

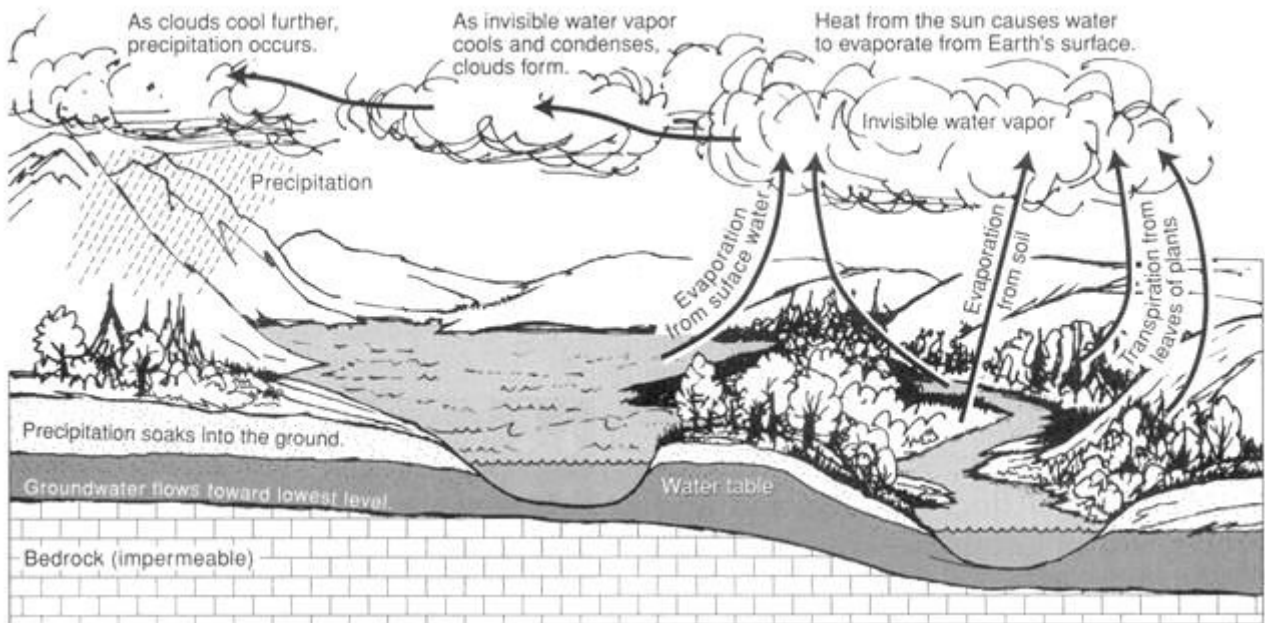
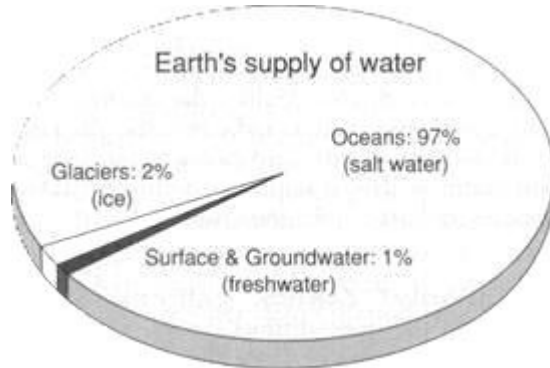
CLIMATE

AIM 1: What is the water or hydrologic cycle?

