



Faculty of Engineering and the Built Environment/  
Department of Metallurgy  
DOORNFONTEIN CAMPUS

**AND**

Faculty of Science  
Department of Geology

B.Eng. METALLURGICAL ENGINEERING(Extraction)

Geology Module  
(GMESCB2)

Lecturer: Sindile Mkhathshwa

**Theory Test 2**  
**16<sup>th</sup> -17<sup>th</sup> August 2020**  
**DURATION: 3 Hours**  
**Total Marks: 188**

1. Low Relief means the (1.0 point)

Low Relief means the mineral boundaries are not easy to be identified.

- \*a. True
- b. False

2. Some minerals such as (1.0 point)

Some minerals such as quartz are highly resistance to alteration.

- \*a. True
- b. False

3. Biotite often alters (1.0 point)

Biotite often alters to the mineral malachite causing it to go a murky green colour.

- \*a. True
- b. False

4. Feldspars do alter, (1.0 point)

Feldspars do alter, and often become cloudy in appearance.

- \*a. True
- b. False

5. Isometric System Min (1.0 point)

Isometric System Minerals such as Pyrite are viewed in crossed polars remain dark even when the microscope stage is rotated.

- a. True
- \*b. False

6. Minerals in the hexa (1.0 point)

Minerals in the hexagonal and tetragonal cut normal to the c axis remain dark on rotation of the stage.

- \*a. True
- b. False

7. A mineral is a natur (1.0 point)

A mineral is a naturally occurring substance with a definite chemical composition and a systematic three-dimensional atomic order.

- a. True
- \*b. False

8. Crystals are divided (1.0 point)

Crystals are divided into systems according to symmetry of their unit cells.

- \*a. True
- b. False

9. Some crystalline min (1.0 point)

Some crystalline minerals polarize the light and split the light into two beams, which travel at different velocities and at right angles to each other. These minerals are known as anisotropic minerals.

- a. True
- \*b. False

10. Polarizing filters t (1.0 point)

Polarizing filters today consist of a plastic sheet containing either microscopic crystals or molecules that only permit light to be transmitted in one direction.

- \*a. True
- b. False

11. Basic crystallograph (1.0 point)

Basic crystallographic systems are isometric, tetragonal, hexagonal, orthorhombic, monoclinic, and triclinic.

- a. True
- \*b. False

12. Crystals with chemic (1.0 point)

Crystals with chemical zoning are described as zoned crystals.

- \*a. True
- b. False

13. Exsolution textures (1.0 point)

Exsolution textures are most readily observed in cross polars as host and exsolved minerals often have similar optical properties and so may have similar relief.

- \*a. True
- b. False

14. On rotation of the m (1.0 point)

On rotation of the microscope stage minerals that are anisotropic will become dark in one particular orientation, such minerals are said to be in extinction.

- a. True
- \*b. False

15. An opaque mineral is (1.0 point)

An opaque mineral is black whether the analyser is in OR out, while the transparent, isotropic mineral is not opaque.

- \*a. True
- b. False

16. The observations typ (1.0 point)

The observations typically made in crossed nicols (XPL) are:  
Isotropy/Anisotropy, Extinction angle, Birefringence colour,  
Twinning/Zoning Specific and textures (Exsolution).

- a. True
- \*b. False

17. The quality of cleav (1.0 point)

The quality of cleavage is described as perfect, imperfect, good, distinct, indistinct, poor, or absent.

- \*a. True
- b. False

18. Looking at the miner (1.0 point)

Looking at the mineral boundaries, we can see the shape of the analysed grain, in order to estimate the habit, several grains of the same mineral should be examined.

- \*a. True
- b. False

19. If the grain shows i (1.0 point)

If the grain shows irregular boundaries only, the grain is anhedral.

- \*a. True
- b. False

20. If the grain has bot (1.0 point)

If the grain has both visible and unclear boundaries, it is subhedral.

- a. True
- \*b. False

21. The shape and size o (1.0 point)

The shape and size of the grains are related to the conditions of growth (crystallization).

- \*a. True
- b. False

22. When crystals grow, (1.0 point)

When crystals grow, depending on how favourable the conditions are, they may develop all of their crystal faces, or none of them at all that is no preferred faces, so a crystal grows as a shapeless blob = anhedral growth or anything in between.

- \*a. True
- b. False

23. Serpentine is formed (1.0 point)

Serpentine is formed as a result of olivine alteration.

