Board Exam Desk

Geology Reviewer

Geology Licensure Examination | PRC | 120 original questions

2026 Edition | Updated November 2026

Original board-style practice questions with an answer key.

Practice questions

Mineralogy and Crystallography

1. A mineral fragment weighs 24.60 g in air and 18.45 g when fully submerged in water. What is its specific gravity?

A. 1.33
B. 4.00
C. 5.00
D. 3.00

2. A pale pink mineral scratches window glass but is itself scratched by quartz. Its hardness best matches which Mohs reference mineral?

A. Orthoclase
B. Apatite
C. Calcite
D. Topaz

3. A silicate mineral whose SiO4 tetrahedra are linked into double chains belongs to which group?

A. Micas
B. Pyroxenes
C. Olivines
D. Amphiboles

4. A dark prismatic mineral in a hand sample shows two good cleavages meeting at about 56 and 124 degrees. It is most likely:

A. Biotite
B. Hornblende
C. Olivine
D. Augite

5. A white carbonate mineral fizzes vigorously when a drop of cold dilute HCl is placed on an unpowdered crystal. Which mineral is it?

A. Magnesite
B. Siderite
C. Dolomite
D. Calcite

6. Which crystal system has three crystallographic axes of unequal length that are all mutually perpendicular?

A. Triclinic
B. Tetragonal
C. Monoclinic
D. Orthorhombic

7. A crystal face cuts the a-axis at 2 unit lengths, the b-axis at 3 unit lengths and is parallel to the c-axis. What are its Miller indices?

A. (236)
B. (320)
C. (110)
D. (230)

8. Using X-rays of wavelength 0.154 nm, a first-order diffraction peak appears at a Bragg angle (theta) of 20 degrees. What is the interplanar spacing d?

A. 0.105 nm
B. 0.082 nm
C. 0.450 nm
D. 0.225 nm

9. Which pair of minerals are polymorphs of each other?

A. Calcite and aragonite
B. Halite and sylvite
C. Magnetite and hematite
D. Olivine and serpentine

10. In a thin section viewed under crossed polars, a mineral stays completely dark as the stage is rotated in every grain orientation. It is most likely:

A. Quartz
B. Garnet
C. Biotite
D. Calcite

11. A colorless mineral in thin section shows low gray first-order colors and repeated parallel twin lamellae under crossed polars. It is most likely:

A. Quartz
B. Orthoclase
C. Muscovite
D. Plagioclase

12. A steel-gray mineral with metallic luster gives a reddish-brown streak on unglazed porcelain. It is most likely:

A. Pyrite
B. Hematite
C. Galena
D. Magnetite

13. Using atomic masses Fe = 55.85 and O = 16.00, what is the weight percent of iron in pure hematite (Fe_2O_3)?

A. 77.7%
B. 72.4%
C. 40.0%
D. 69.9%

14. A mineral group shows complete solid solution between Mg_2SiO_4 and Fe_2SiO_4 end-members. Which group is this?

A. Olivine
B. Pyroxene
C. Plagioclase
D. Garnet

15. Native gold and native copper crystallize in which crystal system?

A. Tetragonal
B. Isometric
C. Orthorhombic
D. Hexagonal

Petrology

16. According to Bowen's reaction series, which mineral is the first to crystallize on the discontinuous branch as a basaltic magma cools?

A. Olivine
B. Pyroxene
C. Biotite
D. Amphibole

17. A coarse-grained intrusive rock consists mostly of plagioclase and hornblende with less than 5% quartz and very little K-feldspar. It is best named:

A. Syenite
B. Gabbro
C. Granite
D. Diorite

18. A gray fine-grained volcanic rock from an island arc has phenocrysts of plagioclase and hornblende and an intermediate silica content. It is best called:

A. Komatiite
B. Andesite
C. Rhyolite
D. Basalt

19. An igneous rock has large well-formed crystals set in a much finer-grained groundmass. What does this texture most likely indicate?

A. Metamorphic recrystallization
B. Rapid quenching in water
C. Slow cooling at great depth
D. Two stages of cooling

20. An ultramafic intrusive rock is composed of more than 90% olivine. What is it called?

A. Lherzolite
B. Pyroxenite
C. Harzburgite
D. Dunite

21. In regional metamorphism of shale, which rock forms at the next higher grade after phyllite?

A. Schist
B. Slate
C. Migmatite
D. Gneiss

22. A metabasalt contains abundant glaucophane and lawsonite. In what tectonic setting did this metamorphism most likely occur?

A. Subduction zone
B. Continental rift
C. Contact aureole
D. Mid-ocean ridge

23. Impure limestone at the contact of a granite stock has recrystallized to garnet, pyroxene, wollastonite and magnetite. This rock is a:

A. Hornfels
B. Greisen
C. Mylonite
D. Skarn

24. A sandstone is made of over 95% well-rounded, well-sorted quartz grains. What does this most strongly indicate?

A. Long transport and reworking
B. Rapid burial near a granite
C. Glacial deposition
D. Proximity to a volcanic arc

25. A poorly sorted sandstone contains about 30% angular feldspar grains. It is classified as an arkose. What source and setting does it suggest?

