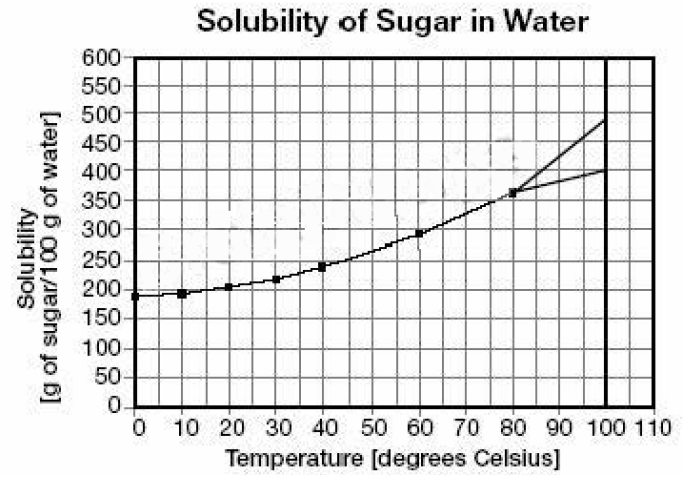
ACT_Science Reasoning Exam

Volume: 94 Questions

Scenario 1

A mixture that is made by dissolving one compound (solute) in another (solvent) is called a solution. The amount of solute that can be dissolved in a solvent at a given temperature is called solubility. For most substances, solubility increases with temperature. When the amount of solute dissolved in a solvent exceeds the solubility, the solution is called supersaturated. Rock candy can be made by dissolving as much sugar in water, as solubility would allow at a high temperature, and then slowly cooling the solution to room temperature. If a thin string is dipped into it and left in the solution, the sugar in excess of the solubility at room temperature will form sugar crystals around the string, making the sweet rock candy. The solubility (in grams of sugar per 100 grams of water) as a function of temperature (in degrees Celsius) is plotted in the graph below.



Question No: 1

A solution of sugar in water is NOT supersaturated when 300 g of sugar and 100 g of water are mixed at a temperature of:

A. 20 degrees Celsius.

B. 40 degrees Celsius.

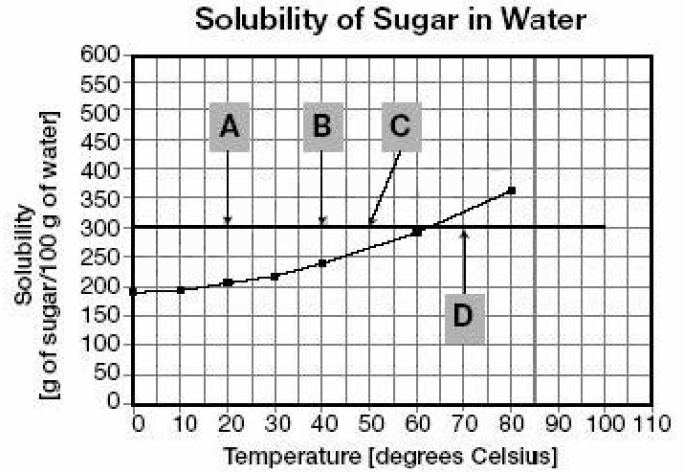
C. 50 degrees Celsius.

D. 70 degrees Celsius.

Answer: D

Explanation:

One way to solve this problem is to draw a line through the graph along the 300 g of sugar per 100g of water mark on the graph, as illustrated in the figure below.



In the passage, a supersaturated solution was defined as one in which the amount of solute dissolved exceeds solubility at a given temperature. The line going through the 300 mark is above the solubility curve, at all temperatures listed in choices A, B, and C. At temperature D, however, 300 g sugar / 100 g of water does not exceed solubility. Therefore, at 70 degrees Celsius, the solution is NOT supersaturated.

Question No: 2
In order for 250 g of sugar to completely dissolve in 100 g of water, the temperature of the solution would have to be at a minimum of:

A. 15 degrees Celsius.

B. 25 degrees Celsius.

C. 45 degrees Celsius.

D. 65 degrees Celsius.

Answer: C

Explanation:
You could use the strategy described in problem 1. If you draw a line through the 250 mark, you will see that it crosses the solubility curve at about 45 degrees Celsius. Below that temperature (choices f and g), the sugar will not dissolve completely. At 65 degrees (choice j) the sugar will dissolve. Choice j is incorrect because 65 degrees is above the minimum temperature required to dissolve the sugar.

Question No: 3
At 100 degrees Celsius the solubility of sugar in water would most likely be:

A. less than 250 g of sugar in 100 g of water.

B. between 250 g of sugar and 350 g of sugar in 100 g of water.

C. between 350 grams of sugar and 400 g of sugar in 100 g of water.

D. more than 400 grams of sugar in 100 g of water.

Answer: D

Explanation:
This question is asking you to extrapolate, make a prediction, based on the given data. The solubility of sugar in water increases, as the temperature increases. You can assume that the trend will continue. So you can rule out choices a and B. Draw a line through the 100 degree Celsius mark, and extend the solubility curve to that mark, following the trend, as illustrated in the figure below. This should help you rule out choice c, since it will require the shape of the curve to change.