- \*a. True
- b. False

24. In optics the refrac (1.0 point)

In optics the refractive index or index of refraction  $n$  of an optical medium is a dimensionless number that describes how light, or any other radiation, propagates through that medium.

- \*a. True
- b. False

25. Petrography is essen (1.0 point)

Petrography is essentially the study of rocks under the microscope with the intention of firstly describing the mineral properties and textures under the microscope followed by identifying the mineral phases and using that information to classify the type of rock being studied.

- \*a. True
- b. False

26. The colour in a mine (1.0 point)

The colour in a mineral in thin section is seen in plane polarized light. Do not confuse the colour of the mineral under crossed polars - in this situation it is not the true colour of the mineral.

- \*a. True
- b. False

27. Opaque minerals do n (1.0 point)

Opaque minerals do not allow any light through in either plane polarised light or under crossed nicols. Examples of opaque minerals are magnetite, ilmenite, and pyrite or in fact any of the metallic lustered minerals (usually sulphides oxides and native elements).

- \*a. True
- b. False

28. Recognition of these (1.0 point)

Recognition of these minerals can only be done under reflected light. Therefore, in transmitted light, it is only possible to note the percentage of opaque minerals, to note their crystal shape and size, and to not confuse them with minerals that are isotropic.

- \*a. True
- b. False

29. When Isometric System (1.0 point)

When Isometric System Minerals such as pyrite and galena are viewed in crossed polars they remain dark even when the microscope stage is rotated since polarised light passing through an isotropic substance does not have its vibration direction altered.

- \*a. True
- b. False

30. Setting up the Micro (24.0 points)

Setting up the Microscope from end to finish for thin section observation:

Correct Answer:

- \*Uncover the Microscope by removing plastic cover
- \*Plug in the power cable
- \*Switch the microscope on (Green Button):
- \*Above on/off switch, set black button to ensure your light source is coming from below and not up
- \*For common rock forming minerals (mostly silicates)
- \*Ensure that Microscope is set to transmitted light mode
- \*Ensure betrend Lens is out of the way
- \*Ensure its not on camera mode for the microscopes we use
- \*Use focussing knobs on the left and right side of the microscope.

- \*Uncover the Microscope by removing plastic cover
- \*Plug in the power cable
- \*Switch the microscope on (Green Button):
- \*Above on/off switch, set black button to ensure your light source is coming from below and not up for \*common rock forming minerals (mostly silicates)
- \*Ensure that Microscope is set to reflected light mode
- \*Ensure betrend Lens is out of the way
- \*Ensure it is on camera mode for the microscopes we use
- \*Use focussing knobs on the left and right side of the microscope.

- \*Cover the Microscope by placing the plastic cover over it
- \*Plug in the power cable
- \*Switch the microscope off (Green Button):
- \*Above on/off switch, set green button to ensure your light source is coming from

below and not up for \*common rock forming minerals (mostly silicates)

\*Ensure that Microscope is set to cross polarised light mode

\*Ensure betrend Lens is in the way

\*Ensure its not on camera mode for the microscopes we use

\*Use focussing knobs on the left and right side of the microscope.

31. Pyroxenes crystalliz (2.0 points)

Pyroxenes crystallize in both

Correct Answer:

\*the orthorhombic and monoclinic crystal systems

32. At high temperatures (5.0 points)

At high temperatures, pyroxenes have more extensive fields of solid solution than they do at lower ones. Consequently, as temperatures decrease, the pyroxene adjusts its composition in the solid state by exsolving a separate phase in the form of lamellae within the host pyroxene grain. The lamellae are exsolved along specific crystallographic directions, producing oriented intergrowths with parallel and herringbone texture. Name the five principal combinations of exsolution pairs?

Correct Answer:

\*augite with enstatite lamellae. augite with pigeonite lamellae. augite with both pigeonite and enstatite lamellae. pigeonite with augite lamellae and enstatite with augite lamellae.

33. How do we describe r (3.0 points)

How do we describe relief?

Correct Answer:

\*low moderate or high

34. Functions of the mic (8.0 points)

Functions of the microscope components

Correct Answer:

\*light source, light filter, condenser, polariser, adjustment lever on the polariser, Iris, stage, objectives, analyser, ocular(s)/eyepiece, coarse focus, and fine focus.

\*light source, light filter, compensator, polariser, adjustment lever on the polariser, Iris, stage, objectives, analyser, ocular(s)/eyepiece, coarse focus, and fine focus.

\*light analyser, light filter, condenser, polariser, adjustment lever on the polariser, Iris, stage, objectives, analyser, ocular(s)/eyepiece, coarse focus, and fine focus.

