EXAMTOPICS

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Question #1 *Topic 1*

HOTSPOT

Speaker: The coastal area of Melos, Greece, was a natural source for obsidian, which was highly sought after as material for making many stone implements during the Neolithic Age and the Bronze Age. A study by archaeologists examining stone implements from Neolithic and Bronze Age sites in Greece shows that, of those implements, the percentage made of obsidian varies with those sites' distance from Melos. For sites within 150 kilometers (km), the percentage is 85-100 percent; for those between 150 and 200 km, the percentage is 40-70 percent; and for those greater than 200 km away, the percentage is less than 30 percent. This variation is due to differential access to water-borne transportation.

Select for Implies is true the statement that the speaker's argument most clearly implies is true, and select for Implies is false the statement that the speaker's argument most dearly implies is false. Make only two selections, one in each column.

Implies is true	Implies is false	
○	○	Obsidian in some form was transported using water-borne transportation during the Neolithic and Bronze Ages.
○	○	Obsidian was not transported over land during the Neolithic and Bronze Ages.
○	○	All of the obsidian used to make stone implements in the study originated in Melos.
○	○	Among the sites in the study, on average, those at a greater distance from Melos were more accessible by water-borne transportation during the Neolithic or Bronze Age than were the other sites.
○	○	In the study, the number of sites within 150 km of Melos is significantly greater than that of sites more than 150 km from Melos.

Suggested Answer:
True: Obsidian was transported using water-borne transportation. False: Obsidian was not transported over land.

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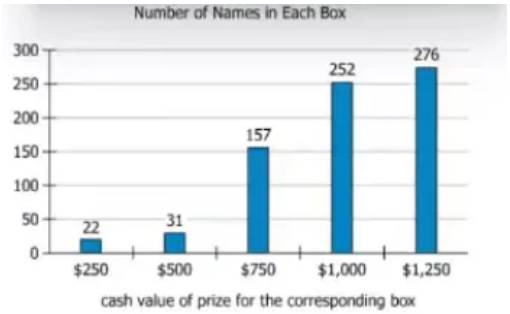
Question #2 *Topic 1*

HOTSPOT

At the annual holiday party of a particular company, each person is given a choice of 5 opportunities to win a prize. Specifically, each employee writes his/her name on a piece of paper and places it into one of 5 boxes, with each box representing a particular prize. One name is drawn from each box at random, and the 5 individuals thus named win the respective prizes.

Gertrude is the last person to arrive at the holiday party and to place her name in one of the boxes. She knows, for each of the boxes, the number of individuals who have already placed their names in the box. And she knows the cash value of each of the prizes, in US dollars. This information is reflected in the graph.

Select from the drop-down menus the options that create the most accurate statement about the expected outcomes (the cash value of the prize corresponding to the chosen box multiplied by the probability of winning) of Gertrude's possible choices.



Gertrude's expected outcome is greatest if she chooses the box for which the cash value of the prize is Select... ▼ (Select... / $250 / $500 / $750 / $1,000 / $1,250). This outcome is roughly Select... ▼ (Select... / $4 / $7 / $9 / $16 / $50).

Suggested Answer:
$1,250 box; expected outcome roughly $4.

Currently there are no comments in this discussion, be the first to comment!

Question #3 *Topic 1*

HOTSPOT

Welleby's Plan

The water in the underground water table beneath the town of Welleby is moderately saline—20,000 milligrams of salt per liter of water (mg/L), or roughly half as saline as ocean water. To lower the level of the water table and thus prevent agricultural land from being inundated with salt water, the town plans to pump water from the table at a rate of 450 kiloliters per day (kL/day) into a large shallow pond, allowing much of the water to evaporate. The town plans to divert 10 percent of the water pumped from the water table to supplement its supply of drinking water, which is currently piped in from great distances. Due to the water's salinity, the town intends to construct a desalination plant to treat the diverted water for use as drinking water.

Desalination Types

Welleby is deciding among the following three desalination methods.

Reverse Osmosis (RO): Water is pushed through a membrane, leaving salts behind. RO systems can handle a large range of water flow rates and use relatively little energy. However, RO membranes are expensive and must be replaced every 2 to 5 years. There is also a possibility that bacteria can grow on the membrane, introducing tastes and odors into the desalinated water.

Multi-Effect Distillation (MED): Saline water is heated to produce water vapor, from which is condensed potable fresh water. This process requires large amounts of energy, regardless of the salinity of the source water. It becomes more cost effective as water volumes increase.

Electrodialysis (ED): Electricity is used to selectively move salts through a membrane. Consumption of energy is directly proportional to the salinity of the water to be treated, so with higher salinities the process rapidly becomes more costly than other methods. ED membranes need to be replaced every 7 to 10 years.

Comparison

The table presents the recommended parameters of use for Reverse Osmosis (RO), Multi-Effect Distillation (MED), and Electrodialysis (ED), as well as construction costs and operating costs. Costs presented in Australian dollars (A$) represent the cost per kiloliter of treated water per day.

