ASFANDYAR KHN ROLL# 7399

QNo : 1 Part 'A'

a:- Hydrolic gradient:

The difference between two hydraulic heads taken from the soil specimen over the distance of flow in the soil specimen when measured is called hydrolic gradient.

The expression to compute hydraulic gradient is given below

$$i = \frac{\Delta h}{\Delta l}$$

b:-

The discription of how easily a liquid will move through a soil is called coefficient of permeability of soil and it is also called hydraulic conducting of soil.

c:-

Liquidity index of soil Liquidity index is defined to understand the consisdency of soil particles and it is represented by IL. It is defined as the ratio of the difference b/w the natural water content of the soil and its plastic limit to it plasticity inde.

d:-

"Soil porosity" refers to the amount of pores or open space between soil particles. Pore spaces maybe formed to due to the movement of roots, worms and insects, expanding gases trapped within these spaces by ground water; and/or the dissolution of the soil parent material.

e:-

The degree of saturation is the ratio of the volumn of water to the volumn of voids. It is denoted by 'S'. S = Vw/Vv. The degree of saturation generally expressed as a percentage. It is equal to zero when the soil is absolutely dry and 100% when the soil is fully saturated.

QNo: 1 Part 2

Q: A sample of wet soil has a volumn of $0.0192 m^3$ and a mass of 32 kg. After drying the samples in an oven its mass reduces to 28.5 kg. Determine i) Bulk density ii) water content iii) Dry density iv) Saturated density v) Void ratio vi) Porosity vii) Degree of Saturation.
Take Sp-Gravity of Soil Solid as 2.65

Given data:- $W = 32 kg$, $V = 0.0192 m^3$, $W_s = 28.5 kg$
$G_s = 2.65$

Required:- $\gamma_B = ?$, $w = ?$, $\gamma_d = ?$, $\gamma_{sat} = ?$
$e = ?$, $n = ?$, $S = ?$

Solution:-

$W_w = W - W_s = 32 - 28.5 = 3.5 kg$

$w = \frac{W_w}{W_s} \times 100 = \frac{3.5}{28.5} \times 100 = 12.3 \%$

$\gamma_B = \frac{W}{V} = \frac{32}{0.0192} = 1666.67 kg/m^3$

$\gamma_d = \frac{W_s}{V} = \frac{28.5}{0.0192} = 1484.37 kg/m^3$

$\gamma_d = \frac{G_s \times \gamma_w}{1+e} \Rightarrow e = \frac{G_s \times \gamma_w}{\gamma_d} - 1 = \frac{2.65 \times 1000}{1484.37} - 1$

$\gamma_{sat} = \frac{(G_s + e)\gamma_w}{1+e} = \frac{(2.65 + 0.785) \times 1000}{1 + 0.785}$

$= 1924.31 kg/m^3$

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QNo : 2 'A'

Prove that $e = \frac{G_s \cdot \gamma_w (1+w_c)}{\gamma_0} - 1$

$$\gamma_B = \frac{W}{V} = \frac{W_s + W_v}{V_s + V_v} = \frac{\frac{W_s}{W_s}(W_s + W_v)}{\frac{V_s}{V_s}(V_s + V_v)}$$

$$\gamma_B = \frac{W_s\left(\frac{W_s}{W_s} + \frac{W_v}{W_s}\right)}{V_s\left(\frac{V_s}{V_s} + \frac{V_v}{V_v}\right)} = \frac{W_s\left(1 + \frac{W_w}{W_s}\right)}{V_s\left(1 + \frac{V_v}{V_s}\right)}$$

$$\gamma_s = \frac{W_s}{V_s} \quad = W_c = \frac{W_w}{W_s}, \quad e = \frac{V_v}{V_s}$$

$$V_B = \frac{\gamma_s (1 + W_c)}{1+e}$$

$$\therefore G_s = \frac{\gamma_s}{\gamma_w}$$

$$\gamma_s = G_s \gamma_w$$

$$\gamma_B = \frac{G_s \cdot \gamma_w (1 + W_c)}{1+e}$$

$$1 + e = \frac{G_s \cdot \gamma_w (1 + w_c)}{\gamma_B}$$

$$\boxed{e = \frac{G_s \cdot \gamma_w (1 + w_c)}{\gamma_B} - 1}$$

Hence proved.

