CLASS TEST

S.No. : 03 IGCE_ABC_060824

MADE EASY

India's Best Institute for IES, GATE & PSUs

Delhi | Bhopal | Hyderabad | Jaipur | Pune | Kolkata

Web: www.madeeasy.in | **E-mail:** info@madeeasy.in | **Ph:** 011-45124612

Railway

CIVIL ENGINEERING

Date of Test : 06/08/2024

ANSWER KEY

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

DETAILED EXPLANATIONS

1. (b)

2. (a)

(a) Corrections to runway take-off length

(i) Correction for elevation $= \frac{7}{100} \times 2500 \times \frac{150}{300} = 87.5$ m

Corrected length = 2500 + 87.5 = 2587.5 m

(ii) Correction for temperature

Rise of temperature = 24 – 14 = 10°C

$$\text{Correction} = \frac{2587.5}{100} \times 10 = 258.75 \text{ m}$$

Corrected length = 2587 + 258.75 = 2845.75 m

Check: Total correction in percent $= \frac{2845.75 - 2500}{2500} \times 100 = 13.83\%$

According to ICAO, the total correction for (i) and (ii) should not exceed 35 percent.

(iii)Correction for gradient= $\frac{20}{100} \times 2845.75 \times 0.5 = 284.575$ m

Corrected length = 2845.75 + 284.575 = 3130.325 m

(b) Correction to runway landing length

Correction for elevation $= \frac{7}{100} \times 3000 \times \frac{150}{300} = 105$ m

Corrected runway landing length =3000 + 105 = 3105 m

Here no corrections are needed to landing length for temperature and gradient.

∴ Difference = 3130.325 – 3105 = 25.325 m $\simeq$ 25.3 m

3. (d)

4. (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.

5. (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

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

$= 87.36 + 75.36$

$= 162.72$ m

The length of straight distance

$= l - 4\,GN$

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

$= 62.16$ m

6. (a)

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

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

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

7. (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

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

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

8. (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, $e_{th} = e_{act} + CD$

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

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

$\Rightarrow \quad 0.2661 = 0.1177 + CD$

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

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

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

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

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

9. (b)

10. (b)

11. (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

12. (b)

13. (a)

14. (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 $= 0.0000006wv^2 = (0.0000006 \times 100^2)w = 0.006w$

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

$\Rightarrow \quad 12 = 0.0156w$

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

15. (c)

16. (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

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

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

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

17. (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

18. (b)

19. (c)

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

20. (c)

The types of railway yards are:

(i) Goods yard : The main function is to provide facilities for receiving, loading, unloading and delivery of goods and the movement of goods vehicle.

(ii) Marshalling yard : The main function is breakup, reform and dispatch of trains onwards. i.e., reception, sorting and departure.

(iii) Locomotive yard : Locomotive yard for housing locomotive. All the facilities for oil filing, watering repairing, cleaning, etc. are provided.

(iv) Passenger bogie yard : Passenger bogie yard provide facilities for safe movement of passenger and vehicles for the passengers.

21. (b)

Grade compensation = 0.04 × 3 = 0.12%

$$\text{Permissible gradient} = \frac{1}{250} - \frac{12}{10000} = \frac{1}{357}$$

22. (c)

Degree of curvature of curve,

$$D = 5°$$

For a BG track, $G = 1.676$ m

$$V = 80 \text{ km/h}$$

$$\text{Radius of curvature, } R = \frac{1718.9}{D} = \frac{1718.9}{5°} = 343.78 \text{ m}$$

$$\text{Superelevation, } e = \frac{GV^2}{127R} = \frac{1.676 \times 80^2}{127 \times 343.78} = 0.2456 \text{ m} = 24.56 \text{ cm}$$

But equilibrium cant in a BG track should not be greater than 16.5 cm.

23. (d)

24. (c)

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

$$= 1.903 \text{ m}$$

25. (a)

$$\text{Length of each rail, } n = \frac{26}{2} = 13 \text{ m}$$

$$\text{Sleeper density} = n + 6 = 13 + 6 = 19$$

$$\text{Total number of rails required} = \frac{1690}{13} = 130$$

∴ Total number of sleepers = Number of rails × Sleeper density

$$= 130 \times 19 = 2470$$

■■■■