Hydro HW #1 Intro to Quant methods

Q1.1. $AGE = (K)(D)$ $K = 1500 \frac{yr}{m}$

$AGE = \left(1500 \frac{yr}{m}\right)(1m) = 1500\ yr$

$AGE = \left(1500 \frac{yr}{m}\right)(2m) = 3000\ yr$

$AGE = \left(1500 \frac{yr}{m}\right)(5.3m) = 7950\ yr$

$K = 3000 \frac{yr}{m}$

$AGE = \left(3000 \frac{yr}{m}\right)(1m) = 3000\ yr$

$AGE = \left(3000 \frac{yr}{m}\right) 2m = 6000\ yr$

$AGE = \left(3000 \frac{yr}{m}\right) 5.3m = 15,900 yr$

Q1.9 $AGE = K \times DEPTH$ $K = 1000 \frac{yr}{m}$

$D = (30\ cm)\left(\frac{1m}{100\ cm}\right) = 0.3\ m$

$AGE = \left(1000 \frac{yr}{m}\right) 0.3m = 300 yr$

Q 1.2

(i) $5^2 \times 5^4 = 5^6 = 15,625$

(ii) $(5^2)^4 = 5^8 = 390,625$

(iii) $x^2 \cdot x^3 = x^5$

(iv) $D^2 \cdot D^3 = D^5$

(v) $(T_0^{\,3})^4 = T_0^{\,12}$ where $T_0 = 10$; $(10)^{12} = 1 \times 10^{12}$

Q1.5 $31.6\ \text{Gsec} = 31.6 \times 10^{9}\ \text{sec} = 3.16 \times 10^{10}\ \text{sec}$

$$(31.6 \times 10^{9}\ \text{sec})\left(\frac{1\ \text{min}}{60\ \text{sec}}\right)\left(\frac{1\ \text{hr}}{60\ \text{min}}\right)\left(\frac{1\ \text{day}}{24\ \text{hr}}\right)\left(\frac{1\ \text{yr}}{365.26\ \text{day}}\right) =$$

$$1001.32\ \text{years} = 1.00 \times 10^{3}\ \text{yr}$$

Q1.4

(i) $0.001 = 1 \times 10^{-3}$

(ii) $0.002 = 2 \times 10^{-3}$

(iii) $0.0025 = 2.5 \times 10^{-3}$

(iv) $0.002523 = 2.523 \times 10^{-3}$

(v) $0.0000023 = 2.3 \times 10^{-6}$

(vi) $\frac{7}{1,000,000,000} = 0.0000000007 = 2.0 \times 10^{-9}$

Q1.3

(i) $1000 = 1.0 \times 10^{3}$

(ii) $2000 = 2.0 \times 10^{3}$

(iii) $2500 = 2.5 \times 10^{3}$

(iv) $2523 = 2.523 \times 10^{3}$

(v) $23,000,000 = 2.3 \times 10^{7}$

(vi) $7,000,000,000 = 7 \times 10^{9}$

Q1.7

(i) 4.0×10^{9}

(ii) 2.65×10^{9}

(iii) 1.0×10^{7}

(iv) 2.35×10^{14}

Q1.8

$$D = m/V = \frac{5.94\times10^{24}\,kg}{1.08\times10^{21}\,m^3} = 5.5\times10^{3}\,kg/m^3$$

$$\left(5.5\times10^{3}\,\frac{kg}{m^3}\right)\left(1000\,\frac{g}{kg}\right)\left(\frac{1\,m^3}{1\times10^{6}\,cm^3}\right) = 5.5\,\frac{gm}{cm^3}$$

Q1.12

$$Vol. = \frac{4\pi r^3}{3} = \frac{4\pi(6.37\times10^{6}\,m)^3}{3} = 1.08\times10^{21}\,m^3$$

Q1.13

$$V = \frac{d}{t}$$

$$tV = \left(\frac{d}{t}\right)t$$

$$\frac{tV}{V} = \frac{d}{V}$$

$$t = \frac{d}{V}$$

$d = 100\,km$

$V = 20\,km/hr$

$$t = \frac{100\,km}{20\,\frac{km}{hr}} = 100\,km\left(\frac{1\,hr}{20\,km}\right) = 5\,hr$$

$V_s = 4\times10^{-2}\,\frac{m}{yr}$ $\quad w = 5\times10^{6}\,m$

$V_s = \frac{w}{t}$ if $t = A$ .... $V_s = \frac{W}{A}$ units $\frac{m}{yr} = \frac{m}{yr}$

$$A = \frac{w}{V} = \frac{5\times10^{6}\,m}{4\times10^{-2}\,m/yr} = (5\times10^{6}\,m)\left(\frac{1\,yr}{4\times10^{-2}\,m}\right) =$$