A. Deep-sea pelagic setting
B. Distant source, long transport
C. Weathered basaltic lava field
D. Nearby granitic source, rapid erosion

26. Which Al_2SiO_5 polymorph is stable at high pressure and low to moderate temperature?

A. Sillimanite
B. Staurolite
C. Kyanite
D. Andalusite

27. In a complete ophiolite sequence, which unit lies directly beneath the pillow basalts?

A. Sheeted dike complex
B. Mantle harzburgite
C. Layered gabbro
D. Pelagic chert

28. Pyroclastic fragments between 2 and 64 mm in size are called:

A. Ash
B. Blocks
C. Lapilli
D. Bombs

29. A point count of a plutonic rock gives quartz 120, plagioclase 180, K-feldspar 60 and biotite 40 points. Using the QAP diagram, the rock is:

A. Tonalite
B. Granodiorite
C. Alkali-feldspar granite
D. Quartz monzonite

30. As seawater evaporates in a closed basin, which of these minerals precipitates first?

A. Halite
B. Sylvite
C. Carnallite
D. Gypsum

Structural Geology

31. On level ground, a sandstone bed dipping 35 degrees has an outcrop width of 48 m measured perpendicular to strike. What is its true thickness?

A. 39.3 m
B. 27.5 m
C. 33.6 m
D. 83.7 m

32. A bed has a true dip of 40 degrees. What apparent dip is seen in a vertical section trending 30 degrees from the strike?

A. 22.8 degrees
B. 36.0 degrees
C. 20.0 degrees
D. 18.7 degrees

33. A coal seam dipping 25 degrees crops out on flat ground. A vertical hole is collared 150 m from the outcrop, measured horizontally in the dip direction. At what depth will it hit the seam?

A. 321.7 m
B. 69.9 m
C. 63.4 m
D. 135.9 m

34. On a fault, the hanging wall has moved down relative to the footwall along the dip direction. What fault type and stress regime does this indicate?

A. Normal fault, extension
B. Reverse fault, compression
C. Thrust fault, compression
D. Strike-slip fault, shear

35. A geologist stands on one side of a vertical strike-slip fault and sees that the opposite block has moved to the right. The fault is:

A. Normal dip-slip
B. Left-lateral (sinistral)
C. Right-lateral (dextral)
D. Oblique reverse

36. On a geologic map, a fold has its oldest beds exposed in the core and limbs dipping away from the axis. What structure is it?

A. Monocline
B. Anticline
C. Recumbent syncline
D. Syncline

37. A bed dips downstream more steeply than the stream gradient. According to the rule of Vs, its outcrop trace across the valley:

A. Parallels the contours
B. Runs straight across
C. Points upstream
D. Points downstream

38. According to Anderson's theory of faulting, which stress arrangement produces thrust (reverse) faults?

A. Sigma 2 vertical, sigma 1 horizontal
B. Sigma 1 vertical, sigma 3 horizontal
C. All three stresses equal
D. Sigma 1 horizontal, sigma 3 vertical

39. A joint plane has a strike of 040 and dips 60 degrees to the southeast (right-hand rule). What is the trend and plunge of its pole?

A. 220 / 30
B. 130 / 30
C. 310 / 60
D. 310 / 30

40. A vein dips 50 degrees. Its outcrop width, measured perpendicular to strike along a hillside sloping 20 degrees opposite to the dip direction, is 30 m. What is its true thickness?

A. 21.6 m
B. 23.0 m
C. 28.2 m
D. 15.0 m

41. A deformed belemnite that was originally 10.0 cm long now measures 12.5 cm. What is its longitudinal strain (extension)?

A. 0.20
B. 0.80
C. 0.25
D. 1.25

42. A rock is under sigma 1 = 100 MPa and sigma 3 = 40 MPa. What is the shear stress on a plane whose normal makes 60 degrees with sigma 1?

A. 55.0 MPa
B. 15.0 MPa
C. 26.0 MPa
D. 30.0 MPa

43. Polished, striated surfaces with fine grooves on a fault plane are mainly used to determine:

A. Rock porosity
B. Age of fault movement
C. Direction of fault slip
D. Depth of faulting

44. A normal fault dips 60 degrees and has a pure dip-slip net slip of 200 m. What is the heave (horizontal separation perpendicular to strike)?

A. 173.2 m
B. 115.5 m
C. 100.0 m
D. 230.9 m

45. Hexagonal columns that form in a thick basalt lava flow are produced mainly by:

A. Hydraulic fracturing
B. Contraction during cooling
C. Unloading by erosion
D. Tectonic compression

Stratigraphy and Paleontology

46. In an undisturbed sequence of flat-lying sedimentary beds, the youngest layer is found:

A. At the top
B. In the middle
C. Where beds are thickest
D. At the bottom

47. A basalt dike cuts sandstone and shale beds, and both are truncated by an erosion surface overlain by conglomerate. Which is the youngest?

A. The conglomerate
B. The sandstone
C. The erosion surface
D. The basalt dike

48. Tilted and folded shale beds are cut by an erosion surface and overlain by horizontal limestone. This contact is an:

A. Nonconformity
B. Paraconformity
C. Angular unconformity
D. Disconformity

49. Horizontal sandstone rests directly on an eroded surface of granite. This contact is best described as a:

A. Conformable contact
B. Disconformity
C. Nonconformity
D. Angular unconformity

50. Which combination of traits makes a fossil the most useful index fossil?

A. Long time range, local distribution
B. Short time range, rare occurrence
C. Long time range, wide distribution
D. Short time range, wide distribution

51. A mineral sample has a daughter-to-parent ratio of 7:1. If the parent isotope has a half-life of 0.70 billion years and no daughter was present at first, how old is the sample?

