CLASS TEST

SN:01SKCE_EFGHI_27092025

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Railway + Airport

CIVIL ENGINEERING

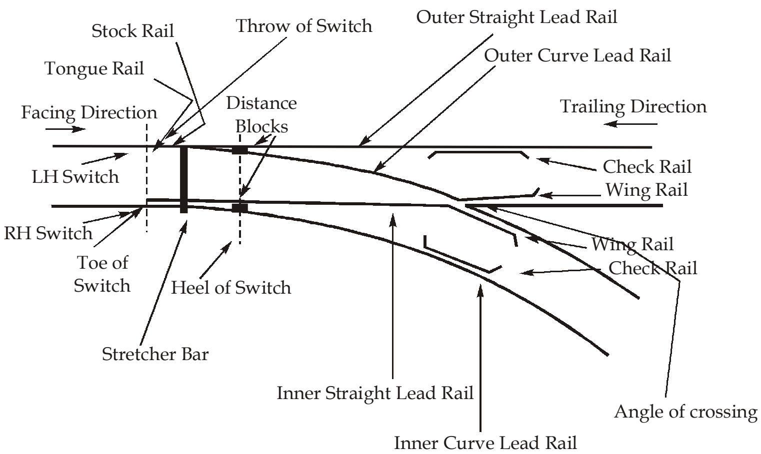
Date of Test : 27/09/2025

ANSWER KEY

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

DETAILED EXPLANATIONS

1. (a)



RIGHT HANDED TURNOUT

Facing direction is that where trains pass over the switches first and then they pass over the crossing. Thus the correct sequence is

Throw of switch, toe of switch, Tongue rain, lead rail and crossing.

2. (d)

3. (b)

Grade compensation = 0.04 × 3 = 0.12%

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

4. (a)

$$\text{H.C} = \mu wn = \frac{1}{6} \times 4 \times 225 = 15 \text{ tonnes}$$

5. (d)

6. (a)

$$e_m = e_{act} + CD$$

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

$$\frac{1.676 \times V_{max}^2}{127 \times \frac{1720}{3}} = \left(\frac{10}{100}\right) + \frac{76}{1000}$$

$$\therefore \quad V_{max} = 87.44 \text{ kmph}$$

7. (a)

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

Given
$N = 10$
$D = 5$ m
$G = 1.676$ m

$$l = (5 - 1.676) \times 10 + 1.676\,(4 \times 10 - \sqrt{1+10^2}\,)$$
$$= 83.44 \text{ m}$$

The length of straight distance $= l - 4GN$
$= 83.44 - (4 \times 1.676 \times 10) = 16.4$ m

8. (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 despatch 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.

9. (b)

Let W = Weight of the train
and x = Required gradient

Resistance due to ruling gradient $= \dfrac{1}{200}W$

Resistance due to required gradient $= \dfrac{1}{x}W$

Resistance due to 2 degree curve $= 0.0004 \times 2 \times W$

So, according to question

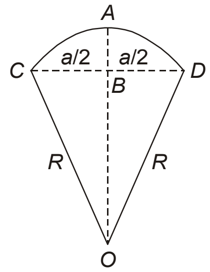
$$\frac{W}{x} + 0.0004 \times 2 \times W = \frac{1}{200}W$$

$$\Rightarrow \quad \frac{1}{x} = \frac{21}{5000}$$

$$\Rightarrow \quad \frac{1}{x} = \frac{1}{238.1} \simeq \frac{1}{238}$$

10 (c)

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



$$AB \times (2AO - AB) = CB \times BD \quad \text{(Property of triangle)}$$

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

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

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

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

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

11. (d)

12. (c)

Track modulus is an index for stiffness of track. It depends upon the gauge, the type of rails, the type and density of sleepers, the type and section of ballast and subgrade.

13. (c)

Flangeway clearance is the distance between adjacent faces of the stock rail (or running rail) and the check (or guard) rails. Heel divergence is the distance between the running faces of the stock rail and gauge face of the tongue rail when measured at the heel of the switch.

14. (c)

15. (a)

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

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

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

$\therefore$ Total number of sleepers = Number of rails × Sleeper density

= 130 × 19 = 2470

16. (b)

For landing, only elevation correction is required.

$$SAT = 15 - 0.0065(H)$$

$$\Rightarrow \quad 10 = 15 - 0.0065(H)$$

$$\Rightarrow \quad H = 769.23 \text{ m}$$

Basic runway length should be increased by 7% per 300 m elevation above MSL.

$$\therefore \text{Correction due to elevation} = \frac{0.07}{300} \times 769.23 \times 1800 = 323.08 \text{ m}$$

$$L_{Corrected} = 1800 + 323.08 = 2123.08 \text{ m}$$

17. (a)

For small airport:

- Maximum grade change should not exceed 2%.
- Length of vertical curve for each one pavement grade change is 90 m.
- Distance between points of intersection of grade line is 75 (a + b).

