CLASS TEST

S.No. : 01 CESK_A+B_200224

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Railway + Airport

CIVIL ENGINEERING

Date of Test : 20/02/2025

ANSWER KEY

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

DETAILED EXPLANATIONS

1. (d)

Radius of exit taxiway, $R = \dfrac{V^2}{125f} = \dfrac{80^2}{125 \times 0.15} = 341.33 \simeq 342 \text{ m}$

2. (b)

3. (c)

$$w = \frac{13(B+L)^2}{R} = \frac{13(6+0.05)^2}{250}$$

$$= 1.903 \text{ m}$$

4. (b)

5. (b)

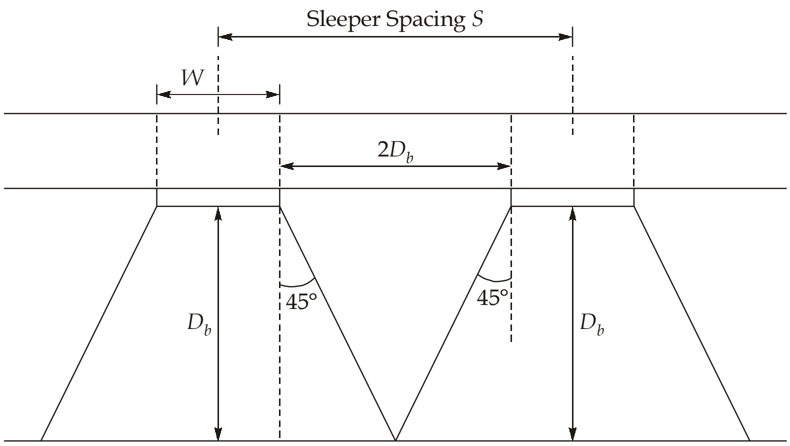
Flat footed rails	Bull headed rails
More strength and stiff	Less strength and stiffness for same weight
Fastenings are lesser and cheaper	Fastenings are more and costly so initial cost is high
Less maintenance cost	More maintenance cost

6. (b)

7. (d)

8. (b)

9. (d)



From figure,

$$S = 2D_b + W$$

$$D_b = \frac{S-W}{2} = \frac{65-25}{2} = 20 \text{ cm}$$

10. (c)

11. (a)

Grade provided = Ruling gradient – Grade compensation

= 1 in 250 – 0.04% × 4°

$$= \frac{1}{250} - \frac{0.16}{100}$$

= 0.0024 = 0.24%

12. (b)

Grade resistance + Curve resistance = Gradient resistance

$$\Rightarrow \quad W \tan\theta + 0.04\% \times 4 \times W = \frac{W}{200}$$

$$\Rightarrow \quad W \tan\theta + 0.0004 \times 4° \times W = \frac{W}{200}$$

$$\Rightarrow \quad \tan\theta = \frac{1}{200} - 0.0004 \times 4$$

$$= 3.4 \times 10^{-3} = \frac{1}{294}$$

13. (b)

$$R = 250 \text{ m}$$

$$e = 20 \text{ cm}$$

$$V_{max} = 58.84 \text{ kmph}$$

$$\therefore \quad \text{Length of transition curve} = \max \begin{cases} 7.2e = 7.2 \times 20 = 144 \text{ m} \\ 0.073(e)V_{\max} = 0.073 \times 20 \times 58.84 = 85.91 \text{ m} \end{cases}$$

$$= 144 \text{ m}$$

14. (a)

Length of track, $l = (D-G)N + G\left(4N - \sqrt{1+N^2}\right)$

Given, $N = 15$, $D = 7.5$m, $G = 1.676$ m

$$l = (7.5-1.676)\times 15 + 1.676\left(4\times 15 - \sqrt{1+15^2}\right)$$

= 87.36 + 75.36 = 162.73 m

The length of straight distance

= l – 4 GN = 162.73 – 4 × 1.676 × 15 = 62.17 m

15. (a)

Type of airport	Maximum rate of change of longitudinal gradient
A and B	0.1% per 30 m length
C type	0.2% per 30 m length
D and E type	0.4% per 30 m length

16. (a)

Hauling capacity $= \mu WN$

W = Load on each driving axle

$\Rightarrow \quad W = 10 \times 2 = 20$ tonnes

N = Number of axles

$\Rightarrow \quad N = 3$

$\therefore$ Hauling capacity $= 0.3 \times 20 \times 3 = 18$ tonnes

17. (a)

Crossing number, $N = 12$

Gauge, $G = 1.676$ m

Outer radius, $R_0 = 1.5\,G + 2\,GN^2$

$R_0 = 1.5 \times 1.676 + 2 \times 1.676 \times 12^2 = 485.2$ m

$$\text{Central radius, } R = R_0 - \frac{G}{2} = 485.2 - \frac{1.676}{2} = 484.4 \text{ m}$$

18. (d)