A. 2.8 billion years
B. 4.9 billion years
C. 1.4 billion years
D. 2.1 billion years

52. Charcoal from an archaeological layer retains 25% of its original carbon-14. Taking the C-14 half-life as 5,730 years, how old is it?

A. 11,460 years
B. 22,920 years
C. 17,190 years
D. 5,730 years

53. Which principle states that facies found in vertical conformable succession were deposited in laterally adjacent environments?

A. Walther's law
B. Faunal succession
C. Law of superposition
D. Original horizontality

54. A vertical section shows beach sandstone overlain by offshore shale, which is overlain by open-marine limestone. This records:

A. A marine transgression
B. A glacial advance
C. A marine regression
D. A delta progradation

55. In petroleum well biostratigraphy of Cenozoic marine strata, which fossil group is most widely used for age dating?

A. Graptolites
B. Ammonites
C. Trilobites
D. Planktonic foraminifera

56. Graptolites are most useful as index fossils for strata of which periods?

A. Paleogene and Neogene
B. Ordovician and Silurian
C. Jurassic and Cretaceous
D. Permian and Triassic

57. The extinction of the non-avian dinosaurs marks which boundary of the geologic time scale?

A. Cretaceous-Paleogene
B. Triassic-Jurassic
C. Ordovician-Silurian
D. Permian-Triassic

58. A 45 m thick sequence of lake sediments accumulated over 150,000 years. What is the average sedimentation rate?

A. 3.0 mm/yr
B. 0.15 mm/yr
C. 0.03 mm/yr
D. 0.30 mm/yr

59. In an overturned turbidite sequence, which feature best shows the original top of each bed?

A. Mud cracks widen downward
B. Beds have uniform grain size
C. Coarsest grains are at the top
D. Grain size fines toward the top

60. A shell dissolves after burial, leaving a cavity that is later filled with mineral matter shaped like the shell. This type of fossil is a:

A. Cast
B. Permineralization
C. Mold
D. Carbonization

Economic Geology and Exploration

61. A tabular ore body is 120 m long, 45 m down-dip and 8 m in true thickness, with a bulk density of 2.9 t/m3. What is its tonnage?

A. 43,200 t
B. 125,280 t
C. 116,640 t
D. 15,660 t

62. An ore reserve of 2.5 million tonnes averages 0.45% Cu. How much copper metal does it contain?

A. 1,125 t
B. 5,625 t
C. 11,250 t
D. 112,500 t

63. A drill hole intersects 1.5 m at 4.2 g/t Au, 2.5 m at 1.8 g/t Au and 3.0 m at 3.1 g/t Au. What is the length-weighted average grade?

A. 3.03 g/t
B. 2.87 g/t
C. 2.60 g/t
D. 3.35 g/t

64. An open pit plan calls for 6.4 Mt of waste to be removed to mine 1.6 Mt of ore. What is the stripping ratio?

A. 4.0 : 1
B. 5.0 : 1
C. 3.0 : 1
D. 0.25 : 1

65. In a typical porphyry copper system, which alteration zone forms the outermost halo with chlorite, epidote and calcite?

A. Propylitic
B. Advanced argillic
C. Potassic
D. Phyllic

66. A gold prospect shows vuggy residual silica, alunite-kaolinite-pyrophyllite alteration and enargite. What deposit type is indicated?

A. High-sulfidation epithermal
B. Mississippi Valley-type
C. Low-sulfidation epithermal
D. Orogenic lode gold

67. Banded colloform-crustiform quartz-adularia veins with bladed calcite and electrum point to which deposit type?

A. Low-sulfidation epithermal
B. High-sulfidation epithermal
C. Porphyry copper core
D. Podiform chromite

68. A lens of massive pyrite-chalcopyrite-sphalerite sits on felsic volcanic rocks above a stockwork of sulfide stringers. This is most likely a:

A. Volcanogenic massive sulfide
B. Porphyry copper deposit
C. Sediment-hosted placer
D. Banded iron formation

69. In a hydrous silicate-type nickel laterite profile, the zone rich in garnierite with the highest nickel grades is usually the:

A. Saprolite zone
B. Ferricrete cap
C. Limonite zone
D. Fresh bedrock

70. Along a gold-bearing meandering river, where are placer gold concentrations most likely?

A. Inner bends and bedrock traps
B. Lake beds at the river mouth
C. Outer cut banks of meanders
D. Floodplain clays far from the channel

71. In soil geochemical surveys for epithermal or orogenic gold, which element is a common pathfinder?

A. Calcium
B. Aluminum
C. Potassium
D. Arsenic

72. Podiform chromite deposits are typically found in which setting?

A. Carbonate platform reefs
B. Granite-hosted pegmatites
C. Felsic volcanic arc rocks
D. Mantle section of an ophiolite

73. Most of the world's large banded iron formations were deposited during which time span?

A. Cenozoic
B. Precambrian
C. Mesozoic
D. Paleozoic

74. Mining and processing cost $30 per tonne, gold sells for $60 per gram, and mill recovery is 90%. What is the breakeven cutoff grade?

A. 0.50 g/t
B. 0.45 g/t
C. 1.80 g/t
D. 0.56 g/t

75. Under standard resource reporting codes, which mineral resource category has the lowest geological confidence?

A. Probable
B. Measured
C. Inferred
D. Indicated

Engineering Geology and Hydrogeology

76. A 250 cm3 rock core has a dry mass of 520.0 g and a saturated mass of 582.5 g. Taking water density as 1 g/cm3, what is its porosity?