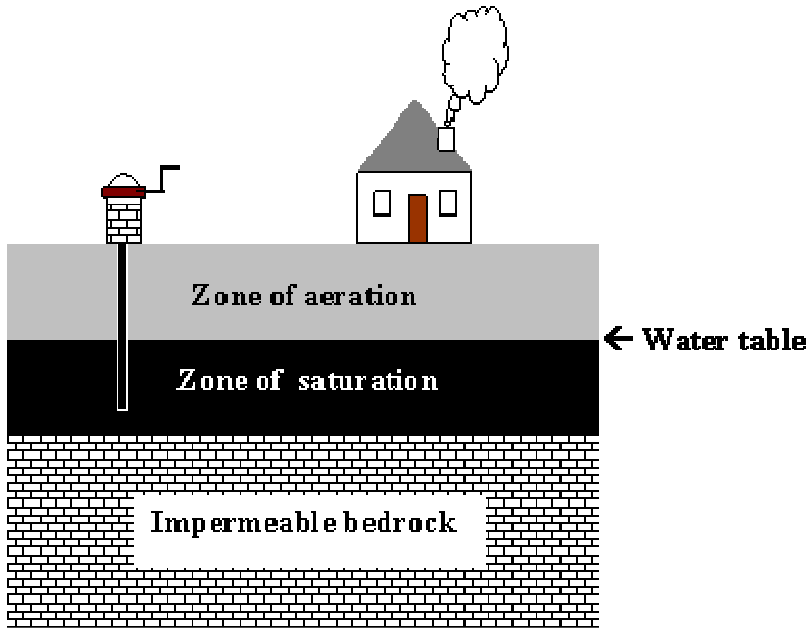
HW

- Read "The Hydrologic Cycle" p184-188
- Do all questions on Part A&B-1 on p188-190

Earth has a limited supply of water that circulates among the atmosphere, land and oceans in a never-ending series of changes.



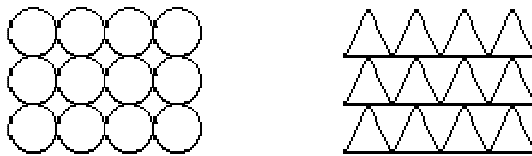
As water passes through the ground (infiltrates), soil and rock act as a natural filter.



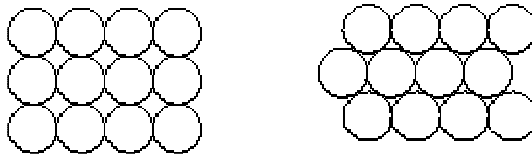
- The **zone of saturation** is the space where all spaces in soil and rocks are filled with water.
- The **water table** is the boundary between the zone of aeration and zone of saturation.
- The **zone of aeration** is the space between the surface and the water table.

The storage and movement of groundwater are affected by porosity, permeability, surface runoff and capillarity.

- **Porosity** is the percentage of empty space (pores) in a certain volume. The porosity depends on shape, packing, mixture of size particles and cementing.
 - **Shape:** A packed sample of rounded particles has a higher porosity than a packed sample of triangle particles



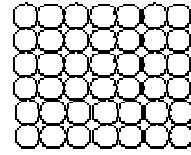
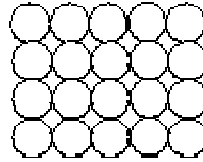
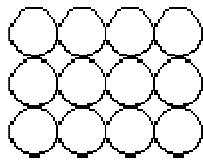
- **Packing:** Porosity decreases when packing increases.



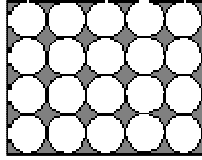
- **Mixture of size particles:** Porosity decreases as smaller particles fill-up spaces between large ones.



Note: Particle size alone does not affect the porosity of a soil. The three samples below have the same porosity.



- **Cementing:** Some rocks have low porosities because of a cementing material that filled up space between particles.

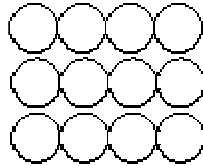


- **Permeability** is the ability of a soil to transmit water. The rate of permeability, or how fast water can pass through a sample, depends on the size and connection of the pores.

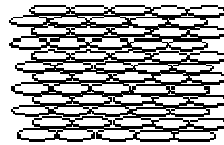
Ex:

Sample A has high permeability because of the large pores that are well connected.

Sample B has low permeability because of the small pores that are not well connected.



