



**PROGRAM** : NATIONAL DIPLOMA  
*ENGINEERING METALLURGY*  
**SUBJECT** : Metallurgy I  
**CODE** : MET 111  
**DATE** : WINTER SSA EXAMINATION 2015  
14 JULY 2015  
**DURATION** : (SESSION 1) 08:00 - 11:00  
**WEIGHT** : 40 : 60  
**TOTAL MARKS** : 187

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**EXAMINER** : MR H BROWN/GA COMBRINK/T MADZIVHANDILA  
Sanso Number  
**MODERATOR** : MR JT DAVIES File Number  
**NUMBER OF PAGES** : 14 PAGES

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**INSTRUCTIONS** : *THE EXAM HAS THREE (3) SEPARATE SECTIONS. ANSWER EACH SECTION IN ITS OWN SEPARATE ANSWER SCRIPT.*

*WHERE SPECIFIC ANSWER SHEETS ARE PROVIDED, USE THESE AND PLACE THEM INSIDE THE APPROPRIATE ANSWER SCRIPT WHEN YOU HAND IN.*

*ALL WORK SHALL BE HANDED IN*

*ALL UJ EXAMINATION REGULATIONS APPLY.*

**REQUIREMENTS** : 1 POCKET CALCULATOR  
NO CORRECTION FLUID SHALL BE USED

**THREE (3) EXAM ANSWER SCRIPTS PER STUDENT**

## SECTION 1

### GEOLOGY MODULE

**ANSWER THE QUESTIONS TO THE GEOLOGY SECTION ON THE ATTACHED ANSWER SHEET PROVIDED. DETACH THE ANSWER SHEET AND PLACE IT WITHIN YOUR ANSWER BOOK. PLEASE ENSURE THAT YOUR NAME AND STUDENT NUMBER ARE ON THE ANSWER SHEET**

1. Most of the heat for regional metamorphism is supplied by
  - a. frictional heating along a fault
  - b. high concentrations of radioactive elements in the soil
  - c. deep burial within the crust
  - d. a nearby igneous intrusion
  - e. heat caused by lava
  
2. Which of the following changes may occur during metamorphism
  - a. certain minerals may re-crystallise
  - b. crystals may grow larger
  - c. the rock melts entirely
  - d. all of the above
  - e. none of the above
  - f. a and b only
  - g. a and c only
  
3. Which of the following is not true about slate?
  - a. exhibits excellent rock cleavage
  - b. contains minute mica flakes
  - c. results from the high-grade metamorphism of quartz sandstone
  - d. may exhibit different colours
  
4. Which statement best describes what happens during the metamorphism of limestone?
  - a. changes under extreme heat and removal of impurities
  - b. extreme pressure causes a decrease in grain size
  - c. the addition of new ions produces a chemically altered rock
  - d. larger crystals are formed to produce marble
  - e. foliation occurs to produce a gneiss
  
5. When minerals in a rock re-crystallise with a preferred orientation, the rock is said to exhibit
  - a. shear
  - b. foliation
  - c. aureoles
  - d. pseudo-bedding
  - e. phyllation
  - f. all of the above

6. Minerals are grouped or classified as oxides, sulphides etc., by
- colour
  - type of cation
  - type of anion
  - hardness
  - none of the above
7. From your knowledge of rock-forming minerals, which two elements should be the most common in the earth's crust?
- aluminium and silicon
  - aluminium and oxygen
  - oxygen and silicon
  - iron and sulphur
8. Minerals which have the same composition but different structures are
- isomorphs
  - phenocrysts
  - isotopes
  - polymorphs
9. Haematite and magnetite can be distinguished from each other because
- both have a black streak
  - haematite is always red in colour and magnetite black
  - both can be blackish in colour but have different streaks
  - magnetite is red brown with a black streak
  - both a and b
  - none of the above
10. A copper-nickel coin will just be scratched by
- fluorite
  - gypsum
  - talc
  - calcite
11. A concordant pluton which has domed the strata into which it has intruded is a
- batholith
  - laccolith
  - sill
  - lopolith
  - stock

