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HIGHWAY

CIVIL ENGINEERING

Date of Test : 15/06/2026

ANSWER KEY >

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

DETAILED EXPLANATIONS

1. (c)

The stopping sight distance for the first vehicle

$$S_1 = 0.278V \cdot t_R + \frac{V^2}{254(f\eta + \eta^0)}$$

$$= 0.278 \times 90 \times 2.5 + \frac{90^2}{254(0.7 \times 0.5)} = 153.6 \text{ m}$$

SSD for second vehicle, $S_2 = 0.278 \times 60 \times 2.5 + \frac{60^2}{254(0.7 \times 0.5)} = 82.2 \text{ m}$

∴ Sight distance to avoid head on collision = $153.6 + 82.2 = 235.8 \text{ m} \approx 236 \text{ m}$

2. (c)

Grade compensation is minimum of :

(i) $\frac{30 + R}{R} = \frac{30 + 100}{100} = 1.3\%$

(ii) $\frac{75}{R} = \frac{75}{100} = 0.75\%$

∴ Compensated gradient = Ruling gradient - grade compensation

$$= \frac{1}{20} - \frac{0.75}{100} = \frac{1}{23.53} \approx \frac{1}{24}$$

3. (b)

$$u = 35 \text{ kmph}$$

$$= \frac{35}{3.6} = 9.72 \text{ m/s}$$

Braking time, $t = 2 \text{ sec}$

∴ $v = u + at$

⇒ $0 = 9.72 + a \times 2$

⇒ $a = -4.86 \text{ m/s}^2$

Now, $a = -f \cdot g$

⇒ $f = \frac{a}{g} = \frac{4.86}{9.81} = 0.495$

4. (a)

Glycerine and dextrine are applied to the standard briquette for avoiding sticking of bitumen.

5. (d)

Average headway = 5 sec

$$\text{Flow of traffic stream} = \frac{1}{\text{headway}} = \frac{1}{\frac{5}{60 \times 60}} = 720 \text{ veh/hr}$$

6. (a)

Safe speed to avoid sliding is given by,

$$\frac{V^2}{gR} \leq \frac{e+f}{1-ef}$$

Given, $e = 0.06$ and $f = 0.15$

$$V^2 \leq 9.81 \times 220 \times \frac{0.06 + 0.15}{1 - 0.06 \times 0.15}$$

$$V^2 \leq 457.34$$

$$V \leq 21.38 \text{ m/s}$$

7. (a)

Given, $T_1 = 15^\circ\text{C}$, $T_2 = 44^\circ\text{C}$

The joint filler is assumed to be compressed upto 50% of its thickness.

$$\delta' = \frac{\delta}{2} = \frac{2.5}{2} = 1.25 \text{ cm}$$

$$\delta' = Le \times \alpha \times (T_2 - T_1)$$

$$1.25 \times 10^2 = Le \times 17 \times 10^{-6} \times (44 - 15)$$

$$Le = \frac{1.25 \times 10^{-2}}{17 \times 10^{-6} \times (29)} = 25.35 \text{ m}$$

8. (a)

9. (a)

10. (c)

Point of potential conflicts depends on the number of lanes on intersecting lanes.

11. (b)

No cross slopes were provided in the Roman roads.

12. (d)

13. (a)

Running time does not include stops and delays. Running time implies the time during which the vehicle was actually in motion.

14. (c)

Given, $h = 45 \text{ cm}$

Radius of contact area, $a = 25 \text{ cm}$

Since,
$$\left(\frac{a}{h}\right) = \frac{25}{45} = 0.556$$

Therefore,
$$b = \sqrt{1.6a^2 + h^2} - 0.675 h = \sqrt{1.6 \times 25^2 + 45^2} - 0.675 \times 45 = 24.625 \text{ cm}$$

15. (a)

$$\begin{aligned} \text{Traffic volume, } q &= uk \\ &= (80 - 0.5k)k \\ &= 80k - 0.5k^2 \end{aligned}$$

Maximum possible volume is capacity of road,

$$\text{For maximum volume, } \frac{dq}{dk} = 0$$

$$\Rightarrow 80 - k = 0$$

$$\Rightarrow k = 80 \text{ veh/km}$$

Now capacity,

$$q_{\max} = (80 - 0.5 \times 80) \times 80 = 40 \times 80 = 3200 \text{ veh/hr}$$

