UNIVERSITY OF JOHANNESBURG

PROGRAM	:	BACHELOR OF ENGINEERING TECHNOLOGY *EXTRACTION METALLURGY*
SUBJECT	:	**ENGINEERING GEOLOGY (METALLURGY) 2A**
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EXAMINERS	:	MS S F MKHATSHWA
MODERATOR	:	MR F E D SENZANI
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STUDENT NUMBER	
STUDENT INITIALS	
STUDENT SURNAME	
STUDENT SERIAL NUMBER (SEE REGISTER	

INSTRUCTIONS : *ANSWER ALL QUESTIONS.*

ALL WORK SHALL BE HANDED IN

ALL UJ EXAMINATION REGULATIONS APPLY.

NO CALCULATORS ALLOWED

SUBMIT THE WHOLE DOCUMENT

1. Crystallography (1.0 point)
Which of the following represent the 7 basic crystal systems?

a. Isometric/Cubic, Tetragonal, Orthorhombic,Hexagonal,Triclinic,Monoclinic, Rhombohedral/trigonal

b. Anisotropic, Tetragonal, Orthorhombic,Hexagonal,Triclinic,Monoclinic, Rhombohedral/trigonal

c. Isometric/Cubic, Tetragonal, Orthogonal,Hexagonal,Triclinic,Monoclinic, Rhombohedral/trigonal

d. Isometric/Cubic, Pentagonal, Orthorhombic,Hexagonal,Triclinic,Mono, Rhombohedral/trigonal

2. Crystallography and the Microscope (1.0 point)
Which minerals are Isometric?

a. Opaque Minerals
b. Olivine
c. Micas
d. Quartz

3. Crystallography and the Microscope 2 (1.0 point)
Opaque minerals always appear.

a. Black under PPL only in Transmitted light Microscopy
b. Black under XPL only in Transmitted light Microscopy
c. Colourless in both PPL and XPL in Transmitted light Microscopy
d. Black under both PPL and XPL in Transmitted light Microscopy

4. The nature of light and natural colour and the microscope (1.0 point)
In Transmitted light Microscopy the illumination

a. Comes from the back of the microscope.
b. Comes from the sides of the microscope.
c. comes from all direction of the microscope.
d. Comes from the top of the microscope.
e. Comes from the base of the microscope.

5. Components of the Microscope (1.0 point)
The lower Polarizer is found.

a. Above the rotating stage of the microscope
b. On the rotating stage of the microscope
c. Below the stage of the microscope/substage

6. Components of the microscope (1.0 point)
The Analyzer is used to.

a. Change from PPL to XPL
b. Change from XPL to PPL
c. Annalise the modifications the pol waves have experienced in the thin section. It is positioned between the objective and the ocular and is either pushed or swung into the tube below the Amici-Bertrand lens. The polarization plane of the analyzer must be perpendicular to that of the lowerpolarizer (i.e., N-S if the lower polarizer direction is E-W).

7. The nature of light and the microscope (1.0 point)
In transparent minerals such as quartz all wavelengths are absorbed.

a. True
b. False

8. The nature of light and the microscope 2 (1.0 point)
In opaque minerals all wavelengths are absorbed and reflected

a. True
b. False

9. The nature of light and the microscope 3 (1.0 point)
Unpolarized light vibrates in one direction perpendicular to the direction of propagation.

a. True
b. False

10. The nature of light and the microscope 4 (1.0 point)
Polarized light vibrates in all directions at right angles to the direction of propagation.

a. True
b. False

11. The nature of light and the microscope 5 (1.0 point)
Polarized light has vibrations in one plane only.

a. True
b. False

12. Components of the microscope 2 (1.0 point)
The microscope has only one polarizer and two analyzers

a. True
b. False

13. Components of the microscope 3 (1.0 point)
The microscope has two analyzers and two polarizers.

a. True
b. False

14. The nature of light the microscope and minerals (1.0 point) When light passes through some minerals it is not split into two separate polarized rayswith different velocities but the light travels equally through the mineral at the same velocity irrespective of its direction.