So,

$$a = x - y = 1.4 - (-0.5) = 1.91\% < 2\%$$

$$b = y - x = -0.5 - 0.5 = (-1)\% = 1\% \text{ (magnitude)} < 2\%$$

$$D = 75(a + b) = 75(1.9 + 1) = 217.5 \text{ m}$$

18. (c)

$$\text{Grade compensation} = \frac{0.03}{100} \times 3 = 0.0009$$

$$\text{Compensated grade} = \frac{1}{200} - 0.0009 = 0.0041$$

$$= 1 \text{ in } 243.90 \simeq 1 \text{ in } 244$$

19. (b)

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

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

20. (d)

(i) Turning radius, $R = \dfrac{V^2}{125 \times f} = \dfrac{50^2}{125 \times 0.15} = 133.33$ m

(ii) From Horonjeff's equation,

$$R = \frac{0.388W^2}{\left[\frac{T}{2} - S\right]} = \frac{0.388 \times 18^2}{\frac{22.5}{2} - \left(6 + \frac{6.5}{2}\right)} = 62.86 \text{ m}$$

(iii) For super-sonic jet,

$$R = 180 \text{ m}$$

$$\therefore \quad R_{min} = [\text{Maximum of (i), (ii) and (iii)}] = 180 \text{ m}$$

21. (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

22. (a)

Grade compensation of BG line = 0.04% per degree of curve

∴ Grade compensation of 2° curve = 2 × 0.04 = 0.08%

Ruling gradient = 1 in 250

$$= \frac{1}{250} \times 100 = 0.4\%$$

∴ Maximum allowable gradient = 0.4 – 0.08

= 0.32%

$$= \frac{1}{312.5} \simeq \frac{1}{313}$$

23. (d)

Total weight of train = Weight of locomotive + Weight of wagons

⇒ W = 120 + 25 × 20 = 620 tonnes

Rolling resistance of each wagon = 20 × 2.2 = 44 kg

Rolling resistance of all wagons = 25 × 44 = 1100 kg = 1.1 tonnes

Rolling resistance of locomotive = 120 × 3 = 360 kg = 0.36 tonnes

∴ Total rolling resistance of train = 0.36 + 1.1 = 1.46 tonnes

Resistance depending upon speed = 0.00008WV

= 0.00008 × 620 × 50

= 2.48 tonnes

Atmosphere resistance = $0.0000006\, WV^2$

= $0.0000006 \times 620 \times 50^2$

= 0.93 tonnes

∴ Train resistance = Rolling resistance + Resistance dependent on speed + Atmospheric resistance + Resistance due to gradient.

$$\Rightarrow \quad 18 = 1.46 + 2.48 + 0.93 + \frac{620}{n} \quad \text{[where gradient is 1 in } n\text{]}$$

n = 47.22 ≃ 48 (approx)

∴ Steepest gradient permissible is 1 in 48.

24. (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 aircraft/min/gates

Capacity of all gates C, = G_C × Number of gate
= 0.02 × 20
= 0.4 aircraft/min
= 24 aircraft/hour

25. (c)

Given, One metric chain = 20 m

Let the reference elevation of start point = 100 m

$$2^{nd} \text{ elevation} = 100 + (5-0) \times 20 \times \frac{1}{100} = 101 \text{ m}$$

$$3^{rd} \text{ elevation} = 101 + (15-5) \times 20 \times \left(\frac{-1}{100}\right) = 99 \text{ m}$$

$$4^{rd} \text{ elevation} = 99 + (30-15) \times 20 \times \left(\frac{0.8}{100}\right) = 101.4 \text{ m}$$

$$5^{rd} \text{ elevation} = 101.4 + (40-30) \times \left(\frac{0.2}{100}\right) \times 20 = 101.8 \text{ m}$$

Maximum difference in elevation = 101.8 – 99 = 2.8 m

Chainage	0	5	15	30	40
Elevation (m)	100	101	99	101.4	101.8

Total turning length, L = 40 × 20 = 800 m

$$\therefore \quad \text{Effective gradient} = \frac{2.8}{800} \times 100 = 0.35\%$$

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