

HIGHWAY ENGINEERING TEST 4

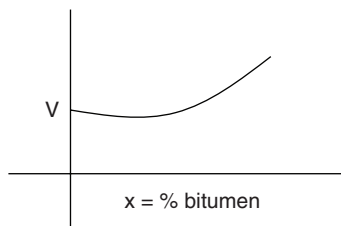
Number of Questions: 25

Time: 60 min.

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. The mean weight of aggregates in the cylinder is 100 and weight of water required to fill the cylinder is 60 g and specific gravity of aggregate is 2.6. Then the angularity number is ____.
2. The grade of tar which is generally used for surface pointing and renewal coats of road is
(A) RT-1 (B) RT-2
(C) RT-3 (D) RT-4
3. The lowest point temperature at which a material gets ignited and burns under specified conditions of test
(A) Fire point
(B) Flash point
(C) Triple point
(D) None of these
4. The elastic modulus of granular layer is 5.5 MPa and thickness of granular layer is 3mm. The composite elastic modulus of granular sub base and base in MPa is.
(A) 1.4 (B) 1.8
(C) 2.4 (D) 1.3
5. If the wheel loads stress at edge is 40kg/cm², warping stresses at edge is 9kg/cm² and frictional stress is 5kg/cm² and then the critical stress in edge region for summer mid day is.
(A) 48 kg/cm²
(B) 42 kg/cm²
(C) 44 kg/cm²
(D) 40 kg/cm²

6.



In the above graph $v = ?$

- (A) marshal stability
 - (B) unit weight
 - (C) flow value
 - (D) percentage voids of total mix
7. In a dual wheel assembly if (p) is equal to each wheel load, ' s ' is centre to centre spacing of dual wheels and ' d ' is the clear distance between wheels, then the equivalent single wheel load for depth between $d/2$ and $2s$ is
(A) p (B) $2p$
(C) between P and $2p$ (D) None

8. Match the following

	Types of Test		Property
a.	Impact	1.	Resistance to weather
b.	Soundness	2.	Hardness
c.	Crushing	3.	Toughness
d.	Abrasion	4.	Strength

Codes:

- | | |
|-------------|-------------|
| a b c d | a b c d |
| (A) 4 3 2 1 | (B) 2 1 4 3 |
| (C) 3 4 1 2 | (D) 3 1 4 2 |
9. The design traffic of a flexible pavement is based on 7 day 24 hours traffic count as per
(A) IRC : 39.2001 (B) IRC : 58 – 2002
(C) IRC : 9 (D) IRC : 7
 10. The parameters required to get the value of radius of relative stiffness of CC pavement is (conventions are as per IRC)
(A) E, k, r, u (B) E, h, k, u
(C) h, k, u, r (D) P, h, k, u
 11. A bitumen concrete mix has average specific gravity of 2.325 and theoretical specific gravity as 2.41. The density of bitumen is 1.03 g/cc with 4.5% bitumen content by weight in mix. The VFB of mix is
(A) 32.8% (B) 30.8%
(C) 20.73% (D) 10.15%
 12. A subgrade soil sample was tested using standard CBR apparatus and the observations are given below:

Load, kg	Penetration, mm
40.8	2.5
60.5	5.0

The CBR value of the sample is

- | | |
|----------|-----------|
| (A) 3.9% | (B) 2.9% |
| (C) 4.8% | (D) 12.2% |
13. The width of expansion joint is 30 mm in a cement concrete pavement. The laying temperature is 10°C and the maximum slab temperature in summer is 50°C. The coefficient of thermal expansion of concrete is $10 \times 10^{-6}/^{\circ}\text{C}$ and the joint filler compresses up to 50% of the thickness. The spacing between expansion joints should be ____ (in m).
 14. What is the deflection at the surface of flexible pavement due a wheel load of 30 kN and a tyre pressure of 0.6 Mpa. Take $E = 20$ MPa
(A) 5.8mm (B) 5.6mm
(C) 5.4mm (D) 5.2mm
 15. A plain cement concrete pavement is constructed at temperature of 20°C. The peak summer temperature is

1. 2.85–2.95 2. C 3. A 4. 1.8 5. C 6. C 7. C 8. D 9. C
10. B 11. A 12. B 13. 37.5 m 14. B 15. 21.2 m 16. 2.50–2.52
17. B 18. A 19. D 20. D 21. B 22. A 23. B 24. D 25. D

HINTS AND EXPLANATIONS

1. Angularity number = 67 -% solid volume

$$= 67 - \left(\frac{100}{60 \times 2.6} \times 100 \right)$$

$$= 2.89 = 3$$

Ans: 2.85 – 2.95

- 2.
- $RT - 3$

Choice (C)

