{5000000}$$

$$\therefore \quad x = ₹112.5$$

27. (c)



Standard deviation of project,

$$\sigma = \sqrt{4+16+4+1} = 5 \text{ days}$$

$$Z = \frac{T_S - T_E}{\sigma} = \frac{31-36}{5} = -1$$

Thus, $P(t \le 31) = P(Z \le -1)$

$$= 0.5 - \phi(1) = 0.5 - (0.8413 - 0.5)$$

$$= 0.1587 = 15.87\%$$

28. (c)

From straight line method of depreciation

$$\text{Depreciation, } D = \frac{c_i - c_s}{n}$$

$$D = \frac{10000 - 1000}{5} = \text{Rs.}1800$$

$$\text{Book value, } B_m = c_i - mD$$

$$B_2 = 10000 - 2 \times 1800$$

$$= \text{Rs. } 6400$$

29. (a)

Project No.	Cost (₹)	No. of Cars	Unit Cost (₹)
1.	450000	150	3000
2.	320000	80	4000
3.	600000	120	5000
4.	360000	90	4000
5.	300000	60	5000
6.	660000	220	3000
7.	280000	70	4000
8.	720000	180	4000

Forecast weighted unit cost,

$$UC = \frac{A + 4B + C}{6}$$

where,

$$A = ₹\,5000$$

$$B = \frac{3000 + 4000 + 5000 + 4000 + 5000 + 3000 + 4000 + 4000}{8} = ₹\,4000$$

$$C = ₹\,3000$$

$$\therefore \quad UC = \frac{5000 + 4 \times 4000 + 3000}{6} = ₹\,4000$$

$$\text{Project cost} = UC \times \text{Number of units}$$

$$= 4000 \times 135 = ₹\,540000$$

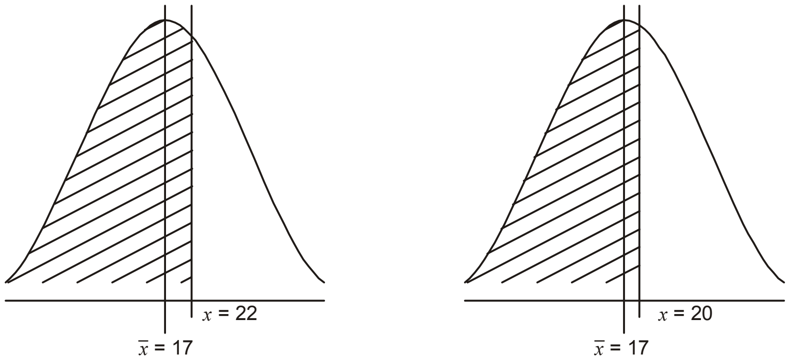
30. (d)

$$\bar{X} = 17 \text{ units}$$

$$\text{Variance, } \sigma^2 = 9$$

$$\text{Standard deviation, } \sigma = 3$$

$$Z = \frac{x - \bar{x}}{\sigma}$$



For 22 days, $Z = \frac{22-17}{3} = \frac{5}{3} = 1.67$

$$P(Z < 1.67) = 95.2\%$$

For 20 days, $Z = \frac{20-17}{3} = \frac{3}{3} = 1$

$$P(Z < 1) = 84.13\%$$

$$\therefore \quad P(Z < 1.66) - P(Z < 1) = 95.2\% - 84.13\%$$

$$= 11.07\%$$

■■■■