HIGHWAY ENGINEERING TEST 4

Number of Questions: 25

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/cm^2
 - (C) 44 kg/cm^2
 - (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)	4321	(B)	2143
(C)	3412	(D)	3142

9. The design traffic of a flexible pavement is based on 7 day 24 hours traffic count as per

(A) <i>IRC</i> : 39.2001	(B) $IRC: 58 - 2002$
(C) <i>IRC</i> : 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*)
- 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%

(A)	32.8%	(В)	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 termal expansion of concrete is $10 \times 10^{-6/\circ}$ 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)) 1	5.6mm
(C)	5.4mm	(D) 5	5.2mm

15. A plain cement concrete pavement is constructed at temperature of 20°c. The peak summer temperature is

Time: 60 min.

3.180 | Highway Engineering Test 4

40°c. The coefficient of thermal expansion of concrete is 8×10^{-6} per °c, the gap at expansion joint is 3.5 cm. The spacing of expansion joint is _____ (in m).

- **16.** In marshall method of mix design, the coarse aggregates, fine aggregates, filler material and bitumen, having respective specific gravities of 2.82, 2.42, 2.68, and 1.02 are mixed in ratio of 52, 34.8, 4.2 and 5.4 percent respectively. The theoretical specific gravity of the mix would be ____
- **17.** In case of governing equations for calculating wheel loads stress using westergaard's approach, the following statements are made.
 - (I) load stress are inversely proportional to wheel load.
 - (II) Modulus of sub grade reaction is useful for load stress calculation.
 - (A) Both statements are true
 - (B) I is true and II is false
 - (C) Both statements are false
 - (D) I is false and II is true

18. Match the following

Type of test property

	Types of cut backs		Materials
1.	Rapid curing (RC)	a.	Bitumen fluxed with kerosene
2.	Medium curing (MC)	b.	Bitumen blended with high boiling point gas oil
3.	Slow curing (BC)	c.	Bitumen fluxed with naphtha (or) gasoline

Codes:

	123		123
(A)	c a b	(B)	bca
(C)	a b c	(D)	c a b

- **19.** Which of the following are the purposes for use of steel bar reinforcement in cement concrete pavements. The correct answer using the code is
 - (1) To increase the flexural strength of concrete
 - (2) To prevent the onset of cracks to allow wider spacing of joints.
 - (3) To allow wider spacing of joints
 - (A) 1 and 2 only (B) 2 and 3 only
 - (C) 1 and 3 only (D) 1, 2 and 3
- 20. Variation of tyre pressure is
 - (A) Equal to 1.0 for an average type pressure of 7 kg/cm²
 - (B) < 1.0 for tyre pressure greater than 7 kg /cm²

- (C) > 1.0 for tyre pressure less than 7 kg /cm²
- (D) all the above are correct
- **21.** A combined value of flakiness and elongation index are to be determined for a sample of aggregates. The sequence in which two tests are conducted is
 - (A) elongation index test followed by flakiness index test
 - (B) flakiness index test followed by elongation index test
 - (C) flakiness index test followed by elongation index on non flaxy aggregates
 - (D) elongation index test followed by flakiness index test on non elongated aggregates
- **22.** Compute the equivalent radius of resisting section of 20 cm slab, if ratio of radius of wheel load distribution to thickness of slab is 0.6.
 - (A) 14.22 cm (B) 14.02 cm
 - (C) 14.8 cm (D) 14.7 cm
- **23.** Match the following

	0		
	Type of test		Purpose
a.	Penetration test	1.	Design of bitumen concrete mix
b.	Marshal test	2.	Overlay design
c.	Ring and ball test	3.	Gradation of Asphalts
d.	Benkelman beam test	4.	Determination of softening point
Cod	les:		
	abcd		abcd

	uovu		uocu
(A)	3 2 4 1	(B)	3142
(C)	2341	(D)	4231

- 24. If 6.5 cm bituminous concrete surface with $E_c = 1000$ kg/cm² is equivalent to thickness t_b of base course, then equivalent thickness t_b of base course having $t_b = 400$ kg/cm² will be.
 - (A) 12.42 cm (B) 9.36 cm
 - (C) 10.48 cm (D) 8.82 cm
- **25.** In the revised *CBR* design method recommended by *IRC* for design of flexible pavement total thickness depends upon
 - (A) CBR value of soil only
 - (B) CBR value of soil and magnitude of wheel load
 - (C) *CBR* value of soil and number of commercial vehicle per day
 - (D) *CBR* value of soil and cumulative standard axle loads

Answer Keys									
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 r	n	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	

