GATE - 2009 - CE

EE1030 : Matrix Theory
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1) Water flows through a 100 mm diameter pipe with a velocity of 0.015 m/sec. If the kinematic viscosity of water is 1.13×10^{-6} m^2/sec, the friction factor of the pipe material is
   a) 0.0015
   b) 0.032
   c) 0.037
   d) 0.048

2) A rectangular open channel of width 4.5 m is carrying a discharge of 100 m^3/sec. The critical depth of the channel is
   a) 7.09 m
   b) 3.69 m
   c) 2.16 m
   d) 1.31 m

3) Water (γ_w = 9.879 kN/m^3) flows with a flow rate of 0.3 m^3/sec through a pipe AB of 10 m length and of uniform cross section. The end 'B' is above end 'A' and the pipe makes an angle of 30°to the horizontal. For a pressure of 12 kN/m^2 at the end 'B', the corresponding pressure at end 'A' is
   a) 12.0 kN/m^2
   b) 17.0 kN/m^2
   c) 56.4 kN/m^2
   d) 61.4 kN/m^2

4) An agricultural land of 437 ha is to be irrigated for a particular crop. The base period of the crop is 90 days and the total depth of water required by the crop is 105 cm. If a rainfall of 15 cm occurs during the base period, the duty of irrigation water is
   a) 437 ha/cumec
   b) 486 ha/cumec
   c) 741 ha/cumec

d) 864 ha/cumec

5) The correct match of **Column I** with **Column II** is

Column I	**Column II**
P. Coriolis effect	1. Rotation of earth
Q. Fumigation	2. Lapse rate and vertical temperature profile
R. Ozone layer	3. Inversion
S. Maximum mixing depth (mixing height)	4. Dobson

a) P-2, Q-1, R-4, S-3
b) P-2, Q-1, R-3, S-4
c) P-1, Q-3, R-2, S-4
d) P-1, Q-3, R-4, S-2

6) A horizontal flow primary clarifier treats wastewater in which 10%, 60% and 30% of particles have settling velocities of 0.1 mm/s, 0.2 mm/s and 1.0 mm/s respectively. What would be the total percentage of particles removed if clarifier operates at a Surface Overflow Rate (SOR) of 43.2 $m^3/m^2 \cdot d$?

a) 43 %
b) 56 %
c) 86 %
d) 100 %

7) An aerobic reactor receives wastewater at a flow rate of 500 m^3/d having a COD of 2000 mg/L. The effluent COD is 400 mg/L. Assuming that wastewater contains 80% biodegradable waste, the daily volume of methane produced by the reactor is

a) 0.224 m^3
b) 0.280 m^3
c) 224 m^3
d) 280 m^3

8) The correct match of **Column I** with **Column II** is

Column I	**Column II**
P. Grit chamber	1. Zone settling
Q. Secondary settling tank	2. Stoke's Law
R. Activated sludge process	3. Aerobic
S. Trickling Filter	4. Contact stabilisation

a) P-1, Q-2, R-3, S-4
b) P-2, Q-1, R-3, S-4
c) P-1, Q-2, R-4, S-3

d) P-2, Q-1, R-4, S-3

9) Which of the following stress combinations are appropriate in identifying the critical condition for the design of concrete pavements ?

Type of Stress	Location
P. Load	1. Corner
Q. Temperature	2. Edge
	3. Interior

a) P-2, Q-3
b) P-1, Q-3
c) P-3, Q-1
d) P-2, Q-2

10) A crest vertical curve joins two gradients of (+3%) and (−2%) for a design speed of 80 km/h and the corresponding stopping sight distance of 120 m. The height of driver's eye and the object above the road surface are 1.20 m and 0.15 m respectively. The curve length (which is less than stopping sight distance) to be provided is

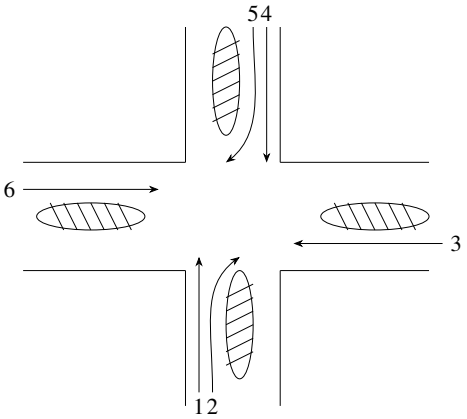
a) 120 m
b) 152 m
c) 163 m
d) 240 m

11) On a specific highway, the speed-density relationship follows the Greenberg's model $\left[v = v_f \ln\left(\frac{k_j}{k}\right)\right]$, where v_f and k_j are the free flow speed and jam density respectively. When the highway is operating at a capacity, the density obtained as per this model is

a) $e \cdot k_j$
b) k_j
c) $\frac{k_j}{2}$
d) $\frac{k_j}{e}$

12) A three-phase traffic signal at an intersection is designed for flows shown in the figure below. There are six groups of flows identified by the numbers 1 through 6. Among these 1, 3, 4, and 6 are through flows and, 2 and 5 are right turning. Which phasing scheme is **not feasible** ?

Combination choice	Phase I	Phase II	Phase III
P	1, 4	2, 5	3, 6
Q	1, 2	4, 5	3, 6
R	2, 5	1, 3	4, 6
S	1, 4	2, 6	3, 5



a) P
b) Q
c) R
d) S