

(可攜帶: Goodman's Introduction to Rock Mechanics)

(可使用工程用計算機 Engineering calculator can be used)

1. A shale of Cretaceous age is composed of 60% illite, 20% chlorite, and 20% pyrite. The porosity (n) values at different depths are as follows: n equals 33.5% at 600 ft; 25.4% at 2500 ft; 21.1% at 3500 ft, and 9.6% at 6100 ft. Estimate the vertical stress at 6000 ft depth in this shale (assuming a continuous thickness of shale from the surface to depth 6000 ft and saturation with water).
2. Plot the stress paths of (a) unconfined compression (b) triaxial compression with constant confining pressure (c) splitting tension (d) ring shear as Mohr circles on the normal stress vs shear stress diagram?

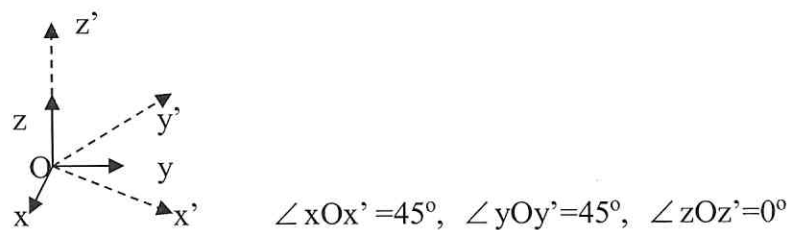
3. In a series of triaxial compression tests on a sandstone, the following represent the stresses at peak load conditions:

| Test | σ_3 (MPa) | σ_1 (MPa) |
|------|------------------|------------------|
| 1 | 2.5 | 10 |
| 2 | 5.0 | 20 |
| 3 | 10 | 40 |
| 4 | 15.0 | 60 |

Determine values of S_i and ϕ ? Estimate the unconfined compressive strength and the tensile strength for this rock?

4. If values of the stress components of a point in x-y-z coordinates are: $\begin{bmatrix} 0 & 10 & 10 \\ 10 & 20 & 0 \\ 10 & 0 & 0 \end{bmatrix}$ (unit: MPa).

Find the stress components in x' - y' - z' coordinates in which x' - y' - z' coordinates are defined as following:



5. A rock mass to be excavated in an open cut has the following recurrent discontinuities:
 Set 1 (Bedding) strikes N 45° E, dipping 30° N 45 W
 Set 2 (Jointing) strikes S 45° E, dipping 30° S 45 W
 Sketch by hand the projections and dip vectors of Sets 1 and 2, and lines of intersection of Sets 1 and 2 on a lower hemisphere stereographic projection?

地質工程試題 (Closed Book)

一、解釋名詞：(25%)

1. RQD (Rock Quality Designation) 2. Rock Mass Rating 3. Strike and Dip
4. JRC (Joint Roughness Coefficient) 5. Fault

二、(A) 礫岩 (B) 凝灰岩 (3) 泥岩 (4) 大理岩

請分別針對上列四種岩石回答下列問題。(15%)

- (1) 它是屬於火成岩、沈積岩、或是變質岩；
(2) 說明其工程性質；
(3) 在台灣可能分佈之區域。

三、(1) 說明台灣山岳隧道較常見之災害有哪些，並分別針對這些災害簡要說明哪些地質情況較易發生此類災害。(2) 請簡要說明此些隧道地質災害之因應對策。(15%)

四、(1) 台灣地狹人稠，一些建築開發有往山坡地發展之趨勢，請問在哪些山坡地進行建築開發較易發生破壞災害。

- (2) 說明山坡地發生崩坍之前奏。(15%)

五、2009 年 8 月 9 日莫拉克颱風帶來的超級雨量在高雄縣甲仙鄉小林村後方山坡誘發大型山崩，造成掩埋村落而致五百人失蹤的巨災。(1) 請說明此災變之過程。(2) 請就工程地質之觀點說明災變之原因。(3) 未來如何防範此類災害再次發生。(15%)

