6302 HW3 Answer Key

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Q 3.1 $\text{DEPTH} = \text{AGE} / K$

$$K = \frac{\text{AGE}}{\text{DEPTH}} = \frac{3000\ \text{yr}}{3\ \text{m}} = 1000\ \frac{\text{yr}}{\text{m}}$$

Q 3.2 $\text{AGE} = (K * \text{DEPTH}) + \text{AGE}_{\text{TOP}}$ $\quad K = 5000\ \frac{\text{yr}}{\text{m}}$

$\text{AGE} - (K * \text{DEPTH}) = \text{AGE}_{\text{TOP}}$ $\quad D = 10\ \text{m}$

$\text{AGE} = 60{,}000\ \text{yr}$

$$60{,}000\ \text{yr} - \left(5000\ \frac{\text{yr}}{\text{m}} \cdot 10\ \text{m}\right) = \text{AGE}_{\text{TOP}}$$

$$10{,}000\ \text{yr} = \text{AGE}_{\text{TOP}}$$

Q 3.3 $w = \frac{3y}{4z}$ AND $x = \frac{2y}{4z}$

$$4xz = 2y$$

$$2xz = y$$

$$w = \frac{3y}{4z} = \frac{3(2xz)}{4z} = \frac{6xz}{4z} = \frac{3}{2}x$$

$$\frac{w}{x} = \frac{3}{2} = 1.5$$

Q 3.4

(i) $5(x+2y) = 5x+10y$

(ii) $5(x+2.2y) = 5x+11y$

(iii) $5.5(x+2y) = 5.5x+11y$

(iv) $5a(x+2y) = 5ax+10ay$

(v) $(x-2y)(x+2y) = x^2-4y^2$

(vi) $x+2y$

$x+2y$

x^2+2xy

$2xy+4y^2 =$

3.6 $6ax + 3ay = 3a(2x + y)$

3.7 EQ 3.30 $\rho = \phi \rho_w + (1-\phi)\rho_s$ ρ = Density (kg/m^3)

$\phi = 0$ $\rho = 0(1000 kg/m^3) + (1-0)\,2500 kg/m^3 = 2500 kg/m^3$

$\phi = 0.1$ $\rho = 0.1(1000 kg/m^3) + (1-0.1)\,2500 kg/m^3 = 2350 kg/m^3$

$\phi = 0.2$ $\rho = 0.2(1000 kg/m^3) + (1-0.2)\,2500 kg/m^3 = 2200 kg/m^3$

$\phi = 0.5$ $\rho = 0.5(1000 kg/m^3) + (1-0.5)\,2500 kg/m^3 = 1750 kg/m^3$

$\phi = 0.8$ $\rho = 0.8(1000 kg/m^3) + (1-0.8)\,2500 kg/m^3 = 1300 kg/m^3$

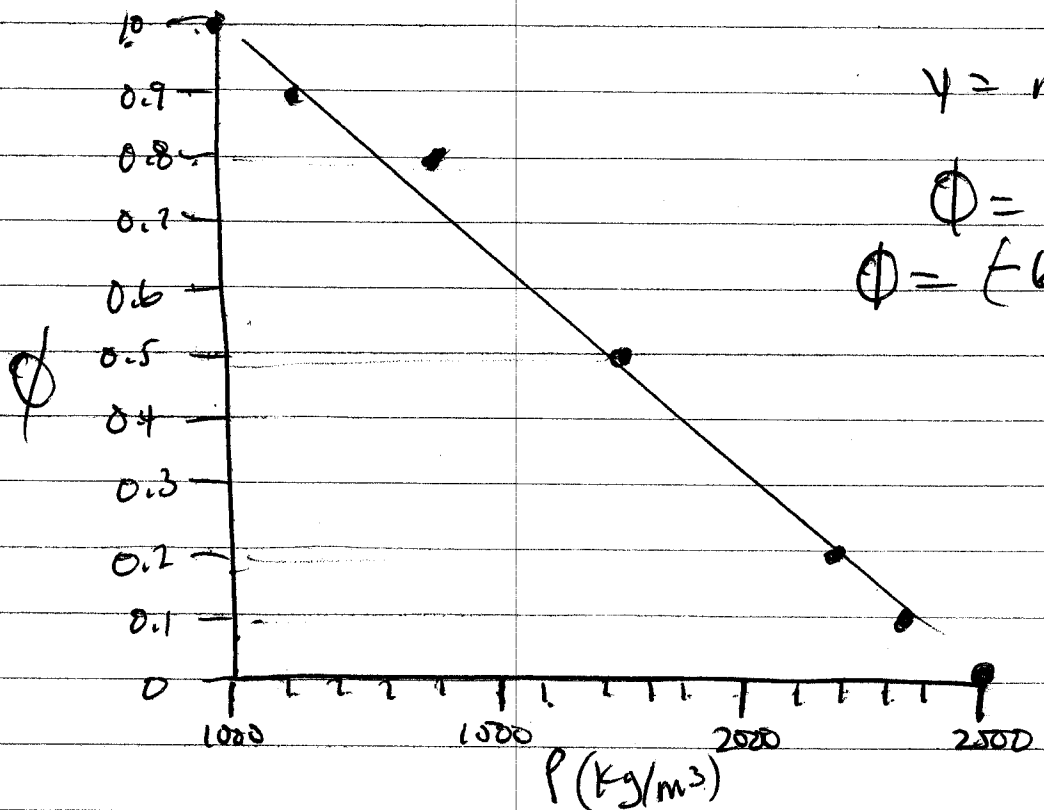
$\phi = 0.9$ $\rho = 0.9(1000 kg/m^3) + (1-0.9)\,2500 kg/m^3 = 1150 kg/m^3$