A



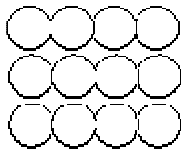
B

- **Surface runoff** occurs when rainfall exceeds the permeability rate of a soil. Water will not penetrate the soil if;
 - a soil is already saturated with water
 - the slope (gradient) of a soil's surface is too great
 - water within a soil is frozen
- **Capillarity** is the ability of a soil to draw water up-ward through tiny spaces between soil grains because of the attraction between water molecules and the soil particles.

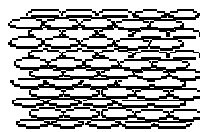
Ex:

Sample A has low capillary action because of the large pores.

Sample B has high capillary action because of the small pores.



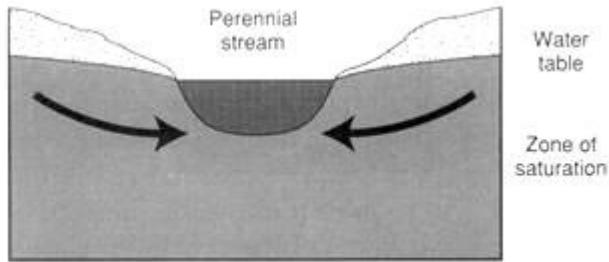
A



B

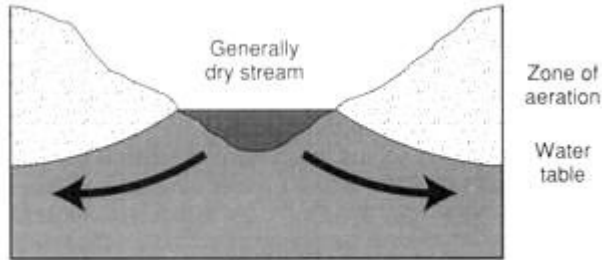
Groundwater can flow into or out of streams.

- **In moist climates** the water table is usually high and therefore groundwater flows into the streams to sustain flow between rainstorms.



Moist climate: Groundwater replenishes the stream.

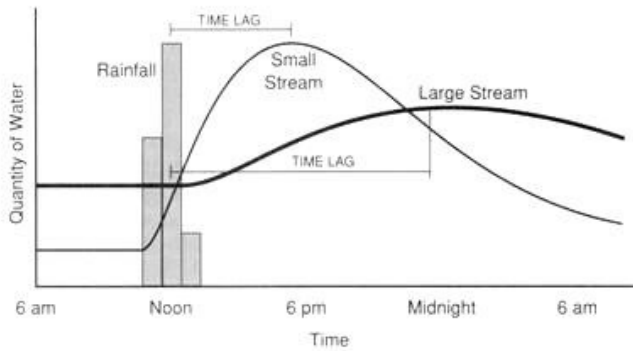
- **In arid climates** the water table is usually low and the water from the stream drains into the ground.



Arid climate: Stream replenishes the groundwater.

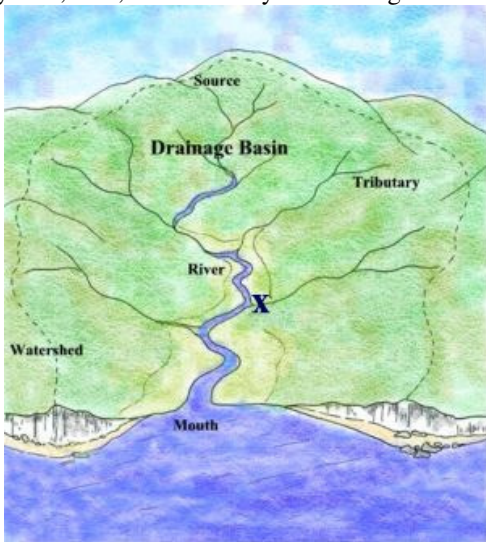
After a period of precipitation, water moves through and over the ground to feed streams.

