

# EARTH SCIENCE



## QUESTION CATALOGUE

# The Physical Setting/ EARTH SCIENCE

## Question Catalogue Contents

### I. PROLOGUE

1. Observation and Classification	
A. Observation	
1. Sensory perception .....	1
2. Inferences .....	1
B. A System of Classification	
1. Classification .....	3
2. Simple Measurements	
A. Measurements	
1. Dimensional quantities .....	4
2. Comparison .....	5
3. Error .....	5
B. Density	
1. Qualitative answers .....	8
2. Quantitative answers .....	11
3. Nature of Change	
A. Characteristics of Change	
1. Rate of change .....	13
2. Cycles - Noncycles .....	16
3. Predictability of change .....	17
4. Enrichment Section .....	18
4. Constructed Response .....	18
GROUP QUESTIONS for Unit I .....	21

### II. DESCRIBING THE EARTH

1. Earth Dimensions	
A. Shape	
1. Evidence .....	31
B. Size (Enrichment)	
1. Measurement techniques .....	33
2. Measurement determination .....	35
C. Atmosphere, Hydrosphere, Lithosphere	
1. Atmosphere .....	35
2. Hydrosphere .....	38
3. Lithosphere .....	40
2. Positions on Earth	
A. Position Determination	
1. Coordinate systems .....	43
B. Position Description	
1. Field Quantities .....	50
2. Fields and Gradients .....	51
3. Constructed Response .....	60
GROUP QUESTIONS for Unit II .....	73

### III. ASTRONOMY

1. Celestial Observations	
A. Motion of Objects in Sky	
1. Star paths .....	109
2. Planetary motions .....	111
3. Earth's moon .....	113
4. Sun and the seasons .....	119
5. Enrichment - Apparent Diameter .....	127
2. Terrestrial Observations	
A. Motion at the Earth's Surface	
1. Foucault pendulum .....	128
2. Coriolis effect .....	129
3. Time	
A. Frames of Reference for Time	
1. Earth motions .....	131
4. Our Solar System	
A. Geocentric & Heliocentric Models	
1. Geocentric model .....	135
2. Heliocentric model .....	136
B. The Nature of Orbits	
1. Geometry of orbits .....	138
2. Gravity and energy transformations .....	142
C. Solar System Astronomy	
1. Planets .....	147
2. Comets, Meteors and Asteroids .....	150
3. Planetary Origins and Atmospheres .....	151
5. Modern Astronomy	
A. Deep Space Astronomy	
1. Cosmology / Galaxies etc. ....	151
2. Doppler Effect .....	153
B. Stellar Astronomy	
1. Our Sun .....	154
2. HR Diagram .....	155
3. Stellar Evolution and Classification .....	157
6. Constructed Response .....	159
GROUP QUESTIONS for Unit III .....	174

### IV. ENERGY IN EARTH PROCESSES

1. Electromagnetic Energy/Energy Transfer	
A. Electromagnetic Energy	
1. Properties .....	215
2. Solar energy .....	217
B. Energy Transfer	
1. Thermodynamics .....	218
2. Conduction .....	220
3. Convection .....	221
4. Radiation .....	223

<b>2. Energy Transformation</b>	
<b>A. Transformation in Earth's Processes</b>	
1. Latent/Specific Heat (qualitative) .....	225
2. Gravitational Energy .....	228
3. Enrichment .....	228
<b>3. Insolation at the Earth's Surface</b>	
<b>A. Insolation Factors</b>	
1. Angle .....	229
2. Duration .....	235
3. Ozone .....	239
4. Scattering and Reflection .....	239
<b>4. Terrestrial Radiation</b>	
<b>A. Radiation Factors</b>	
1. Material radiation .....	243
2. Greenhouse Effect .....	245
<b>5. Constructed Response .....</b>	<b>248</b>
<b>GROUP QUESTIONS for Unit IV .....</b>	<b>251</b>

## **V. WEATHER AND THE ATMOSPHERE**

<b>1. Atmospheric Variables</b>	
<b>A. Local Atmospheric Variables</b>	
1. Weather prediction .....	279
2. Temperature variations .....	280
3. Pressure variations/Wind .....	281
4. Moisture variations .....	285
5. Air movement .....	287
6. Environmental Changes .....	289
<b>2. Synoptic Weather Data</b>	
<b>A. Synoptic Analysis</b>	
1. Airmass characteristics/Fronts .....	291
2. Airmass source regions .....	296
3. Airmass tracks .....	299
4. Station Models .....	301
<b>3. Atmospheric Energy Exchanges</b>	
<b>A. Input of Moisture &amp; Energy</b>	
1. Evaporation and transpiration .....	304
2. Vapor pressure .....	308
3. Relative humidity/Dew point .....	309
<b>B. Moisture and Energy Transfer</b>	
1. Density differences .....	312
2. Wind speed and direction .....	313
3. Adiabatic changes .....	315
<b>C. Moisture in Atmosphere</b>	
1. Condensation and Sublimation .....	317
2. Cloud formation .....	318
<b>D. Moisture from Atmosphere</b>	
1. Precipitation .....	319
2. Wind - Water interaction .....	320

