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Questions to be Challenged in

GATE 2020

Civil Engineering

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Date of Exam : 09/02/2020 (Forenoon)

Q.52 Traffic volume count has been collected on a 2 lane road section which needs upgradation due to severe traffic flow condition. Maximum service flow rate per lane is observed as 1280 veh/h at level of service 'C'. The Peak Hour Factor is reported as 0.78125. Historical traffic volume count provides Annual Average Daily Traffic as 122270 veh/day. Directional split of the traffic flow is observed to be 60 : 40. Assuming that traffic stream consists of 'All Cars' and all drivers are 'Regular Commuters', the number of extra lane(s) (round off to the next higher integer) to be provide, is _____.

Ans. (6)

Directional design hourly volume (DDHV)

$$DDHV = AADT \times K \times D$$

where, D = Volume proportion in major direction, K = The proportion of AADT occuring in peak hour.

$$DDHV = 12270 \times 0.6 \times K \qquad [\because K \text{ Assumed } 1]$$
$$= 7362$$

f_{HV} = Heavy veh. adjustment factor = 1 for car

f_P = Road user familarity adjustment factor

= 1 for regular commuters

As per HCM,

Number of lanes required,

$$N = \frac{DDHV}{PHF \times MSF \times F_{HV} \times f_p}$$

$$= \frac{7362}{0.78125 \times 1280 \times 1 \times 1} = 7.362 = 8 \text{ lanes}$$

Number of extra lanes = 8 – 2 = 6 lanes

GATE Ans. Key (1)

■■■■

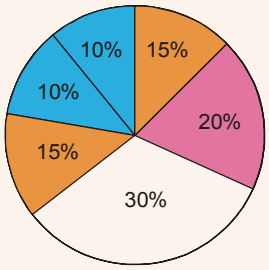
Date of Exam : 09/02/2020 (Afternoon)

SECTION A : GENERAL APTITUDE

Q.2 The monthly distribution of 9 Watt LED bulbs sold by two firms X and Y from January to June 2018 is shown in the pie-chart and the corresponding table. If the total number of LED bulbs sold by two firms during April-June 2018 is 50000, then the number of LED bulbs sold by the firm Y during April-June 2018 is _____.

Months	Ratio of LED bulbs sold by two firms X : Y
January	7 : 8
February	2 : 3
March	2 : 1
April	3 : 2
May	1 : 4
June	9 : 11

January	15%
February	20%
March	30%
April	15%
May	10%
June	10%



(a) 11250
(b) 9750
(c) 8250
(d) 8750

Ans. (*)

LED bulbs sold

By $Y_{April} = \frac{2}{5} \times 15 = 6\%$ ...(A)

$Y_{May} = \frac{4}{5} \times 10 = 8\%$

$Y_{June} = \frac{10}{20} \times 11 = 5.5\%$

LED bulb sold by Y during April-June

$A + B + C = (6 + 8 + 5.5)\% = 19.5\%$

Total LED bulb sold by X and Y 35% this value = 50000

So, LED bulb sold by Y (April to June)

$\frac{50000}{35} \times 19.5 = 27857.142$

[As 35% of total = 5000

$$\text{Total} = \frac{50000}{0.35} = 142857.142$$

Y (April- June) = 19.5% of total 0.195 × 1442857.14 = 2785.142]

No option is matching.

Mistake in paper was that examiner intended to give total as 50000 and the options were place accordingly as 19.5% of 50000 = 9750 which is (d).

But this will be wrong as total is NOT 50000 as per language. So correct answer is 27857.142.

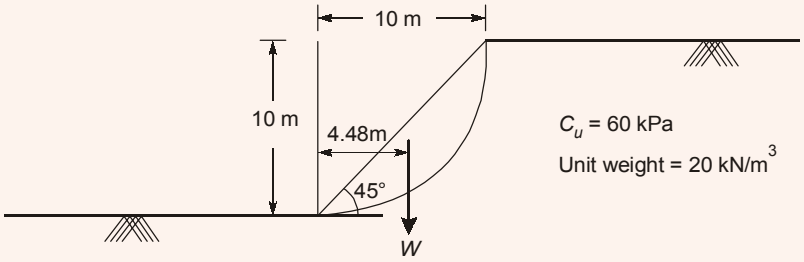
Which matches with none of options.