\*light source, light filter, condenser, polariser, adjustment lever on the polariser, pupil, stage, objectives, analyser, ocular(s)/eyepiece, coarse focus, and fine focus.

35. Pleochroism is: (2.0 points)

Pleochroism is:

Correct Answer:

\*colour change of a mineral in PPL as the stage is rotated

\* is zero for isotropic minerals in any direction under PPL and XPL

36. Grains under the mic (1.0 point)

Grains under the microscope are described as euhedral:

Correct Answer:

\*exhibit clear grain boundaries

37. Cleavage is the mine (2.0 points)

Cleavage is the minerals ability to separate into smaller particles, bounded by smooth planar surfaces parallel to the directions of faces of possible crystal forms. Some minerals show bi directional cleavage. Choose the minerals in the list that show bi directional cleavage

Correct Answer:

\*Pyroxene and amphibole

38. Certain minerals may (1.0 point)

Certain minerals may be more subject to chemical alteration than others, and this chemical alteration may be partially or wholly complete in the rock. New products are usually formed from the original mineral, and this can sometimes help with the identification. Alteration often begins near the grain boundaries and works inwards. In other cases, it may fill cracks and fractures in the mineral, or it may start at the Centre or core of the mineral. Select the mineral that does not undergo alteration.

Correct Answer:

\*Quartz

39. The mineral being st (2.0 points)

.The mineral being studied using a microscope should be put into categories, name the correct categories:

Correct Answer:

\*Isotropic and anisotropic.



40. One of the options s (6.0 points)

One of the options show the correct discontinuous sequence of minerals in Bowens reaction series, Choose the correct option

Correct Answer:

\*Olivine, pyroxene, amphibole, biotite, Potassium feldspar, Muscovite, quartz.

41. Some crystalline min 2 (1.0 point)

Some crystalline minerals polarize the light and split the light into two beams, which travel at different velocities and at right angles to each other. Examples of this are quartz, and calcite amongst others and these minerals are known as \_\_\_\_\_ minerals. Choose the word to fill in the blank space

Correct Answer:

\*Anisotropic

42. The continuous branc (2.0 points)

The continuous branch of Bowen's reaction series consists of a mineral sequence. Name the mineral and its different end members

Correct Answer:

\*Calcium feldspar

\*Sodium rich feldspar

43. Birefringence is (2.0 points)

Birefringence is

Correct Answer:

\*The change in colour in XPL as the stage is rotated

44. Interference colour (4.0 points)

Interference colour is

Correct Answer:

\* the colour exhibited by a section of an anisotropic mineral under XPL

\*is zero for isotropic minerals in any direction under XPL.

45. size and results (3.0 points)

Standard thin sections are:

Correct Answer:

\*30 microns thick but thin sections thicker than 30 microns will produce higher order interference colours

46. recognition crystals light setting to view and common types (4.0 points)

Twinning is

Correct Answer:

\*recognized by adjacent portions of a single crystal having different extinction positions

observed with crossed polars

\*a symmetrical growth of two or more crystals of the same mineral

\*the common plane of the twinned crystals (which is called the twinning plane) is a symmetry plane, seen in thin section as a straight line separating two identical crystals which have a symmetrical optical orientation to the twinning plane.

47. types and characteristics in XPL (4.0 points)

. Twinning in plagioclase

Correct Answer:

\*commonly shows lamellar twinning

\*happens if more than one crystal is twinned, having a parallel twinning plane, the twinning is called polysynthetic (sometimes also called lamellar twinning).

48. light directions propagation vibrations etc. (4.0 points)

Under PPL:

Correct Answer:

\*Natural light vibrates (oscillates) in all the directions perpendicular to the direction of propagation

\*there is infinity of planes of vibrations (all possible planes that intersect/contain the direction of propagation).

\*plane polarized light (PPL) has one single plane of vibration, in which the direction of vibration is always perpendicular to the direction of propagation

49. Properties (6.0 points)

Light is part of:

Correct Answer:

\*the electromagnetic spectrum, which ranges from radio waves to gamma rays.

\*electromagnetic retardation waves, as their names suggest are fluctuations of electric and magnetic fields, which can transport energy from one location to another.

50. What is the study of (3.0 points)

What is the study of Crystallography?

Correct Answer:

\*Crystallography is the study of crystals and their crystalline state and forms a natural introduction to the study of rocks under the microscope

51. In general a near perfect (4.0 points)

In general a near perfect crystal will only result if

Correct Answer:

\*it is able to grow freely without meeting any obstruction and if the chemical environment around the crystal remains stable.