Correction for elevation = 7% per 300 m

$$= \frac{7}{100} \times 1920 \times \frac{275}{300} = 123.2 \text{ m}$$

Corrected length = 1920 + 123.2 = 2043.2 m

19. (d)

20. (d)

21. (b)

22. (c)

Hauling capacity $= \mu n w_d$

$= 0.2 \times 3 \times 20 = 12$ tonnes

For train moving on straight and level track,

Hauling capacity = Total train resistance

Total train resistance $= R_{T1} + R_{T2} + R_{T3} + R_g$ $\quad (\because R_g = W + \tan\theta = 0)$

R_{T1} = resistance independent of speed $= 0.0016w$

R_{T2} = resistance dependent of speed $= 0.00008wv = (0.00008 \times 100)w = 0.008w$

R_{T3} = atmospheric resistance $= 0.0000006wv^2 = (0.0000006 \times 100^2)w = 0.006w$

$\therefore \quad 12 = 0.0016w + 0.008w + 0.006w$

$\Rightarrow \quad 12 = 0.0156w$

$\Rightarrow \quad w = 769.23 \text{ tonnes} \simeq 769 \text{ tonnes}$

23. (a)

Radius of broad gauge curve,

$$R = \frac{1146}{3} = 382 \text{ m}$$

$$e_{eq} = \frac{GV^2}{127R} = \frac{1.676\times70^2}{127\times382} = 0.169 \text{ m} > 0.165 \text{ m}$$

Adopt $e_{eq} = 0.165$ m

$$e_{th} = e_{eq} + \text{CD} = 16.5 + 7.6 = 24.1 \text{ cm}$$

$\therefore$ $$24.1 = \frac{1.676\times V_m^2}{127\times382}\times100$$

$\Rightarrow$ $V_m = 83.52$ kmph

24. (c)

Since, V_{avg} = Weighted average of given movement of trains

$\Rightarrow$ $$V_{avg} = \frac{5(60)+8(80)+12(90)+6(110)}{5+8+12+6} = 86.45 \text{ kmph}$$

Now, $e_{th} = e_{act} + CD$

$\Rightarrow$ $$\frac{GV_{max}^2}{127R} = \frac{GV_{avg.}^2}{127R} + CD$$

$\Rightarrow$ $$\frac{1.750\times130^2}{127\times\frac{1750}{2}} = \frac{1.750\times86.45^2}{127\times\frac{1750}{2}} + CD$$

$\Rightarrow$ $0.2661 = 0.1177 + CD$

$\Rightarrow$ $CD = 0.1484 \text{ m} = 14.84 \text{ cm} \not> 10 \text{ cm}$

Provide $CD = 10$ cm and calculate V_{max} again

$$\frac{GV_{max}^2}{127R} = \frac{GV_{avg}^2}{127R} + CD$$

$\Rightarrow$ $$\frac{1.750\times V_{max}^2}{127\times\frac{1750}{2}} = \frac{1.750\times86.45^2}{127\times\frac{1750}{2}} + \left(\frac{10}{100}\right)$$

$\Rightarrow$ $V_{max} = 117.574 \text{ kmph} \simeq 118 \text{ kmph}$

25. (a)

26. (b)

$$R = \frac{0.388w^2}{\frac{T}{2} - S}$$

$$R = \frac{0.388w^2}{\frac{T}{2} - \left[6 + \frac{\text{Trade of main landing gear}}{2}\right]}$$

$$300 = \frac{0.388 \times 35^2}{\frac{22.5}{2} - \left[6 + \frac{\text{Trade of main landing gear}}{2}\right]}$$

Trade of main landing gear = 7.332 m ≈ 7.33 m

27. (a)

Gate capacity for single gate,

$$G_C = \frac{1}{\text{Weighted service time}}$$

$$= \frac{1}{(0.2 \times 30) + (0.2 \times 40) + (0.6 \times 60)}$$

$$= 0.02 \text{ aircraft/min/gates}$$

Capacity of all gates C, $= G_C \times$ Number of gate

$$= 0.02 \times 20$$

$$= 0.4 \text{ aircraft/min}$$

$$= 24 \text{ aircraft/hour}$$

28. (c)

$$\text{A.R.T.} = T_a + \frac{1}{3}(T_m - T_a)$$

$$= 25 + \frac{1}{3}(35 - 25) = 28.33°\text{C}$$

29. (c)

- Zero fuel weight is the sum of empty operating weight and maximum payload.
- Maximum landing weight is less than maximum takeoff weight because fuel is burned during flight.
- Maximum ramp weight is greater than maximum takeoff weight because extra fuel is also required for taxing.

30. (c)

Internal force developed, F = $\alpha TEA = 2 \times 10^{-5} \times 30 \times 20 \times 10^5 \times 60$

= 72000 kg

Resistance of track = 720 kg/km

∴ Length to resist at one end = $\frac{72000}{720}$ km

= 100 km

∴ Total breathing length required = 2 × 100 = 200 km

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