4. Climate Pattern Factors	
A. Factors	
1. Latitude .....	322
2. Elevation .....	324
3. Large Bodies Water / Ocean Current .....	325
4. Mountain barriers .....	330
5. Wind belts .....	333
6. Storm Tracks/Emergency Preparation .....	334
5. Constructed Response .....	335
GROUP QUESTIONS for Unit V .....	362

## **VI. GROUND WATER**

1. Earth's Water	
A. Ground Water	
1. Infiltration .....	407
2. Permeability .....	410
3. Porosity .....	412
4. Capillary .....	413
B. Surface Water	
1. Runoff .....	414
C. Water Pollution	
1. Types of pollutants .....	417
2. Concentration of pollutants .....	418
2. The Local Water Budget	
A. Water Budget Variables	
1. Precipitation .....	420
2. Potential Evapotranspiration .....	421
3. Moisture Utilization .....	422
5. Moisture deficit .....	423
7. Moisture surplus .....	425
B. Streams	
1. Stream discharge & water budget .....	426
C. Climates and Local Water Budget	
1. Climatic regions .....	427
3. Constructed Response .....	428
GROUP QUESTIONS for Unit VI .....	429

## **VII. THE EROSIONAL PROCESS**

1. Weathering	
A. Evidence of Weathering	
1. Weathering Processes .....	441
2. Weathering Rates .....	445
3. Soil Formation .....	450
4. Soil Solution .....	450

<b>2. Erosion</b>	
<b>A. Evidence of Erosion</b>	
1. Displaced Sediments .....	451
2. Properties of Transported Materials .....	452
<b>B. Factors affecting Transportation</b>	
1. Gravity .....	453
2. Water Erosion .....	454
3. Wind and Ice erosion .....	455
4. Effect of Erosional Agents .....	459
5. Predominant Agent .....	460
<b>C. Coastal Processes</b>	
1. Coastal Processes .....	460
<b>3. Constructed Response .....</b>	<b>462</b>
<b>GROUP QUESTIONS for Unit VII .....</b>	<b>465</b>

## **VIII. THE DEPOSITIONAL PROCESS**

<b>1. Deposition</b>	
<b>A. Factors</b>	
1. Size .....	493
2. Shape .....	499
3. Density .....	501
4. Velocity .....	503
<b>2. Erosional - Depositional System</b>	
<b>A. Characteristics</b>	
1. Erosional - Depositional change .....	506
2. Dominant process .....	509
3. Erosional-depositional interface .....	512
4. Dynamic equilibrium .....	515
<b>3. Landscape Characteristics</b>	
<b>A. Quantitative Observations</b>	
1. General .....	516
2. Stream patterns .....	518
3. Soil associations .....	525
<b>B. Relationship of Characteristics</b>	
1. Landscape regions of New York State .....	526
<b>4. Landscape Development</b>	
<b>A. Environmental Factors</b>	
1. Uplifting and leveling force .....	534
2. Climate .....	536
3. Bedrock .....	539
4. Time .....	541
6. Man .....	542
<b>5. Constructed Response .....</b>	<b>544</b>
<b>GROUP QUESTIONS for Unit VIII .....</b>	<b>545</b>

## **IX. THE FORMATION OF ROCKS**

<b>1. Rocks and Sediments</b>	
<b>A. Comparative Properties</b>	
2. Differences .....	583
<b>2. Minerals</b>	
<b>A. Relation to Rocks</b>	
1. Composition .....	584
<b>B. Characteristics</b>	
1. Physical, chemical properties .....	587
2. Chemical composition .....	590
3. Structure .....	591
<b>3. Rock Formation</b>	
<b>A. Sedimentary Rocks</b>	
1. Compression cementation .....	593
2. Chemical processes/Particle size .....	595
3. Biological processes .....	597
<b>B. Non-sedimentary Rocks</b>	
1. Solidification process .....	599
2. Recrystallization process .....	603
<b>C. Environment of Formation</b>	
1. Inferred characteristics .....	605
2. Distribution .....	608
<b>4. Rock Cycle</b>	
<b>A. Evidence</b>	
1. Transition zones .....	609
2. Rock cycle .....	610
<b>5. Constructed Response .....</b>	<b>611</b>
<b>GROUP QUESTIONS for Unit IX .....</b>	<b>612</b>