GATE Ans. Key (b)

End of Solution

SECTION B : TECHNICAL

Q.49 A 10 m high slope of dry clay soil (unit weight = 20 kN/m^3), with a slope angle of 45° and the circular slip surface, is shown in the figure (not drawn to the scale). The weight of the slip wedge is denoted by W. The undrained unit cohesion (c_u) is 60 kPa.

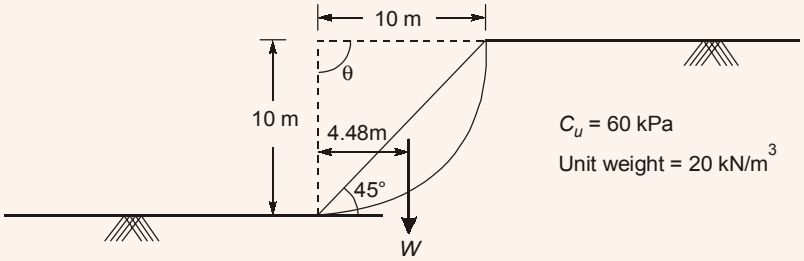


The factor of safety of the slope against slip failure, is

(a) 0.58 (b) 1.84

(c) 1.57 (d) 1.67

Ans. (*)



Consider unit length of slope

$$\text{Area of circular arc} = \frac{\theta}{360} \times \pi r^2 - \text{Area of } \Delta$$

$$= \frac{90}{360} \times \pi \times 10^2 - \frac{1}{2} \times 10 \times 10 = 28.54 \text{ m}^2$$

Height of wedge = Volume × γ = (Area × 1) × γ

$$= 28.54 \times 1 \times 20 = 570.8 \text{ kN}$$

$$\text{FOS} = \frac{M_R}{M_0} = \frac{[c \times (r\theta)] \times r}{W \times x} = \frac{60 \times 10 \times \frac{\pi}{2} \times 10}{570.8 \times 4.48}$$

$$= 3.68$$

GATE Ans. Key (b)

End of Solution

Q.52 Crops are grown in a field having soil, which has field capacity of 30% and permanent wilting point of 13%. The effective depth of root zone is 80 cm. Irrigation water is supplied when the average soil moisture drops to 20%. Consider density of the soil as 1500 kg/m^3 and density of water as 1000 kg/m^3. If the daily consumptive use of water for the crops is 2 mm, the frequency of irrigating the crops (in days), is

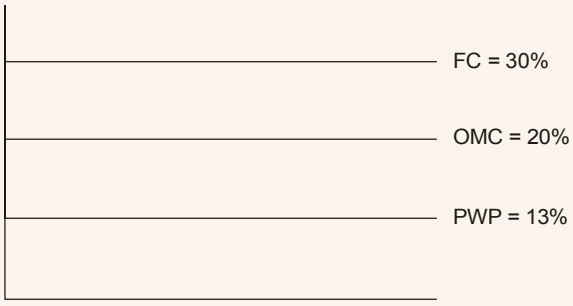
(a) 7 (b) 13

(c) 10 (d) 11

Ans. **(*)**

FC = 30%

PWP = 13%



$$d_w = \frac{\gamma_d}{\gamma_w} \cdot d \times (FC - OMC)$$

$$= \frac{1500}{1000} \times 80(0.3 - 0.2)$$

$$= 12 \text{ cm or } 120 \text{ mm}$$

Consumptive use = 2 mm/day

So, frequency of irrigation = $\frac{120}{2}$ = 60 days

GATE Ans. Key (c)

End of Solution