Question No: 4
In order to produce rock candy at 20 degrees Celsius from a solution of 300 g of sugar not completely dissolved in 100 g of water, the solution must be:

A. first heated above 60 degrees Celsius, then slowly cooled to 20 degrees Celsius.

B. slowly stirred at 20 degrees Celsius.

C. slowly cooled to 0 degrees Celsius.

D. slowly cooled below 0 degrees Celsius, then heated to 20 degrees Celsius and stirred.

Answer: A

Explanation:
The question could be answered by going back to the passage. Rock candy is made by first completely dissolving the excess sugar, at a high temperature, then slowly cooling to room temperature Choices B, C, and D don't describe heating, followed by slow cooling.

Question No: 5

How much sugar must be added to a solution of 50 g of sugar in 100 g of water at 45 degrees Celsius in order for the solution to be supersaturated?

A. more than 10 grams

B. more than 20 grams

C. more than 100 grams

D. more than 200 grams

Answer: D

Explanation:
You can solve this problem by drawing a line through the 45 degree Celsius mark. It intersects the solubility curve at about 250 g of solute per 100 g of solvent. In order for a solution to be supersaturated, the amount of sugar has to exceed solubility. Therefore, a total of more than 250 g is necessary. If a solution already contains 50 g of sugar, more than 200 grams are required.

Question No: 6
Solubility is defined as:

A. a supersaturated mixture.

B. a mixture that is made by dissolving a solute in a solution.

C. the amount of solute that can be dissolved in a solvent at a given temperature.

D. the temperature that causes super saturation.

Answer: C

Explanation:
According to the passage, solubility is defined as the amount of solute that can be dissolved in a solvent at a given temperature.

Question No: 7
What is the approximate difference in temperature for the solubility of 200 grams of sugar/100 grams of water and 250 grams of sugar/100 grams of water?

A. 10 degrees Celsius

B. 20 degrees Celsius

C. 30 degrees Celsius

D. 40 degrees Celsius

Answer: B

Explanation:
The solubility of 200 grams of sugar/100 grams of water is 20 degrees Celsius. The solubility of 250 grams of sugar/100 grams of water is 40 degrees Celsius. Therefore the difference in temperature is 20 degrees Celsius.

Question No: 8
In a solution of sugar and water, which is the solvent and which is the solute?

A. solvent: sugar; solute: water

B. solvent: rock candy; solute: water

C. solvent: water; solute: sugar

D. solvent: water; solute: rock candy

Answer: C

Explanation:
According to the passage, the compound that is dissolved is the solute, while the liquid is the solvent. Therefore in sugar water, sugar is the solute and water is the solvent.

Scenario 2
You set up an experiment to investigate the different rates at which soil and water heat and cool.
You use the following equipment:
Thermometers (measuring in °C)
Container of soil
Container of water
Radiation Lamp
Timer
You obtain the temperature of the soil and water over a period of time and collect the following

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data:

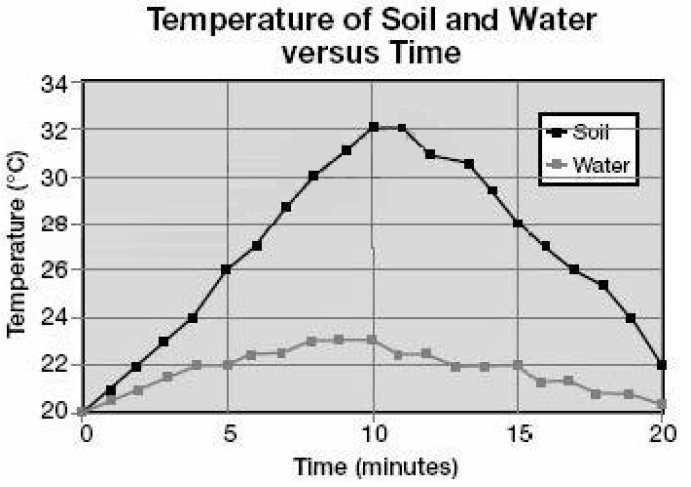
DATA TABLE I: During Heating-up Period

TIME (MIN)	SOIL TEMPERATURE (°C)	WATER TEMPERATURE (°C)
0	20.0	20.0
1	21.0	20.5
2	22.0	21.0
3	23.0	21.5
4	24.0	22.0
5	26.0	22.0
6	27.0	22.5
7	28.5	22.5
8	30.0	23.0
9	31.0	23.0
10	32.0	23.0

DATA TABLE II: During Cooling-off Period

TIME (MIN)	SOIL TEMPERATURE (°C)	WATER TEMPERATURE (°C)
11	32.0	22.5
12	31.0	22.5
13	30.5	22.0
14	29.5	22.0
15	28.0	22.0
16	27.0	21.5
17	26.0	21.5
18	25.0	21.0
19	23.5	21.0
20	22.0	20.5

The following graph was then using the data.



