

1. An external heat engine drives most of the surface processes on the Earth. The source of energy for this engine is:

- a) *radioactive decay of U, Th, and K* **b) *thermonuclear fusion in the sun*** c) *burning of fossil fuels*
 d) *gravitational collapse of the solar nebula* e) *tides driven by lunar gravitation*.

2. Plate motion is believed to be driven by solid state convection of the silicate mantle. This convection is driven by the Earth's internal heat engine, which is powered by:

- a) ***radioactive decay of uranium, thorium, and potassium*** b) *thermonuclear fusion in the sun*
 c) *burning of fossil fuels* d) *fission reactions in the Earth's core* e) *radioactive decay of ^{14}C* .

3. The age of the Earth, as indicated by radiometric dating of meteorite, lunar, and terrestrial rocks, generally believed to be:

- a) *10 billion years* **b) *4.5 billion years*** c) *545 million years* d) *40 million years*
 e) *7000 years*.

4. The inner core of the Earth is composed of

- a) *solid silicate* b) *liquid silicate magma* c) *liquid metal* **d) *solid metal*** e) *olivine*.

5. The upper mantle of the Earth is composed of:

- a) ***solid silicate*** b) *liquid silicate magma* c) *liquid metal* d) *solid metal* e) *green cheese*.

6. In the scientific method, an observation in the laboratory or field is considered fact if it is

- a) *consistent with previous hypotheses*
 b) *consistent with prevailing theory*
c) *repeatable*
 d) *made by a reputable scientist*
 e) *cited by a reputable scientist*

7. What is the most likely geologic setting in which to find basaltic volcanism?

- a) *continent-continent convergent boundary (e.g. Himalayas)*
 b) *ocean-continent convergent boundary (e.g. Andes Mountains)*
 c) *ocean-ocean convergent boundary (e.g. Fiji-Tonga)*
d) *ocean-ocean divergent plate boundary (mid-ocean ridge), and oceanic islands*
 e) *transform plate boundary (e.g. San Andreas Fault zones)*

8. The electronic charge on the electron is

- a) *-1*** b) *0* c) *+1* d) *1.67×10^{-24}* e) *+2*

9. For a given element, the average mass number (number of protons plus neutrons in the nucleus) is known as the:

- a) *atomic number* **b) *atomic weight*** c) *mass number* d) *ionic charge* e) *ionic weight*.

10. The number of electrons lost by an element in chemical reactions is its common ionic charge. This is also known as its:

- a) *atomic number* b) *atomic weight* c) *mass number* **d) *valence*** e) *ionic weight*.

11. The atomic number of an element is:

- a) *the number of protons in the nucleus*** b) *the neutron in the nucleus* c) *the number of electrons*
 d) *protons plus neutrons in the nucleus* e) *the average number of protons plus neutrons*