- The time lag is the time delay between maximum precipitation and maximum stream capacity.
 - Small streams respond quickly, with only a brief time lag.
 - Large streams respond slowly, with a longer time lag.
 - Brief time lag is also associated with high gradient and arid land.
 - Longer time lag is also associated with low gradient, snow and dense vegetation.



A watershed is a drainage basin.

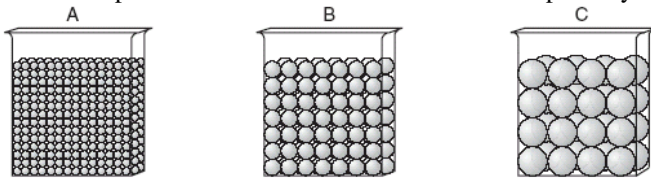
An area drained by a river system. A drainage basin includes all areas that gather precipitation water and direct it to a particular stream, stream system, lake, or other body of standing water.



TEST YOUR UNDERSTANDING

8/07

16 The diagrams below represent three containers, A, B, and C, which were filled with equal volumes of uniformly sorted plastic beads. Water was poured into each container to determine porosity and infiltration time.



(Not drawn to scale)

Which data table best represents the porosity and infiltration time of the beads in the three containers?

Beaker	Porosity (%)	Infiltration Time (sec)
A	40	5.2
B	40	2.8
C	40	0.4

(1)

Beaker	Porosity (%)	Infiltration Time (sec)
A	20	5.2
B	30	2.8
C	40	0.4

(3)

Beaker	Porosity (%)	Infiltration Time (sec)
A	40	0.4
B	40	2.8
C	40	5.2

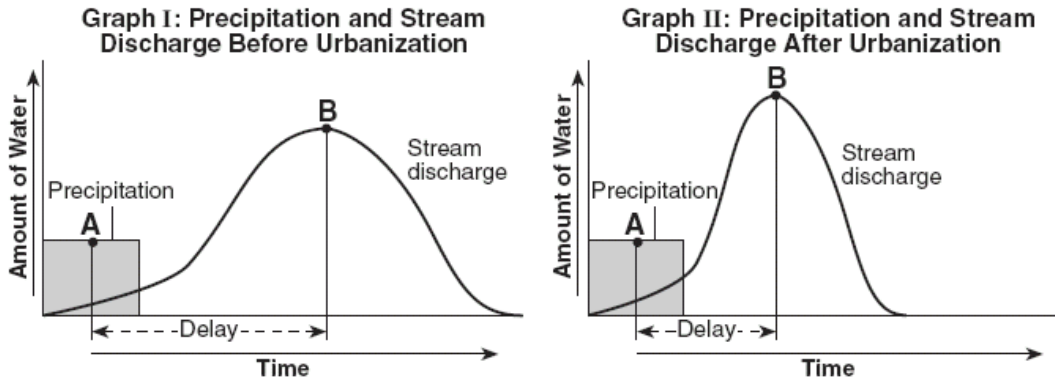
(2)

Beaker	Porosity (%)	Infiltration Time (sec)
A	20	0.4
B	30	2.8
C	40	5.2

(4)

