Write your name out in full on the scantron form and fill in the corresponding ovals to spell out your name. Also fill in your student ID number in the space provided. Do not include the dash and do not leave any spaces. Make sure you have all 8 pages of the exam. There are 55 questions. For each question, select the correct answer and fill in your choice on the scantron form. You MUST use pencil on the scantron form!

1. Which of the following is NOT true of frost wedging in rocks?
   A. it is also called “freeze and thaw”
   B. it is a direct result of water in cracks freezing and expanding by 9% in volume
   C. it is a form of mechanical weathering
   D. it only occurs in the polar regions on Earth
   E. it is responsible for causing blocks of rock to dislodge, forming talus

2. Which of the following processes is a chemical weathering phenomenon?
   A. frost wedging
   B. hydrolysis
   C. unloading
   D. biological activity
   E. spalling

3. From the following list, choose a mineral that is commonly subject to the weathering process called dissolution:
   A. marble
   B. limestone
   C. rock salt
   D. halite
   E. all of the above

4. What mineral commonly breaks down into clay when it is chemically weathered?
   A. quartz
   B. muscovite
   C. feldspar
   D. olivine
   E. calcite

5. Which of the soil horizons make up humus?
   A. the O horizon
   B. the E horizon
   C. the A horizon
   D. the O and A horizons
   E. the A and E horizons

6. Which of the following statements about sedimentary rocks is TRUE?
   A. sedimentary rocks only make up about 5% of the crust
   B. sedimentary rocks are the type of rock we see most often at the Earth’s surface
   C. diagenesis during burial turns loose sediment into sedimentary rock
   D. the process of turning loose sediment into rock is called lithification
   E. all of the above
7. Which of the following pairs of words about sedimentary rocks do NOT belong together?
   A. bedding and stratification
   B. clay and mud
   C. chemical and sandstone
   D. conglomerate and breccia
   E. detrital and clastic

8. Which type of sediment consists of broken down particles of rocks produced by weathering and erosion?
   A. clastic
   B. detrital
   C. lithic fragments
   D. all of the above
   E. none of the above

9. Sediment particles in quartz sandstone that formed in a desert are typically:
   A. poorly sorted and angular
   B. poorly sorted and well rounded
   C. well sorted and angular
   D. well sorted and well rounded
   E. made of feldspar

10. Which of the following terms or products are NOT associated with the evaporation of seawater?
    A. halite
    B. evaporites
    C. gypsum
    D. calcite
    E. apatite

11. Living creatures can be involved in the production of sedimentary rocks by two different processes: biochemical and biogenic. Which of the following can form ONLY through a biochemical process?
    A. phosphorites
    B. chalk
    C. chert
    D. coquina
    E. limestone

12. Which of the following is NOT a type of sedimentary structure?
    A. mudcracks
    B. graded bedding
    C. ripple marks
    D. rock color
    E. cross-bedding

13. A short time break or a change in sediment type in a depositional environment results in the creation of (1) ______ between individual beds. A very long time break produces (2) ________ in the rock record.
    A. (1) an unconformity (2) a graded bed
    B. (1) an unconformity (2) a bedding plane
    C. (1) a bedding plane (2) a graded bed
    D. (1) a bedding plane (2) an unconformity
    E. (1) a graded bed (2) an intrusive contact
14. Which of the following descriptions is NOT correct when talking about graded bedding?  
   A. it is a gravitational effect produced when sediment drops out of flowing water  
   B. there is a gradual change in sediment size throughout a bed  
   C. small sediment grains are at the bottom and large grains are at the top  
   D. graded beds are often associated with turbidity currents on ocean slopes  
   E. graded beds can be formed on a river bed during floods

15. Which of the following statements about paleocurrents is FALSE?  
   A. cross-bedding can be used to determine a paleocurrent  
   B. cross-beds are inclined downwards in the direction of the paleocurrent  
   C. a paleocurrent refers to an ancient wind or water flow direction  
   D. ripple marks are indicators of paleocurrents  
   E. symmetric ripples indicate a constant, one-directional paleocurrent direction

16. The order of sedimentary facies when moving from a beach towards deep water is:  
   A. carbonate facies – mud facies – sand facies  
   B. carbonate facies – sand facies – mud facies  
   C. sand facies – mud facies – carbonate facies  
   D. sand facies – carbonate facies – mud facies  
   E. mud facies – carbonate facies – sand facies

17. Which of the following statements about metamorphism is FALSE?  
   A. metamorphic rocks form from existing sedimentary, igneous, or metamorphic rocks  
   B. metamorphism involves melting of existing rocks to form new minerals  
   C. during metamorphism, existing minerals are transformed into new minerals  
   D. metamorphism is controlled by pressure, temperature, fluids, and time  
   E. metamorphic means “change of form”

18. The depth at which metamorphism begins depends on pressure and temperature. The pressure is controlled by the (1) ______ whereas the temperature is controlled by the (2) _______.  
   A. (1) weight of the overlying rocks (2) geothermal gradient  
   B. (1) lithostatic pressure (2) rock type  
   C. (1) lithostatic stress (2) radioactive decay  
   D. (1) differential stress (2) convection in the mantle  
   E. (1) depth of diagenesis (2) isotherms