A. 33.3%
B. 75.0%
C. 25.0%
D. 12.0%

77. A sand has a porosity of 0.30. What is its void ratio?

A. 0.43
B. 0.30
C. 0.70
D. 0.23

78. A confined aquifer is 40 m wide and 12 m thick with K = 15 m/day. The head drops 3.0 m over 600 m. What is the flow rate using Darcy's law?

A. 0.9 m3/day
B. 360 m3/day
C. 3.0 m3/day
D. 36.0 m3/day

79. Groundwater flows through a sand with K = 15 m/day under a gradient of 0.005. If effective porosity is 0.25, what is the average seepage velocity?

A. 0.075 m/day
B. 0.30 m/day
C. 0.019 m/day
D. 3.0 m/day

80. An unconfined aquifer has porosity 0.35 and specific retention 0.12. If the water table falls 1.5 m over 2.0 km2, how much water drains?

A. 1,050,000 m3
B. 3,000,000 m3
C. 690,000 m3
D. 360,000 m3

81. Water in a newly drilled well rises well above the top of the aquifer without pumping. The aquifer is most likely:

A. Perched above a lens
B. Unconfined (water table)
C. Confined (artesian)
D. Fully dewatered

82. A 2.0 m core run has pieces of 25, 18, 12, 30, 9, 15, 7 and 22 cm. What is the Rock Quality Designation (RQD)?

A. 50%
B. 61%
C. 69%
D. 75%

83. A long dry slope of cohesionless sand stands at 28 degrees, and the sand has a friction angle of 34 degrees. What is the factor of safety (infinite slope)?

A. 1.21
B. 0.79
C. 1.19
D. 1.27

84. Which clay mineral is chiefly responsible for high shrink-swell behavior in expansive foundation soils?

A. Illite
B. Montmorillonite
C. Chlorite
D. Kaolinite

85. During strong shaking, which material is most susceptible to liquefaction?

A. Stiff overconsolidated clay
B. Unweathered granite
C. Dense dry gravel
D. Loose saturated fine sand

86. A reservoir is planned over thick, cavernous limestone. What is the main engineering geology concern?

A. Liquefaction of the abutments
B. Excess swelling of the rock
C. Seepage loss through karst
D. Low rock hardness for aggregate

87. Which unfractured material typically has the lowest hydraulic conductivity?

A. Clay
B. Medium sand
C. Clean gravel
D. Silty sand

88. A well pumps a confined aquifer with K = 20 m/day and thickness 15 m. Steady drawdowns at 10 m and 100 m differ by 0.80 m. Using the Thiem equation, what is the pumping rate?

A. 240 m3/day
B. 1508 m3/day
C. 655 m3/day
D. 104 m3/day

89. A compacted fill has a bulk density of 2.10 Mg/m3 at a water content of 15%. What is its dry density?

A. 1.78 Mg/m3
B. 1.83 Mg/m3
C. 1.95 Mg/m3
D. 2.42 Mg/m3

90. Gasoline leaks from an underground tank into a sandy aquifer. Where will the free product mainly accumulate?

A. Evenly through the aquifer
B. Within the clay aquitard
C. On top of the water table
D. At the aquifer base

Geophysics and Geologic Hazards

91. A station records an S-P interval of 12 s. Assuming Vp = 6.0 km/s and Vs = 3.5 km/s, how far away is the earthquake?

A. 72.0 km
B. 100.8 km
C. 42.0 km
D. 30.0 km

92. Using the standard energy-magnitude relation, how much more energy does a magnitude 7.0 earthquake release than a magnitude 5.0?

A. About 100 times
B. About 32 times
C. About 1,000 times
D. About 20 times

93. A seismic reflection has a two-way travel time of 0.80 s through a layer with a velocity of 2,500 m/s. How deep is the reflector?

A. 500 m
B. 3,125 m
C. 1,000 m
D. 2,000 m

94. A gravity station is 150 m above the datum. Using 0.3086 mGal/m, what free-air correction is applied?

A. 16.8 mGal
B. 46.3 mGal
C. 29.5 mGal
D. 63.1 mGal

95. Which ground geophysical method is best suited to map a buried magnetite-rich skarn body?

A. Ground-penetrating radar
B. Magnetic survey
C. Seismic refraction
D. Radiometric survey

96. Which geophysical method is most effective for detecting disseminated sulfides in a porphyry copper system?

A. Induced polarization
B. Seismic reflection
C. Gravity survey
D. Magnetotelluric only

97. Surface temperature is 28 C and the geothermal gradient is 30 C per km. What is the expected temperature at 2.5 km depth?

A. 75 C
B. 133 C
C. 103 C
D. 58 C

98. A 3.0 km high plateau is in Airy isostatic balance. With crust density 2.8 g/cm3 and mantle 3.3 g/cm3, how deep is its crustal root?