52. In different crystal (1.0 point)

In different crystals of the same mineral although the interfacial angle is the same

Correct Answer:

\*the overall form of the crystals may be extremely variable

53. Setting up the Micro 2 (1.0 point)

Setting up the Micro (1.0 point)

Setting up the Microscope for thin section observation:

\*a. Uncover the Microscope by removing plastic cover Plug in the power cable

Switch the microscope on (Green Button):

Above on/off switch, set black button to ensure your light source is coming from below and not up

For common rock forming minerals (mostly silicates) Ensure that Microscope is set to transmitted light mode Ensure betrend Lens is out of the way

Ensure its not on camera mode for the microscopes we use

Use focussing knobs on the left and right side of the microscope.

b. Uncover the Microscope by removing plastic cover Plug in the power cable

Switch the microscope on (Green Button):

Above on/off switch, set black button to ensure your light source is coming from below and not up for common rock forming minerals (mostly silicates)

Ensure that Microscope is set to reflected light mode Ensure betrend Lens is out of the way

Ensure it is on camera mode for the microscopes we use

Use focussing knobs on the left and right side of the microscope.

c. Cover the Microscope by placing the plastic cover over it Plug in the power cable

Switch the microscope off (Green Button):

Above on/off switch, set green button to ensure your light source is coming from below and not up for common rock forming minerals (mostly silicates)

Ensure that Microscope is set to cross polarised light mode Ensure betrend Lens is in the way

Ensure its not on camera mode for the microscopes we use

Use focussing knobs on the left and right side of the microscope.

54. Pyroxenes crystalliz 2 (1.0 point)

Pyroxenes crystalliz (1.0 point)

**Pyroxenes crystallize in both**

\*a. the orthorhombic and monoclinic crystal systems

b. the cubic and monoclinic crystal systems

c. the monoclinic and hexagonal crystal systems

d. the tetragonal and orthorhombic crystal systems.

55. At high temperatures 2 (1.0 point)

At high temperatures (1.0 point)

**At high temperatures, pyroxenes have more extensive fields of solid solution than they do at lower ones. Consequently, as temperatures decrease, the pyroxene adjusts its composition in the solid state by exsolving a separate phase in the form of lamellae within the host pyroxene grain. The lamellae are exsolved along specific crystallographic directions, producing oriented intergrowths with parallel and herringbone texture. Name the five principal combinations of exsolution pairs**

\*a. augite with enstatite lamellae. augite with pigeonite lamellae. augite with both pigeonite and enstatite lamellae. pigeonite with augite lamellae and enstatite with augite lamellae.

b. augite with quartz lamellae. augite with pigeonite lamellae. augite with both pigeonite and enstatite lamellae. pigeonite with augite lamellae and enstatite with augite lamellae.

c. enstatite with augite lamellae. augite with pigeonite lamellae. augite with both pigeonite and enstatite lamellae. pigeonite with augite lamellae and enstatite with augite lamellae.

56. How do we describe r 2 (1.0 point)

How do we describe r (1.0 point)

**How do we describe relief**

a. well shaped. Poorly shaped and moderately shaped

b. Poor well or high

\*c. low moderate or high

57. Functions of the mic 2 (1.0 point)

Functions of the mic (1.0 point)

**Functions of the microscope components**

\*a. light source, light filter, condenser, polariser, adjustment lever on the polariser, Iris, stage, objectives, analyser, ocular(s)/eyepiece, coarse focus, and fine focus.

b. light source, light filter, compensator, polariser, adjustment lever on the polariser, Iris, stage, objectives, analyser, ocular(s)/eyepiece, coarse focus, and fine focus.

c. light analyser, light filter, condenser, polariser, adjustment lever on the polariser, Iris, stage, objectives, analyser, ocular(s)/eyepiece, coarse focus, and fine focus.

d. light source, light filter, condenser, polariser, adjustment lever on the polariser, pupil, stage, objectives, analyser, ocular(s)/eyepiece, coarse focus, and fine focus.

