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## CPMT-PERT

### CIVIL ENGINEERING

Date of Test : 07/10/2025

#### ANSWER KEY ➤

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

## DETAILED EXPLANATIONS

1. (a)

Only  $D$  is predecessor to activity  $F$

2. (c)

Nodes are usually represented by squares or rectangles in AON networks but any other geometrical shape can also be used.

3. (c)

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

For duration of 5 days

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

5. (c)

$$\text{Variance, } v = \left( \frac{t_p - t_0}{6} \right)^2$$

Here  $t_p = 1 \text{ hour} = 60 \text{ minutes}$ ,  $t_0 = 5 \text{ minutes}$

$$\therefore v = \left( \frac{60 - 5}{6} \right)^2 = 84.03 \text{ minutes}$$

6. (b)

Free float is that duration by which an activity can be delayed without delaying any succeeding activity. Interfering float is equal to head event slack.

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  $4T \pm 3\sigma$ .

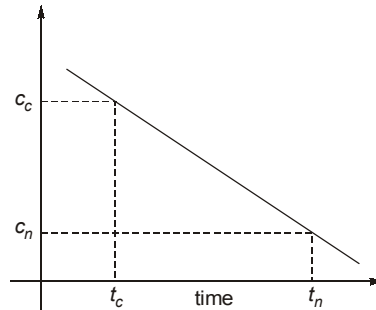
$$\sigma \text{ for entire project} = \sqrt{K^2 + K^2 + K^2 + K^2}$$

$$\Rightarrow \sigma = 2K$$

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

9. (c)

$$\text{Cost slope} = \frac{C_c - C_n}{t_n - t_c}$$



10. (d)

$$\begin{aligned} \text{FDB} &= 1 - \left( \frac{C_s}{C_i} \right)^{1/n} \\ &= 1 - \left( \frac{2000}{16000} \right)^{1/3} = 0.5 \end{aligned}$$

11. (d)

Cost of machine = ₹100000

Rate of interest,  $i = 10\% = 0.1$

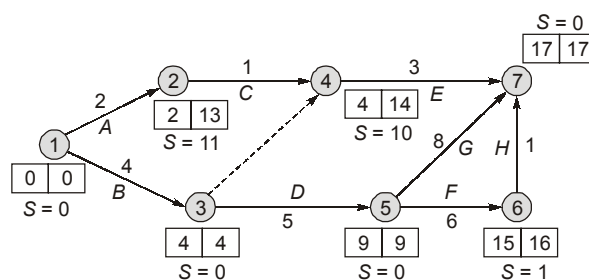
$$\text{Capital recovery factor (CRF)} = \frac{i(1+i)^n}{(1+i)^n - 1}$$

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

$$\begin{aligned} \therefore \text{The annual equipment cost} &= 100000 \times 0.11746 \\ &= ₹11746 \end{aligned}$$

12. (a)

For given network diagram,



Project completion time = 17 weeks

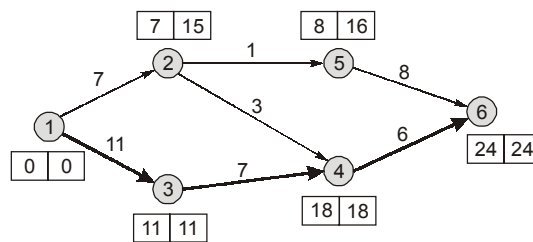
Critical path = 1-3-5-7

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

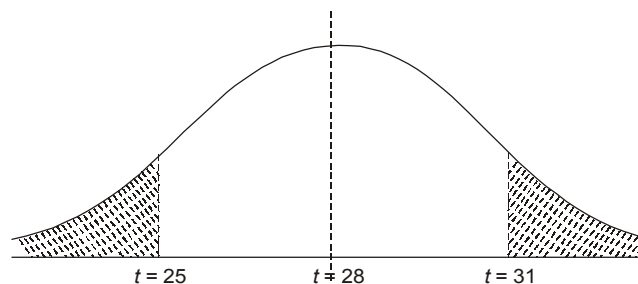


Expected time = 24 days

Critical path = 1-3-4-6

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

14. (a)