19. Which of the following will have no effect on the process of metamorphism?  
   A. the addition of water to the rocks being metamorphosed  
   B. the length of time of metamorphism  
   C. the type of rock that got metamorphosed  
   D. the pressures and temperatures that the rocks experienced  
   E. all of the above will have an impact on metamorphism

20. A foliation develops in a metamorphic rock because:  
   A. platy minerals always align with each other during any type of metamorphism  
   B. the original rock that got metamorphosed must have had a foliation in it  
   C. differential stress causes minerals to align parallel to each other  
   D. high temperatures during metamorphism always cause minerals to recrystallize with a foliation  
   E. this is what defines a metamorphic rock in the first place
21. Which of the following is NOT a type of metamorphic texture?
   A. hornfels
   B. schistosity
   C. slaty cleavage
   D. gneissosity
   E. gneissic texture

22. Which of the following metamorphic rocks does not belong in the same list as the others?
   A. quartzite
   B. greenschist
   C. phyllite
   D. gneiss
   E. slate

23. Which of these features has something to do with contact metamorphism?
   A. mineral recrystallization
   B. magma
   C. country rock
   D. aureole
   E. all of the above

24. Which type of metamorphism is associated with the process of metasomatism?
   A. thermal
   B. hydrothermal
   C. regional
   D. burial
   E. dynamic

25. Which type of metamorphism is associated with fault motion or shear zones, often forming the rock mylonite?
   A. impact
   B. contact
   C. regional
   D. burial
   E. dynamic

26. If two different types of rocks get metamorphosed at exactly the same temperatures and pressures as each other, then:
   A. the sequence of index minerals will be identical as the two rocks get metamorphosed
   B. the mineral assemblages will be identical
   C. the metamorphic grade will be the same in each case
   D. the resultant metamorphic rocks will nonetheless be identical
   E. none of the above

27. On a map of metamorphic rock distributions, the lines on the map that separate regions having different index minerals are called:
   A. isotherms
   B. isograds
   C. isobars
   D. isopleths
   E. isochromatics
28. What is meant by the term **chronological sequence**?
   A. it refers to the absolute ages of rocks
   B. it is one of the principles of stratigraphy used to determine relative ages
   C. it is the geologic time scale that we use to characterize the ages of all rocks
   **D. it is the order that things happened in geologic history**
   E. it is the amount of time that a radioactive substance takes to decay

29. The principle of **stratigraphic superposition** states that:
   A. all sedimentary beds start off being horizontal
   B. all sedimentary beds are eventually deformed and tilted by tectonic forces
   C. **any sedimentary bed is older than the bed above it and younger than the bed below it**
   D. any sedimentary bed is younger than the bed above it and older than the bed below it
   E. any sedimentary bed must be older than any feature that cuts through it or disrupts it

30. If we see a sedimentary bed that has a dike cutting through it as well as a fault that cuts through both the bed and the dike, we can use the principle of cross-cutting relationships to infer:
   A. the bed formed first, then the fault, then the dike
   B. **the bed formed first, then the dike, then the fault**
   C. the fault formed first, then the bed, then the dike
   D. the dike formed first, then the bed, then the fault
   E. no age sequence can be inferred from this information

31. The type of unconformity across which the beds have different inclinations is called a/an:
   A. disconformity
   **B. angular unconformity**
   C. nonconformity
   D. malconformity
   E. intrusive contact

32. The correct arrangement of the different types of geologic time divisions, from longest to shortest, is:
   A. epochs, periods, eras, eons
   B. periods, eons, epochs, eras
   C. **eons, eras, periods, epochs**
   D. eons, epochs, eras, periods
   E. eras, periods, epochs, eons

33. Which of the **eons** listed below is NOT considered to be part of the Precambrian?
   A. Phanerozoic
   B. Proterozoic
   C. Archean
   D. Hadean
   E. Cambrian

34. Cambrian, Ordovician, Silurian, Devonian, Carboniferous (**Camels Only Sit Down Carefully**). What comes next?
   A. Triassic
   B. Tertiary
   C. Quaternary
   **D. Permian**
   E. Jurassic
35. The epoch that we currently live in is called the (1)______ and it began (2)_____ years ago:
   A. (1) Quaternary     (2) 1000
   B. (1) Pleistocene    (2) 100,000
   C. (1) Tertiary       (2) 1 million
   D. (1) Holocene       (2) 10,000
   E. (1) Cenozoic       (2) 10 million

36. Which of the following statements is true of beta decay:
   A. an atom releases a pair of protons and a pair of neutrons from the nucleus
   B. an atom releases a proton and a neutron from the nucleus
   C. an atom releases an electron from the nucleus causing a neutron to turn into a proton
   D. an atom absorbs an electron into the nucleus causing the atomic number to decrease by 1
   E. an atom remains unchanged but gives off gamma rays and generates a lot of heat

