RIB RANK IMPROVEMENT BATCH
CIVIL ENGINEERING

RIB-R | T10

Session 2019-20 | S.No. : 220819_SK2A

ANSWER KEY ➤ Highway and Surveying

1.	(a)	7.	(a)	13.	(a)	19.	(b)	25.	(c)
2.	(c)	8.	(d)	14.	(c)	20.	(b)	26.	(b)
3.	(a)	9.	(d)	15.	(d)	21.	(c)	27.	(d)
4.	(a)	10.	(b)	16.	(b)	22.	(a)	28.	(b)
5.	(b)	11.	(b)	17.	(d)	23.	(d)	29.	(c)
6.	(d)	12.	(a)	18.	(c)	24.	(b)	30.	(d)

DETAILED EXPLANATIONS

3. (a)

$$\text{Correction per chain} = -(l - l') = l' - l = +0.1\text{m}$$

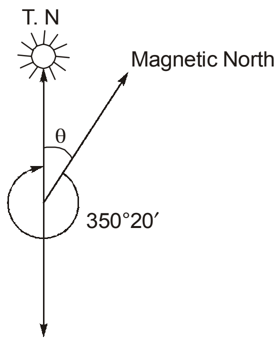
$$\text{Correction per metre} = \frac{(\ell - \ell')}{\ell} = \frac{+0.1}{20}$$

$$\text{Total correction, } C_a = \frac{0.1}{20} \times 841.5 = +4.2 \text{ m}$$

$$\text{Correct distance, } L = 841.5 + 4.2 = 845.7 \text{ m}$$

4. (a)

At noon true bearing of sun = 180° or 0°



∴ Magnetic declination, $\theta = 360° - 350°20' = 9°40'\text{E}$

6. (d)

In special cases like villages and mountaineous region, a super elevation of 10° can be provided.

8. (d)

$$K_1 d_1 = K_2 d_2$$

$$\therefore \quad K_2 = \frac{30}{75} \times 200 = 80 \text{ N/cm}^3$$

11. (b)

$$\text{Shrinkage factor} = \frac{18}{20} = 0.9$$

$$\text{Reduced plan area} = (\text{Shrinkage factor})^2 \times \text{Actual plan area}$$

$$\Rightarrow \quad 324 = (0.9)^2 \times \text{Actual plan area}$$

$$\Rightarrow \quad \text{Actual plan area} = 400 \text{ cm}^2$$

$$\therefore \quad \text{Actual area of survey in m}^2 = 400 \times (20)^2 = 16 \times 10^4$$

14. (c)

$$\text{Least count for an extended vernier} = \frac{\text{Smallest division of the main scale (s)}}{\text{Number of divisions of the vernier (n)}}$$

$$\Rightarrow \quad 10'' = \frac{10'}{n}$$

$$\therefore \quad n = 60$$

For an extended vernier

'n' division of vernier should be equal to '$(2n - 1)$' divisions of main scale

$$\therefore \quad M = 2n - 1 = 119 \text{ and } N = n = 60$$

15. (d)

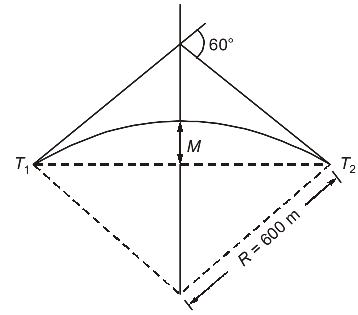
$$\text{H.I} = \text{R.L} + \text{B.S}$$

$$= 112.23 + 1.500 = 113.730 \text{ m}$$

$$\text{R.L} = \text{H.I} + \text{FS} \qquad \text{(as staff held inverted)}$$

$$= 113.730 + 0.575 = 114.305 \text{ m}$$

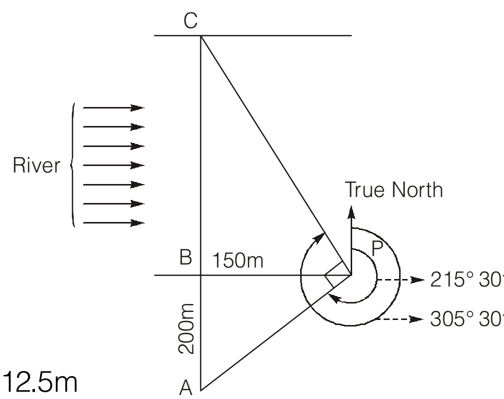
16. (b)