58. Pleochroism is (1.0 (1.0 point)

Pleochroism is (1.0 point)

**Pleochroism is**

- a. colour of a mineral in XPL as the stage is rotated
- \*b. colour change of a mineral in PPL as the stage is rotated
- c. extinction in PPL as the stage is rotated
- d. is zero for isotropic minerals in any direction under PPL and XPL
- e. is the colour exhibited by a section of an anisotropic mineral under cross polarised light

59. Grains under the mic 2 (1.0 point)

Grains under the mic (1.0 point)

**Grains under the microscope are described as euhedral.**

- a. If they have irregular outlines
- b. if they are bounded by straight crystal faces
- c. subhedral if both straight and irregular margins are present.
- \*d. exhibit their proper crystal outlines or form

60. Cleavage is the mine 2 (1.0 point)

Cleavage is the mine (1.0 point)

**Cleavage is the minerals ability to separate into smaller particles, bounded by smooth planar surfaces parallel to the directions of faces of possible crystal forms. Some minerals show bi directional cleavage. Choose the minerals in the list that show bi directional cleavage.**

- a. Quartz and microcline
- b. Pyroxene and microcline
- c. Amphibole and plagioclase
- \*d. Pyroxene and amphibole

61. Certain minerals may 2 (1.0 point)

Certain minerals may (1.0 point)

**Certain minerals may be more subject to chemical alteration than others, and this chemical alteration may be partially or wholly complete in the rock. New products are usually formed from the original mineral, and this can sometimes help with the identification. Alteration often begins near the grain boundaries and works inwards. In other cases, it may fill cracks and fractures in the mineral, or it may start at the Centre or core of the mineral. Select the mineral that does not undergo alteration.**

- a. Orthoclase
- b. Biotite
- \*c. Quartz
- d. Orthoclase feldspar
- e. Plagioclase feldspar

62. Choose the isotropic (1.0 point)

Choose the isotropic (1.0 point)

**Choose the isotropic mineral from the list.**

- \*a. Augite
- b. Hornblende
- c. Biotite
- d. Quartz
- e. Fluorite
- f. Calcite

63. The mineral being st 2 (1.0 point)

The mineral being st (1.0 point)

**The mineral being studied using a microscope should be put into categories, choose the correct categories:**

- a. Coloured Opaque and Colourless
- b. Isotropic and anisotropic.
- c. Hard, soft
- d. Pyroxene, amphibole
- \*e. a and b

64. One of the options is 2 (1.0 point)

One of the options is (1.0 point)

**One of the options show the correct discontinuous sequence of minerals in Bowens reaction series. Choose the correct option.**

a. Amphibole, Pyroxene, Biotite, Potassium feldspar, Muscovite, quartz, Olivine

b. Olivine, quartz, pyroxene, biotite, potassium feldspar, muscovite, amphibole.

\*c. Olivine, pyroxene, amphibole, biotite, Potassium feldspar, Muscovite, quartz.

d. Olivine, amphibole, pyroxene, biotite, Potassium feldspar, Muscovite, quartz.

65. The minerals listed (1.0 point)

The minerals listed (1.0 point)

**The minerals listed belong to the isometric crystal system. One of them is not. Choose the mineral that is not isometric.**

a. Copper, Cuprite, Fluorite

b. Cuprite

c. Fluorite

\*d. Beryl

e. Garnet

66. Some crystalline min 3 (1.0 point)

Some crystalline min 2 (1.0 point)

**Some crystalline minerals polarize the light and split the light into two beams, which travel at different velocities and at right angles to each other. Examples of this are quartz, and calcite amongst others and these minerals are known as**

a. Isotropic minerals

b. Feldspar minerals

c. Garnet minerals

\*d. Anisotropic minerals

e. Pyroxene minerals

f. Amphibole minerals



67. Felsic minerals have (1.0 point)

Felsic minerals have (1.0 point)

Felsic minerals have the following properties:

- \*a. Colour light
- b. SG low
- c. Typical mineral families Quartz, feldspars, feldspathoids, olivine
- d. Abundant in acidic igneous rocks

68. The continuous branch 2 (1.0 point)

The continuous branch (1.0 point)

**The continuous branch of Bowen's reaction series consists of the mineral sequence, olivine, pyroxene and**

- a. Calcium feldspar
- b. Biotite
- \*c. Amphibole
- d. Quartz
- e. Sodium rich feldspar

69. Birefringence is (1. (1.0 point)

Birefringence is (1.0 point)

**Birefringence is**

- a. a value that can be used to determine interference colour of a mineral section in cross polarised light.
- b. change in colour under PPL as the stage is rotated
- c. the difference between the largest and smallest refractive index of a mineral section
- \*d. a and c

70. Interference colour 2 (1.0 point)

Interference colour (1.0 point)

**Interference colour is**

- a. the colour exhibited by a section of an anisotropic mineral under XPL
- b. a value that can be used to determine relief
- c. the colour that results from dirty layers on the thin section
- d. is zero for isotropic minerals in any direction under PPL and XPL
- \*e. a and d

