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| <u>FACULTY</u> | : Science |
| <u>DEPARTMENT</u> | : Geology |
| <u>CAMPUS</u> | : APK |
| <u>MODULE</u> | : GLG01A1/GLG1A10 MINERALS, ROCKS AND EARTH DYNAMICS |
| <u>SEMESTER</u> | : First |
| <u>EXAM</u> | : SSA 2 July 2019 |

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|---------------------------|------------------|-----------------------|-------|
| <u>DATE</u> | : July 2019 | <u>SESSION</u> | : |
| <u>ASSESSOR(S)</u> | : PROF AJB SMITH | | |
| <u>MODERATOR</u> | : DR D ROSE | | |
| <u>DURATION</u> | : 3 HOURS | <u>MARKS</u> | : 180 |

NUMBER OF PAGES: 8 PAGES

INSTRUCTIONS:

1. Answer ALL THE QUESTIONS.
 2. Number your answers clearly
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QUESTION 1 – MULTIPLE CHOICE

- 1.1 Aside from the Earth, the terrestrial planets are
A. Mars, Mercury, and Venus.
B. Mars, Venus, and Jupiter.
C. Jupiter, Saturn, Uranus, and Neptune.
D. Mars and Saturn. (2)
- 1.2 The primary evidence that our Sun is a third-, fourth-, or fifth-generation star comes from the fact that our
A. Solar System contains too many heavy atoms to be first-generation.
B. Solar System is too large to be first-generation.
C. Sun is too hot to be a first-generation star.
D. Sun is too large to be a first-generation star. (2)
- 1.3 The atmosphere is divided into several distinct layers. From the ground up they are, in order,
A. stratosphere, troposphere, mesosphere, and thermosphere.
B. troposphere, stratosphere, thermosphere, and mesosphere.
C. troposphere, stratosphere, mesosphere, and thermosphere.
D. stratosphere, troposphere, thermosphere, and mesosphere. (2)
- 1.4 The densest layer of the Earth is the
A. crust. B. outer core.
C. mantle. D. inner core. (2)
- 1.5 Alfred Wegener saw Pangaea as a jigsaw puzzle, where the puzzle pieces were
A. oceans. B. mid-ocean ridges.
C. continents. D. plate tectonics. (2)
- 1.6 Volcanoes that are submerged beneath the surface of the sea are termed
A. abyssal plains. B. mid-ocean ridges.
C. fracture zones. D. seamounts. (2)
- 1.7 An earthquake would be LEAST likely at a(n)
A. active margin. B. continent-continent convergent zone.
C. passive margin. D. subduction zone. (2)
- 1.8 In a hot-spot volcanic island chain, such as the Hawaiian Islands, which of the following is true?
A. All volcanoes in the chain can be simultaneously active.
B. The ages and distance between volcanoes can be used to calculate plate velocities.
C. The presence of volcanism is related to a plate boundary.
D. The magma source moves to form a hot-spot track. (2)
- 1.9 The atomic number of an element corresponds to the
A. number of electrons. B. number of neutrons.
C. number of protons. D. total weight of one atom. (2)

- 1.10. Minerals are grouped into mineral classes primarily on the basis of
 A. chemistry, specifically the cations within the chemical formula.
 B. chemistry, specifically the anions within the chemical formula.
 C. hardness; hard, soft, and medium are the three primary classes.
 D. the number of cleavage directions present. (2)
- 1.11 Which of the following processes is not responsible for the formation of magma within the Earth?
 A. decompression (due to a drop in pressure)
 B. addition of volatiles
 C. transfer of heat from adjacent magma or very hot rocks
 D. loss of volatiles to the atmosphere (2)
- 1.12 If you find a tuff in the field, what type of geologic activity could you reasonably assume has occurred?
 A. an igneous intrusion
 B. a volcanic eruption
 C. sea-level rise
 D. tectonic uplift (2)
- 1.13 When limestone becomes chemically altered so that half of the calcium atoms are replaced by magnesium, the resultant rock is termed
 A. agate.
 B. jasper.
 C. dolostone.
 D. travertine. (2)
- 1.14 Which environment would most likely produce sedimentary deposits characterized by very well-sorted, very well-rounded grains that are nearly pure quartz?
 A. river
 B. beach
 C. glacier
 D. alluvial fan (2)
- 1.15 A protolith
 A. is always metamorphic rock.
 B. is always igneous rock.
 C. is always sedimentary rock.
 D. may belong to any of the three primary rock types. (2)
- 1.16 The mineral assemblage within metamorphic rock is
 A. always identical to that found within its protolith.
 B. dependent only on the mineral assemblage of its protolith.
 C. dependent only on the temperature and pressure of formation.
 D. dependent on both the mineral assemblage of its protolith and the temperature and pressure of formation. (2)
- 1.17 The textural term for a basaltic lava flow that has a smooth, ropy appearance is _____.
 A. pahoehoe
 B. pumice
 C. a'a
 D. ignimbrite (2)

1.18 If a volcano was actively releasing a large amount of volcanic gas and then abruptly stopped, what might happen to the volcano in the near future?