Recovery refers to the percent of source water that is recovered as treated water—potable drinking water.

For each of the following statements about the three desalination methods, select Accurately reflects if it accurately reflects the information provided, and otherwise select Does not accurately reflect.

Parameter	RO	MED	ED
Salinity range of source water (mg/L)	<32,000	>35,000	3,000–12,000
Salinity of treated water (mg/L)	<200	<10	<10
Minimum rate of water treatment (kL/day)	0.5	120	90
Recovery (%)	>80	40–65	>90
Construction costs (A$)	600–1,800	2,500–3,900	570–3,250
Operating costs (A$)	0.65–1.50	0.55–2.80	1.00–2.80

Accurately reflects	Does not accurately reflect	
○	○	The method that uses the longest-lasting membranes has the lowest maximum operating cost.
○	○	The two methods that are suitable for the lowest salinity source water produce the lowest salinity treated water.
○	○	The difference between the projected maximum and minimum operating costs for all methods that use membranes is smaller than that for all methods that do not use membranes.

Suggested Answer:
1) Longest-lasting membranes (ED) has the lowest maximum operating cost: Does not accurately reflect (ED max A$2.80 equals MED and exceeds RO's A$1.50). 2) The two methods suitable for the lowest-salinity source (ED and RO) produce the lowest-salinity treated water: Does not accurately reflect (RO gives <200 mg/L; the <10 mg/L methods are MED and ED). 3) Max-min operating cost spread for membrane methods (RO 0.85, ED 1.80; combined 2.15) is smaller than for non-membrane MED (2.25): Accurately reflects.

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HOTSPOT

Welleby's Plan

The water in the underground water table beneath the town of Welleby is moderately saline—20,000 milligrams of salt per liter of water (mg/L), or roughly half as saline as ocean water. To lower the level of the water table and thus prevent agricultural land from being inundated with salt water, the town plans to pump water from the table at a rate of 450 kiloliters per day (kL/day) into a large shallow pond, allowing much of the water to evaporate. The town plans to divert 10 percent of the water pumped from the water table to supplement its supply of drinking water, which is currently piped in from great distances. Due to the water's salinity, the town intends to construct a desalination plant to treat the diverted water for use as drinking water.

Desalination Types

Welleby is deciding among the following three desalination methods.

Reverse Osmosis (RO): Water is pushed through a membrane, leaving salts behind. RO systems can handle a large range of water flow rates and use relatively little energy. However, RO membranes are expensive and must be replaced every 2 to 5 years. There is also a possibility that bacteria can grow on the membrane, introducing tastes and odors into the desalinated water.

Multi-Effect Distillation (MED): Saline water is heated to produce water vapor, from which is condensed potable fresh water. This process requires large amounts of energy, regardless of the salinity of the source water. It becomes more cost effective as water volumes increase.

Electrodialysis (ED): Electricity is used to selectively move salts through a membrane. Consumption of energy is directly proportional to the salinity of the water to be treated, so with higher salinities the process rapidly becomes more costly than other methods. ED membranes need to be replaced every 7 to 10 years.

Comparison

The table presents the recommended parameters of use for Reverse Osmosis (RO), Multi-Effect Distillation (MED), and Electrodialysis (ED), as well as construction costs and operating costs. Costs presented in Australian dollars (A$) represent the cost per kiloliter of treated water per day.

Recovery refers to the percent of source water that is recovered as treated water—potable drinking water.

For a town seeking to desalinate source water with a salinity of 12,000 mg/L, select Consistent for each of the following statements that is consistent with the information and recommendations provided, and otherwise select Not consistent.

Parameter	RO	MED	ED
Salinity range of source water (mg/L)	<32,000	>35,000	3,000–12,000
Salinity of treated water (mg/L)	<200	<10	<10
Minimum rate of water treatment (kL/day)	0.5	120	90
Recovery (%)	>80	40–65	>90
Construction costs (A$)	600–1,800	2,500–3,900	570–3,250
Operating costs (A$)	0.65–1.50	0.55–2.80	1.00–2.80

Consistent	Not consistent	
○	○	If preventing unwanted tastes and odors is of primary importance, the town should choose ED.
○	○	If minimizing operating costs is of primary importance, the town should choose MED.
○	○	If minimizing the energy needed to desalinate the source water is of primary importance, the town should choose RO.

Suggested Answer:

1) Choose ED to prevent tastes and odors: Consistent (12,000 mg/L is within ED's 3,000-12,000 range, and only RO carries the bacterial taste/odor risk). 2) Choose MED to minimize operating costs: Not consistent (MED is recommended only for source water above 35,000 mg/L). 3) Choose RO to minimize energy: Consistent (RO uses relatively little energy and handles <32,000 mg/L, while ED energy rises with salinity and 12,000 mg/L is at the top of its range).

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