INTRODUCTION TO GEOPHYSICS
MA 471 QUIZ 3 (2 Hours)

1. A refracted arrival has a slope of 0.0005 s/m. The direct layer arrival has a slope of 0.0008 s/m. The intercept time of the refracted arrival is 0.020 s.
   (a) What is the velocity of the upper layer? — 3m
   (b) What is the velocity of the lower layer? — 3m +1
   (c) What is the depth to the lower layer? — 3m
   (10)

2. Construct a travel time curve to a distance of 80 m for traverse; assume the top overburden is 8 m thick soil layer with P-wave velocity 400 m/s over a phyllite layer 22 m thick with P-wave velocity 1200m/s. (10)
   (a) What is the crossover distance? 2
   (b) Calculate the critical angle and the critical distance. 4
   (c) Calculate the intercept time T_i 2

3. If the distance from the anode of the potential electrode to the anode of the current electrode is 10m along a 30m traverse, what is the Apparent Resistivity if R is 25Ω ? (8)
   (VES Mode)

4. Show with a simple sketch the general four-electrode configuration for resistivity measurement. (4)

5. List all the equipment you will need to carry out a seismic refraction investigation. (5)

6. Mention 3 factors that control the density of a rock (6) · 2each × 3

7. State the corrections that are applied to Gravity Data 2 × 3 (3)

8. What causes earthquakes (2) and what are the seismic waves they emit? (4)

9. Mention five applications of Geophysical Methods (10) 2 × 5

10. What is a geological fault? (1) Describe the three main types of faults with diagrams and the forces that cause them. 2 × 3 (6)

11. Briefly describe the rock cycle. (6)

12. Briefly explain the following terms as used in rock magnetism: Induced magnetism, ½ Thermoremanent magnetization, ½ Diamagnetism, ½ Para-magnetism ½ and Ferromagnetism. ½ + ½ (3)

2+ Bonus

= (80)

Q6. - Density of rock forming minerals
- Age
- Depth of burial
- Porosity
- Cementation
- Fluid in pores

6

Q7. - Instrument drift
- Earth tides
- Latitude correction
- Elevation (Free-air and Bouguer)
- Terrain
- Buildings

3

Q8.a. Tectonic activities - Transform boundaries; when plates slide past/against each other, generating seismic waves

2

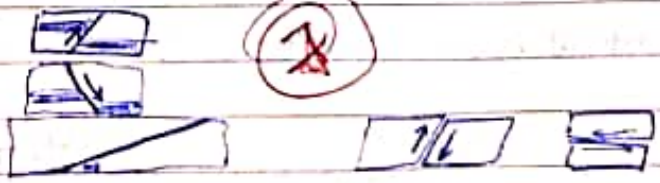
b. * P-waves * S-waves (Body wave
* Rayleigh waves * Love waves (Surface wave

2

Q9. - Minerals exploration
- Hydrocarbon exploration
- Hydrogeology exploration
- Engineering Geology - Foundation engineering
- Solid earth Geophysics

10

Q10. - Reverse
- Normal
- Thrust



2

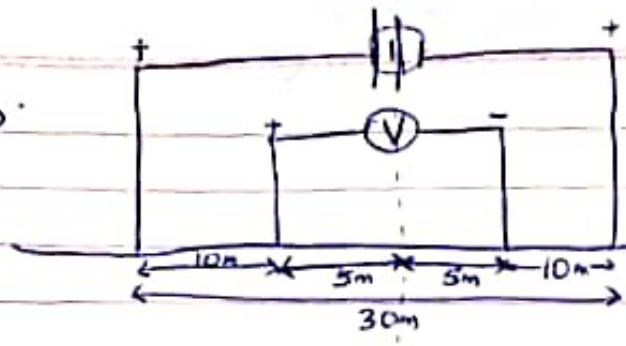
Q11. Rock Cycle

Metamorphic rocks can weather to form sedimentary rocks or melt to later crystallise to form igneous rock.
Igneous rocks weather to form sed. rocks or are buried and develop high temperature & pressure to form Metamorphic Rocks.

10

Geophones
Trigger Cable

Q3.



(2)

VES Geometric Factor $(k_g) = \frac{\pi(l^2 - b^2)}{2b}$

$l = 10m$ $\quad R = 25\Omega$

$b = 5m$

$k_g = \frac{\pi (10^2 - 5^2)}{2 \times 5}$ (3)

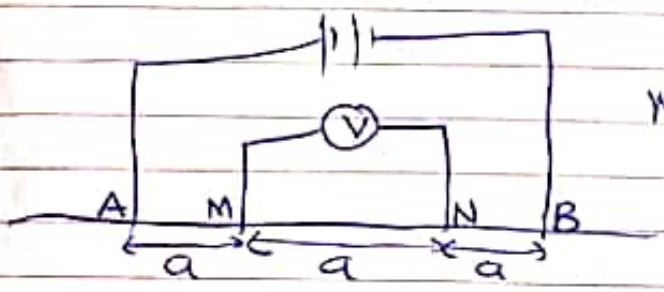
$k_g = 23.562\,m$

$\rho_A = R \cdot k_g$

$\rho_A = 25 \times 23.562$ (3)

$\rho_A = 589.05\,\Omega m$

Q4.