## **X. THE DYNAMIC CRUST**

<b>1. Evidence of Crustal Movement</b>	
<b>A. Minor Crustal Changes</b>	
1. Deformed rock strata .....	649
2. Displaced fossils .....	652
3. Displaced strata .....	653
<b>B. Major Crustal Changes</b>	
1. Zones of crustal activity .....	655
3. Vertical movements .....	659
4. Ocean floor spreading .....	660
5. Continental drift .....	665
6. Magnetic poles .....	667
<b>2. Earthquakes</b>	
<b>A. Wave Properties</b>	
1. Types of waves .....	668
2. Velocities .....	668
3. Transmission .....	670
<b>B. Location of Epicenter</b>	
1. Epicenter .....	674
2. Origin time .....	680

<b>3. Earth's Crust and Interior</b>	
<b>A. Properties</b>	
1. Solid and liquid zones .....	681
2. Crustal thickness .....	682
3. Crustal composition .....	683
4. Density, Temperature, & Pressure .....	684
5. Interior composition .....	686
<b>4. Theories of Crustal Change</b>	
<b>A. Inferred Processes</b>	
1. Mantle convection cells .....	687
2. Geosynclinal development .....	689
3. Process relationships .....	690
<b>5. Constructed Response .....</b>	<b>691</b>
<b>GROUP QUESTIONS for Unit X .....</b>	<b>693</b>

## **XI. INTERPRETING GEOLOGICAL HISTORY**

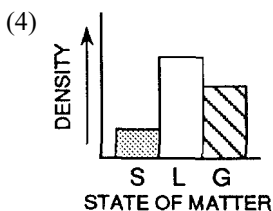
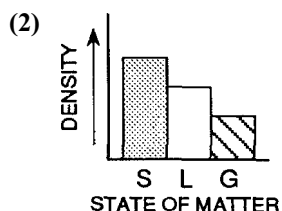
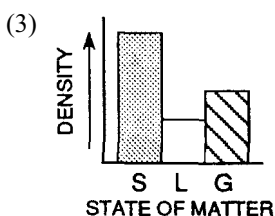
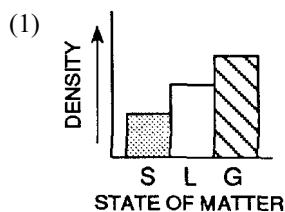
<b>1. Geologic events</b>	
<b>A. Sequence of Geological Events</b>	
1. Chronology of layers .....	743
2. Igneous intrusions & extrusions .....	747
3. Faults, joints, and folds .....	750
4. Internal characteristics .....	753
<b>2. Correlation Techniques</b>	
<b>A. Correlation</b>	
1. Continuity .....	754
2. Similarity of rock .....	754
3. Fossil evidence .....	755
4. Volcanic time markers .....	759
5. Anomalies to correlation .....	759
<b>3. Determining Geologic Ages</b>	
<b>A. Rock Record</b>	
2. Scale of geologic time .....	760
3. Erosional record .....	765
4. Geologic history of an area .....	767
<b>B. Radioactive Decay</b>	
1. Decay rates .....	770
2. Half-lives .....	772
<b>4. The Fossil Record</b>	
<b>A. Ancient Life</b>	
1. Variety of life forms .....	777
2. Evolutionary development .....	780
<b>5. Constructed Response .....</b>	<b>781</b>
<b>GROUP QUESTIONS for Unit XI .....</b>	<b>785</b>

# I. PROLOGUE

## 2. Simple Measurements

1053. Which graph best represents the relationship between the density of a substance and its state of matter (phase) for most earth materials, *excluding* water?

[Key: S = solid, L = liquid, G = gas]



1410. Which material has the greatest density?

- (1) ice at  $-20^{\circ}\text{C}$
- (2) a mixture of water and ice at  $0^{\circ}\text{C}$
- (3) water vapor at  $200^{\circ}\text{C}$
- (4) **water at  $4^{\circ}\text{C}$**

1844. Water has the greatest density at

- (1)  $100^{\circ}\text{C}$  in the gaseous phase
- (2)  $0^{\circ}\text{C}$  in the solid phase
- (3)  $4^{\circ}\text{C}$  in the solid phase
- (4)  **$4^{\circ}\text{C}$  in the liquid phase**