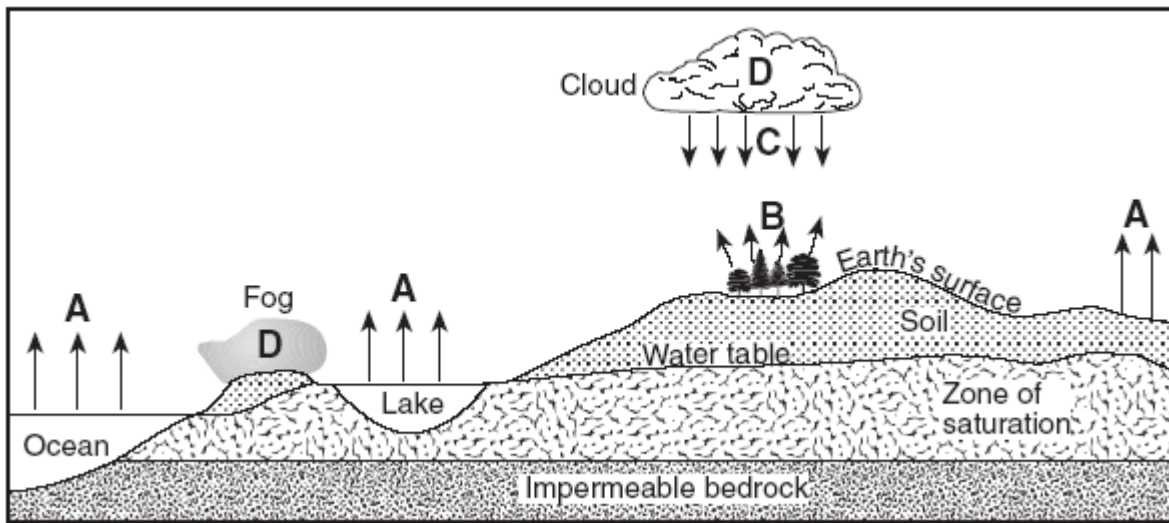
1/07

Base your answers to questions 39 and 40 on the two graphs below, which show the relationship between the amount of rainfall during a storm and the amount of discharge into a nearby stream. Letter *A* represents the time when approximately 50% of the precipitation from the storm has fallen. Letter *B* represents the time when peak runoff from the storm is flowing into the stream. The delay is the difference in time between letters *A* and *B* on the graph. Graph I shows data before urbanization in an area. Graph II shows data after urbanization in the same area.



- 39 The delay time between points *A* and *B* on both graphs is due mainly to the time needed for
- (1) groundwater to evaporate
 - (2) precipitation water to move into the streams
 - (3) green plants to absorb precipitation
 - (4) rainfall rate to decrease
- 40 How did urbanization affect delay time between points *A* and *B* and the maximum stream discharge?
- (1) The delay time decreased, and the maximum discharge decreased.
 - (2) The delay time decreased, and the maximum discharge increased.
 - (3) The delay time increased, and the maximum discharge decreased.
 - (4) The delay time increased, and the maximum discharge increased.

Base your answers to questions 49 and 50 on the cross section below, which represents part of Earth's water cycle. Letters *A*, *B*, *C*, and *D* represent processes that occur during the cycle. The level of the water table and the extent of the zone of saturation are shown.

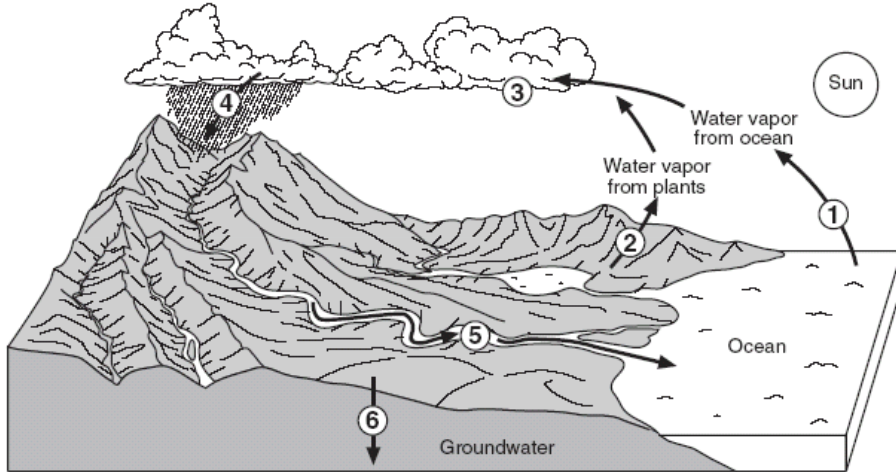


- 49 Which two letters represent processes in the water cycle that usually cause a lowering of the water table?
- (1) *A* and *B*
 - (2) *A* and *C*
 - (3) *B* and *D*
 - (4) *C* and *D*
- 50 What are two water cycle processes *not* represented by arrows in this cross section?
- (1) transpiration and condensation
 - (2) evaporation and melting
 - (3) precipitation and freezing
 - (4) runoff and infiltration

8/06

- 7 Which surface soil type has the *slowest* permeability rate and is most likely to produce flooding?
- (1) pebbles
 - (2) sand
 - (3) silt
 - (4) clay

66 The diagram below shows a model of the water cycle. The arrows show the movement of water molecules through the water cycle. The circled numbers represent the processes that occur as the water molecules reach the different stages of the water cycle.