Highway Engineering Test 4 | 3.181

HINTS AND EXPLANATIONS			
1.	Angularity number = $67 - \%$ solid vol	ume	13. $L_e = \frac{\delta^1}{\alpha(t-t)} = \frac{\delta}{2(\alpha)(t-t)}$
	$= 67 - \left(\frac{100}{60 \times 2.6} \times 100\right)$		$\frac{\alpha(l_2-l_1)}{30} = 2(\alpha)(l_2-l_1)$
	= 2.89 = 3	Ans: 2.85 – 2.95	$= \frac{1}{2x10x10^{-6}x(40)} = \frac{37500}{500} \text{ mm}$
2.	<i>RT</i> – 3	Choice (C)	= 37.5 m Ans: 37.5 m
3.	Fire point	Choice (A)	$14. \ \Delta = \frac{1.5 pa}{E_s}$
4.	$E_1 = E_2 \times 0.2 \times h^{0.45}$ = 5.5 × 0.2 × (3) ^{0.45} = 5.5 × 0.2 × (3) ^{0.45} = 1.8 MPa	Apg: 1.8	Contact area = $\frac{\text{wheel load}}{\text{Tyre Pressure}} = \frac{30 \times 10^3}{0.6 \text{ n/mm}}$ $\pi \times a^2 = 50 \times 10^3$
5	-1.6 M u.	Alls. 1.6	$a = \sqrt{50 \times 10^3}$
	$= 40 + 9 - 5 = 44 \text{ kg/cm}^2$	Choice (C)	$a = \sqrt{\pi}$
6.	Flow value	Choice (C)	u = 120.111111 $1.5 \times 0.6 \times 126.1$ f(run = 0.0000000000000000000000000000000000
7.	In between P and $2P$	Choice (C)	$\Delta = \frac{1}{20} = 5.6 \text{ mm} \text{ Choice (B)}$
8.	Choice (D)		15. $L_e = \frac{\delta}{\alpha(t_2 - t_1)}$
9.	<i>IRC</i> – 9	Choice (C)	$\delta = 3.5 \text{ cm}$
10.	E, h, k, u	Choice (B)	$\alpha = 8 \times 10^{-6} \text{per}^{\circ} c$ $t = 40^{\circ} c$
11.	$VFB = \frac{v_b \times 100}{VMA}$ $VMA = \frac{V_a + V_b}{V_t} \times 100$		$t_{2} = 40 \ C$ $t_{1} = 20^{\circ}C$ $L_{e} = \frac{3.5}{8 \times 10^{-6} (40 - 20)} = 21.2 \text{ m}$ Ans: 21.2 m 16. $G_{t} = \frac{100}{\frac{W_{1}}{W_{1}} + \frac{W_{2}}{W_{2}} + \frac{W_{3}}{W_{3}} + \frac{W_{4}}{W_{2}}}$
	$V_{b} = \frac{-m}{G_{b}} = \frac{2.220 \times 10}{1.03} = 10.15$ $V_{a} = \frac{G_{t} - G_{m}}{G_{t}} \times 100$ $= \frac{2.41 - 2.325}{241} \times 100 = 20.73$ $VMA = \frac{10.15 + 20.73}{1} \times 100 = 30.88$		$W_{1} = 52 \qquad G_{1} = 2.82$ $W_{2} = 34.8 \qquad G_{2} = 2.42$ $W_{3} = 4.2 \qquad G_{3} = 2.62$ $W_{4} = 5.4 \qquad G_{4} = 1.02$ $G_{t} = \frac{100}{\frac{52}{2.82} + \frac{34.8}{2.42} + \frac{4.2}{2.62} + \frac{5.4}{1.02}}$ $= 2.517 \qquad \text{Ans: } 2.50 - 2.52$
	$VFB = \frac{10.15 \times 100}{30.88} = 32.8\%$	Choice (A)	17. Choice (B)
12.	$CBR = \frac{\text{load at } 2.5\text{mm}}{\text{standard load}} \times 100$		 18. Choice (A) 19. Choice (D) 20. Choice (D)
	At 2.5 mm = $\frac{40.6}{1370} \times 100 = 2.97\%$	Choice (B)	21. Choice (B)

3.182 | Highway Engineering Test 4

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. $\frac{t_b}{t_c} = \left(\frac{E_c}{E_b}\right)^{\frac{1}{3}}$
 $\frac{t_b}{6.5} = \left(\frac{1000}{400}\right)^{\frac{1}{3}} = 8.82 \text{ cm}$ Choice (D)
25. Choice (D)