$$A = 1.25\times10^{8}\,yrs$$

Q 2.2

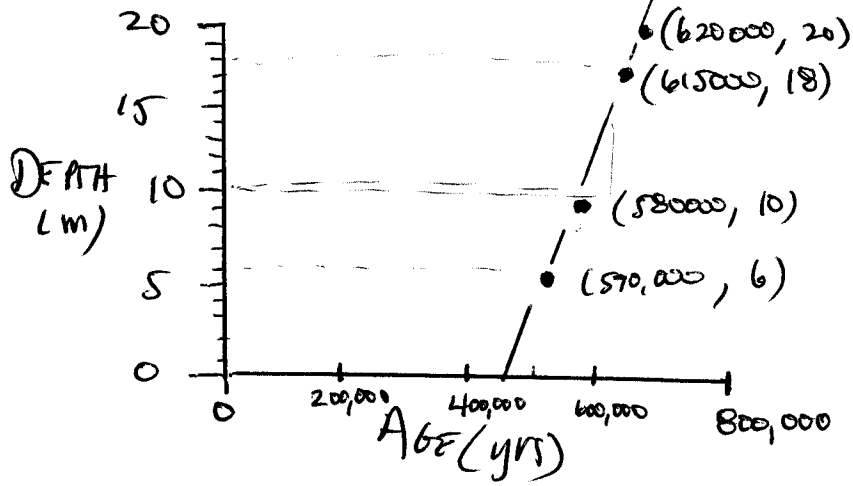
$$m = \text{SLOPE} = \text{GRADIENT} = \frac{\text{RISE}}{\text{RUN}} = \frac{\Delta y}{\Delta x} = \frac{\Delta \text{AGE}}{\Delta \text{DEPTH}}$$

$$m = \frac{\text{AGE}_B - \text{AGE}_A}{\text{DEPTH}_B - \text{DEPTH}_A} = \frac{1.05 \text{ m.y.} - 1.01 \text{ m.y.}}{100\text{m} - 20\text{m}} =$$

$$\frac{0.04 \text{ m.y.}}{80\text{m}} = 0.0005 \frac{\text{m.y.}}{\text{m}}$$

Q 2.3

RATE OF SEDIMENTATION = m/yr = $\frac{\text{Y AXIS (DEPTH)}}{\text{X AXIS (AGE)}}$



X-intercept = AGE AT WHICH LAKE DRIED OUT $\cong$ 450,000 yrs

RATE of SED = M of LINE = $\frac{\Delta y}{\Delta x} = \frac{\Delta \text{ DEPTH}}{\Delta \text{ AGE}} = \frac{D_2 - D_1}{A_2 - A_1} =$

$$\frac{(20 - 6\text{m})}{(620{,}000 - 520000 \text{ yr})} = \frac{14\text{m}}{50{,}000 \text{ yr}} = 2.8 \times 10^{-4} \frac{\text{m}}{\text{yr}}$$

$$\text{RATE} = 2.8 \times 10^{-4} \text{ m/yr}$$

Q 2.4

τ = STRENGTH (UNITS: Pa)

τ_0 = STRENGTH WHEN COMPRESSION = 0

P = NORMAL PRESSURE (COMPRESSION)

$$\tau = \tau_0 + mP$$

Q2.8

$\phi = 0.6 \times 2^{-z}$ Where ϕ = POROSITY (DECIMAL%)
z = DEPTH

$$\phi = (0.6)(2^{-2}) = (0.6)(0.25) = 0.15$$

$$\phi = 0.15 \times 100\% = 15\%$$

POROSITY AT DEPTH of 2km = 15%

Q 2.11 — SEE ATTACHED GRAPH

Q 3.2

$A_{BE} = (K \cdot \text{DEPTH}) + A_{BE}$ of TOP

$A = (KD) + A_T$

$A - (KD) = A_T$

$(60000\text{yr}) - \left(\frac{5000\text{yr}}{1\text{m}}\right)(10\text{m}) = A_T$

$60{,}000\text{yr} - 50{,}000\text{yr} = A_T$

$10{,}000\text{yr} = A_T$

K = SED. CONSTANT = $\frac{5000\text{ yr}}{\text{m}}$

$D = 10\text{ m}$

$A = A_{BE} = 60{,}000$ yrs

Q 3.3

GIVEN $W = \frac{3y}{4z}$ AND $X = \frac{2y}{4z}$

HINT: SOLVE FOR y, AND SUBSTITUTE INTO OTHER EQUATION

① $(4z)W = \left(\frac{3y}{4z}\right)4z$

$4zW = 3y$

$1.33zW = \frac{4zW}{3} = y$

② $X = \frac{2y}{4z} = \frac{2(1.33zW)}{4z} =$

$\left(\frac{2.66}{4}\right)\left(\frac{zW}{2}\right) = 0.665W$

$\frac{X}{0.665} = \left(\frac{0.665W}{0.665}\right)$

$\frac{X}{0.665} = W$

FINAL ANSWER

★ $1.50 = \frac{1}{0.665} = \frac{W}{X}$ ★

Q 4.5

$\frac{r^2}{m}g = \left(\frac{GM}{r^2}\right)\left(\frac{r^2}{M}\right)$

HINT: RE-ARRANGE EQUATION AND VALIDATE UNIT ALGEBRA

$\frac{r^2}{m} \cdot g = 6$

$\left(\frac{m^2}{kg}\right) \cdot \frac{m}{sec^2} = 6$

★ $\frac{m^3}{kg\text{-}sec^2} = 6 = m^3\, kg^{-1}\, sec^{-2}$ ★

Q 5.3

GIVEN

$360^\circ = 2\pi$

CONVERT THE FOLLOWING ANGLES

(i) $180^\circ \left(\frac{2\pi}{360^\circ}\right) = \pi = 3.14$ RAD

(ii) $(90^\circ)\left(\frac{2\pi}{360^\circ}\right) = 0.5\pi = 1.57$ RAD

(iii) $(270^\circ)\left(\frac{2\pi}{360^\circ}\right) = 1.5\pi = 4.71$ RAD

(iv) $(100^\circ)\left(\frac{2\pi}{360^\circ}\right) = 0.56\pi = 1.75$ RAD