GY111 Earth Materials Name:_____
Exam 1A (correct answers in red) S.N.:_____

I. True/False Questions: circle a "T" for true or "F" for false (10% total -or- 0.5 per)

1. (T F) James Hutton created the theory of evolution.
2. (T F) The fundamental structure of silicate minerals is built upon the silicon-oxygen tetrahedron (SiO4).
3. (T F) After a theory has survived much scientific scrutiny, it may be elevated to hypothesis status.
4. (T F) Convergent plate tectonic boundaries are located where plates move toward one another.
5. (T F) Transform plate boundaries only affect oceanic lithosphere.
6. (T F) A dike is a concordant tabular intrusive igneous body.
7. (T F) An electron possesses a neutral charge.
8. (T F) The Earth's interior, if subdivided into layers by composition, consists of the crust, mantle and core.
9. (T F) The inner and outer core are made of the same substance but have much different mechanical properties.
10. (T F) The continental crust is composed of granite/diorite and the oceanic crust is composed of basalt/gabbro.
11. (T F) Cleavage and crystal form are distinctly different physical properties.
12. (T F) Atoms with equal numbers of protons are always isotopes of the same element.
13. (T F) Color is generally an unreliable diagnostic physical property for minerals.
14. (T F) The oceanic ridge systems are the longest mountain ranges on Earth.
15. (T F) The age of ocean lithosphere decreases as an ocean ridge is approached.
16. (T F) A mineral is always a solid material.
17. (T F) A mineral can be composed of organic material.
18. (T F) The nucleus of an atom is composed of protons and electrons.
19. (T F) The atomic mass of an atom is the sum of the number of neutrons and protons.
20. (T F) Ionic bonding occurs when electrons are shared equally between two atoms.

II. Multiple Guess (80% total -or- 2 points per question)

1. Alfred Wegener was famous for developing the:
a) Theory of Uniformitarianism
b) Nebular hypothesis
c) Theory of General Relativity
d) Theory of Continental Drift

2. Explosive volcanic eruptions are associated with:
a) Felsic magma
b) Composite Cone volcanoes
c) Pyroclastic deposits
d) All of the above

3. The Columbia River basalt flows are associated with a:
a) Fissure eruption
b) Mt. St. Helens eruption
c) Shield Volcano
d) Divergent plate boundary

4. An atom that consists of 8 protons and 8 neutrons would have a:
a) atomic mass = 8
b) atomic number of 16
c) 8 electrons
d) all of the above

5. The relationship between the isotopes of C^{12} and C^{14} would be that
a) C^{14} has 14 electrons and C^{12} has 12 electrons.
b) C^{14} and C^{12} have the same number of neutrons.
c) C^{14} has the same number of protons as C^{12}.
d) None of the above.

6. The Nebular Hypothesis attempts to explain how:
a) Life on Earth evolved
b) the Universe formed
c) the Solar System formed
d) None of the above

7. Of the following, which term does not name a compositional layer of the interior Earth:
a) Core
b) Asthenosphere
c) Crust
d) Mantle

8. Of the following terms, which is considered to have the properties of a liquid:
a) Outer core
b) Oceanic lithosphere
c) Continental lithosphere
d) Lower mantle

9. Deep ocean trenches are always associated with which type of plate boundary:
a) Divergent
b) Transform
c) Convergent
d) None of the above.

10. Of the following terms, which is not a type of fundamental plate boundary:
a) Divergent
b) Transverse
c) Transform
d) Convergent

11. A subduction zone is associated with which type of tectonic boundary:
a) Divergent
b) Convergent
c) Transform
d) None of the above

12. A rift is associated with which type of tectonic boundary:
a) Divergent
b) Convergent
c) Transform
d) None of the above

13. Intrusive igneous rocks that may contain diamonds are termed:
a) Stocks
b) Diatremes
c) Volcanic domes
d) None of the above

14. What major tectonic plate does not contain a continent?
a) North American
b) Pacific
c) Indian-Australian
d) Antarctic

15. Of the following terms, which contributes essentially no mass to an atom:
a) Neutrons
b) Electrons
c) Protons
d) None of the above

16. A proton is characterized by:
a) Negative charge, mass=1
b) Positive charge, mass=0
c) Positive charge, mass=1
d) Negative charge, mass=0

17. The atomic number of a given element is always calculated by:
a) Summing electrons+neutrons
b) Summing electrons+protons
c) Summing protons
d) Summing protons+neutrons

18. Which of the following terms describes the bonding between Na and Cl in the Halite structure:
a) Covalent
b) Metallic
c) Ionic
d) None of the above

19. A unique property of metallic bonding is that the substance:
a) is extremely hard
b) has very low density
c) is soluble in H_2O
d) is able to conduct electricity (flow of free electrons).