$\phi = 1.0$ $\rho = 1.0(1000 kg/m^3) + (1-1)\,2500 kg/m^3 = 1000 kg/m^3$

ϕ = porosity

ρ_w = Density of water = $1000 kg/m^3$

ρ_s = Density of sediment = $2500 kg/m^3$



$y = mx + B$

$\phi = \rho + 1$

$\phi = (-6.7 \times 10^{-4})\rho + 1$

$M = \frac{0.8 - 0.1}{1300 - 2350} = \frac{0.7}{-1050} =$

Q 3.10

$$\rho = \rho_g\left[\left(1 - \frac{V_p}{V}\right)\right]$$

ρ_g = density grains

V_p = Vol. pore

V = TOTAL Vol.

EQ 3.9 $\rightarrow$ $\rho = \frac{M}{V}$

SUBSTITUTE

$$\frac{\frac{M}{V}}{\left(1 - \frac{V_p}{V}\right)} = \rho_g \qquad \frac{M/V}{\left(1 - \frac{V_p}{V}\right)} = \rho_g$$

$$\frac{\frac{M}{V}}{\left(\frac{V}{V} - \frac{V_p}{V}\right)} = \rho_g$$

$$\frac{M/V}{\left(\frac{V - V_p}{V}\right)} = \rho_g$$

$$\frac{M}{\cancel{V}} \cdot \frac{V}{(V - V_p)} = \rho_g$$

$$\frac{M}{V_T - V_p} = \rho_g \quad \star$$

$V_T = 0.11\ m^3$

$M = 205\ Kg$

$\phi = 0.32$

$V_p = (\phi)(V_T)$

$V_p = (0.32)(0.11\ m^3) = 0.0352\ m^3$

Avg Density $\rho = \rho_g\left[1 - \left(\frac{V_p}{V_T}\right)\right] =$

$$2741\ \frac{Kg}{m^3}\left[1 - \frac{0.0352\ m^3}{0.11\ m^3}\right] = \boxed{1864\ \frac{Kg}{m^3}} \star$$

GRAIN Density $\rho_g = \frac{M}{V_T - V_p} = \frac{205\ Kg}{0.11\ m^3 - 0.0352\ m^3} = \frac{205\ kg}{0.0748\ m^3} = \boxed{2741\ \frac{kg}{m^3}}$

$\rho_{avg} = 1864\ \frac{Kg}{m^3}$ $\quad \rho_g = 2741\ \frac{kg}{m^3}$

Q 3.11

$$V = \frac{2(\rho_p - \rho_f) g r^2}{9\eta}$$

V = velocity
ρ_p = density particle
ρ_f = density of fluid
$g = 9.8\ m/sec^2$
r = particle radius
η = viscosity

$$V_1 = \frac{2(\rho_{p_1} - \rho_f) g r_1^2}{9\eta}$$

where $\rho_{p_1} = \rho_{p_2}$

$$V_2 = \frac{2(\rho_{p_2} - \rho_f) g r_2^2}{9\eta}$$

Hence $\frac{2(\rho_{p_2} - \rho_f) g}{9\eta} = \frac{2(\rho_{p_2} - \rho_f) g}{9\eta} =$ CONSTANT K

$V_1 = K r_1^2$

$V_2 = K r_2^2 \Longrightarrow$

$K = \frac{V_2}{r_2^2} \Longrightarrow$ SUBSTITUTE $V_1 = \frac{V_2 (r_1)^2}{(r_2)^2}$