• These minerals or substances are known as isotropic substances and examples of isotropicsubstances are glass, and opal which lack regular internal structure and all cubic system minerals (Isometric System) such as diamond, fluorite, and garnet.
• Other crystalline minerals polarize the light and split the light into two beams which travelat different velocities and at right angles to each other. Examples of this are quartz, and calcite amongst others. These minerals are known as anisotropic minerals.

• Minerals in the Tetragonal and Hexagonal Systems have a single refracting plane down thec crystallographic axis, where light is vibrating equally in all directions. Therefore, minerals cut in the basal pinacoid plane of these two systems may appear isotropic.

• The phenomena of double refraction can be demonstrated by means of a clear calciterhomb.

a. True
b. False

15. Thin sections (1.0 point)
The final thickness of a thin section is critical at 0,02 mm or 2 microns in thickness.

a. True
b. False

16. Functions of the different components on a microscope (1.0 point)
Light source: provides light rays to the substage part of the microscope.

a. True
b. False

17. Polarizer (1.0 point)
Is used to polarize the light rays from the source into multiple planes of vibration.

a. True
b. False

18. Light (1.0 point)
The intensity of light is adjustable in optical microscopy.

a. True
b. False

19. Components of the microscope 4 (1.0 point)
The microscope is fitted with filters to protect the eyes of the observer.

a. True
b. False

20. Colour (1.0 point)
The colour of minerals under PPL can be described as colourless, coloured or opaque.

a. True
b. False

21. Mineral Shape (1.0 point)
Grain or mineral shapes under the microscope are described as:

a. • euhedral, if they are bounded mainly by straight crystal faces,
• twinned if both straight and irregular margins are present.
• anhedral if they have irregular outlines.

b. • Anhedral, if they are bounded mainly by straight crystal faces,
• subhedral if both straight and irregular margins are present.
• anhedral if they have irregular outlines.

c. • euhedral, if they are bounded mainly by straight crystal faces,
• subhedral if both straight and irregular margins are present.
• anhedral if they have irregular outlines.

d. All of the above

22. Light 2 (1.0 point)
Is Light part of the Electromagnetic wave Spectrum?

a. No
b. yes
c. seldom

23. Minerals (1.0 point)
Muscovite has bright second order interference colours

a. True
b. False

24. Minerals 2 (1.0 point)
Biotite is brownish under PPL and shows slight pleochroism.

a. True
b. False

25. Cleavage and relief (1.0 point)
Cleavage and relief are viewed under XPL.

a. True
b. False

26. Relief (1.0 point)
The following types of relief are recognized.

a. • High relief: The boundaries of the minerals are not defined i.e., the R.I. of themineral is greater than the R.I. of the resin.
• Fair relief: The boundaries of the minerals are just visible i.e., the R.I. of the mineral isjust greater than the resin.
• Low Relief: The mineral boundaries are invisible i.e., the R.I. of the mineral is less thanor equal to that of the resin.
• Twinkling: The minerals grain boundaries vary from very sharply defined to just discernible on-stage rotation. This effect occurs in minerals where the two R.I.s varyconsiderably such as the mineral sphene.

b. • High relief: The boundaries of the minerals are occasionally defined i.e., the R.I. of themineral is greater than the R.I. of the resin.
• Fair relief: The boundaries of the minerals are just visible i.e., the R.I. of the mineral isjust greater than the resin.
• Low Relief: The mineral boundaries are invisible i.e., the R.I. of the mineral is less thanor equal to that of the resin.
• Twinkling: The minerals grain boundaries vary from very sharply defined to just discernible on-stage rotation. This effect occurs in minerals where the two R.I.s varyconsiderably such as the mineral sphene.