12. By definition, lava is
- a. magma
  - b. molten rock with or without dissolved gases and suspended crystals
  - c. a type of pyroclastic material
  - d. magma that reaches the earth's surface before it solidifies
13. An intrusive rock with a high silica content is
- a. rhyolite
  - b. basalt
  - c. granite
  - d. andesite
  - e. none of the above
  - f. both a and c
14. Basic igneous rocks usually
- a. crystallise out after acid igneous rocks
  - b. crystallise out before acid igneous rocks
  - c. often contain pyroxene
  - d. both a and c
  - e. both b and c
15. The texture of an igneous rock
- a. is controlled by the composition of the magma
  - b. is the shape of the rock body
  - c. determines the colour of the rock
  - d. records the rock's cooling history
  - e. both c and d
  - f. none of the above
16. The first mineral to melt if granite were to be heated should be
- a. quartz
  - b. calcite
  - c. olivine
  - d. amphibole
17. Lava
- a. may be both solid and liquid
  - b. may be acid or basic
  - c. includes rocks such as rhyolite and granite
  - d. all of the above are correct
  - e. a and b only are correct

18. Granite

- a. has a composition the same as basalt, but differs in being coarse-grained
- b. is generally pale in colour and has olivine as an essential mineral
- c. has a composition the same as basalt but differs in being fine-grained
- d. is generally dark-coloured and does not have any quartz present
- e. none of the above
- f. a and b only are correct

19. Basalt and gabbro

- a. have the same minerals
- b. form from magma at a high temperature
- c. form from magma with the same silica content
- d. none of the above are correct
- e. all of the above are correct
- f. a and c only are correct

20. Which two rocks contains the largest dominant grain size?

- a. quartz sandstone and arkose
- b. mudstone and siltstone
- c. shale and claystone
- d. breccia and conglomerate

21. Clastic material is which of the following?

- a. the residue of particles that remain after rocks disintegrate only in water
- b. the residue of particles that remain after rocks weather
- c. oxidised particles found in several types of rocks

22. Which one of the following is not a way to name clastic sedimentary rocks?

- a. grain size
- b. colour
- c. sorting
- d. rounding

23. What is the main classification term used for chemical sedimentary rocks?

- a. composition
- b. temperature
- c. size
- d. texture
- e. grain size

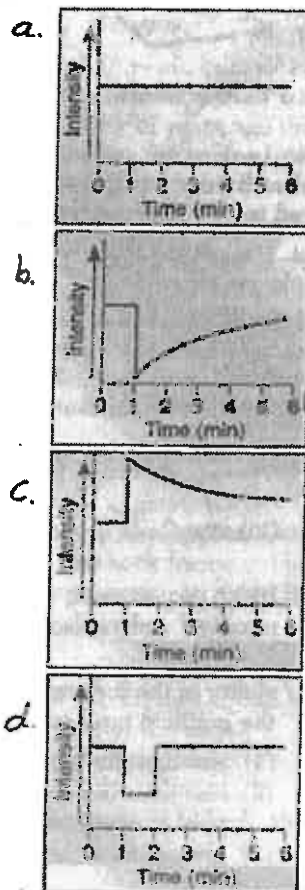
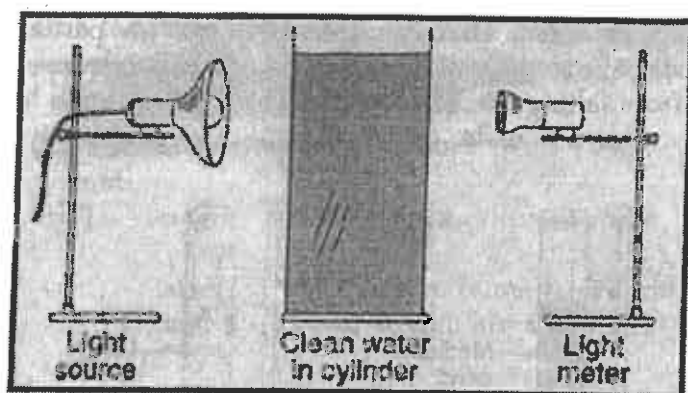
24. Sedimentary rocks are products of the ..... of the ..... rocks that are subsequently ..... at the Earth's surface by ....., ....., .....
- eruption, younger, dwindling, glaciers, wind, water
  - lava, igneous, older, rain, snow, wind
  - weathering, older, deposited, water, wind and glaciers
25. Shale differs from mudstone in that
- shale has larger grains than mudstone
  - shale is layered and fissile whereas mudstone is massive
  - shale has smaller grains than mudstone
  - there is no difference between shale and mudstone
26. Which of the following represents the most abundant group of sedimentary rocks?
- limestones and dolomites
  - mudstones and shales
  - sandstones and conglomerates
  - cherts and limestones
27. A piece of glass will be scratched by
- quartz
  - corundum
  - apatite
  - gold
  - all of the above
  - a and b
  - b only
28. Quartz can be distinguished from orthoclase by
- its lack of cleavage
  - its colour
  - its hardness
  - both a and c
  - all of the above
29. Hornblende
- is a femic mineral
  - has a higher RD than microcline
  - is a pyroxene
  - has cleavages intersecting at 90 degrees
  - none of the above
  - a and b are both correct