Complete the table *below* by identifying the name of the water cycle process occurring at *each* number.

Number	Water Cycle Process
1	
2	
3	
4	
5	
6	

6/06

50 The diagram below shows tubes A and B partly filled with equal volumes of round plastic beads of uniform size. The beads in tube A are smaller than the beads in tube B. Water was placed in tube A until the pore spaces were filled. The drain valve was then opened, and the amount of time for the water to drain from the tube was recorded. The amount of water that remained around the beads was then calculated and recorded. Data table 1 shows the measurements recorded using tube A.

Data Table 1: Tube A	
water required to fill pore spaces	124 mL
time required for draining	2.1 sec
water that remained around the beads after draining	36 mL

If the same procedure was followed with tube B, which data table shows the measurements most likely recorded?

Data Table 2: Tube B	
water required to fill pore spaces	124 mL
time required for draining	1.4 sec
water that remained around the beads after draining	26 mL

(1)

Data Table 2: Tube B	
water required to fill pore spaces	124 mL
time required for draining	3.2 sec
water that remained around the beads after draining	36 mL

(3)

Data Table 2: Tube B	
water required to fill pore spaces	168 mL
time required for draining	3.2 sec
water that remained around the beads after draining	46 mL

(2)

Data Table 2: Tube B	
water required to fill pore spaces	168 mL
time required for draining	1.4 sec
water that remained around the beads after draining	36 mL

(4)

6/04

15 During a dry summer, the flow of most large New York State streams generally

- (1) continues because some groundwater seeps into the streams
- (2) increases due to greater surface runoff
- (3) remains unchanged due to transpiration from grasses, shrubs, and trees
- (4) stops completely because no water runs off into the streams

1/04

15 When rainfall occurs, the rainwater will most likely become surface runoff if the land surface is

- (1) sandy (3) covered with grass (2) impermeable (4) nearly flat

8/03

16 Most water vapor enters Earth's atmosphere by the processes of

- (1) condensation and precipitation (2) radiation and cementation
- (3) conduction and convection (4) evaporation and transpiration

6/03

12 The flowchart below shows part of Earth's water cycle. The question marks indicate a part of the flowchart that has been deliberately left blank.



Which process should be shown in place of the question marks to best complete the flowchart?

- (1) condensation (2) deposition (3) evaporation (4) infiltration

8/02

10 An environmental scientist needs to prepare a report on the potential effects that a proposed surface mine in New York State will have on the watershed where the mine will be located. In which reference materials will the scientist find the most useful data with which to determine the watershed's boundaries?

- (1) topographic maps (2) geologic time scales (3) tectonic plate maps (4) planetary wind maps