37. An isotope that undergoes decay starts off as a/an (1)_____ and becomes a (2)_____:
   A. (1) unstable isotope  (2) stable isotope
   B. (1) daughter        (2) son
   C. (1) daughter        (2) parent
   D. (1) parent          (2) daughter
   E. (1) parent          (2) mutant

38. Which of the following statements about radioactive decay is TRUE?:
   A. the rate of decay of an isotope never changes
   B. alpha decay is always followed by beta decay
   C. the amount of daughter isotopes is always decreasing
   D. all available atoms of an unstable isotope will fully decay after two half-lives
   E. all daughter isotopes are stable isotopes

39. If the half-life of a radioactive isotope is 1 million years, and a crystal forms containing 100 of these isotopes, how old is the crystal at the point when only 25 of the original radioactive isotopes are left in the crystal?
   A. 1 million years old
   B. 2 million years old
   C. 3 million years old
   D. 4 million years old
   E. 5 million years old

40. How old have moon rocks been determined to be, based on radiometric dating?
   A. 4.6 billion years old
   B. 4.5 billion years old
   C. 4.1 billion years old
   D. 4 billion years old
   E. 2 billion years old

41. Stress is the same as:
   A. force
   B. pressure
   C. strain
   D. force divided by area
   E. pressure divided by volume
42. If a rock deforms under the influence of a stress, but then returns to its original shape when the stress is removed, then the deformation behavior is described as:
   A. brittle
   B. plastic
   C. elastic
   D. ductile
   E. magical

43. An example of a region of faulting and earthquakes in a **continental interior** setting is the:
   A. New Madrid region
   B. Pacific Northwest region
   C. Western Pacific region
   D. San Andreas fault region
   E. none of the above

44. The type of fault that forms in a region of the crust undergoing **extension** is:
   A. reverse fault
   B. **normal fault**
   C. oblique-slip fault
   D. left-lateral fault
   E. right-lateral fault

45. In 1983, one of the largest earthquakes in the recorded history of the United States occurred near Borah Peak in Idaho. What was the magnitude of that earthquake?
   A. M 4.6
   B. M 5.5
   C. M 6.4
   D. **M 7.3**
   E. M 8.2

46. If a fault is dipping, the block of rock above the fault is the (1) _________ and the block of rock below the fault is the (2) _________.
   A. (1) footwall (2) hanging wall
   B. (1) footwall (2) fault scarp
   C. (1) fault plane (2) footwall
   D. (1) hanging wall (2) fault plane
   E. (1) hanging wall (2) footwall

47. Which of the following answers is the most accurate analysis of this statement: “When a fault slips, the hanging wall moves up and the footwall moves down.”
   A. this is only true of a normal fault
   B. it depends on which side of the fault is the footwall, which varies depending on the fault type
   C. with strike-slip faults, sometimes the opposite occurs
   D. **occurs along reverse faults and may produce mountains as the hanging wall gets uplifted**
   E. this motion may create valleys called grabens and mountains called horsts

48. All faults must have dips that fall in the range:
   A. 60º to 90º
   B. 30º to 90º
   C. **0º to 90º**
   D. 0º to 180º
   E. 30º to 45º
49. Along the San Andreas fault, the west side is moving towards the north and the east side is moving relatively towards the south. This makes the San Andreas fault:
   A. a normal fault
   B. a right-lateral fault
   C. a left-lateral fault
   D. a reverse fault
   E. either a left or right-lateral fault (depending on what side of the fault you are standing on)

50. Rocks that warp upwards in the center of a fold produce a type of fold called a/an (1) ______ whereas rocks that warp downwards in the center produce a/an (2) ______.
   A. (1) anticline (2) monocline
   B. (1) anticline (2) syncline
   C. (1) syncline (2) anticline
   D. (1) syncline (2) monocline
   E. (1) anti-plunging fold (2) plunging fold

BONUS QUESTIONS

51. An example of a transported soil is:
   A. loess
   B. topsoil
   C. pedocal
   D. pedalfer
   E. laterite

52. A good way to tell if a detrital sedimentary rock has silt in it is:
   A. by putting hydrochloric acid on it to see if it fizzes
   B. by licking it
   C. by chewing it vigorously
   D. by rubbing it gently across your teeth
   E. by seeing if it sticks to your tongue

53. Which of the following is NOT a type of metamorphic facies?
   A. zeolite
   B. blueschist
   C. phyllite
   D. eclogite
   E. granulite

54. If a certain species is known, based on fossil evidence, to have existed on Earth from the Permian to the Cretaceous Periods, in which of the following aged rocks would we never find fossils of this creature?
   A. Permian
   B. Cretaceous
   C. Jurassic
   D. Devonian
   E. Triassic

55. If the tectonic extension direction in a region is oriented NW to SE, how would resultant joints be oriented?
   A. also NW to SE
   B. N to S
   C. E to W
   D. NE to SW
   E. joints could actually form in any orientation