Question No: 9
Based on the results of the experiment, what is true about the heating and cooling rates of soil and water?

A. Water heats faster, but cools slower.

B. Water heats and cools faster.

C. Soil heats faster, but cools slower.

D. Soil heats and cools faster.

Answer: D

Explanation:
The graphs and the data tables both show that the temperature of the soil increases more quickly during the heating up period and decreases more quickly during the cooling off period. This indicates that the soil heats and cools faster. The correct choice is d.

Question No: 10
During the heating-up period, which surface was raised to a higher temperature?

A. soil

B. water

C. They were raised in temperature by equal amounts.

D. You cannot tell based on the data given.

Answer: A

Explanation:
The graphs and the data table show that the temperature of the soil increases more than the temperature of the water during the heating up period, and the soil reaches a higher maximum temperature.

Question No: 11
If you repeated this experiment but you let the water and the soil heat for 20 minutes and then cool for 20 minutes instead of the 10 minutes used in this experiment how you would expect the graph of temperature versus time to change?

A. Only the soil temperature curve would change. The water temperature curve would remain the same.

B. Both the soil and the water temperature curves would change so that they would have the same basic shape but higher maximum temperature values.

C. Both the soil and water temperature curves would change shape but maintain the same maximum temperature values.

D. Only time for the experiment would change. The soil temperature and water temperature curves would remain the same.

Answer: B

Explanation:
Changing the length of time for the heating up period would allow both the soil and the water to reach higher maximum temperature values. The soil will still heat faster than the water so it will still have a higher curve on the temperature versus time graph than the water.

Question No: 12
Based on this experiment, compare the heating and cooling of air masses above the ocean and the land.

A. The air above the ocean and land heats and cools at the same rate.

B. The air above land heats and cools faster.

C. The air above the ocean heats and cools faster.

D. The air above the land heats faster but the air above the ocean cools faster.

Answer: B

Explanation:
Since soil heats faster, the air above land should then be heated faster by the heat radiated by the land. This narrows the selection to choices B and D. Since the soil also cools faster, the air above the land will cool faster as it comes to equilibrium with the cooler ground temperature by losing heat to the ground. This narrows the final choice to N.

Question No: 13
Predict the relative air temperature over ocean and land during the day and night.

A. During the day: air above the land is warmer, above the ocean is cooler. At night: air above the land is cooler, above the ocean is warmer.

B. During the day: air above the land is cooler, above the ocean is warmer. At night: air above the land is warmer, above the ocean is cooler.

C. During the day: air above the land is cooler, above the ocean is warmer. At night: air above the land is cooler, above the ocean is warmer.

D. During the day: air above the land is warmer, above the ocean is cooler. At night: air above the land is warmer, above the ocean is cooler.

Answer: A

Explanation:
Since the air above the land heats and cools faster it will get warmer faster during the day. This means during the day the air over the land will be warmer than the air over the ocean. At night, however, the temperature of the land will cool faster than the temperature of the ocean. This means the air above the ocean will be warmer than the air above the land at night.

Question No: 14
A sea breeze is a breeze blowing from the ocean onto the land. Air moves from cooler regions to warmer regions. When would a sea breeze occur?

A. Sea breezes occur during the night.

B. Sea breezes occur during the day.

C. Sea breezes occur during the night and the day.

D. Sea breezes never occur.

Answer: B

Explanation:
During the day, the air above the land is warmer than over the ocean since the land heats faster than the oceans (as seen by the soil heating faster than the water in this experiment). Since air will move from cooler regions to warmer regions, the cool air over the ocean will move over to the land. This creates the sea breeze during the day.

Question No: 15
You complete this experiment a second time, and find that the water reached a higher temperature than the soil. Which of the following could be used to explain why your results are different?

A. The water was unfiltered.

B. The soil came from your garden.

C. The heating lamp was faulty.

D. You used different sized containers in the second experiment.

Answer: C

Explanation:
It is not likely that unfiltered water or soil from your garden will heat differently than any other water or soil. Also, the size of the containers is not likely to affect the outcome of the experiment. However, if the heating lamp were faulty, it would cause your results to be inaccurate.

Question No: 16
What is the difference in temperature between soil and water during the 13th minute?

A. 7 degrees Celsius

B. 7.5 degrees Celsius

C. 8 degrees Celsius

D. 8.5 degrees Celsius

Answer: D

Explanation:
In the 13th minute, the soil is 30.5 degrees Celsius and the water is 22.0. The difference in temperature is 8.5 degrees Celsius.

Scenario 3
The heart is an organ that pumps blood throughout the circulatory system in the body. Red blood cells are a tissue in the body that carry nutrients to the body's cells and waste away from the body's cells. The heart rate increases or decreases depending on the body's needs to transport nutrients and waste.
In an experiment, a female had her heart monitored. For one minute, she sat in a chair quietly. At the end of the first minute to the end of the third minute she did jumping jacks. Finally, she sat again in the chair and waited until her heart rate went back to her resting heart rate as measured in the first minute. After performing this experiment, the following graph was created.