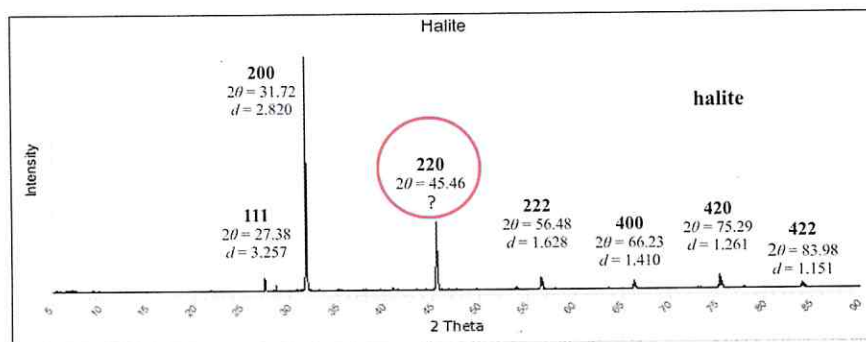
六、如下圖所示之照片，請問 (1) 拍攝地點在哪裡？(2) 岩石種類為何？(3) 說明此照片所顯示之地質現象。(15%)



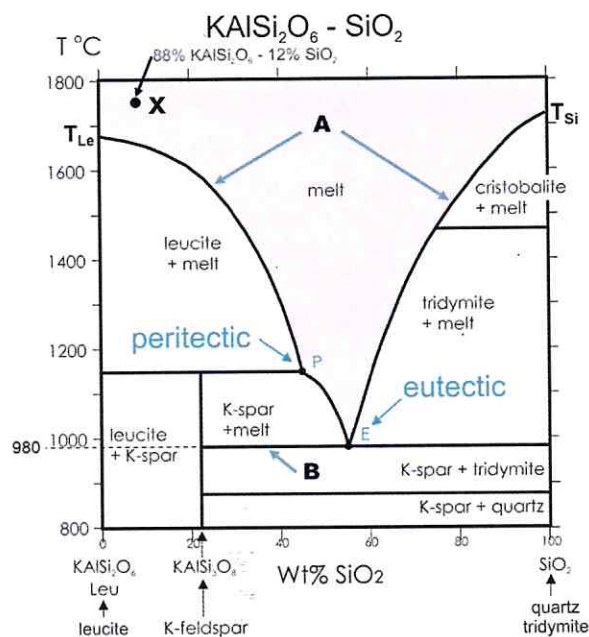
1. Please define the terminologies of (a) Spectroscopy (b) Mass-spectroscopy and (c) Diffraction techniques. (15)
2. Fourier Transform Infra-red spectroscopy (FTIR) is commonly applied for analyze the organic matters. (a) Please tell how "Fourier Transform" employed for this method. (b) For a powder sample, it is generally required to mix the powder with KBr and forms a pill before measurement. What is this process for and why KBr? (10)
3. Please tell the working principle of X-ray diffraction (XRD) and its major functions for material analyses. Why X-ray is used in XRD technique as an incident light source instead of visible light? (10)
4. XRD peak broadening may be created by the size or strain effect. Please describe how "size" and "strain" effect generate to the full-width-half-maximum (FWHM) as a function of the incident angle of light. (10)
5. Describe the working principles of X-ray Photoelectron Spectroscopy (XPS) and list the material information it may provide. (10)
6. Please compare the working principles of Scanning Electron Microscope (SEM) and Transmission Electron Microscope (TEM). Why do we need to coat conductive layers onto the specimen for SEM but not for TEM? (15)
7. Why the applied voltage of electron gun in SEM and TEM devices determines the resolution and contrast of the images? (10)
8. Please describe how Dynamic Light Scattering (DLS) method being applied for the measurements to the particle size distribution. How the concentration of the suspension would affect the analysis results?
9. Atomic Absorption spectroscopy (AAS) and Inductive Coupled Plasma spectroscopy (ICP) is commonly used for measuring the concentration of a solution. Please tell the working principles and compare the differences of their analyzing data of two instruments. (10)

吳鎮坤

- (10 pt) Explain the Bowen's Reaction Series.
- (15 pt) Give the definition of a mineral. According to the definition, is liquid water a mineral ($\text{H}_2\text{O}_{(l)}$)? Is ice cube a mineral ($\text{H}_2\text{O}_{(s)}$)?
- (5 pt) (a) Explain the Bragg's law by plotting the relationship among x-ray wavelength, interatomic spacing, and angle of diffraction. (5 pt) (b) Write down the equation and use it to calculate the missing d value in the below figure. (5 pt) (c) Explain the scientific meaning of the x and y axis. (5 pt) (d) Explain why there are no brackets for describing the value like 200 or 220.