- A. It will become extinct because the magma supply has been rapidly withdrawn.
- B. It will erupt effusively because the supply of volcanic gas has dissipated.
- C. It will erupt explosively because the volcanic gases have no way to escape slowly.
- D. It will erupt effusively because the gases have made the magma less viscous.

(2)

1.19 The point on the Earth's surface directly above the point where an earthquake occurs is termed the

- A. hypocenter (focus).
- B. eye of the fault.
- C. epicenter.
- D. vertex.

(2)

1.20 Which of the following hazards is most likely to occur days to weeks after an earthquake?

- A. fire
- B. liquefaction
- C. disease
- D. foreshocks

(2)

1.21 A body of rock affected by tensile stress will likely undergo _____.

- A. shortening
- B. stretching
- C. shear strain
- D. rotation

(2)

1.22 Mountain ranges formed along subduction zones are formed, in part, by _____ in the crust.

- A. compression
- B. extension
- C. stretching
- D. elongation

(2)

1.23 As understood by modern geologists, the principle of uniformitarianism implies that

- A. the Earth has always had the same basic appearance that it has today.
- B. igneous, metamorphic, and sedimentary rocks are uniformly mixed throughout the crust.
- C. physical processes observed today (such as erosion and volcanic eruptions) have been active in the past at roughly the same rates.
- D. physical processes observed today (such as erosion and volcanic eruption) occurred much more rapidly in the past, quickly sculpting the Earth's surface.

1.24 How much of a radioactive parent isotope will remain after three half-lives have passed?

- A. one-third ($1/3$)
- B. one-eighth ($1/8$)
- C. three-halves ($3/2$)
- D. one-sixth ($1/6$)

(2)

1.25 The Earth became internally differentiated, with a metallic core distinct from the rocky mantle, during the

- A. Archean Eon.
- B. Proterozoic Eon.
- C. Hadean Eon.
- D. Paleozoic Era.

(2)

- 1.26 The Cambrian Period is a time in the Earth's history when
 A. the first abundant shelly organisms appeared in the fossil record.
 B. the Earth's interior was so hot that a solid outer crust, if present, was likely being extensively remelted.
 C. stable continental interiors, termed cratons, first formed.
 D. the dinosaurs appeared and came to dominate large-scale terrestrial life. (2)
- 1.27 Chemically, oil and gas are both _____.
 A. pure forms of carbon B. hydrocarbons
 C. carbohydrates D. carbonate minerals (2)
- 1.28 Which of the following would make the best reservoir rock in a conventional hydrocarbon system?
 A. high-porosity, high-permeability rock
 B. low-porosity, low-permeability rock
 C. high-porosity, low-permeability rock
 D. low-porosity, high-permeability rock (2)
- 1.29 The ability of a metal to be bent, molded, and stretched is termed _____.
 A. tempering B. malleability
 B. cold working D. dexterity (2)
- 1.30 Mineral-rich veins within plutons, deposited by hot groundwater into fractures within rock, characterize _____ deposits.
 A. hydrothermal B. residual mineral
 C. placer D. sedimentary (2)

(2)
(60)

QUESTION 2 – COSMOLOGY AND THE STRUCTURE OF THE EARTH

- 2.1.1 What is the Big Bang, and when did it occur according to current estimates? (5)
- 2.1.2 Except for the Earth, name the other three terrestrial planets in our solar system. (3)
- 2.2.1 What is the geothermal gradient? (2)
- 2.2.2 Name which type of Earth material the following are:
 a) Coal
 b) Quartz
 c) Carbon dioxide (3)
- 2.2.3 Compare oceanic and continental crust based on their composition and density. (3)
- (16)**

QUESTION 3 – CONTINENTAL DRIFT AND PLATE TECTONICS

- 3.1.1 Was it possible for a dinosaur to walk from Paris to New York during the early Jurassic? Explain why or why not. (3)
- 3.1.2 How does the observed pattern of marine magnetic anomalies form, and how does its existence help prove plate tectonics? (4)
- 3.2.1 Compare the oceanic crust to the continental crust with respect to age. Why is this so? (3)
- 3.2.2 Name and provide sketches of the three types of plate boundaries. (6)
- (16)**