30. Metamorphic rocks

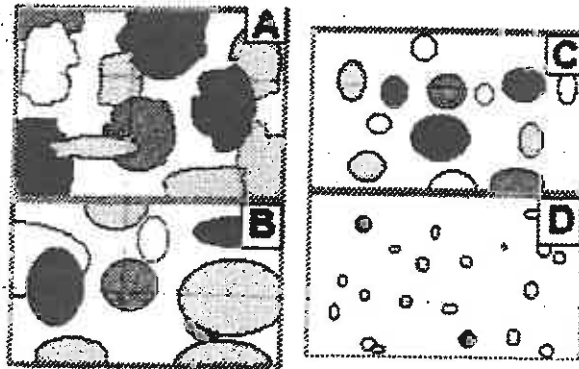
- a. may once have been igneous or sedimentary
- b. may be weathered and eroded to produce sediment
- c. if melted will again become igneous
- d. none of the above
- e. all of the above

Total marks question 1 to 30 = 60

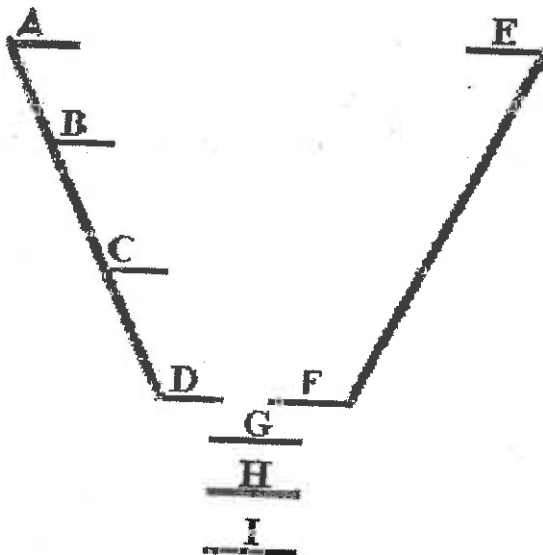
31. The diagram below shows a cylinder filled with clean water. At the left of the cylinder is a light source, and at the right of the cylinder is a meter that measures the intensity (brightness) of light as it passes through the water. One minute after the light is turned on, a mixture of sand, silt and clay is poured into the cylinder. Which graph shows the probable change in light intensity recorded during the 6-minute period after the light is turned on? (4)



32. In the diagram below relative sizes of sediment type are shown. Which of the following rock types is listed in the same order as their respective sediment sizes as shown in the diagram i.e. A B C D ?



- sandstone, shale, breccia, conglomerate
  - conglomerate, sandstone, shale, breccia
  - breccia, conglomerate, sandstone, shale
  - shale, breccia, conglomerate, sandstone
  - conglomerate, breccia, shale, sandstone
- (4)
33. In the sketch of Bowen's Reaction Series as shown below, as we move from A to D, what is the best general statement which can be made?

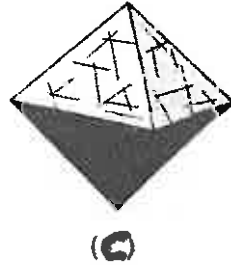
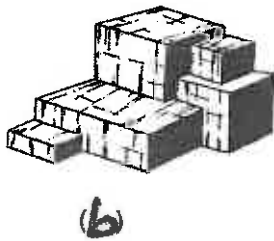
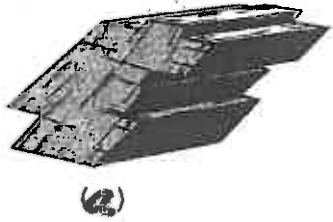


- the melting point of the minerals increases
- there is an overall decrease in the density of the minerals
- the temperature increases
- there is an overall increase in the density of the minerals
- the colour changes from red to green
- both b and c
- none of the above

(3)



34. Provide the name of a mineral whose cleavage corresponds to the shape of each model shown below.



(6)

SECTION ONE FULL MARKS = 77

STUDENT NUMBER.....NAME.....