Q No 2 'B'

1- Grain size Classification / Particle Size Classification

i - US Bureau of Soil Classification

Clay	Silt	Sand				Gravel	
		Very fine sand	fine sand	medium sand	Course sand.	fine gravel	Course gravel
Particle size < 0.002 mm	0.05 mm	0.1 mm	0.25 mm	0.5 mm	1.00 mm	2.00 mm	

ii - ASTM soil classification System (American Society To Testing and material.)

Clay	Colloids or colloidal clay	Silt	Sand.		Gravel.
			fine sand	Coarse sand	
0.001 mm	0.005 mm	0.074 mm	0.25 mm	2.00 mm	

iii - M.I.T Soil classification System (Massachusetts)

Clay			Silt			Sand			Gravel.
Fine clay	Medium clay	Coarse clay	Fine Silt	Medium Silt	Coarse Silt	Fine Sand	Medium Sand	Coarse sand.	
0.0002 mm	0.0006 mm	0.002 mm	0.006 mm	0.02 mm	0.06 mm	0.2 mm	0.6 mm	2.00 mm	

QNo: 3'A'

Quick sand:- When the seepage pressure due to upword flow of water in sand/sandy soil balance the downward force of gravity (weight or material) a condition of instability rises in sand. Sand in this state is called quick sand.

* Seepage flow of water under gravitational forces in a permeable medium.

Criticle hydralic gradient:-

At the bottom surface.

i.e at x-x.

upward force $= (h-L)\gamma_w \cdot A \longrightarrow (1)$

Downward force $= \gamma_w \times \frac{(G_s+e)}{(1+e)} \times V$

Since, $\gamma_B = \frac{W}{V} \Rightarrow W = \gamma_w \frac{(G_s+e)}{1+e} \times V$

where $V = A \times L$

$W = \gamma_w \times \frac{(G_s+e)}{(1+e)} \times A \times L \longrightarrow (2)$

The soil is literally behaving like a liquid rather than solid.

At balance; Upward force = Downward force

$(h+L)\gamma_w \times A = \gamma_w \times \frac{(G_s+e)}{1+e} \times A \times L$

$\frac{h+L}{L} = \frac{G_s+e}{1+e} \times \frac{L}{L}$

$$\frac{h}{L} + 1 = \frac{G_s + e}{1 + e}$$

$$\therefore \quad \frac{h}{L} = \frac{G_s + e}{1+e} - 1$$

$$i_c = \frac{G_s + e - 1 - e}{1+e}$$

$$i_c = \frac{G_s - 1}{1+e}.$$

QNo:3 Part 'B'

Given data:-

$V = 65\,ml = 0.000065\,m^3$ As $1\,ml = 10^{-6}\,m^3$

$W = 0.96\,N$, $W_d = 0.785\,N$

$G_s = 2.65$

Required: $S = ?$

Solution: $\gamma_B = \dfrac{\gamma_w \times (G_s + eS)}{(1+e)} \longrightarrow (1)$

$\gamma_B = \dfrac{W}{V} = \dfrac{0.96}{0.000065} = 14769\,N/m^3$

$\gamma_w = 9800\,N/m^3$

As $e = \dfrac{V_v}{V_s}$

$V_s = 0.000030\,m^3$

As $\gamma_s = \dfrac{W_s}{V_s}$

$V_s = \dfrac{W_s}{\gamma_s} = \dfrac{0.785}{25970}$

But $G_s = \dfrac{\gamma_s}{\gamma_w}$

$\gamma_s = G_s \times \gamma_w$

$\gamma_s = 2.65 \times 9800$

$\gamma_s = 25970\,N/m^3$

Also;

$V = V_v + V_s$

$V_v = V - V_s$

$V_v = V - V_s$

$V_v = 0.000065 - 0.000030$

$V_v = 0.000035\,m^3$

$e = \dfrac{0.000035}{0.000030}$

$e = 1.167$

Putting the values in (1) & Solve it for S

$S = 0.527$ or 52.7%