- (10 pt) (a) Explain the **A**, **B**, T_{Le} , T_{Si} , and **eutectic point**. (10 pt) (b) Qualitatively determine the mineral composition during the **mineral X** cooling pathway at 1700°C, 1400°C, 1100°C, 980°C and 900°C.



5. Read the following description about SANIDINE and answer the questions.

SANIDINE—(K,Na)AlSi₃O₈



Crystallography. Monoclinic; $2/m$. Crystals are often tabular parallel to {010}; also elongated on a with square cross section as in Fig. 19.78a. Carlsbad twins common.

$C2/m$; for high sanidine, $a = 8.56$, $b = 13.03$, $c = 7.17$ Å; $\beta = 115^\circ 59'$; $Z = 4$. ds : 4.22(6), 3.78(8), 3.31(10), 3.278(6), 3.225(8).

Physical Properties. *Cleavage* {001} perfect, {010} good. $H = 6$. $G = 2.56$ – 2.62 . *Luster* vitreous. *Color* colorless and commonly transparent. *Streak* white. *Optics*: (–); $\alpha = 1.518$ – 1.525 ; $\beta = 1.523$ – 1.530 , $\gamma = 1.525$ – 1.531 . Occurs in two orientations with optic plane parallel with {010} and $2V = 0^\circ$ – 60° , and with optic plane normal to {010} and $2V = 0^\circ$ – 25° .

Composition and Structure. A complete solid solution exists at high temperature between sanidine and high albite; part of the intermediate region is known as *anorthoclase* (see Fig. 18.47). The structure of sanidine shows a disordered (random) distribution of Al and Si in the tetrahedral framework (see Fig. 18.48). The Al and Si distribution in orthoclase is more ordered (see Fig. 12.9 and related text).

Diagnostic Features. Can be characterized with confidence only by optical or X-ray techniques. Optic orientation and $2V$ differ from orthoclase. Microcline and plagioclase show different types of twinning.

Occurrence. As phenocrysts (see Fig. 19.80) in extrusive igneous rocks such as rhyolites and trachytes. Sanidine is characteristic of rocks that cooled quickly from an initial high temperature of eruption. Most sanidines are cryptoperthitic.

Name. Sanidine is derived from the Greek word *sanis* meaning *tablet*, and the Greek word *idos*, meaning *appearance*, in allusion to its typical tabular habit.

- (10 pt) There are two symbol “H” and “G” in **Physical Properties** section. What do these two symbols mean?
- (10 pt) According to the symmetry, which crystal system does this mineral belong to?
- (5 pt) Why the *color* and *streak* are different?
- (5 pt) What kind of information can you learn from the **Composition and Structure** section?
- (5 pt) Can you see the light go through this mineral?

(各題各佔 20%)

1. 循環經濟或資源回收，常以慧星圖表示多種的資源循環方式，以達完整完全的永續目標，請解釋慧星圖之組成及意義。
2. 由於金邦會的規定，現在各大企業均以 ESG 報告為資訊揭露的主流，略有別於傳統之社會責任報告，試申述 ESG 報告的重要及最新發展趨勢。
3. 生命週期分析中 (LCA)，有一步驟稱為“特徵化”，請敘述其作法，並舉一例說明。
4. 生命週期分析 (LCA) 中有一步驟稱為“標準化”，請敘述其作法，並舉一例說明。
5. 邁向「碳淨零」已在我國如火如荼展開，相關的路徑圖也將益趨明確，請舉一種“製造業”，論述該產業之最新進展、未來規劃，以及可預見的挑戰。

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