CLASS TEST

S.No. : 04SKCE_MKNL_240924

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Railway + Airport

CIVIL ENGINEERING

Date of Test : 24/09/2024

ANSWER KEY ➤

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

DETAILED EXPLANATIONS

1. (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.

2. (d)

Length of BG rail = 12.8 m

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

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

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

3. (a)

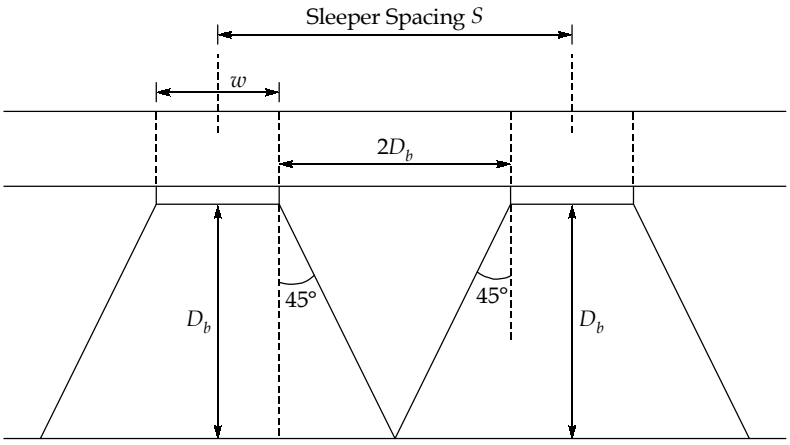
Grade provided = Ruling gradient – Grade compensation

= 1 in 250 – 0.04% × 4°

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

= 0.0024 = 0.24%

4. (d)



From figure,

$$S = 2D_b + w$$

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

6. (b)

$$R = 250 \text{ m}$$
$$e = 20 \text{ cm}$$
$$V_{max} = 58.84 \text{ kmph}$$

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

$$= 144 \text{ m}$$

7. (a)

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

Given, $N = 16$, $G = 1.676$ m, $D = 7.5 + 1.676 = 9.176$ m

$$l = (9.176 - 1.676) \times 16 + 1.676\left(4 \times 16 - \sqrt{1+16^2}\right)$$

$= 120 + 80.395$

$= 200.395$ m

The length of straight distance

$= l - 4\,GN$

$= 200.395 - 4 \times 1.676 \times 16$

$= 93.13$ m

8. (c)

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

$= 1.903$ cm

9. (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, $= G_C \times$ Number of gate

$= 0.02 \times 20$

$= 0.4$ aircraft/min

$= 24$ aircraft/hour

10. (a)

Hauling capacity = μWN

W = Load on each driving axle

$\Rightarrow$ W = 10 × 2 = 20 tonnes

N = Number of axles = 3

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

11. (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 cm

$\therefore$ $$24.1 = \frac{1.676 \times V_{max}^2}{127 \times 382} \times 100$$

$\Rightarrow$ V_{max} = 83.52 kmph

12. (d)

Crosswind is considered to select the correct orientation of runway using wind-rose diagram.

13. (b)

Internal force developed = $(E\ \alpha\ T)A$

$F = 25 \times 10^5 \times 2 \times 10^5 \times 40 \times 50 = 100000$ kg = 980.67 kN

Resistance of track = 3678 kg/km

Length to resist at one end = $\frac{980.67}{3678} = 0.265$ km

Total breathing length required = 530 km

14. (d)

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

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

15. (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.

16. (c)

(a) Correction for elevation $= \frac{7}{100} \times 2200 \times \frac{500}{300} = 256.67$ m

$\therefore$ Corrected length runway = 2200 + 256.67 = 2456.67 m

(b) Airport reference temperature $= T_a + \frac{T_m - T_a}{3} = 15° + \frac{25° - 15°}{3} = 18.33°C$

Standard temperature at airport = 15°C – 0.0065 × 500 = 11.75°C

Rise in temperature = 18.33 – 11.75 = 6.58°C

Correction for temperature $= 2456.67 \times \frac{1}{100} \times 6.58 = 161.65$ m

$\therefore$ Corrected length of runway = 2456.67 + 161.65 = 2618.31 m

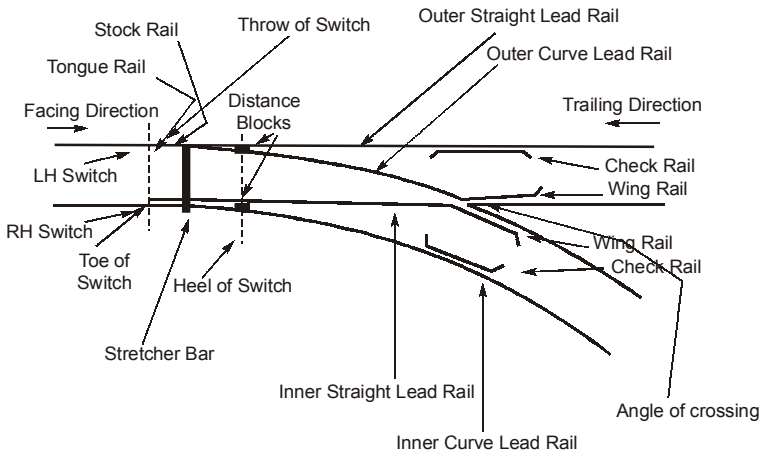
Check: Percent correction $= \frac{2618.31 - 2200}{2200} \times 100 = 19\% < 35\%$

(c) Correction for gradient $= \frac{20}{100} \times 2618.31 \times 0.5 = 261.831$ m

Final corrected length = 261.831 + 2618.31 = 2880.14 m

$\simeq$ 2881 m

17. (b)



RIGHT HANDED TURNOUT

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

Crossing, head rail, tongue rail, toe of switch.

19. (b)

$$\begin{aligned} CL &= 2\,GN \\ &= 2 \times 1.676 \times 16 \\ &= 53.63 \text{ m} \end{aligned}$$

25. (c)

$$\text{Runway length} = \frac{\text{Stopping distance}}{0.6} = \frac{1800}{0.6} = 3000 \text{ m}$$

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