71. Standard thin section (1.0 point)

Standard thin section (1.0 point)

**Standard thin sections are**

- \*a. 30 microns thick but thin sections thicker than 30 microns will produce higher order interference colours
- b. 0.3 microns thick. Thin sections thicker than 40 microns will produce higher order interference colours
- c. 10 microns thick. Thin sections thicker than 10 microns will produce higher order interference colours

72. Twinning is (1.0 point) (1.0 point)

Twining is (1.0 point)

Twining is

- a. recognized by adjacent portions of a single crystal having different extinction positions
- b. observed with crossed polars
- c. a symmetrical growth of two or more crystals of the same mineral
- d. the common plane of the twinned crystals (which is called the twinning plane) is a symmetry plane, seen in thin section as a straight line separating two identical crystals which have a symmetrical optical orientation to the twinning plane.
- e. observed continuing the rotation of the stage to shows interference colours and crystal position of extinction.
- \*f. all of the above

73. Twinning in plagiocl (1.0 point)  
Twining in plagiocl (1.0 point)  
Twining in **plagioclase**

- a. commonly shows lamellar twinning
- b. happens If more than one crystal is twinned, having a parallel twinning plane, the twinning is called polysynthetic (sometimes also called lamellar twinning).
- c. happens If more than two crystals are twinned, having parallel twinning planes, the twinning is called polysynthetic (sometimes also called lamellar twinning).
- \*d. a and b

74. Under PPL: (1.0 poin (1.0 point)  
Under PPL: (1.0 point)  
**Under PPL:**

- a. Natural light vibrates (oscillates) in all the directions perpendicular to the direction of propagation
- b. there is infinity of planes of vibrations (all possible planes that intersects/contain the direction of propagation.
- c. plane polarized light (PPL) has one single plane of vibration, in which the direction of vibration is always perpendicular to the direction of propagation
- \*d. all the above.

75. Grains under the mic 3 (1.0 point)  
Grains under the mic 2 (1.0 point)  
**Grains under the microscope are described as euhedral.**

- a. If they have irregular outlines
- b. if they are bounded mainly by straight crystal faces
- c. subhedral if both straight and irregular margins are present.
- \*d. exhibit their proper crystal outlines or form

76. Cleavage is the mine 3 (1.0 point)

Cleavage is the mine 2 (1.0 point)

**Cleavage is the minerals ability to separate into smaller particles, bounded by smooth planar surfaces parallel to the directions of faces of possible crystal forms. Some minerals show bi directional cleavage. Choose the minerals in the list that show bi directional cleavage.**

- a. Quartz and microcline
- b. Pyroxene and microcline
- c. Amphibole and plagioclase
- \*d. Pyroxene and amphibole

77. Certain minerals may 3 (1.0 point)

Certain minerals may 2 (1.0 point)

**Certain minerals may be more subject to chemical alteration than others, and this chemical alteration may be partially or wholly complete in the rock. New products are usually formed from the original mineral, and this can sometimes help with the identification. Alteration often begins near the grain boundaries and works inwards. In other cases, it may fill cracks and fractures in the mineral, or it may start at the Centre or core of the mineral. Select the mineral that does not undergo alteration.**

- a. Orthoclase feldspar
- b. Plagioclase feldspar
- b. Biotite
- \*c. Quartz

78. Choose an isotropic (1.0 point)

Choose an isotropic (1.0 point)

**Choose an isotropic mineral from the list.**

- \*a. Hornblende
- b. Biotite
- c. Quartz
- d. Fluorite
- e. Calcite

79. One of the options (1.0 point)

One of the options (1.0 point)

**One of the options show the correct discontinuous sequence of minerals in Bowens reaction series. Choose the correct option.**

- a. Amphibole, Pyroxene, Biotite, Potassium feldspar, Muscovite, quartz, Olivine
- b. Olivine, quartz, pyroxene, biotite, potassium feldspar, muscovite, amphibole.
- c. Olivine, amphibole, pyroxene, biotite, Potassium feldspar, Muscovite, quartz.
- \*d. Olivine, pyroxene, amphibole, biotite, Potassium feldspar, Muscovite, quartz.