c. • High relief: The boundaries of the minerals are sharply defined i.e., the R.I. of themineral is less than the R.I. of the resin.
• Fair relief: The boundaries of the minerals are distinctly visible i.e., the R.I. of the mineral isjust greater than the resin.
• Low Relief: The mineral boundaries are invisible i.e., the R.I. of the mineral is less thanor equal to that of the resin.
• Twinkling: The minerals grain boundaries vary from very sharply defined to just discernible on-stage rotation. This effect occurs in minerals where the two R.I.s varyconsiderably such as the mineral sphene.

d. • High relief: The boundaries of the minerals are sharply defined i.e., the R.I. of themineral is greater than the R.I. of the resin.
• High relief: The boundaries of the minerals are sharply defined i.e., the R.I. of themineral is greater than the R.I. of the resin.
• Fair relief: The boundaries of the minerals are just visible i.e., the R.I. of the mineral isjust greater than the resin.
• Low Relief: The mineral boundaries are invisible i.e.; the R.I. of the mineral is less thanor equal to that of the resin.
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27. Cleavage (1.0 point)
Which of the following minerals have cleavage planes in two directions?

a. Biotite
b. Muscovite
c. Quartz
d. Olivine
e. None of the above

28. Alteration (1.0 point)
Serpentine is formed as a result of pyroxene alteration.

a. True
b. False

29. Minerals 3 (1.0 point)
Pyroxene and Amphiboles have cleavage in 3 directions.

a. True
b. False

30. Pleochroism (1.0 point)
Define Pleochroism.

a. The change in colour of a mineral in PPL
b. The change in colour of a mineral in XPL
c. The colour of a mineral in PPL
d. The colour of a mineral in XPL

31. Cleavage Planes (1.0 point)
The intersection angles of cleavage planes in Pyroxene and Amphibole are the same.

a. True
b. False

32. Cleavage 2 (1.0 point)
Quartz has cleavage planes in two directions.

a. True
b. False

33. Olivine (1.0 point)
Olivine has curved fractures under PPL and cleavage is absent.

a. True
b. False

34. Crystallization (1.0 point)
Pyroxenes crystalize in both.

a. The orthorhombic and tetragonal crystal systems
b. The cubic and monoclinic crystal systems
c. The monoclinic and hexagonal crystal systems
d. The tetragonal and orthorhombic crystal systems
e. None of the above

35. Quartz (1.0 point)
Quartz is usually colourless-white within common rock thin sections in PPL.

a. True
b. False

36. The nature of light the microscope and minerals 2 (1.0 point) Anisotropic crystals have variable refractive indices because light travelling throughthe crystals will do so at different speeds, depending on the direction of travel (the orientation of the crystal to the incident light).

a. True
b. False

37. Interference colours (1.0 point)
Interference colours are:

a. The colours exhibited by a section of an anisotropic mineral under XPL.
b. The colours exhibited by a section of an anisotropic mineral under PPL.
c. The colours resulting from dirty layers on the thin section in PPL.

38. Birefringence (1.0 point)
in simple terms define Birefringence

a. The change in colour of a mineral in XPL and PPL as the stage is rotated.
b. The change in colour of a mineral in PPL as the stage is rotated.
c. The change in colour of thin section glass in XPL as the stage is rotated.
d. None of the above

39. Alteration 2 (1.0 point)
Alteration in feldspar under PPL

a. Has an opaque appearance.
b. Appears as normal.
c. Appears pink.
d. Appears brown.
e. None of the above

40. Common rock forming minerals and alteration (1.0 point)
Which of the minerals listed below does not alter easily?

a. Muscovite
b. Biotite
c. Feldspar
d. Muscovite
e. All of the above
f. None of the above

41. Extinction (1.0 point)
Extinction is observed:

a. In PPL when the stage is rotated.
b. In minerals which become black at a specific angle in XPL.
c. in opaque minerals in XPL
d. Never under transmitted light microscopy for common rock forming minerals.