$$\text{Length of long chord, } T_1T_2 = 2R\sin(\Delta/2) = 2 \times 600 \times \sin(60/2) = 600 \text{ m} \quad (\because \Delta = 60°)$$

$$\text{Length of mid-ordinate, } M = R[1-\cos(\Delta/2)] = 600[1-\cos(60/2)] = 600 \times 0.134 = 80.4 \text{ m}$$

17. (d)



$$\tan \angle PAB = \frac{150}{200} = \frac{3}{4}$$

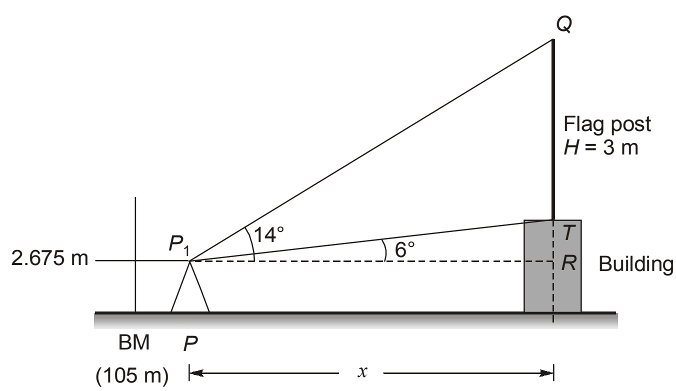
$$\Rightarrow \quad \angle PAB = 36.87°$$

$$\angle APC = 305°\,30' - 215°\,30' = 90°$$

$$\therefore \quad \angle ACP = 180° - \angle PAB - \angle APC = 53.13° = \angle BCP$$

$$\therefore \quad BC = \frac{PB}{\tan \angle BCP} = \frac{15°}{\tan 53.13°} = 112.5\text{m}$$

18. (c)



From ΔP_1TR,

$$\tan 6° = \frac{TR}{x}$$

$$TR = x \tan 6° \quad \text{...(i)}$$

From ΔP_1RQ,

$$\tan 14° = \frac{QR}{x} = \frac{QT + TR}{x}$$

$$\Rightarrow \quad \tan 14° = \frac{3 + TR}{x} \quad \text{...(ii)}$$

From (i) and (ii), we get

$$x \tan 6° = x \tan 14° - 3$$

$$x = 20.80 \text{ m}$$

$$\therefore \quad TR = 20.80 \tan 6° = 2.186 \text{ m}$$

$$\therefore \quad \text{RL of flag – post top } (Q) = 105 + 2.675 + \text{TR} + 3$$

$$= 105 + 2.675 + 2.186 + 3$$

$$= 112.86 \text{ m}$$

19. (b)

As per IRC recommendation compensated gradient cannot be less than 4%.

20. (b)

$$h_0 = 550 \log_{10}\left(\frac{D_c}{D_a}\right) = 550 \log_{10}\left(\frac{1.5}{1}\right)$$

$$= 550 \log_{10}\left(\frac{30}{20}\right) = 550\left[\log_{10} 30 - \log_{10} 20\right] = 96.85 \text{ mm}$$

21. (c)

$$Y_a = \frac{q_a}{s_a} = \frac{400}{1250} = 0.32$$

$$Y_b = \frac{q_b}{s_b} = \frac{250}{1000} = 0.25$$

$$Y = Y_a + Y_b = 0.32 + 0.25 = 0.57$$

$$L = 2n + R = 2 \times 2 + 12 = 16 \text{ sec}$$

$$C_0 = \frac{1.5L + 5}{1 - Y} = \frac{1.5 \times 16 + 5}{1 - 0.57} = 67.5 \text{ sec}$$