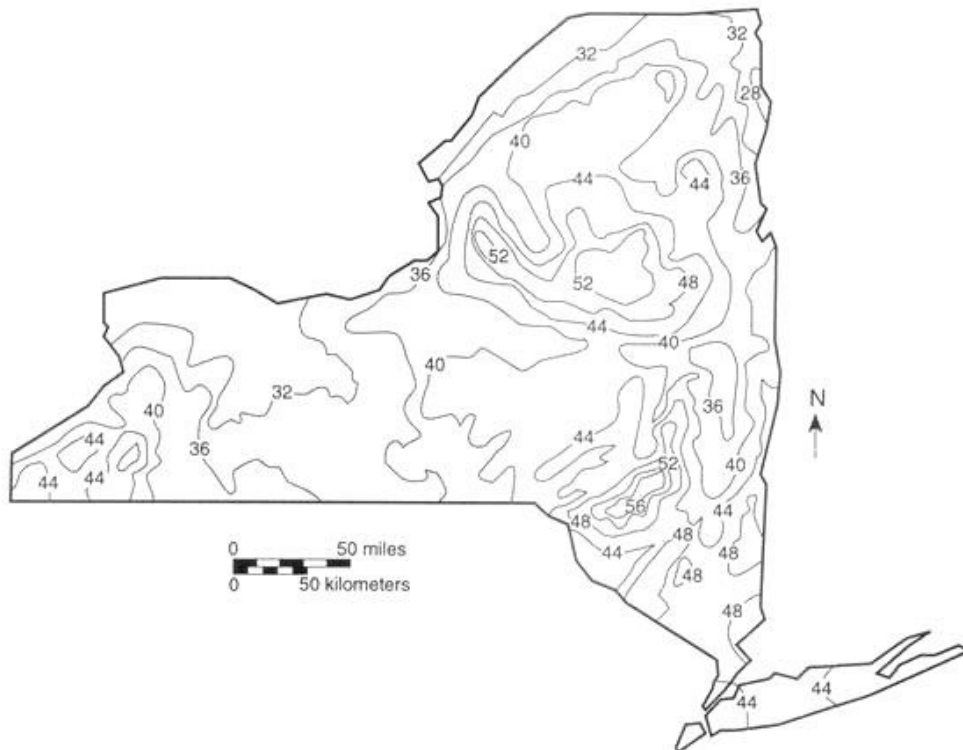
6/02

9 Which condition would cause surface runoff to increase in a particular location?

- (1) covering a dirt road with pavement (2) reducing the gradient of a steep hill
- (3) planting grasses and shrubs on a hillside (4) having a decrease in the annual rainfall

1/02

Base your answers to questions 9 and 10 on the field map below, which shows the average annual precipitation in New York State for the past 25 years. Isoline values represent inches per year.



9 Jamestown received more rainfall per year than Elmira. A reason for this difference is that Jamestown is located

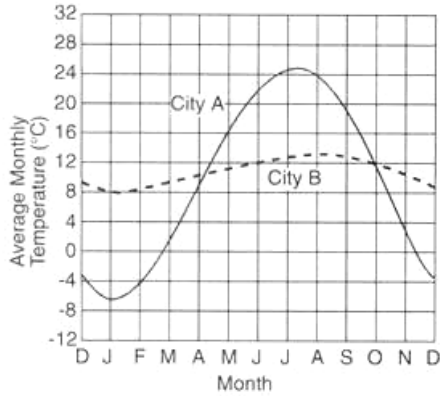
- (1) closer to a large body of water (2) at a higher latitude (3) at a lower elevation (4) in the prevailing southerly wind belt

10 Which of these locations had the lowest average annual precipitation?

- (1) Kingston (2) New York City (3) Old Forge (4) Plattsburgh

8/01

11 The graph below shows the average monthly temperatures for two cities, A and B, which are both located at 41° north latitude.



Which statement best explains the difference in the average yearly temperature range for the two cities?

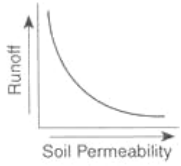
- (1) City B is located in a different planetary wind belt. (2) City B receives less yearly precipitation.
(3) City B has a greater yearly duration of insolation. (4) City B is located near a large body of water,

26 In general, the probability of flooding decreases when there is an increase in the amount of

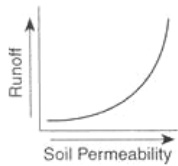
- (1) precipitation (2) infiltration (3) runoff (4) snow melt

6/01

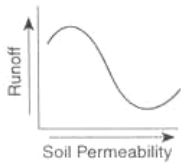
33 Which graph shows the effect of soil permeability on the amount of runoff in an area?



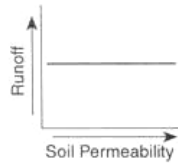
(1)



(3)



(2)



(4)