42. Twinning (1.0 point)
Twinning is common in the following minerals.

a. Quartz
b. Muscovite
c. Biotite
d. olivine
e. None of the above

43. Twinning 2 (1.0 point)
Twinning in Feldspar can be identified as

a. Crosshatched twinning indicates microcline.
Albite and pericline lamellar twinning or polymetric twinningindicates plagioclase.
Simple twinning generally indicates orthoclase feldspar. Simple twinning generally indicatesorthoclase feldspar.
b. Crosshatched twinning indicates albite.
Albite and pericline lamellar twinning or polysynthetic twinningindicates plagioclase.
Simple twinning generally indicates orthoclase feldspar. Simple twinning generally indicatesorthoclase feldspar.
c. Crossed extinction twinning indicates microcline.
Albite and pericline lamellar twinning or polysynthetic twinningindicates plagioclase.
Simple twinning generally indicates orthoclase feldspar. Simple twinning generally indicatesorthoclase feldspar.
d. Crosshatched twinning indicates microcline.
Albite and pericline lamellar twinning or polysynthetic twinningindicates plagioclase.
Simple twinning generally indicates orthoclase feldspar.
e. None of the above

44. Mineral properties and the microscope 2 (1.0 point)
The following are observed under XPL:
Colour
Relief
Pleochrois
mCleavage
• Alteration
• Shape

a. True
b. False

45. Mineral properties and the microscope (1.0 point)
The Following are observed in XPL:
• Isotopism/Anisotropism
• Birefringence (Colour chart)
• Interference colour
• Twinning
• Alteration/at Times
• Shape/form/Texture

a. True
b. False
c.

46. Interference colours 2 (1.0 point)
In some olivine-bearing rocks, thin sections of 40 microns in thickness may show blue second ordercolours.

a. True
b. False

47. Minerals and the microscope (1.0 point)
Common differences in pyroxene and amphibole are cleavage angles and colour.

a. True
b. False

48. Minerals and the microscope 2 (1.0 point)
One can determine a mineral using colour and birefringence properties only, in transmitted lightmicroscopy.

a. True
b. False

49. Bowen's reaction series (1.0 point)
Plagioclase crystallizes in the following series.

a. Discontinuous
b. Continuous

50. Mineral properties and the microscope 3 (1.0 point)
In XPL quartz normally exhibits the following colours:

a. First order grey colours
b. Second order bright colours
c. Second order grey colours

51. Mineral properties and the microscope 4 (1.0 point)
Pyroxene has cleavage lines intersecting at

a. 2 Degrees
b. 45 Degrees
c. 10 Degrees
d. None of the above

52. Minerals and the optical microscope (1.0 point)
Amphiboles normally has cleavage planes intersecting at

a. +/- 56 and 124 degrees
b. +/- 90 degrees and +/-124 degrees

53. Shape habit and form (1.0 point)
Minerals under the microscope can have Lath, Euhedral, Subhedral, Anhedral, six-sided oreight-sided shapes or forms.

a. True
b. False

54. Cleavage 3 (1.0 point)
Cleavage is the mineral's ability to separate into larger particles, bounded by smooth planar surfaces parallel to the directions of faces of possible crystal forms. In certain minerals there isno cleavage (quartz), other minerals show one direction of cleavage (micas) and others show two directions of cleavage (amphibole and pyroxene). When two directions of cleavage are visible one should also note the angle at which the two main directions meet. This can be usedto differentiate pyroxene from amphibole.

a. True
b. False

55. Cleavage 4 (1.0 point)
All common rock-forming minerals under PPL have cleavage.

a. True
b. False

56. Relief 2 (1.0 point)
Relief can be described as low, fair/moderate or high under XPL.

a. True
b. False

57. Relief 3 (1.0 point)
Relief can be described as low, fair/moderate or high in PPL.

a. True
b. False

58. XPL (1.0 point)
When the polarizer and analyzer are used together their planes of vibration are not at right anglesto one another and this is known as crossed nicols or crossed.
polars

a. True
b. False

59. Transmitted light microscopy (1.0 point)
When Isometric System Minerals such as quartz and olivine are viewed in crossed polars theyremain dark even when the microscope stage is rotated since polarized light passing through an isotropic substance does not have its vibration direction altered.

a. True
b. False