CLASS TEST

S.No. : 02 IGCE_G_22042024

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Railway

CIVIL ENGINEERING

Date of Test : 22/04/2024

ANSWER KEY

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

DETAILED EXPLANATIONS

1. (d)

Length of BG rail = 12.8 m

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

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

$\therefore$ Number of sleepers = 18 × 62.5 = 1125

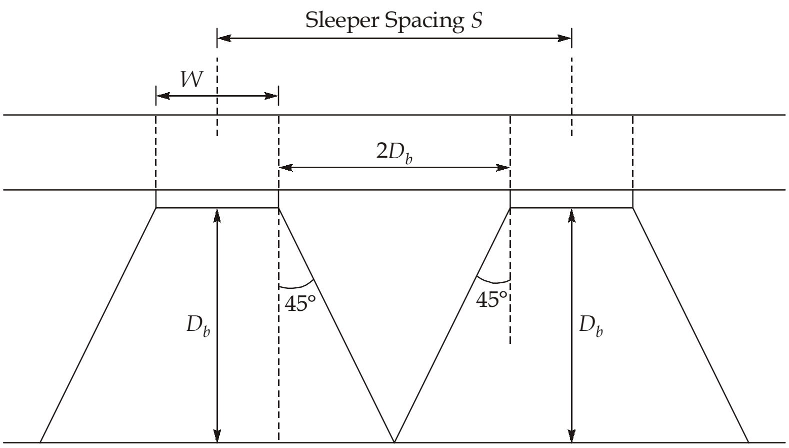
2. (a)

Grade provided = Ruling gradient – Grade compensation

= 1 in 250 – 0.04% × 4°

$$= \frac{1}{250} - \frac{0.16}{100} = 0.0024 = 0.24\%$$

3. (d)



From figure,

$$S = 2D_b + W$$

$$D_b = \frac{S-W}{2} = \frac{\frac{13}{20} - 0.25}{2} = 0.2 \text{ m} = 20 \text{ cm}$$

7. (c)

- 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.

8. (a)

$$\text{The length of straight distance} = DN - GN - G\sqrt{1+N^2}$$

$$= 7.5 \times 16 - 1.676 \times 16 - 1.676\sqrt{1+16^2} = 66.31 \text{ m}$$

9. (c)

$$\text{Hauling capacity} = \mu n w_d = 0.2 \times 3 \times 20 = 12 \text{ tonnes}$$

For train moving on straight and level track,

$$\text{Hauling capacity} = \text{Total train resistance}$$

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

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

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

$$\Rightarrow \quad 12 = 0.0156w$$

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

10. (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.

11. (a)

$$\text{Degree of curve} = \frac{1750}{R}$$

$$\Rightarrow \quad 4 = \frac{1750}{R}$$

$$\Rightarrow \quad R = 437.5 \text{ m} \simeq 438 \text{ m}$$

13. (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

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

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

$$\Rightarrow \quad V_m = 84 \text{ kmph}$$

14. (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

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

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

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

15. (d)

$$L_{corrected} = 1800 \times 1.28 = 2304 \text{ m}$$

Let's take x is the length corrected after applying elevation corrections.

$$\therefore \quad x \times 1.15 = 2304$$

$$x = 2003.47 \text{ m}$$

$$\therefore \quad \text{Elevation correction} = 2003.47 - 1800 = 203.47 \text{ m}$$

$$\therefore \quad 203.47 = \frac{0.07}{300} \times H \times 1800$$

$$H = 484.47 \text{ m}$$

17. (a)

$$\text{Internal force developed,} \quad F = A(T\alpha A) = 2 \times 10^{-5} \times 30 \times 20 \times 10^5 \times 60$$

$$= 72000 \text{ kg}$$

$$\text{Resistance of sleeper} = 350 \text{ kg/km}$$

$$\therefore \quad \text{Number of sleeper} = \frac{72000}{350} = 206 \text{ sleeper}$$

$$\therefore \quad \text{Breathing length} = 2[(n - 1)s] = 2[(206 - 1) \times 0.30] = 123 \text{ m}$$

18. (a)

The length of the transition curve is the larger out of the following three values.

$$V_{max} = 0.27\sqrt{(120 + 75) \times \frac{1750}{4}} = 78.86 \text{ kmph}$$

(i) $L = 0.720 \times e = 0.720 \times 120 = 86.4$ m

(ii) $L = 0.008\, D \times V_{max} = 0.008 \times 75 \times 78.86 = 47.3$ m

(iii) $L = 0.008\, e \times V_{max} = 0.008 \times 120 \times 78.86 = 75.7$ m

19. (c)

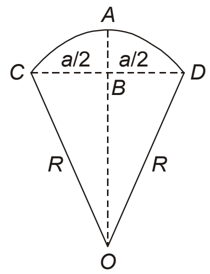
$$R_{st} = 0.15\, W_L + 0.005\, W_W$$

$$= 0.15 \times 120 + 0.005 \times (20 \times 18)$$

$$= 18 + 1.8 = 19.8t$$

22 (c)

Given: Versine = $V = AB = 2$ cm, $a = 11.8$ m



$$AB \times (2AO - AB) = CB \times BD$$

(Property of triangle)

$$V \times (2R - V) = \frac{a}{2} \times \frac{a}{2}$$

$$2RV - V^2 = \frac{a^2}{4}$$

$$2RV = \frac{a^2}{4} \qquad (\because \; V << R)$$

$$V = \frac{a^2}{8R}$$

$$R = \frac{(11.8)^2}{8 \times 0.02} = 870.25 \text{ m}$$

23. (a)

Corrugations occur:

(i) Where the ballast consists of broken bricks
(ii) Where brakes are applied to trains for stopping them
(iii) Where trains start
(iv) In electrified sections
(v) In long tunnels

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)

$$\text{Number of gate} = \frac{720}{24 \times 60} \times \frac{50}{2} = 12.5 \text{ gates} \simeq 13$$

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