A. 2.5 km
B. 16.8 km
C. 19.8 km
D. 0.5 km

99. A hot, fast, ground-hugging mixture of volcanic gas and rock fragments that sweeps down a volcano's flank is a:

A. Lahar
B. Pyroclastic density current
C. Phreatic plume
D. Lava flow

100. Which kind of earthquake is most likely to generate a large ocean-wide tsunami?

A. Deep-focus intraslab event
B. Shallow megathrust event
C. Small volcanic tremor
D. Strike-slip event on land

101. Why does prolonged heavy rainfall often trigger landslides on soil slopes?

A. It lowers the slope angle
B. It increases soil cohesion
C. It increases friction angle
D. It raises pore water pressure

102. Why can one earthquake have a single magnitude but many different intensity values?

A. Magnitude is measured locally
B. Magnitude depends on damage
C. Intensity uses only one seismograph
D. Intensity varies by location

103. The absence of direct S-wave arrivals beyond about 104 degrees from an earthquake shows that:

A. The inner core is liquid
B. The mantle is molten
C. The outer core is liquid
D. The crust is very thin

104. At which boundary does P-wave velocity jump from about 7 km/s to about 8 km/s?

A. Gutenberg discontinuity
B. Lehmann discontinuity
C. Mohorovicic discontinuity
D. Conrad discontinuity

105. The Volcanic Explosivity Index (VEI) of an eruption is based mainly on:

A. Erupted volume and plume height
B. Number of deaths and damage
C. Magma silica content only
D. Lava temperature and viscosity

Philippine Geology and Mining Laws

106. What is the dominant sense of movement on the Philippine Fault Zone?

A. Pure normal dip-slip
B. Low-angle thrusting
C. Left-lateral strike-slip
D. Right-lateral strike-slip

107. The July 1990 magnitude 7.8 Luzon earthquake was caused by rupture along which structure?

A. Cotabato Trench
B. Manila Trench
C. Philippine Fault Zone
D. West Valley Fault

108. Along which trench does South China Sea lithosphere subduct eastward beneath Luzon?

A. Cotabato Trench
B. Manila Trench
C. East Luzon Trough
D. Philippine Trench

109. At the Philippine Trench east of Mindanao, which plate is being subducted?

A. Eurasian Plate
B. Philippine Sea Plate
C. Indo-Australian Plate
D. Pacific Plate

110. How does the Palawan Microcontinental Block differ from the Philippine Mobile Belt?

A. It is an active spreading ridge
B. It is a young volcanic island arc
C. It is a stable continental fragment
D. It is a seismically active trench

111. In the years after the 1991 eruption of Mount Pinatubo, what was the most persistent hazard in the lowlands around the volcano?

A. Rain-triggered lahars
B. Repeated tsunamis
C. Ground subsidence from mining
D. Basaltic lava flows

112. Taal Volcano's main island sits within a lake that occupies a large:

A. Fault-bounded graben only
B. Crater of a cinder cone
C. Caldera
D. Glacial cirque

113. The refractory chromite deposits of Coto in Zambales are hosted by which geologic unit?

A. A limestone reef
B. An ophiolite complex
C. A sedimentary basin
D. A granite batholith

114. The enargite-gold ores of the Lepanto mine in Mankayan, Benguet are a classic example of which deposit type?

A. Banded iron formation
B. High-sulfidation epithermal
C. Podiform chromite
D. Nickel laterite

115. The large nickel laterite deposits of Surigao and southern Palawan formed mainly through:

A. Hydrothermal vein filling
B. Magmatic segregation in granite
C. Weathering of ultramafic rocks
D. Marine evaporation

116. Under RA 7942 (Philippine Mining Act of 1995), what is the term of a Mineral Production Sharing Agreement?

A. Up to 10 years, non-renewable
B. Up to 50 years, non-renewable
C. Up to 5 years, renewable
D. Up to 25 years, renewable

117. Under RA 7942, which agreement allows a foreign-owned company to undertake large-scale exploration, development and utilization of minerals?

A. Financial or Technical Assistance Agreement
B. Quarry permit
C. Mineral Production Sharing Agreement
D. Small-scale mining contract

118. Which Republic Act is the People's Small-Scale Mining Act of 1991?

A. RA 7586
B. RA 7942
C. RA 8749
D. RA 7076

119. Which government agency mainly administers mineral resources under RA 7942?

A. Philippine Space Agency
B. Bureau of Fisheries
C. Mines and Geosciences Bureau
D. Bureau of Soils and Water

120. The 2013 magnitude 7.2 Bohol earthquake produced a surface rupture along the North Bohol Fault. What was its dominant movement?

A. Normal dip-slip
B. Right-lateral strike-slip
C. Reverse (thrust)
D. Left-lateral strike-slip

Answer key

Geology

1. B. 4.00

SG = weight in air / loss of weight in water = 24.60/(24.60 - 18.45) = 24.60/6.15 = 4.00.

2. A. Orthoclase

Glass is about 5.5 and quartz is 7, so the mineral is near 6, the hardness of orthoclase on the Mohs scale.

3. D. Amphiboles

Double-chain (inosilicate) structure defines the amphiboles; pyroxenes are single chains, micas are sheets and olivine has isolated tetrahedra.

4. B. Hornblende

Cleavage angles near 56/124 degrees are diagnostic of amphiboles such as hornblende; pyroxenes like augite cleave at about 87/93 degrees.

5. D. Calcite

Calcite reacts readily with cold dilute HCl; dolomite, magnesite and siderite react weakly unless powdered or heated.

6. D. Orthorhombic

Orthorhombic: a, b and c unequal and all at 90 degrees; tetragonal has two equal axes, monoclinic and triclinic have inclined axes.