16. (d)

$$V_v = \frac{G_t - G_m}{G_t} \times 100 = \frac{2.442 - 2.268}{2.442} \times 100$$

$$V_v = 7.12\%$$

$$V_b \% = G_m \times \frac{W_b \%}{G_b} = 2.268 \times \frac{5}{1.1} = 10.309\%$$

$$\text{VMA} = V_v + V_b = 7.12 + 10.309 = 17.429\%$$

$$\text{VFB} = \frac{V_b \%}{\text{VMA}\%} \times 100 = \frac{10.309}{17.429} \times 100 = 59.15\% \approx 59\%$$

17. (a)

Since the carriageway is divided i.e., dual carriageway.

Maximum of both direction traffic will be taken i.e.,

$$A = 2400 \text{ cvpd}$$

$$\begin{aligned} N_s &= \frac{365ADF \left\{ (1+r)^n - 1 \right\}}{r \times 10^6} \times LSF \\ &= \frac{365 \times 2400 \times 0.6 \times 3.0 \left\{ (1+0.07)^{15} - 1 \right\}}{0.07 \times 10^6} = 39.62 \text{ msa} \end{aligned}$$

18. (d)

Time	Volume	HEF	Volume × HEF
8:00 - 9:00	500	14.5	7250
9:00 - 10:00	350	17.6	6160
10:00 - 11:00	200	15.3	3060
11:00 - 12:00	150	18.1	2715
			Σx = 19185

$$\text{Average daily traffic} = \frac{\Sigma x}{4} = \frac{19185}{4} = 4796.25$$

$$\text{Weekly average daily traffic} = \frac{4796.25 \times DEF}{7} = \frac{4796.25 \times 5.7}{7} = 3905.52$$

$$\text{Annual average daily traffic, AADT} = 3905.52 \times 1.35 = 5272.45$$

19. (b)

$$\lambda = 280 \text{ veh/hr}$$

Probability for 10 vehicles arriving within 2 minutes time interval

$$P(n, t) = \frac{(\lambda t)^n e^{-\lambda t}}{n!}$$

$$\begin{aligned} P\left(10, \frac{2}{60}\right) &= \frac{\left(280 \times \frac{2}{60}\right)^{10} e^{-280 \times \frac{2}{60}}}{10!} \\ &= \frac{5.016 \times 10^9 \times 8.84 \times 10^{-5}}{10!} \\ &= 0.122 \end{aligned}$$

20. (a)

Practical capacity of a rotary is given by

$$Q_p = \frac{280w \left(1 + \frac{e}{w}\right) \left(1 - \frac{p_{\max}}{3}\right)}{1 + \frac{w}{L}}$$

Statement-I: True

As with increase in length of weaving section, practical capacity increases.

Statement-II: False

As with increase in weaving ratio, numerator decreases and practical capacity of rotary ultimately decreases.

21. (c)

Angularity number, AN = 67% - % solid volume

$$= 67 - \left(\frac{V_a}{V_{cyl}} \times 100 \right)$$

$$= 67 - \left(\frac{3.9}{2.65} \times 100 \right)$$

$$= 67 - 58.87$$

$$= 8.13\%$$

$$\therefore \text{AN} = 8.00$$

22. (d)

For a particular vehicle on a high speed track.

$$\frac{e+f}{1-ef} = \frac{V^2}{127R}$$

$$\Rightarrow \frac{e+0.15}{1-e \times 0.15} = \frac{180^2}{127 \times 350}$$

$$\Rightarrow e + 0.15 = 0.7289 - 0.109 e$$

$$\Rightarrow 1.109e = 0.5789$$

$$\Rightarrow e = 0.522 = \frac{1}{1.915}$$

$$\therefore N = 1.915$$

23. (b)

$$y_A = \frac{q_A}{S_A} = \frac{450}{1250} = 0.36$$

$$y_B = \frac{q_B}{S_B} = \frac{250}{1050} = 0.238$$

$$Y = y_A + y_B = 0.36 + 0.238 = 0.598$$

Total lost time = $2 \times 3 = 6$ seconds (as it is two phase signal)

$$\text{Optimum cycle time, } C_o = \frac{1.5L + 5}{1 - Y} = \frac{1.5 \times 6 + 5}{1 - 0.598} = 34.83 \text{ seconds}$$

$$G_B = \frac{y_B}{Y} (C_o - L) = \frac{0.238}{0.598} (34.83 - 6) = 11.47 \text{ sec}$$