METALLURGY 1 MET 111

JULY 2015 SUPPLEMENTARY

ANSWER SHEET FOR GEOLOGY SECTION

- |                  |                   |
|------------------|-------------------|
| 1. a b c d e     | 23. a b c d e     |
| 2. a b c d e f g | 24. a b c         |
| 3. a b c d       | 25. a b c d       |
| 4. a b c d e     | 26. a b c d       |
| 5. a b c d e f   | 27. a b c d e f g |
| 6. a b c d e     | 28. a b c d e     |
| 7. a b c d       | 29. a b c d e f   |
| 8. a b c d       | 30. a b c d e     |
| 9. a b c d e f   | 31. a b c d       |
| 10. a b c d      | 32. a b c d e     |
| 11. a b c d e    | 33. a b c d e f g |
| 12. a b c d      | 34. a.....        |
| 13. a b c d e f  | b.....            |
| 14. a b c d e    | c.....            |
| 15. a b c d e f  |                   |
| 16. a b c d      |                   |
| 17. a b c d e    |                   |
| 18. a b c d e f  |                   |
| 19. a b c d e f  |                   |
| 20. a b c d      |                   |
| 21. a b c        |                   |
| 22. a b c d      |                   |



## **SECTION TWO: PHYSICAL METALLURGY**

**INSTRUCTION:** *Answer this section in its own separate answer script and hand it is separately.*

### **Question 1**

1.1 Name five groups of materials into which material can be classified (5)

1.2 Which one of the following materials has the highest hardness? (2)

(a) Aluminium,

(b) Diamond,

(c) Steel?

1.3 Which of the following pure metals is the best conductor of electricity (2)

(a) Copper

(b) Zinc

(d) Silver?

1.4 Which manufacturing process is suitable for the following metal or alloy?

(a) Steel (1)

(b) Copper (1)

(c) Aluminium (1)

(d) Zinc (1)

(e) Cast iron (1)

### **Question 2**

2.1 Give 5 advantages of the Extrusion process (5)

2.2 What is the different between rolling and extrusion (4)

2.3 Give 3 Advantages of rolling thread over cutting (machining): (3)

### **Question 3**

3.1 briefly explain the process of sand casting, also give example of products made using sand casting (10)

**Question 4**

5.1 draw and label the stress-strain curve for a ductile metal (10)

5.2 Define hardness of material (2)

5.3 What is ductile to brittle transition temperature (DBTT) (2)

**Total marks FOR SECTION TWO**

**[50]**

### **SECTION THREE: EXTRACTIVE METALLURGY**

INSTRUCTION: *Answer this section in its own separate answer script and hand it is separately.*

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#### **QUESTION 1:**

1.
  - 1.1. What is Pyrolusite?
  - 1.2. What is Bornite?
  - 1.3. What is Skutterudite?
  - 1.4. What is Cinnabar?
  - 1.5. What minerals can we exploit to extract titanium from? Also give their chemical formula.

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(12)

#### **QUESTION 2:**

In each case say whether the statements made below is TRUE or FALSE

2.
  - 2.1. Operations require shutdowns to maintain essential equipment and the length of the shutdown determines the capacity of the stockpile required.
  - 2.2. With ore feeding, often the ore will not flow readily from a storage reservoir onto a belt and this requires a negative feeding device.
  - 2.3. When using the secondary crushers tramp metals must not be feed in with the ore.
  - 2.4. The most common type of secondary crusher is the Pebble Mill.
  - 2.5. Milling is the final stage in the comminution process.
  - 2.6. Semi-Autogenous mills use only steel balls to crush the ore.
  - 2.7. One function of dewatering is to reduce unit capacity.
  - 2.8. In Screening vibration improves inefficiency.

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(8)

#### **QUESTION 3:**

What are the five properties of a mineral that can be used when you want to separate or concentrate the mineral?

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(5)

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**QUESTION 4:**

Make a sketch of a chain feeder and explain briefly how it works

(10)

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**QUESTION 5:**

Explain what is meant by the term “degree of liberation”

Explain what influences liberation size.

Make a drawing explaining what occurs during comminution.

(10)

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**QUESTION 6:**

Make a labelled sketch illustrating (i.e. showing or depicting) the difference between an open circuit crushing system and a closed circuit crusher system

(10)

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**QUESTION 7:**

There are seven (7) main purposes for screening, give any five (5) of them.

(5)

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**TOTAL MARKS SECTION THREE**

**[60]**

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**FULL MARKS FOR EXAM**

**[187]**