

**Question 1 (20 Marks)**

- 1) List 2 minerals with their chemical formulae that are typical of a rock ‘**Eclogite**’ (4marks).

Minerals names	Minerals formulae
1) Pyrope	$\text{Mg}_3\text{Al}_2(\text{Si},\text{Al})_3\text{O}_{12}$
2) Omphacite	$(\text{Ca},\text{Na})(\text{Mg},\text{Fe}^{2+},\text{Fe}^{3+},\text{Al})\text{SiO}_2\text{O}_6$

- 2) List 3 possible minerals with their chemical formulae that are typical of a rock ‘**blueschist**’ (6 marks)

Minerals names	Minerals formulae
1) Glaucophane	$\text{Na}_2\text{Mg}_3\text{Al}_2(\text{Si}_8\text{O}_{22})(\text{OH})_2$
2) Kyanite	$\text{Al}_2\text{SiO}_5$ or $\text{Al}_2\text{O}_3\text{SiO}_2$
3) Lawsonite	$\text{CaAl}_2(\text{Si}_2\text{O}_7)(\text{OH})_2\cdot\text{H}_2\text{O}$

- 3) List 1 silicate mineral with its chemical formulae that is typical of a ‘**granulite**’ rock of pelitic composition (2 marks)

Sillimanite	$\text{Al}_2\text{SiO}_5$ or $\text{Al}_2\text{O}_3\text{SiO}_2$
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- 4) List 1 silicate mineral with its chemical formulae that is typical of contact metamorphic rocks of pelitic composition (2 marks)

Andalusite	$\text{Al}_2\text{SiO}_5$ or $\text{Al}_2\text{O}_3\text{SiO}_2$
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- 5) List 2 typical minerals of an amphibolite (4 marks) **Hornblende and plagioclase**  
6) List 1 typical mineral of a mafic rock metamorphosed under greenschist facies (2 marks) **chlorite**

**Question 2 (30 marks)**

Based on the mineral composition and textures of the four different metamorphic rocks numbered from 1 to 4 in the table below:

Mineralogy	Texture
<b>Rock 1</b> 30% glaucophane, 20% lawsonite, 20% garnet and 30% albite.	A bleu rock with medium grained texture and light foliation marked by the alignment of glaucophane minerals.
<b>Rock 2</b> 30% andalusite, 10% garnet, 20% quartz, 20% biotite and 20% plagioclase	Very fine grained texture with some large crystals of andalusite. No foliation is observed.
<b>Rock 3</b> 30% Hornblende, 20% Garnet 5% Quartz and 5% opaques, 30% Plagioclase,	Coarse grained texture with no foliation
<b>Rock 4</b> 20% Staurolite, 10% Muscovite and 20% Biotite, 20% garnet, 30% Quartz	medium grained texture with staurolite porphyroblasts and strong foliation marked by the alignment of micas.

Rock No.	Rock name	Type of metamorphism	Metamorphic facies and grade	Possible parent rock (protolith)
Rock 1 (6 marks)	Bleuschist	Regional metamorphism/Subduction	Bleuschist Metam/HP-LT	Mafic rock
Rock 2 (6 marks)	Andaluste-hornfels	Contact Metam	Hbd-Hornfels/Low to Int T	Pelitic/shale
Rock 3 (6 marks)	Amphibolite	Regional/ Burial/Barovian	Amph facies/Interm	Mafic (eg. basalt/gabbro)
Rock 4 (6 marks)	Staurolite-schist	Regional/ Burial/Barovian	Amph facies/Inter	Pelitic/shale

**Question 3 (30 marks):** Give the definition of the following terms and illustrate with sketches or examples when possible: **see chapter 3 and 4 lectures notes**

- Isograde
- Paragenese
- Poikiloblast,
- Pseudomorph
- Geothermal gradient
- Index Mineral

**Question 4 (20 marks)**

What is the difference between shock metamorphism and contact metamorphism?

Discuss and illustrate with examples from South Africa

Shock metamorphism is caused by meteorite impact, it's a HP and HT temperature type of metamorphism, while contact metamorphism is caused by intrusion of magma, it is a low Pressure, medium to High T type of metamorphism. The 2 types occur at 2 different contexts, the 1<sup>st</sup> one is more local comparing to the 2<sup>nd</sup> one which can local or regional in extend. The examples in SA are Vredefort impact crater metamorphism and Bushveld contact metamorphism. For more information/details see relevant chapters on these 2 types of metamorphism in the lectures notes.