QUESTION 4 – EARTH MATERIALS: MINERALOGY AND ROCK TYPES

- 4.1.1 What are the ways a mineral can crystallize in nature? (5)
- 4.1.2 How can you determine the hardness of a mineral? On which scale is hardness usually measured? (3)
- 4.2.1 Why do magmas rise to the surface of the Earth? (2)
- 4.2.2 What is fractional crystallization? Briefly explain how it works and why different types of magmas result. (4)
- 4.2.3 How are dykes and sills the same and how are they different? (3)
- 4.3.1 Describe the difference between lithification and diagenesis. (3)
- 4.3.2 What is an alluvial fan? How is it different from a marine delta? (4)
- 4.4.1 Use a sketch to name the three polymorphs of Al_2SiO_5 and place them at their respective metamorphic conditions. (4)
- 4.4.2 What is a metamorphic aureole? What is the relationship between grade of metamorphism and proximity to the intrusion? What types of conditions are responsible for the formation of an aureole? (4)
- (32)**

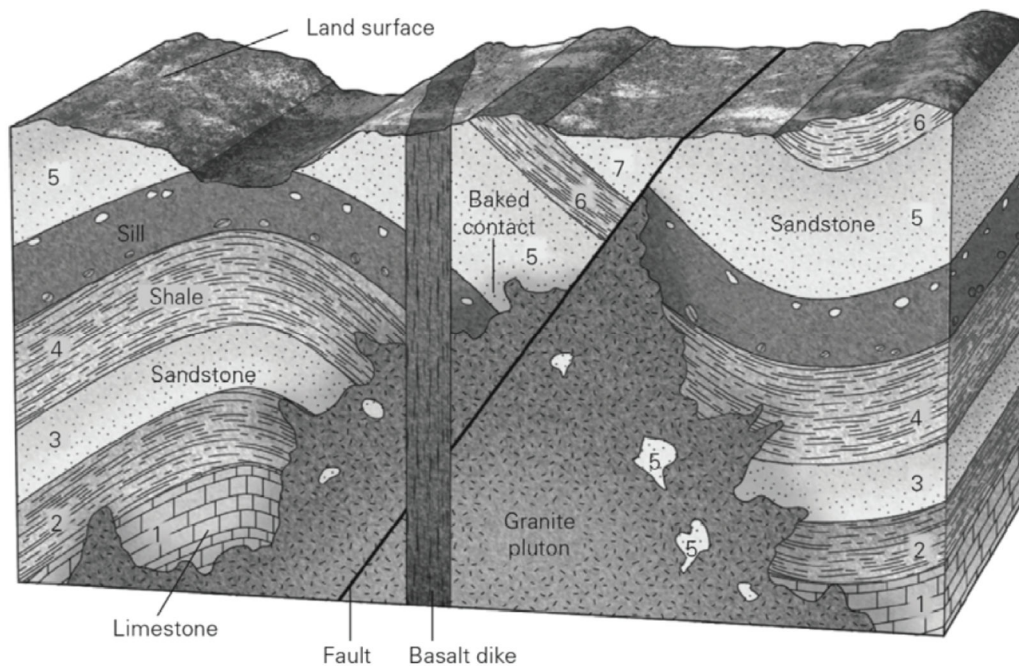
QUESTION 5 – THE DYNAMIC EARTH: VOLCANOES, EARTHQUAKES AND MOUNTAIN BUILDING

- 5.1.1 Name and briefly define the three main products produced by volcanic eruptions. (6)
- 5.1.2 How does a caldera form? Provide a simple sketch of a caldera. (3)

- 5.2.1 In which four geological settings can earthquakes occur? (4)
- 5.2.2 Explain how sediment liquefaction occurs in an earthquake and how it can cause damage. (4)
- 5.3.1 What types of geologic structures would you expect to find in an area that had undergone compression? (3)
- 5.3.2 Compare and contrast domes and basins. If both are composed solely of sedimentary beds that have been eroded such that the ground surface is level, how would you identify each? (4)
- (24)**

QUESTION 6 – HISTORY OF THE EARTH

- 6.1.1 Place the geological units in the diagram below from oldest to youngest.



- 6.1.2 Why have no rocks older than 4.12 Ga been found in the Earth's crust? (6)
- 6.2.1 What caused the buildup of oxygen in the atmosphere at roughly 2.5 Ga? (2)
- 6.2.2 What is meant by the term "snowball Earth?" What period of time in the Earth's history does this refer to and what were conditions like at this time? Support your answer with evidence. (3)

(5)
(16)

QUESTION 7 – EARTH RESOURCES

- 7.1.1 What is meant by the term fossil fuel? Where did the energy in a fossil fuel originate? What three energy resources are fossil fuels? (5)
- 7.1.2 What are the main challenges related to nuclear energy? (3)

7.2.1 What is the difference between an ore mineral and other minerals, and between an ore and other kinds of rocks?

(5)

7.2.2 Distinguish between cement and concrete.

(3)

(16)

(Grand total: 180)