1891. A mineral sample is found to have a density of 3.0 grams per cubic centimeter. It is then broken into two pieces, with one piece twice as large as the other. The smaller of the two pieces will have a density of

- (1)  $1.0\text{ g/cm}^3$
- (2)  $1.5\text{ g/cm}^3$
- (3)  **$3.0\text{ g/cm}^3$**
- (4)  $6.0\text{ g/cm}^3$

2026. Water has its greatest density at a temperature of

- (1)  $-6^{\circ}\text{C}$
- (2)  $10^{\circ}\text{C}$
- (3)  $32^{\circ}\text{C}$
- (4)  **$4^{\circ}\text{C}$**

2090. Compared to the density of liquid water, the density of an ice cube is

- (1) **always less**
- (2) always greater
- (3) always the same
- (4) sometimes less and sometimes greater

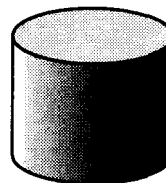
4646. As air on the surface of Earth warms, the density of the air

- (1) **decreases**
- (2) increases
- (3) remains the same

# B. Density

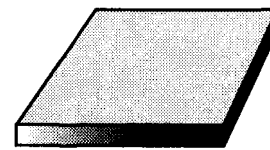
## 1. Qualitative answers

2136. The diagrams below represent two solid objects, *A* and *B*, with different densities.



Object A

(Density =  $0.8\text{ g/cm}^3$ )



Object B

(Density =  $1.2\text{ g/cm}^3$ )

What will happen when the objects are placed in a container of water (water temperature =  $4^{\circ}\text{C}$ )?

- (1) Both objects will sink.
- (2) Both objects will float.
- (3) **Object A will float, and object B will sink.**
- (4) Object B will float, and object A will sink.

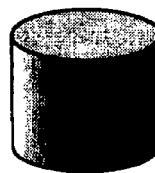
2196. Under the same conditions of temperature and pressure, three different samples of the same uniform substance will have the same

- (1) shape
- (2) **density**
- (3) mass
- (4) volume

2263. A quantity of water is frozen solid and then heated from  $0^{\circ}\text{C}$  to  $10^{\circ}\text{C}$ . Which statement best describes the properties of the water during this time?

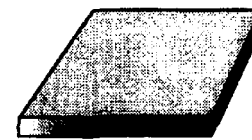
- (1) Mass and volume change.
- (2) **Volume and density change.**
- (3) Mass changes but volume remains constant.
- (4) Volume changes but density remains constant.

3331. The diagrams below represent two solid objects *A* and *B*, with different densities.



Object A

(Density =  $0.8\text{ g/cm}^3$ )



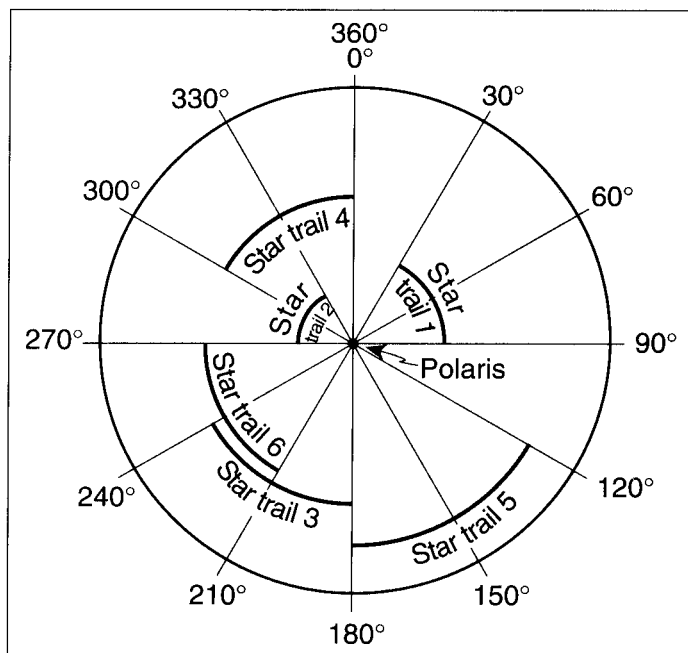
Object B

(Density =  $1.2\text{ g/cm}^3$ )

What will happen when the objects are placed in a container of water (water temperature =  $4^{\circ}\text{C}$ )?

- (1) Both objects will sink.
- (2) Both objects will float.
- (3) **Object A will float and object B will sink.**
- (4) Object B will float and object A will sink.

5166. A camera was placed outside at night and pointed directly at *Polaris* and several other stars. The lens was kept open and a time-exposure photograph was taken. The diagram below represents that photograph of *Polaris* and star trails, with an angular protractor to measure apparent motion.