7. B. (320)

Reciprocals of the intercepts are 1/2, 1/3 and 0; clearing fractions by multiplying by 6 gives (320).

8. D. 0.225 nm

Bragg's law n(lambda) = 2d sin(theta): d = 0.154/(2 x sin 20) = 0.154/0.684 = 0.225 nm.

9. A. Calcite and aragonite

Calcite and aragonite are both CaCO3 with different crystal structures; the other pairs differ in chemical composition.

10. B. Garnet

Isometric minerals such as garnet are optically isotropic and remain extinct under crossed polars in all orientations.

11. D. Plagioclase

Polysynthetic (albite-law) twinning with low first-order gray colors is the classic identifying feature of plagioclase.

12. B. Hematite

Hematite gives a red-brown streak even when the specimen is metallic gray; magnetite streaks black, galena gray and pyrite greenish-black.

13. D. 69.9%

Fe2O3 molar mass = 2(55.85) + 3(16.00) = 159.7; %Fe = 111.7/159.7 = 69.9%. 72.4% is magnetite and 77.7% is FeO.

14. A. Olivine

Forsterite (Mg2SiO4) and fayalite (Fe2SiO4) are the end-members of the olivine solid-solution series.

15. B. Isometric

Gold and copper both have face-centered cubic structures, which belong to the isometric (cubic) system.

16. A. Olivine

On the discontinuous branch the order is olivine, pyroxene, amphibole then biotite, so olivine forms first at the highest temperature.

17. D. Diorite

Intermediate plagioclase plus hornblende with little quartz or K-feldspar defines diorite; gabbro has calcic plagioclase with pyroxene.

18. B. Andesite

Andesite is the intermediate, plagioclase-hornblende volcanic rock typical of subduction-related island arcs.

19. D. Two stages of cooling

Porphyritic texture records slow crystal growth at depth followed by faster cooling of the remaining melt.

20. D. Dunite

Dunite is peridotite with over 90% olivine; harzburgite and lherzolite contain significant pyroxene.

21. A. Schist

The pelitic progression is slate, phyllite, schist, gneiss and then migmatite at the highest grades.

22. A. Subduction zone

Glaucophane-lawsonite (blueschist facies) needs high pressure at low temperature, conditions found in subduction zones.

23. D. Skarn

Calc-silicate rock formed by metasomatism of carbonate rocks next to an intrusion is a skarn.

24. A. Long transport and reworking

Quartz arenite is texturally and compositionally mature, meaning unstable grains were removed by prolonged transport and reworking.

25. D. Nearby granitic source, rapid erosion

Abundant fresh angular feldspar survives only with short transport from a granitic or gneissic source and limited chemical weathering.

26. C. Kyanite

Kyanite occupies the high-pressure field; andalusite is low pressure and sillimanite high temperature. Staurolite is not Al2SiO5.

27. A. Sheeted dike complex

From top down an ophiolite has pelagic sediments, pillow basalts, sheeted dikes, gabbro and then mantle peridotite.

28. C. Lapilli

Ash is under 2 mm, lapilli are 2 to 64 mm, and blocks or bombs are larger than 64 mm.

29. B. Granodiorite

Q = 120/360 = 33%, and plagioclase/(total feldspar) = 180/240 = 75%, which plots in the granodiorite field (65 to 90%).

30. D. Gypsum

After carbonates, gypsum or anhydrite forms first, then halite, and the potassium-magnesium salts come last.

31. B. 27.5 m

t = w sin(dip) = 48 x sin 35 = 48 x 0.574 = 27.5 m.

32. A. 22.8 degrees

tan(apparent) = tan(true) x sin(angle from strike) = 0.839 x 0.5 = 0.420, so apparent dip = 22.8 degrees.

33. B. 69.9 m

Depth = horizontal distance x tan(dip) = 150 x tan 25 = 150 x 0.466 = 69.9 m.

34. A. Normal fault, extension

Hanging wall down is a normal fault, which forms when the crust is extended (maximum principal stress vertical).

35. C. Right-lateral (dextral)

If the far block appears displaced to the right regardless of which side you stand on, the fault is right-lateral or dextral.

36. B. Anticline

An anticline has older rocks in the core and limbs dipping away from the hinge; a syncline has the youngest rocks in its core.

37. D. Points downstream

Beds dipping downstream at an angle greater than the valley gradient produce a V that points downstream.

38. D. Sigma 1 horizontal, sigma 3 vertical

Thrust faults form when the greatest principal stress is horizontal and the least (sigma 3) is vertical.

39. D. 310 / 30

Dip direction is 130, so the pole trends 130 + 180 = 310 and plunges 90 - 60 = 30 degrees.

40. C. 28.2 m

When slope and dip are in opposite directions, t = w sin(dip + slope) = 30 x sin 70 = 28.2 m.

41. C. 0.25

Extension e = (final - original)/original = (12.5 - 10.0)/10.0 = 0.25; 1.25 is the stretch.

42. C. 26.0 MPa

tau = (sigma1 - sigma3)/2 x sin(2 theta) = 30 x sin 120 = 26.0 MPa; 55 MPa is the normal stress on that plane.

43. C. Direction of fault slip

Slickensides and slickenlines record the direction of relative motion along the fault surface.

44. C. 100.0 m

Heave = net slip x cos(dip) = 200 x cos 60 = 100.0 m; the throw is 200 x sin 60 = 173.2 m.