24. (a)

$$N = \left| -\frac{1}{30} - \left(+\frac{1}{20} \right) \right| = \frac{1}{12}$$

$$L_V = \frac{NS^2}{1.5 + 0.035S} = \frac{\frac{1}{12} \times 220^2}{1.5 + 0.035 \times 220}$$

$$= 438.41 \text{ m} > \text{HSD} (= 220 \text{ m})$$

(OK)

Equation of cubic parabola transition curve,

$$y = \left(\frac{2N}{3L_V^2} \right) x^3$$

$$\therefore b = \frac{2N}{3L_V^2} = \frac{2 \times \frac{1}{12}}{3 \times (438.41)^2} = 2.890 \times 10^{-7} = 289 \times 10^{-9}$$

25. (b)

$$\frac{\alpha}{2} = \frac{180L_C}{2\pi(R-d)} = \frac{180 \times 180}{2\pi(400-1.9)} = 12.95^\circ$$

$$\therefore \text{SSD} > L_C$$

∴ Set back distance from the centre line of pavement,

$$m = R - (R-d) \cos \frac{\alpha}{2} + \left(\frac{S-L_C}{2} \right) \sin \frac{\alpha}{2}$$

$$= 400 - (400-1.9) \cos 12.95 + \left(\frac{300-180}{2} \right) \sin 12.95$$

$$= 12.025 + 13.446 = 25.47 \text{ m}$$

$$\text{Set back distance from inner edge} = m - 2d = 25.47 - 2 \times 1.9$$

$$= 21.67 \text{ m} \simeq 22 \text{ m}$$

26. (c)

Based on head light sight distance,

$$\text{Length of valley curve, } L_v = \frac{Ns^2}{2h + 2s \tan \alpha}$$

$$L_v = \frac{Ns^2}{1.5 + 0.035s}$$

$$\text{Assuming } L_v > \text{HSD, } L_v = \frac{\left| -\frac{1}{40} - \frac{1}{60} \right| \times 120^2}{1.5 + 0.035 \times 120}$$

$$L_v = 105.26 \text{ m} \quad \not> \text{HSD}$$

Hence the assumption is incorrect,

For $L_v < HSD$

$$L_v = 25 - \frac{1.5 + 0.035s}{N} = 2 \times 120 - \frac{1.5 + 0.035 \times 120}{\left| -\frac{1}{40} - \frac{1}{60} \right|} = 103.2 \text{ m}$$

27. (c)

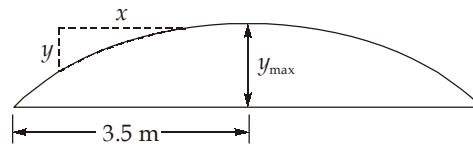
$$BI = 630 [IRI]^{1.12}$$

Here, IRI is in m/km, IRI = 3465 mm/km = 3.465 m/km

$$BI = 630 [3.465]^{1.12} = 2534 \text{ mm/km}$$

28. (c)

For a two lane road without raised kerbs, width of pavement, $W = 7.0$ m. For bituminous concrete pavement in heavy rainfall region, provide camber of 2% i.e. 1 in 50. So, for parabolic camber,



$$y = \frac{2x^2}{WN}$$

$$W = 7 \text{ m}$$

$$N = 50$$

$$x = 3.5 \text{ m}$$

\therefore

$$y_{max} = \frac{2 \times 3.5^2}{7 \times 50}$$

\Rightarrow

$$y_{max} = 0.07 \text{ m} = 70 \text{ mm}$$

29. (d)

Speed (kmph)	Average speed (kmph)	No. of vehicles	Cummulative no. of vehicles	Cummulative vehicles
20 – 30	25	40	40	5.71%
30 – 40	35	50	90	12.86%
40 – 50	45	100	190	27.14%
50 – 60	55	150	340	48.57%
60 – 70	65	200	540	77.14%
70 – 80	75	100	640	91.43%
80 – 90	85	60	700	100%

The upper value of speed limit (i.e 85th percentile speed) is marked on the sign board

$$V_{85} = 65 + \left(\frac{75 - 65}{91.43 - 77.14} \right) \times (85 - 77.14)$$

$$V_{85} = 70.5 \text{ kmph} \approx 70 \text{ kmph}$$

Hence, 70 kmph speed is marked on the sign board.

30. (b)