For given project,

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

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

$$\begin{aligned} \text{Probability of completion within 25 days} \\ = 100 - 84 = 16\% \end{aligned}$$

For probability of completion after 31 days

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

$$\text{Probability of completion} = 100 - 84 = 16\%$$

$$\text{Total probability} = 16 + 16 = 32\%$$

15. (d)

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

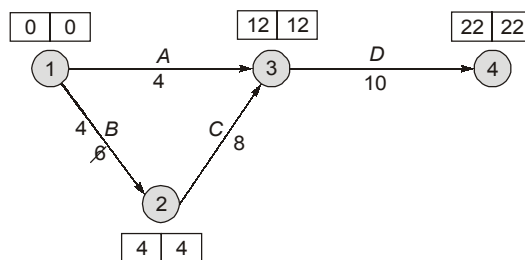
1. Indirect cost decreases.
2. Direct cost increases.

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



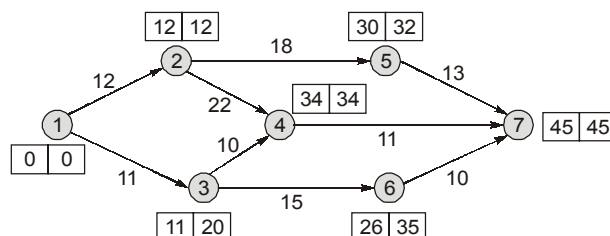
Critical path is still *B-C-D*

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  $\Rightarrow$  Time duration = 18 days

(ii) 1 – 2 – 4 – 5 – 6  $\Rightarrow$  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  $\rightarrow$  ₹ 600/day

(ii) only F  $\rightarrow$  ₹ 700/day

(iii) B and C  $\rightarrow$  200 + 300 = ₹ 500/day

(iv) B and E  $\rightarrow$  200 + 200 = ₹ 400/day

(v) D and C  $\rightarrow$  300 + 300 = ₹ 600/day

(vi) D and E  $\rightarrow$  300 + 200 = ₹ 500/day

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

19. (a)

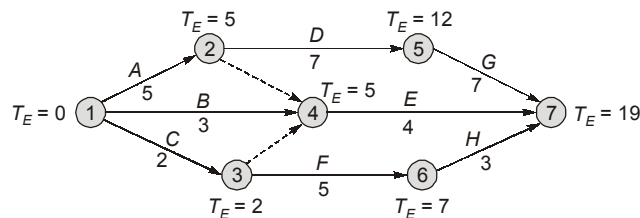
Path available	Duration (days)	Standard deviation (days)
1 – 2 – 4 – 6	$5 + 8 + 17 = 30$	
1 – 2 – 4 – 5 – 6	$5 + 8 + 5 + 18 = 36$	2.345
1 – 2 – 5 – 6	$5 + 13 + 18 = 36$	2.69
1 – 3 – 5 – 6	$4 + 11 + 18 = 33$	

So, number of critical path = 2

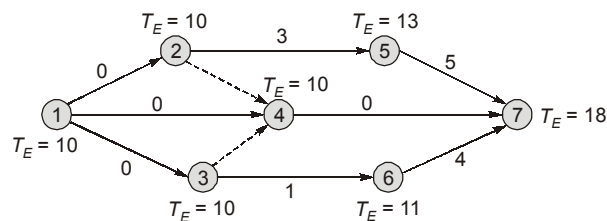
Path with more uncertainty = 1 – 2 – 5 – 6

20. (c)