Wenner Configuration

(4)

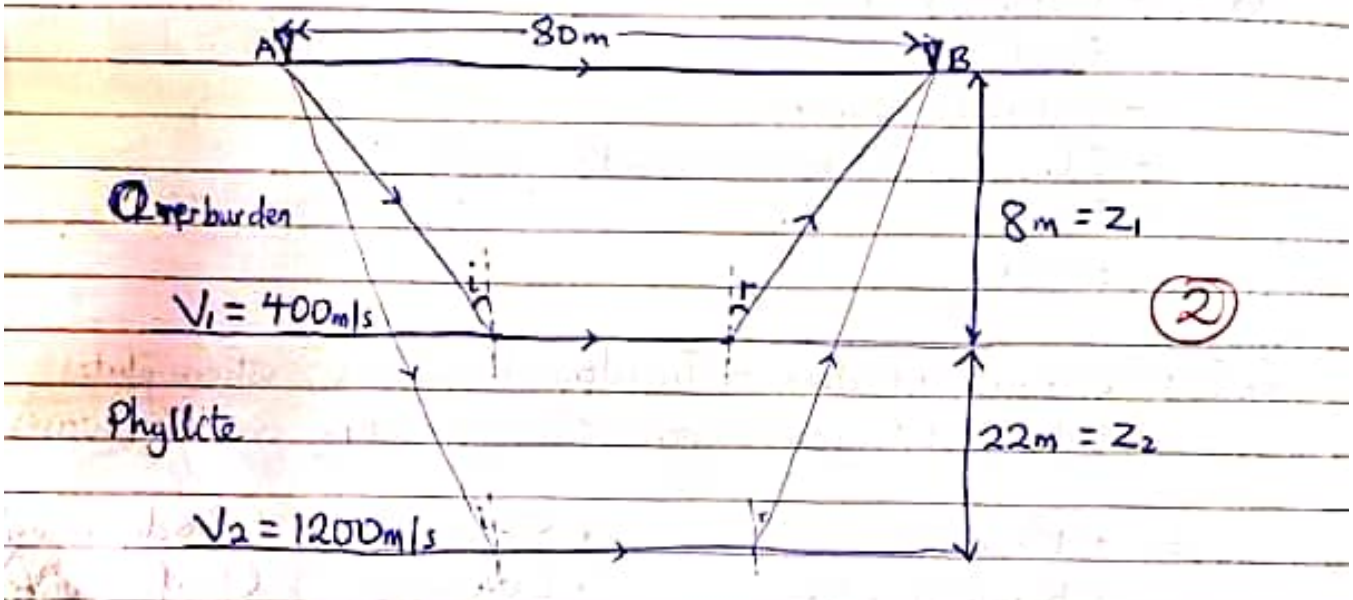
A = Positive current electrode
B = Negative current electrode
M = Positive Potential electrode
N = Negative Potential Electrod
a = Electrode space for Wenner Configuration

Q5. Seismograph, Spread Cable, Laptop with data collection software, Sledge Hammer, Strike Plate, Geophones, Trigger Cable (5)

Sedimentary rocks are buried and undergo high temperature & pressure to form Metamorphic Rock.

Q12. Refer to Handout

Q2.



a. Cross over distance

$$X_c = 2z\sqrt{\frac{V_2 + V_1}{V_2 - V_1}}$$

$$X_c = 2 \times 8\sqrt{\frac{1200 + 400}{1200 - 400}} \quad (2)$$

$$X_c = \underline{22.62m}$$

b. Critical Angle $\sin i_c = \frac{V_1}{V_2}$, $i_c = \sin^{-1}\left(\frac{V_1}{V_2}\right)$

$$i_c = \sin^{-1}\left[\frac{400}{1200}\right] = \underline{19.47^\circ} \quad (2)$$

Critical Distance $= 2z \tan\theta = 2(8)\tan 19.47 = \underline{5.656m}$ (2)

c. Time Intercept, $T_i = \frac{2z\sqrt{V_2^2 + V_1^2}}{V_2 V_1} = \frac{2 \times 8\sqrt{1200^2 + 400^2}}{1200 \times 400}$

$$T_i = \underline{0.042s} \quad (2)$$

MA 471 Quiz 3

Q1. (a) ~ (b)

$S_2 = 0.0005$ s/m
$S_1 = 0.0008$ s/m
$T_i = 0.02$ s (1)

$S = \frac{T}{D}$, but $V = \frac{D}{T}$, hence $S = \frac{1}{V}$

$V_1 = \frac{1}{S_1} = \frac{1}{0.0008 \text{ s/m}}$ (3)

$V_1 = \underline{1250}$ m/s

$V_2 = \frac{1}{S_2} = \frac{1}{0.0005 \text{ s/m}}$ (3)

$V_2 = \underline{2000}$ m/s

∴ the velocity of the upper layer is 1250 m/s while the velocity of the lower layer is 2000 m/s.

c. If $T_i = \frac{2z\sqrt{V_2^2 + V_1^2}}{V_2 V_1}$

then Depth to the lower layer $(z) = \frac{T_i \cdot V_2 V_1}{2\sqrt{V_2^2 + V_1^2}}$

$z = \frac{0.02 \times 2000 \times 1250}{2\sqrt{2000^2 + 1250}}$ (3)

$z = \underline{10.6}$ m.