20. Minerals that have different physical properties, but have the same chemical formula, are termed:
a) Polymorphs
b) Isotopes
c) Glasses
d) Ionic Substances

21. A mineral which breaks along perfect smooth planar directions (e.g. muscovite) is said to have:
a) Poor Cleavage
b) Concoidal Fracture
c) Perfect Crystal Form
d) Perfect Cleavage

22. Silicate structures are composed of SiO_4 units. This arrangement forms a geometry that is termed a:
a) Octahedron
b) Cube
c) Tetrahedron
d) Dodecahedron

23. The Earth's crust is composed of primarily 8 common elements. Which of the following does not belong to that list:
a) Oxygen (O)
b) Iron (Fe)
c) Gold (Au)
d) Magnesium (Mg)

24. Of the following silicate mineral groups, which possesses an internal structure that shares all four corners of the silicate tetrahedra (i.e. framework silicates):
a) Olivine
b) Pyroxene
c) Quartz
c) Mica

25. The term ferromagnesian is best described by silicate minerals containing:
a) Ca and Na
b) Fe and Mn
c) Fe and Mg
d) K and Al

26. Of the following list, which would be considered a felsic silicate mineral:
a) Olivine
b) K Feldspar
c) Pyroxene
d) All of the above

27. Of the following minerals, which does not appear on the Moh's hardness scale:
a) Talc
b) Garnet
c) Quartz
d) Diamond

28. Molten rock that occurs within the Earth's lithosphere is referred to as:
a) lava
b) extrusive
c) magma
d) mafic

29. If a lava is cooled very rapidly, which of the following is most likely to form:
a) volcanic glass (e.g. obsidian)
b) granite
c) aphanitic rock (e.g. basalt)
d) gabbro

30. The texture of a rock composed dominantly of minerals that are too small to be seen with the unaided eye, but has large feldspar crystals embedded in the groundmass, would be termed:
a) Aphanitic
b) Porphyritic
c) Phaneritic
d) Glassy

31. The texture of a rock composed of pumice fragments, volcanic glass, and ash would best be termed as:
a) Pyroclastic
b) Aphanitic
c) Phaneritic
d) Porphyritic

32. The plagioclase feldspars occupy which part of the Bowen's reaction series chart (as diagramed in class):
a) Lower half
b) Upper right
c) Upper left
d) Do not appear on the chart

33. From the igneous rock classification chart, a rock with a felsic composition and an aphanitic texture would be termed:
a) Basalt
b) Granite
c) Rhyolite
d) Gabbro

34. According to the igneous rock classification system, a rock with an intermediate composition and a aphanitic texture would be termed:
a) Rhyolite
b) Basalt
c) Andesite
d) Gabbro

35. A massive discordant pluton composed of granite that is exposed over an area greater than 100 km^2 is best described as a:
a) Stock
b) Dike
c) Sill
d)Batholith

36. The largest tectonic plate is the:
a) Pacific
b) South American
c) Eurasian
d) Antarctic

37. A hydrothermal vein is formed by the crystallization of a silicate magma rich in:
a) Carbon dioxide (CO_2)
b) Water (H_2O)
c) Methane (CH_4)
d) Sulfur Dioxide (SO_2)

38. The type of lava flow that produces a smooth braided "ropy" surface is termed:
a) Pahoehoe
b) aa
c) Ash-flow deposit
d) Ash-fall deposit

39. The Palisades sill located in the Hudson River valley near New York City is a famous example of what igneous process:
a) Pyroclastic Ash-flow deposit
b) Pahoehoe lava flow
c) Magma differentiation
d) None of the above

40. The type of volcano associated with eruptions of low viscosity basaltic magma to form lava flows would be termed:
a) Cinder Cone Volcano
b) Composite Cone Volcano
c) Shield Volcano
d) Lava Dome Volcano

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Discussion Questions (10%)

I. (5%) List and briefly describe the various types of silicate mineral structures based on the SiO4 tetrahedron. Describe how the tetrahedra are linked, and give a mineral example of each type.

1. Isolated tetrahedra: SiO4 tetrahedra do not share any corners. Each tetrahedron is held in place by bonds with other atoms such as Mg or Fe. A mineral example would be olivine.

2. Single Chain: in the single chain structure each SiO4 tetrahedron shares 2 corners with an adjacent tetrahedron to form links in a chain structure. A mineral example would be pyroxene.

3. Double Chain: in the double chain arrangement the tetrahedra are linked in each of the 2 chains by sharing 2 corners as in the single chain structure. However, every other tetrahedron in the chain shares 3 corners to form a linkage with the other chain structure hence the name double chain. A mineral example would be amphibole.

4. Sheet Structure: a sheet structure is formed when all SiO4 tetrahedra share 3 corners with adjacent tetrahedra. This forms a continuous 2-dimensional structure referred to as a “sheet”. A mineral example would be muscovite.

5. Framework Structure: in the framework silicates all 4 corners of each SiO4 tetrahedron are shared by adjacent tetrahedra to form a continuous 3-dimensional network structure. A mineral example would be quartz.

II. (5%) Describe the 3 fundamental types of plate tectonic boundaries and the motion of the plates at the boundary. Give a geographic example of each type.

1. Divergent: where adjacent tectonic plates both move directly away from the plate boundary, therefore, over time the two plates must diverge. A present-day geographic example of this type of boundary would be the mid Atlantic ocean ridge.

2. Convergent: where two adjacent plates move directly toward the plate boundary. One of the plates, which must be oceanic type lithosphere, is destroyed by a process of assimilation into the mantle referred to as "Subduction". A geographic example would be the Aleutian Island Arc system.

3. Transform: where two adjacent plates move in opposite directions parallel to the plate boundary. A current example would be the San Andreas fault system in southern California.