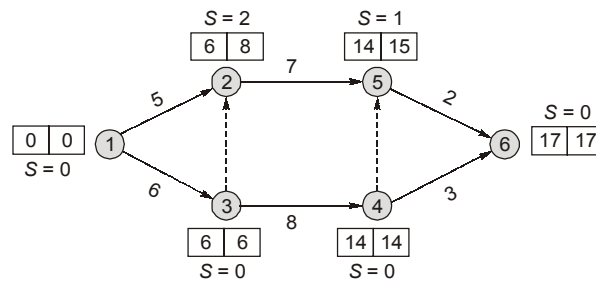
For given network diagram



After updating

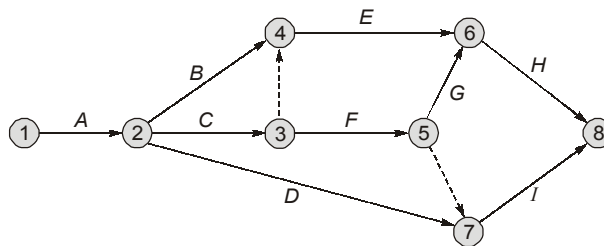


21. (b)



Sum of slacks = 2 + 1 = 3 days

22. (c)



23. (b)

Tension in toe cable = Rolling resistance + Grade resistance  
As grade resistance = 10 kg/tonne/1% slope

$$\therefore 1105 \text{ kg} = \frac{R \times 13000}{10^3} + \frac{10 \times 13000}{10^3} \times 4$$

So rolling resistance = 45 kg/tonne

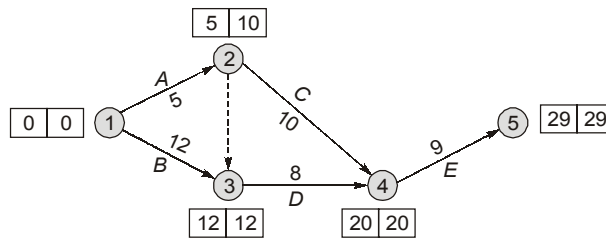
24. (b)

$$\begin{aligned} \text{Expected time} &= \frac{t_0 + t_p + 4t_m}{6} = \frac{12 + 25 + 20 \times 4}{6} \\ &= \frac{117}{6} \text{ minutes} \end{aligned}$$

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

$$\begin{aligned} \text{Minimum time allotted, } t_{\min} &= t_E - 3\sigma \\ &= \frac{117}{6} - \frac{3 \times 13}{6} = 13 \text{ minutes} \end{aligned}$$

25. (a)  
For given relationship



26. (b)

Let  $N$  be the number of unit

At breakdown point,

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

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

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

Suppose the selling price per unit be ₹  $x$

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

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

$$\therefore x = ₹112.5$$

27. (a)

$$\text{Rolling resistance} = 15 \times 50 = 750 \text{ kg}$$

$$\text{Grade resistance} = 15000 \times \frac{2}{100} = 300 \text{ kg}$$

$$\begin{aligned} \text{Pull available for towing the load} &= \text{Maximum rimpull} - \text{rolling resistance} - \text{upgrade resistance} \\ &= 6300 - 750 - 300 = 5250 \text{ kg} \end{aligned}$$

28. (c)

From straight line method of depreciation

$$\text{Depreciation, } D = \frac{C_i - C_s}{n}$$

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

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

$$\begin{aligned} B_2 &= 10000 - 2 \times 1800 \\ &= \text{Rs. } 6400 \end{aligned}$$



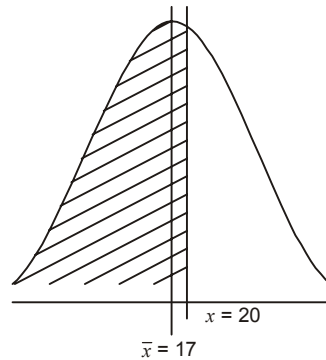
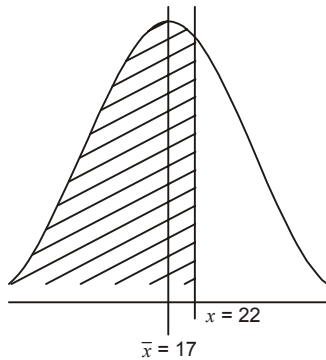
30. (d)

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

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

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

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



For 22 days,

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

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

For 20 days,

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

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

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

$$= 11.07\%$$

■ ■ ■ ■