3. Fire point

Choice (A)

$$\begin{aligned} 4. E_1 &= E_2 \times 0.2 \times h^{0.45} \\ &= 5.5 \times 0.2 \times (3)^{0.45} \\ &= 5.5 \times 0.2 \times (3)^{0.45} \\ &= 1.8 \text{ MPa.} \end{aligned}$$

Ans: 1.8

- 5.
- $\sigma_{\text{critical}} = \sigma_e + \sigma_{w(e)} - \sigma_f$

$$= 40 + 9 - 5 = 44 \text{ kg/cm}^2$$

Choice (C)

6. Flow value

Choice (C)

7. In between
- P
- and
- $2P$

Choice (C)

8. Choice (D)

- 9.
- $IRC - 9$

Choice (C)

- 10.
- E, h, k, u

Choice (B)

$$11. VFB = \frac{v_b \times 100}{VMA}$$

$$VMA = \frac{V_a + V_b}{V_t} \times 100$$

$$V_b = \frac{G_m \times W_b}{G_b} = \frac{2.325 \times 4.5}{1.03} = 10.15$$

$$V_a = \frac{G_t - G_m}{G_t} \times 100$$

$$= \frac{2.41 - 2.325}{2.41} \times 100 = 20.73$$

$$VMA = \frac{10.15 + 20.73}{1} \times 100 = 30.88$$

$$VFB = \frac{10.15 \times 100}{30.88} = 32.8\%$$

Choice (A)

$$12. CBR = \frac{\text{load at 2.5mm}}{\text{standard load}} \times 100$$

$$\text{At 2.5 mm} = \frac{40.8}{1370} \times 100 = 2.97\%$$

Choice (B)

$$13. L_e = \frac{\delta^1}{\alpha(t_2 - t_1)} = \frac{\delta}{2(\alpha)(t_2 - t_1)}$$

$$= \frac{30}{2 \times 10 \times 10^{-6} \times (40)} = 37500 \text{ mm}$$

$$= 37.5 \text{ m}$$

Ans: 37.5 m

$$14. \Delta = \frac{1.5 pa}{E_s}$$

$$\text{Contact area} = \frac{\text{wheel load}}{\text{Tyre Pressure}} = \frac{30 \times 10^3}{0.6 \text{ n/mm}}$$

$$\pi \times a^2 = 50 \times 10^3$$

$$a = \sqrt{\frac{50 \times 10^3}{\pi}}$$

$$a = 126.1 \text{ mm}$$

$$\Delta = \frac{1.5 \times 0.6 \times 126.1}{20} = 5.6 \text{ mm}$$

Choice (B)

$$15. L_e = \frac{\delta}{\alpha(t_2 - t_1)}$$

$$\delta = 3.5 \text{ cm}$$

$$\alpha = 8 \times 10^{-6} \text{ per}^\circ\text{C}$$

$$t_2 = 40^\circ\text{C}$$

$$t_1 = 20^\circ\text{C}$$

$$L_e = \frac{3.5}{8 \times 10^{-6} (40 - 20)} = 21.2 \text{ m}$$

Ans: 21.2 m

$$16. G_t = \frac{100}{\frac{W_1}{G_1} + \frac{W_2}{G_2} + \frac{W_3}{G_3} + \frac{W_4}{G_4}}$$

$$W_1 = 52 \quad G_1 = 2.82$$

$$W_2 = 34.8 \quad G_2 = 2.42$$

$$W_3 = 4.2 \quad G_3 = 2.62$$

$$W_4 = 5.4 \quad G_4 = 1.02$$

$$G_t = \frac{100}{\frac{52}{2.82} + \frac{34.8}{2.42} + \frac{4.2}{2.62} + \frac{5.4}{1.02}}$$

$$= 2.517$$

Ans: 2.50 – 2.52

17. Choice (B)

18. Choice (A)

19. Choice (D)

20. Choice (D)

21. Choice (B)

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22. $h = 20 \text{ cm}$, $a/h = 0.6$

$$a = 0.6 \times 20 = 12 \text{ cm}$$

$$b = \sqrt{(1.6a^2 + h^2)} - 0.675h$$

$$= \sqrt{1.6(12)^2 + (20)^2} - (0.675 \times 20)$$

$$= 14.22 \text{ cm}$$

Choice (A)

23. Choice (B)

24. $\frac{t_b}{t_c} = \left(\frac{E_c}{E_b} \right)^{\frac{1}{3}}$

$$\frac{t_b}{6.5} = \left(\frac{1000}{400} \right)^{\frac{1}{3}}$$

$$t_b = 6.5 \left(\frac{1000}{400} \right)^{\frac{1}{3}} = 8.82 \text{ cm}$$

Choice (D)

25. Choice (D)