45. B. Contraction during cooling

Columnar joints form as the lava cools and contracts, producing tension cracks that meet at about 120 degrees.

46. A. At the top

By the law of superposition, in undeformed strata each layer is younger than the one beneath it.

47. A. The conglomerate

Cross-cutting shows the dike is younger than the beds, and the conglomerate above the erosion surface is younger than all of them.

48. C. Angular unconformity

An angular unconformity separates older tilted strata from younger beds lying at a different angle above them.

49. C. Nonconformity

A nonconformity is an erosion surface where sedimentary rock overlies plutonic or metamorphic rock.

50. D. Short time range, wide distribution

An index fossil should have lived for a short time, be widely distributed and be abundant and easy to recognize.

51. D. 2.1 billion years

D/P = 7 means 1/8 of the parent remains, which is 3 half-lives: 3 x 0.70 = 2.1 billion years.

52. A. 11,460 years

25% remaining equals two half-lives: 2 x 5,730 = 11,460 years.

53. A. Walther's law

Walther's law relates vertical facies successions without breaks to side-by-side depositional environments.

54. A. A marine transgression

Deeper-water facies stacked on shallower ones show the shoreline moving landward, a transgression.

55. D. Planktonic foraminifera

Planktonic foraminifera evolved rapidly and are widespread in Cenozoic marine rocks; the other groups were extinct by then.

56. B. Ordovician and Silurian

Graptolites evolved rapidly and spread widely in Ordovician and Silurian seas, making them key zone fossils for those periods.

57. A. Cretaceous-Paleogene

Non-avian dinosaurs died out at the Cretaceous-Paleogene boundary, about 66 million years ago.

58. D. 0.30 mm/yr

Rate = 45,000 mm / 150,000 yr = 0.30 mm per year.

59. D. Grain size fines toward the top

In a graded bed the original top is where the grains are finest, so the fining direction marks way-up.

60. A. Cast

The empty cavity is a mold; when it is filled with sediment or minerals the result is a cast.

61. B. 125,280 t

Volume = 120 x 45 x 8 = 43,200 m3; tonnage = 43,200 x 2.9 = 125,280 t.

62. C. 11,250 t

Contained Cu = 2,500,000 t x 0.0045 = 11,250 t.

63. B. 2.87 g/t

(1.5x4.2 + 2.5x1.8 + 3.0x3.1)/7.0 = 20.1/7.0 = 2.87 g/t; 3.03 g/t is the simple unweighted mean.

64. A. 4.0 : 1

Stripping ratio = waste/ore = 6.4/1.6 = 4.0 : 1.

65. A. Propylitic

Porphyry alteration zones outward from potassic through phyllic to propylitic, the outer chlorite-epidote-calcite halo.

66. A. High-sulfidation epithermal

Vuggy silica, advanced argillic alteration and enargite are hallmarks of acidic, high-sulfidation epithermal systems.

67. A. Low-sulfidation epithermal

Adularia, banded quartz textures and bladed calcite (boiling) are typical of near-neutral low-sulfidation epithermal veins.

68. A. Volcanogenic massive sulfide

A seafloor massive sulfide lens over a feeder stringer zone in volcanic rocks is the classic VMS (Kuroko-type) setting.

69. A. Saprolite zone

Ni leached from the upper limonite moves down and is fixed in Mg-silicates such as garnierite in the saprolite zone.

70. A. Inner bends and bedrock traps

Dense gold settles where flow slows, such as point bars on inner bends and riffles or cracks in bedrock.

71. D. Arsenic

Arsenic travels with gold in many hydrothermal systems and forms broader, easier-to-detect soil anomalies.

72. D. Mantle section of an ophiolite

Podiform chromite forms dunite-enveloped pods in harzburgite of the ophiolite mantle sequence.

73. B. Precambrian

Major banded iron formations formed mainly in the Precambrian, especially about 2.5 to 1.8 billion years ago.

74. D. 0.56 g/t

Cutoff = cost/(price x recovery) = 30/(60 x 0.90) = 0.56 g/t.

75. C. Inferred

Inferred resources have the least confidence; measured is highest, and probable is a reserve, not a resource category.

76. C. 25.0%

Pore volume = 582.5 - 520.0 = 62.5 cm3; porosity = 62.5/250 = 25.0%. 33.3% is the void ratio.

77. A. 0.43

e = n/(1 - n) = 0.30/0.70 = 0.43.

78. D. 36.0 m3/day

i = 3.0/600 = 0.005; A = 40 x 12 = 480 m2; Q = 15 x 0.005 x 480 = 36.0 m3/day.

79. B. 0.30 m/day

Darcy flux q = 15 x 0.005 = 0.075 m/day; seepage velocity = q/ne = 0.075/0.25 = 0.30 m/day.

80. C. 690,000 m3

Sy = 0.35 - 0.12 = 0.23; volume = 2,000,000 m2 x 1.5 m x 0.23 = 690,000 m3.

81. C. Confined (artesian)

Pressure head in a confined aquifer lifts water above the aquifer top; in an unconfined aquifer it stays at the water table.

82. B. 61%

Only pieces 10 cm or longer count: 25+18+12+30+15+22 = 122 cm; RQD = 122/200 = 61%.

83. D. 1.27

FS = tan(phi)/tan(beta) = tan 34/tan 28 = 0.675/0.532 = 1.27.

84. B. Montmorillonite

Montmorillonite (smectite) takes water between its layers, causing large volume change on wetting and drying.