80. Some crystalline min 4 (1.0 point)

Some crystalline min 3 (1.0 point)

**Some crystalline minerals polarize the light and split the light into two beams, which travel at different velocities and at right angles to each other. Examples of this are quartz, and calcite amongst others and these minerals are known as \_minerals. Choose the word to fill in the blank space.**

- a. Isotropic
- b. Feldspar
- c. Garnet
- \*d. Anisotropic
- e. Pyroxene
- f. Amphibole

81. The continuous branch 3 (1.0 point)

The continuous branch 2 (1.0 point)

**The continuous branch of Bowen's reaction series consists of the mineral sequence, olivine, pyroxene and ?**

- a. Sodium rich feldspar
- b. Biotite
- \*c. Amphibole
- d. Quartz

82.What is the study of (1.0 point)

What is the study of (1.0 point)

**What is the study of Crystallography?**

a. The study of Macroscopic characteristics of rocks

\*b. Crystallography is the study of crystals and their crystalline state and forms a natural introduction to the study of rocks under the microscope

c. The study of colours and habit of common rock forming minerals under transmitted light

d. the study of the strength of a crystal in three dimensional arrangements

83.In general a near pe 2 (1.0 point)

In general a near pe (1.0 point)

**In general a near perfect crystal will only result if**

a. it is able to grow quickly without meeting any obstruction and if the chemical environment around the crystal remains stable.

b. it is unable to grow freely without meeting any obstruction and if the chemical environment around the crystal remains stable.

c. it is able to grow freely even when meeting any obstruction and if the chemical environment around the crystal remains stable.

\*d. it is able to grow freely without meeting any obstruction and if the chemical environment around the crystal remains stable.

84.In different crystal 2 (1.0 point)

In different crystal (1.0 point)

**In different crystals of the same mineral although the interfacial angle is the same**

a. the overall form of the crystals may not be variable

b. the overall form of the crystals is the same

\*c. the overall form of the crystals may be extremely variable

d. the overall characteristics of all crystals may not be variable

85.Certain minerals can (1.0 point)

Certain minerals can (1.0 point)

Certain minerals can be recognized by their characteristic shape in microscopy.

\*a. True

b. False

86.In some minerals suc (1.0 point)

In some minerals suc (1.0 point)

In some minerals such as plagioclase, twinning is repeated in several layers, and is referred to as lamellar twinning.

\*a. True

b. False

87.Low Relief means the 2 (1.0 point)

Low Relief means the (1.0 point)

Low Relief means the mineral boundaries are not easy to be identified.

\*a. True

b. False

88.When Isometric Syste 2 (1.0 point)

When Isometric Syste (1.0 point)

When Isometric System Minerals such as Pyrite are viewed in crossed polars remain dark even when the microscope stage is rotated.

\*a. True

b. False

89.Minerals in the hexa 2 (1.0 point)

Minerals in the hexa (1.0 point)

Minerals in the hexagonal and tetragonal cut normal to the c axis remain dark on rotation of the stage.

\*a. True

b. False

90.When the polariser a (1.0 point)

When the polariser a (1.0 point)

When the polariser and analyser are used together their planes of vibration are at right angles to one another and this is known as crossed nicols or crossed polars.

\*a. True

b. False

91. A mineral is a natural (1.0 point)

A mineral is a natural (1.0 point)

A mineral is a naturally occurring substance with a definite chemical composition and a systematic three-dimensional atomic order.

\*a. True

b. False

92. Crystals are divided into (1.0 point)

Crystals are divided into (1.0 point)

Crystals are divided into systems according to symmetry of their unit cells.

\*a. True

b. False

93. Some crystalline minerals (1.0 point)

Some crystalline minerals (1.0 point)

Some crystalline minerals polarize the light and split the light into two beams, which travel at different velocities and at right angles to each other. These minerals are known as anisotropic minerals.

\*a. True

b. False

94. The extent of the wavelength (1.0 point)

The extent of the wavelength (1.0 point)

The extent of the wavelength determines colour of light.

\*a. True

b. False

95. Polarizing filters (1.0 point)

Polarizing filters (1.0 point)

Polarizing filters today consist of a plastic sheet containing either microscopic crystals or molecules that only permit light to be transmitted in one direction.

\*a. True

b. False

96. Basic crystallography (1.0 point)

Basic crystallography (1.0 point)

Basic crystallographic systems are isometric, tetragonal, hexagonal, orthorhombic, monoclinic and triclinic.

\*a. True

b. False



97. Crystals with chemical zoning (1.0 point)

Crystals with chemical zoning (1.0 point)

Crystals with chemical zoning are described as zoned crystals.

- \*a. True
- b. False

98. Common minerals that show exsolution textures (1.0 point)

Common minerals that show exsolution textures (1.0 point)

Common minerals that show exsolution textures are feldspars and pyroxene.