$\Downarrow$

$\frac{V_1}{V_2} = \frac{(r_1)^2}{(r_2)^2} = \left(\frac{r_1}{r_2}\right)^2$

For LAKE of CONSTANT DEPTH

$V_1 = \frac{d}{t_1}$ $V_2 = \frac{d}{t_2}$

$\frac{\frac{d}{t_1}}{\frac{d}{t_2}} = \left(\frac{r_1}{r_2}\right)^2$

$\frac{t_2}{t_1} = \left(\frac{r_1}{r_2}\right)^2$

where $r_1 = 0.1\ mm$ $t_1 = 10\ days$

$r_2 = 1\ mm$ $t_2 = ?$

$\frac{t_2}{10} = \left(\frac{0.1\ min}{1\ mm}\right)^2 = 0.01$; $t_2 = 0.1\ day =$

Q 4.1 $t = \lambda \ln(Q_0/Q)$ $Q_0 = 100$ ppb

$Q = 5$ ppb

$\lambda = 5 \times 10^6$ yr

$t = (5\times10^6 yr) \ln\left(\frac{100 ppb}{5 ppb}\right) = (5\times10^6 yr)\ln(20) =$

$(5\times10^6 yr)(2.996) =$ 1.5×10^7 yr

Q 4.2 Given form $\text{LOG}\left(\frac{a}{b}\right) = \text{LOG}(a) - \text{LOG}(b)$

Also $t = \lambda \ln\left(\frac{Q_0}{Q}\right) = \lambda(\ln Q_0 - \ln Q) =$

Problem

$t = 100{,}000{,}000$ yr

$Q = 10$ ppb

$\lambda = 1.01\times10^9$ yr

$Q_0 = ?$

$t = \lambda \ln(Q_0) - \lambda \ln(Q)$

$\frac{t}{\lambda} = \ln(Q_0) - \ln(Q)$

$\frac{t}{\lambda} + \ln(Q) = \ln(Q_0)$

$\ln(Q_0) = \frac{1\times10^8 yr}{1.01\times10^9 yr} + \ln(10_{ppb}) =$

$\ln\left(\frac{2.4}{10}\right)$

$0.099 + 2.30 =$ 2.40

$\ln(Q_0) = 2.40$

$Q_0 = 11.04$ ppb

4.3

$10.3 = 3a + 2b + c$

$7 = a + b + 1.3c$

$5 = 10a - 1.35b - 1.1c$

$1.3c - \frac{c}{3}$

$1.3c = 0.33c$

$0.97c$

$10.3 = 3a + 2b + c$

$10.3 - 2b - c = 3a$

$\frac{10.3 - 2b - c}{3} = a$ ⟶ SUBSITUTE $7 = a + b + 1.3c$

$7 = \left[\frac{10.3 - 2b - c}{3}\right] + b + 1.3c$

$7 = \frac{10.3}{3} - \frac{2b}{3} - \frac{c}{3} + b + 1.3c$

$7 = 3.43 + \frac{1}{3}b + 0.97c$

$7 - 3.43 = 0.33b + 0.97c$

$3.57 - 0.97c = 0.33b$

$\frac{3.57 - 0.97c}{0.33} = b$

~~SUBSITUTE~~

~~$5 = 10.5 - 2\left(\frac{3.57 - 0.97c}{0.33}\right)$~~

$7 = \left[\frac{10.3 - 2\left(\frac{3.57 - 0.97c}{0.33}\right) - c}{3}\right] + \left(\frac{3.57 - 0.97c}{0.33}\right) + 1.3c$

$7 = \left[\frac{10.3 - \frac{7.14}{0.33} - \frac{1.94c}{0.33} - c}{3}\right] + \frac{3.57}{0.33} - \frac{0.97c}{0.33} + 1.3c$

Q4.3 PART 2

$$7 = \left[\frac{10.3 - 21.64 - 6.9c}{3}\right] + 10.82 - 1.64c$$

$$21 = 10.3 - 21.64 - 6.9c + 32.46 - 4.92c$$

$$21 = 21 - 11.8c$$

$$0 = -11.8c$$

$$\boxed{0 = c}$$

$$b = \frac{3.57 - 0.97c}{0.33} =$$

$$\frac{3.57}{0.33} = 10.8$$

$$\boxed{b = 10.8}$$

$$a = \frac{10.3 - 2b - c}{3} =$$

$$\frac{10.3 - 2(10.8) - 0}{3} = \frac{10.3 - 21.6}{3} = \frac{-11.3}{3} = -3.77$$

$$\boxed{a = -3.77}$$

✓ $10 = 3(-3.77) + 2(10.8) + 0 = -11.31 + 21.6 = 10$

✓ $7 = -3.77 + 10.8 + 1.3(0) = 7.0$

$\$ = 10(-3.77) + 1.35(10.8) - 1.1(0) =$

-37.7