85. D. Loose saturated fine sand

Cyclic loading raises pore pressure in loose, saturated, cohesionless sand until it loses effective stress and strength.

86. C. Seepage loss through karst

Solution cavities and conduits in karst can cause major leakage from reservoirs and under dam foundations.

87. A. Clay

Clay has very small, poorly connected pore throats and so has K many orders of magnitude lower than sand or gravel.

88. C. 655 m3/day

Q = 2 pi K b (h2 - h1)/ln(r2/r1) = 2 pi x 20 x 15 x 0.80/ln 10 = 1508/2.303 = 655 m3/day.

89. B. 1.83 Mg/m3

Dry density = bulk density/(1 + w) = 2.10/1.15 = 1.83 Mg/m3.

90. C. On top of the water table

Gasoline is a light non-aqueous phase liquid (LNAPL), less dense than water, so it floats on the water table.

91. B. 100.8 km

d = t/(1/Vs - 1/Vp) = 12/(0.2857 - 0.1667) = 12/0.1190 = 100.8 km.

92. C. About 1,000 times

Energy grows by about 10^1.5 (31.6) per magnitude unit, so for 2 units it is 10^3 = about 1,000 times.

93. C. 1,000 m

Depth = v x t/2 = 2,500 x 0.80/2 = 1,000 m.

94. B. 46.3 mGal

Free-air correction = 0.3086 x 150 = 46.3 mGal; 16.8 mGal would be the Bouguer slab correction for 2.67 g/cm3.

95. B. Magnetic survey

Magnetite has very high magnetic susceptibility, producing strong anomalies in a magnetic survey.

96. A. Induced polarization

Disseminated sulfide grains become polarized under current, giving high chargeability in induced polarization surveys.

97. C. 103 C

T = 28 + 30 x 2.5 = 28 + 75 = 103 C.

98. B. 16.8 km

Root = h x rho_c/(rho_m - rho_c) = 3.0 x 2.8/0.5 = 16.8 km.

99. B. Pyroclastic density current

Pyroclastic density currents are fast, hot gas-particle flows; lahars are water-saturated volcanic debris flows.

100. B. Shallow megathrust event

Large shallow subduction megathrust ruptures lift or drop the seafloor vertically and displace the water column.

101. D. It raises pore water pressure

Rising pore pressure reduces effective normal stress and thus the shear strength available to resist sliding.

102. D. Intensity varies by location

Magnitude measures energy at the source; intensity describes shaking effects, which change with distance and site conditions.

103. C. The outer core is liquid

S-waves cannot travel through liquids, so the liquid outer core blocks them and creates the S-wave shadow zone.

104. C. Mohorovicic discontinuity

The Moho marks the crust-mantle boundary, where P-wave speed rises to about 8 km/s in mantle peridotite.

105. A. Erupted volume and plume height

The VEI is a logarithmic scale using the volume of tephra erupted together with eruption column height.

106. C. Left-lateral strike-slip

The Philippine Fault Zone is a major left-lateral (sinistral) strike-slip fault running from Luzon to Mindanao.

107. C. Philippine Fault Zone

The 1990 Luzon earthquake ruptured the Digdig segment of the Philippine Fault Zone, producing long surface ruptures.

108. B. Manila Trench

The Manila Trench, west of Luzon, is where the South China Sea plate subducts eastward.

109. B. Philippine Sea Plate

The Philippine Sea Plate subducts westward beneath the Philippine Mobile Belt along the Philippine Trench.

110. C. It is a stable continental fragment

The Palawan block is a continental fragment that rifted from the South China margin and is far less seismically active.

111. A. Rain-triggered lahars

Thick pyroclastic deposits were remobilized by monsoon and typhoon rains for years, creating destructive lahars.

112. C. Caldera

Lake Taal fills a large caldera formed by earlier major explosive eruptions, with Volcano Island inside it.

113. B. An ophiolite complex

The Coto chromite deposits lie in ultramafic rocks of the Zambales Ophiolite Complex.

114. B. High-sulfidation epithermal

Lepanto is a well-known high-sulfidation epithermal deposit with enargite and advanced argillic alteration.

115. C. Weathering of ultramafic rocks

Intense tropical weathering of ultramafic rocks leaches magnesium and silica and concentrates nickel in the regolith.

116. D. Up to 25 years, renewable

An MPSA runs for a period not over 25 years and may be renewed for another term not over 25 years.

117. A. Financial or Technical Assistance Agreement

The FTAA is the mode under RA 7942 for large-scale mining that may be entered into by qualified foreign-owned firms.

118. D. RA 7076

RA 7076 governs small-scale mining; RA 7942 is the Mining Act, RA 7586 is NIPAS and RA 8749 is the Clean Air Act.

119. C. Mines and Geosciences Bureau

The Mines and Geosciences Bureau under the DENR implements the Philippine Mining Act.

120. C. Reverse (thrust)

The Bohol earthquake ruptured the North Bohol Fault as a reverse fault, uplifting the hanging wall to form a scarp.

Topics to review

• Minerals, rocks and petrology

• Structural geology and geologic maps

• Stratigraphy and Philippine tectonics

• Economic geology, hydrogeology and geohazards

Online question banks and study resources

Geology - Pass Harbor (Question bank)

Official PRC board information

Current PRC exam programs

Independent study material prepared by Board Exam Desk.