How many hours was the lens kept open to create the star trails in this photograph?

- (1) 1 hour                      (2) 6 hours                      (3) 3 hours                      (4) 4 hours

393. Why do stars appear to move through the night sky at the rate of 15 degrees per hour?

- (1) The Earth actually moves around the Sun at a rate of 15° per hour.  
 (2) The stars actually move around the center of the galaxy at a rate of 15° per hour.  
**(3) The Earth actually rotates at a rate of 15° per hour.**  
 (4) The stars actually revolve around the Earth at a rate of 15° per hour.

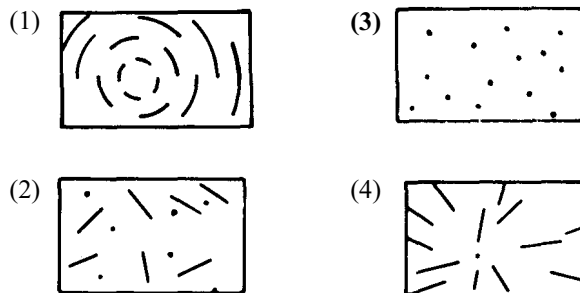
530. Based on observations made in the Northern Hemisphere, which statement is the best supporting evidence that the Earth rotates on its axis?

- (1) The stars appear to follow daily circular paths around Polaris.**  
 (2) The apparent solar diameter varies throughout the year.  
 (3) The length of the daylight period varies throughout the year.  
 (4) The seasons (spring, summer, fall, and winter) repeat in a cyclic pattern.

2097. To an observer in New York State, stars appear to rise in the

- (1) north                      **(3) east**  
 (2) south                      (4) west

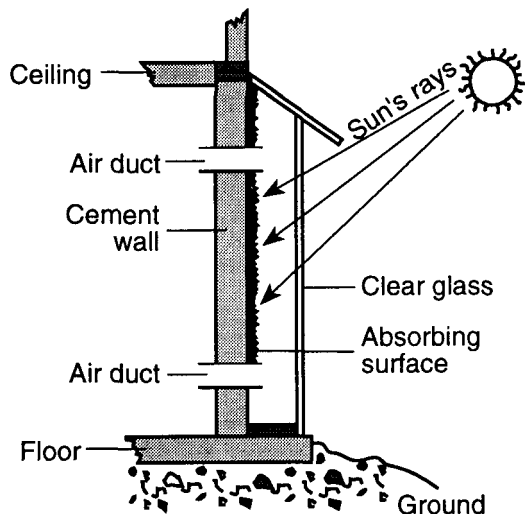
644. How would a three-hour time exposure photograph of stars in the northern sky appear if the Earth did *not* rotate?



998. How does the position of *Polaris* appear to change as an observer travels due north from the Equator?

- (1) The angle of *Polaris* above the northern horizon decreases.  
**(2) The angle of *Polaris* above the northern horizon increases.**  
 (3) *Polaris* appears to move westward.  
 (4) *Polaris* appears to move eastward.

Base your answers to questions 3283 through 3287 on the Earth Science Reference Tables and the diagram and table below. The diagram shows a cross section of a solar-energy collecting system constructed as a portion of a wall of a house. It consists of an energy-absorbing surface, a clear glass covering, and air ducts through the wall into the house. The table gives the house temperatures during a spring day. No other heat source is available for the house.



Time of Day	House Air Temperature (°C)
6 a.m.	12
8 a.m.	14
10 a.m.	16
noon	19
2 p.m.	22
4 p.m.	20

3283. For maximum absorption of solar radiation, the energy-absorbing surface should be  
 (1) smooth and light colored (2) smooth and dark colored (3) rough and light colored (4) **rough and dark colored**
3284. What is the purpose of the clear glass covering of this solar collector?  
 (1) The glass radiates infrared energy.  
 (2) The glass radiates ultraviolet energy.  
 (3) **The glass allows short-wave radiation to enter and traps long-wave reradiation.**  
 (4) The glass allows long-wave radiation to enter and traps short-wave reradiation.
3285. In New York State, on which exterior wall should the solar collector be placed to receive the most insolation?  
 (1) a north-facing wall (2) **a south-facing wall** (3) an east-facing wall (4) a west-facing wall
3286. When did the maximum air temperature occur in the house?  
 (1) just before sunrise  
 (2) just before the time of the maximum angle of insolation for the day  
 (3) **just after the time of the maximum angle of insolation for the day**  
 (4) just after sunset
3287. Which diagram best represents the direction of air flow through the system under normal solar heating conditions?

