CLASS TEST

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Railway Engineering

CIVIL ENGINEERING

Date of Test : 20/08/2023

ANSWER KEY ➤

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

DETAILED EXPLANATIONS

1. (d)

Length of BG rail = 12.8 m

Number of BG rails in 800 m = $\frac{800}{12.8} = 62.5 \simeq 63$

Now, Sleeper density = 12.8 + 5 = 17.8 $\simeq$ 18 sleepers per rail

$\therefore$ Number of sleepers = 18 × 63 = 1134

2. (a)

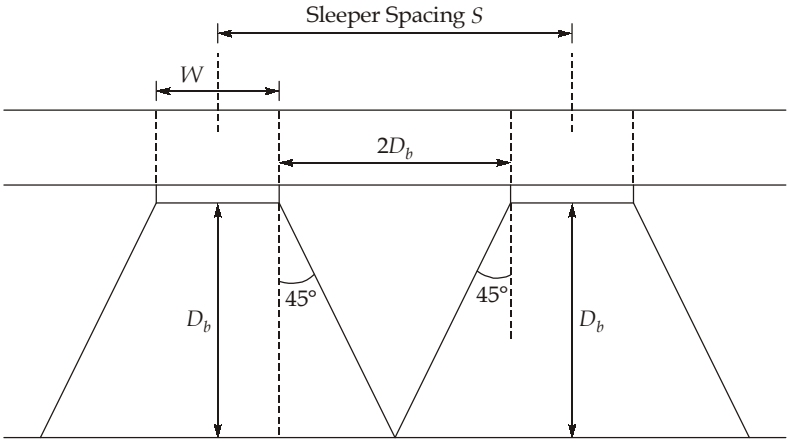
Grade provided = Ruling gradient – Grade compensation

= 1 in 250 – 0.04% × 4°

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

= 0.0024 = 0.24%

4. (d)



From figure,

$S = 2D_b + W$

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

8. (d)

- Normally, the tread of wheels is absolutely dead centre of the head of the rail, as the wheel is coned to keep it in the central position automatically. These wheels are coned at a slope of 1 in 20.
- Coning of wheel reduces the wear and tear of the wheel flanges and rails which is due to rubbing action of flanges with inside faces of the rail head.

9. (c)

Composite Sleeper Index (CSI), measures the mechanical strength of timber, derived from its composite properties of strength and hardness

$$\text{CSI} = \frac{S + 10H}{20}$$

where, S = Strength index at 12% moisture content

H = Hardness index at 12% moisture content.

10. (a)

The distance at which outer signal is to be placed, is found on the basis of maximum allowable speed. It is 540 m for BG track in India.

11. (b)

12. (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

$= l - 4\,GN$

$= 162.73 - 4 \times 1.676 \times 15$

$= 62.17$ m

13. (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 $= R_{T1} + R_{T2} + R_{T3} + R_g$ $(\because R_g = W + \tan\theta = 0)$

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 $= 0.0000006wv^2 = (0.0000006 \times 100^2)w = 0.006w$

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

$\Rightarrow \quad 12 = 0.0156w$

$\Rightarrow \quad w = 769.23$ tonnes $\simeq 769$ tonnes

14. (d)

Actual cant provided on main line $= e_{th} - D = 7.78 - 7.5 = 0.28$ cm

The actual cant provided for branch line $= -(e_{act})_{main} = -0.28$ cm.

15. (c)

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

$$= 1.903 \text{ m}$$

16. (a)

$$\text{Degree of curve} = \frac{1718.9}{R}$$

$$\Rightarrow \quad 4 = \frac{1718.9}{R}$$

$$\Rightarrow \quad R = 429.7 \text{ m} \simeq 430 \text{ m}$$

18. (a)

$$\text{Radius, } R = \frac{G - d - h\sin\alpha}{2\sin\left(\frac{\alpha+\beta}{2}\right) \times \sin\left(\frac{\alpha-\beta}{2}\right)}$$

where $\alpha = 6°47'35''$ and $\beta = 1°34'27''$

$$= \frac{1676 - 136 - 864 \times 0.1183}{2 \times 0.07295 \times 0.04553}$$

$$= 216442.3 \text{ mm}$$

$$= 216.4 \text{ m}$$

19. (a)

Radius of broad gauge curve,

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

$$e_{eq} = \frac{GV^2}{127R} = \frac{1.676 \times 70^2}{127 \times 382} = 0.169 \text{ m} > 0.165 \text{ m}$$

Adopt $e_{eq} = 0.165$ m

$e_{th} = e_{eq} + \text{CD}$

$= 16.5 + 7.6 = 24.1$ cm

$$\therefore \quad 24.1 = \frac{1.676 \times V_m^2}{127 \times 382} \times 100$$

$$\Rightarrow \quad V_m = 83.52 \text{ kmph}$$

20. (b)

Hauling capacity $= \mu WN$

W = Load on each driving axle

$$\Rightarrow \quad W = 10 \times 2 = 20 \text{ tonnes}$$

N = Number of axles

$$\Rightarrow \quad N = 3$$

$$\therefore \quad \text{Hauling capacity} = 0.3 \times 20 \times 3 = 18 \text{ tonnes}$$

21. (c)

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

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

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

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

$$\Rightarrow \quad \frac{1.750\times 130^2}{127\times\frac{1750}{2}} = \frac{1.750\times 86.45^2}{127\times\frac{1750}{2}} + CD$$

$$\Rightarrow \quad 0.2661 = 0.1177 + CD$$

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

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

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

$$\Rightarrow \quad \frac{1.750\times V_{max}^2}{127\times\frac{1750}{2}} = \frac{1.750\times 86.45^2}{127\times\frac{1750}{2}} + \left(\frac{10}{100}\right)$$

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

24. (a)

Cant deficiency = Theoretical cant – actual cant

Theoretical cant is provided on the basis of equilibrium speed while cant is provided at actual speed. So if actual speed is more than equilibrium speed, cant deficiency is caused.

25. (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

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

$= 100$ km

$\therefore$ Total breathing length required = $2 \times 100 = 200$ km

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