22. (a)

$$e + f = \frac{V^2}{127R}$$

$$\therefore \quad e = \frac{50^2}{127 \times 100} - 0.15 = 0.04685$$

23. (d)

$\because$ Pavement width is 7 m and thus it is a two lane road i.e. $n = 2$

$$w_m = \frac{nl^2}{2R} = \frac{2 \times 7^2}{2 \times 250} = 0.196$$

24. (b)

$$\text{Amber or yellow time, } Y = \frac{S + W + l}{V}$$

where, S = Safe stopping distance, W = Distance from stop line untill rear vehicle is clear, l = Length of vehicle, V = Approach speed

$$\frac{S}{V} = \text{Stopping time for approaching vehicle}$$

25. (c)

Flow of traffic stream (q) by floating car method is

$$q = \frac{n_a + n_y}{t_a + t_w}$$

$$n_a = 200,\ n_y = 20$$

$$t_a = t_w = \frac{3}{60} = \frac{1}{20}\text{hrs}$$

$$q = \frac{200+20}{\frac{1}{20}+\frac{1}{20}} = 2200 \text{ vehicles per hour}$$

26. (b)

Stress developed due to wheel load at interior is given by,

$$S_i = \frac{0.316P}{h^2}\left[4\log_{10}\left(\frac{l}{b}\right)+1.069\right]$$

where, l = 100 cm, b = 10 cm, h = 18 cm, P = 5000 kg

$$\therefore \quad S_i = \frac{0.316\times 5000}{18^2}\left[4\log_{10}\left(\frac{100}{10}\right)+1.069\right] = 24.7 \text{ kg/cm}^2$$

27. (d)

$$\text{Optimum signal cycle, } C_0 = \frac{1.5L+5}{1-(y_A+y_B)} = \frac{1.5\times 10+5}{1-(0.15+0.45)} = 50 \text{ seconds}$$

Flow on road A = Green time of road A

$$\Rightarrow \quad G_A = \frac{y_A}{\gamma}(C_0 - L)$$

$$= \frac{0.15}{0.6}(50-10) = 10 \text{ seconds}$$

$$\text{Percent time flow on road } A = \frac{G_A}{C_0}\times 100 = \frac{10}{50}\times 100 = 20\%$$

28. (b)

	Corner (kg/cm^2)	Edge (kg/cm^2)	Interior (kg/cm^2)
Wheel load	25 (T) 25 (C)	28 (T) 28 (C)	23 (C) 23 (T)
Warping stress (summer)	8 (C) 8 (T)	9 (C) 9 (T)	10 (C) 10 (T)
Warping stress (winter)	6 (T) 6 (C)	7 (T) 7 (C)	8 (T) 8 (C)
Frictional stress (summer)	0	5 (C)	5 (C)
Frictional stress (winter)	0	4 (T)	4 (T)

Tension is critical in concrete slab,

So, combinations are:

$$\text{At corner (top)} = 25 + 6 = 31 \text{ kg/cm}^2$$

$$\text{At edge (top)} = 28 + 7 + 4 = 39 \text{ kg/cm}^2$$

$$\text{at interior (bottom)} = 23 + 10 + 4 = 37 \text{ kg/cm}^2$$

$\because$ Warping stress depends on daily variation.

29. (c)

$$\text{Jam density, } k_j = \frac{1000}{\text{space headway}}$$

$$= \frac{1000}{5} = 200\text{veh./km}$$

$$\text{Maximum flow, } q_{max} = \frac{k_j \times V_{sf}}{4}$$

$$= \frac{200 \times 76}{4} = 3800 \text{ vph}$$

30. (d)

$$\frac{t_1}{t_2} = \left(\frac{c_2}{c_1}\right)^{1/5}$$

$$\therefore \quad c_2 = \left(\frac{10}{7.5}\right)^5 \times 60 = (1.33)^5 \times 60 \simeq 250$$

■■■■