12. A molecule composed of two atoms of hydrogen (H) would be:

- a) ^2H **b) H_2** c) H^2 d) 2H e) 2H_2

13. Oxygen has 8 protons in the nucleus. ^{16}O is:
 a) **an oxygen atom with 8 protons and 8 neutrons**
 b) an oxygen ion with a charge of sixteen
 c) a molecule composed of sixteen atoms of oxygen
 d) an oxygen atom with sixteen neutrons
 e) an atom of sixtensium.
14. The most abundant element in the Earth's crust and mantle is:
 a) aluminum b) boron c) silicon d) magnesium **e) oxygen.**
15. An atom that loses its outer electrons so that it gains a net positive charge is known as a(n):
 a) anion b) positron **c) cation** d) isotope e) electron
16. Those elements of the periodic table that form ionic bonds with oxygen and are enriched in the crust and mantle of the Earth are termed:
 a) atmophile b) siderophile c) chalcophile **d) lithophile** e) thermophile
17. A naturally occurring, homogeneous solid of definite chemical composition and ordered atomic arrangement that is usually formed by inorganic processes is known as a(n)
 a) element **b) mineral** c) rock d) crystal e) planet.
18. Forsterite (Mg_2SiO_4) and fayalite (Fe_2SiO_4) are different chemical end-members of olivine and have the same crystal structure. They are known as
 a) **isomorphs** b) pseudomorphs c) polymorphs d) mightymorphs e) tetrahedra.
19. The minerals, calcite and aragonite, both have the formula (CaCO_3), but have different crystal structures. These minerals are known as:
 a) isomorphs b) pseudomorphs **c) polymorphs** d) mightymorphs e) tetrahedra.
20. Which of the following is a native-element mineral (a pure element that occurs naturally):
 a) quartz b) beryl c) calcite **d) graphite** e) pyrite
21. An example of a natural solid that is not a mineral is
 a) diamond b) ice **c) obsidian** d) gold e) graphite
22. In the crystal structures of the common silicate minerals, each silicon atom is surrounded by four oxygens in the form of a:
 a) triangle **b) tetrahedron** c) hexahedron d) octahedron e) dodecahedron
23. Each of the oxygens in quartz is bonded to two silicon atoms, whereas in olivine each oxygen is bonded to only one Si atom. The degree to which the oxygens are shared between Si atoms is the degree of:
 a) allocation b) bifurcation **c) polymerization** d) differentiation e) elongation
24. The compositions of rocks such as granite that are composed almost entirely of quartz, alkali feldspar and mica are said to be:
 a) **felsic or silicic** b) intermediate c) mafic d) ultramafic e) basaltic.
25. A rock formed by the processes of solid-state recrystallization of pre-existing rock is called:
 a) igneous **b) metamorphic** c) hydrothermal d) sedimentary e) limestone.
26. A rock formed by the processes of melting followed by cooling and crystallization is called:
 a) **igneous** b) metamorphic c) hydrothermal d) sedimentary e) limestone.
27. Although silica (SiO_2) composes 40 to 70% by weight of most igneous rocks, the mineral quartz (SiO_2) is only abundant in the rock
 a) lherzolite or peridotite (ultramafic) b) gabbro c) diorite d) basalt **e) granite.**

28. the most abundant mineral in ultramafic rocks is typically:
 a) quartz b) feldspar c) mica **d) olivine** e) epidote
29. A gabbro is the coarse-grained compositional equivalent of a:
 a) rhyolite **b) basalt** c) andesite d) granite e) peridotite.
30. A deposit of (usually) silicic volcanic ash, pumice, and debris as a result of an explosive eruption is a(n):
 a) aa b) pahohoe **c) ash flow** d) composite cone e) pumice.
31. The polymerization of SiO_4 tetrahedra in a magma:
 a) **increases with increasing silica content** b) causes a change of color
 c) causes an electrical discharge d) is a major cause of earthquakes
 e) causes a rise in pressure.
32. Partial melting and fractional crystallization, together contribute to the process of:
 a) assimilation **b) igneous fractionation** c) subduction d) xenolith formation
 e) explosive eruption
33. A small igneous body of rock that has intruded conformably between the layers of a sedimentary rocks is known as a:
 a) aa **b) sill** c) stock d) dike e) pluton.
34. Which of the following is an ultramafic rock:
 a) granite b) basalt c) gabbro d) diorite **e) peridotite**
35. Ultramafic rocks are primarily found in the
 a) oceanic crust b) continental crust **c) mantle** d) core e) ocean islands
36. A mafic volcanic rock typical of the ocean basins which is commonly dark in color and has a moderate density ($\rho = 2.9 - 3.1 \text{ g/cm}^3$) is a:
 a) andesite **b) basalt** c) gabbro d) rhyolite e) peridotite
37. Pillow lavas form:
 a) where lava erupts onto ice **b) where lava erupts under water**
 c) where ash flows enter the ocean d) from fissure eruptions e) from dormant volcanoes.
38. A molten silicate material that flows out onto the surface of the Earth is known as a:
a) lava b) intrusion c) pluton d) magma e) volcano.
39. Cinder cones and extensive fluid lava flows such as those in Hawaii are most typical of:
 a) weathered granite **b) basaltic volcanism** c) rhyolitic volcanism d) dormant volcanism
 e) andesitic volcanism
40. As a Hawaiian-type basaltic eruption progresses and more and more magma flows out, the temperature of the magma delivered to the flow front may increase which decreases the viscosity. The high-temperature lava forms a ropy surface called:
 a) aa **b) pahohoe** c) ash flow d) nués ardente e) pumice.