- \*a. True
- b. False

99. Exsolution textures (1.0 point)

Exsolution textures (1.0 point)

Exsolution textures are most readily observed in cross polars as host and exsolved minerals often have similar optical properties and so may have similar relief.

- \*a. True
- b. False

100. On rotation of the microscope stage (1.0 point)

On rotation of the microscope stage (1.0 point)

On rotation of the microscope stage minerals that are anisotropic will become dark in one particular orientation, such minerals are said to be in extinction.

- \*a. True
- b. False

101. Extinction angles (1.0 point)

Extinction angles (1.0 point)

Extinction angles can only be measured relative to planar crystal boundaries or cleavage planes. The extinction angle is the measure between the cleavage direction or habit of a mineral and the extinction.

- \*a. True
- b. False

102. An opaque mineral (1.0 point)

An opaque mineral (1.0 point)

An opaque mineral is black whether the analyser is in or out, while the transparent, isotropic mineral is not opaque.

- \*a. True
- b. False

103. If the mineral is is (1.0 point)  
If the mineral is is (1.0 point)  
If the mineral is isotropic, it shows 4 positions of extinction and 4 positions of maximum interference when rotating the stage.

- \*a. True
- b. False

104. The observations typ 2 (1.0 point)  
The observations typ (1.0 point)  
The observations typically made in crossed niclos (XPL) are:  
Isotropy/Anisotropy, Extinction angle, Birefringence colour,  
Twinning/Zoning Specific and textures (Exsolution).

- \*a. True
- b. False

105. The quality of cleav 2 (1.0 point)  
The quality of cleav (1.0 point)  
The quality of cleavage is described as perfect, imperfect, good, distinct, indistinct, poor, or absent.

- \*a. True
- b. False

106. Perfect cleavage: mi (1.0 point)  
Perfect cleavage: mi (1.0 point)  
Perfect cleavage: micas, all phyllosilicates, Good cleavage: feldspars, pyroxenes, amphiboles, Weak cleavage: apatite, sodalite, olivine; Absent: quartz.

- \*a. True
- b. False

107. Looking at the miner 2 (1.0 point)  
Looking at the miner (1.0 point)  
Looking at the mineral boundaries, we can see the shape of the analysed grain, in order to estimate the habit, several grains of the same mineral should be examined.

- \*a. True
- b. False

108. If the grain boundar (1.0 point)  
If the grain boundar (1.0 point)  
If the grain boundaries are well developed with predictable interfacial angles, the grain is called euhedral.

- \*a. True
- b. False

109. If the grain shows i 2 (1.0 point)  
If the grain shows i (1.0 point)  
If the grain shows irregular boundaries only, the grain is anhedral.

- \*a. True
- b. False

110. If the grain has bot 2 (1.0 point)  
If the grain has bot (1.0 point)  
If the grain has both visible and unclear boundaries, it is subhedral.

- \*a. True
- b. False

111. Pyrite can be used t (1.0 point)  
Pyrite can be used t (1.0 point)  
Pyrite can be used to set up your microscope due to its isotropic property.

- \*a. True
- b. False

112. Serpentine is formed 2 (1.0 point)  
Serpentine is formed (1.0 point)  
Serpentine is formed as a result of olivine alteration.

- \*a. True
- b. False

113. Anisotropic crystals (1.0 point)  
Anisotropic crystals (1.0 point)  
Anisotropic crystals have variable refractive indices because light travelling through the crystals will do so at different speeds, depending on the direction of travel.

- \*a. True
- b. False

114. In optics the refrac 2 (1.0 point)  
In optics the refrac (1.0 point)  
In optics the refractive index or index of refraction n of an optical medium is a dimensionless number that describes how light, or any other radiation, propagates through that medium.

- \*a. True
- b. False

115. There is a direct re (1.0 point)

There is a direct re (1.0 point)

There is a direct relationship between the optical properties of a mineral and its internal structure or crystallography.

\*a. True

b. False

116. Crystals are solid b (1.0 point)

Crystals are solid b (1.0 point)

Crystals are solid bodies enclosed by natural forces formed by crystallization of an element or a combination of elements.

\*a. True

b. False

117. Petrography is essen 2 (1.0 point)

Petrography is essen (1.0 point)

Petrography is essentially the study of rocks under the microscope with the intention of firstly describing the mineral properties and textures under the microscope followed by identifying the mineral phases and using that information to classify the type of rock being studied.

\*a. True

b. False