

# AP<sup>®</sup> ENVIRONMENTAL SCIENCE

## 2015 SCORING GUIDELINES

### Question 3

Oil spills can be devastating in scope and damage. Since 1900, there have been many oil spills around the world that have had significant ecological and economic impacts.

- (a) Using the data in the graph above, **determine** the maximum volume of oil estimated to have been spilled during the Deepwater Horizon (BP) incident.

*(1 point for identifying a specific number  $\geq 185$  million gallons and  $\leq 199$  million gallons. Include units)*

- (b) **Describe** TWO environmental problems that can result from oil spills in coastal areas.

*(2 points: 1 point for each of two reasonable descriptions of an environmental problem)*

- Birds may lose their buoyancy or ability to fly if their feathers are coated with oil
- Degradation of nursery grounds, feeding grounds, and habitat may lead to a loss of biodiversity
- Food webs may be disrupted when populations of specific organisms in the web are reduced or suffer negative health impacts
- Oil spill may decrease the amount of sunlight reaching photosynthetic organisms in water
- Organisms may be killed by smothering, or by ingesting, inhaling, or absorbing oil

- (c) **Identify** one economic impact that results from oil spills in coastal areas.

*(1 point for an economic impact which may be a positive or negative impact)*

Negative Economic Impacts	Positive Economic Impacts
Cost of cleanup efforts	Financial aid brought into local economies through grants, disaster relief, and settlements
Decline in tourism/loss of revenue from tourism or commercial fishing	Increase in jobs and revenue during cleanup and monitoring of spill
Monetary value of lost crude oil	

- (d) Chemical dispersants have been used in cleanup efforts following major oil spills.

- (i) **Discuss** both one advantage and one disadvantage of the use of chemical dispersants for oil spill cleanup.

*(2 points: 1 point for an advantage and 1 point for a disadvantage)*

Advantages of Chemical Dispersants	Disadvantages of Chemical Dispersants
Breaks down oil into smaller droplets, diluting the concentration of oil to reduce its toxicity	Dispersants increase underwater damage as the dispersed oil settles
Easy to apply quickly and easily, or is less costly than shoreline cleanup	May be toxic to organisms/humans
Minimizes spreading of surface oil	May increase the area affected by the oil spill
Protects birds from surface oil	Oil is dispersed but not removed

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2015 SCORING GUIDELINES**

**Question 3 (continued)**

**(ii) Identify** either one biological or one physical method (other than chemical dispersal) used for oil spill cleanup in coastal waters or on beaches and **describe** how the method is used.  
(1 point for description of an acceptable method)

Biological Method	Physical Methods
Introduction of microbes that degrade the oil	Burning oil on the surface of water
	Dredging and vacuuming to remove oil
	Physical washing of rocks/organisms
	Use of absorbent material to remove oil or to keep the spill from spreading
	Using booms to contain oil on the surface and skimmers to separate the oil from the water

**(e)** Catastrophic spills make up less than 20 percent of the oil that pollutes marine waters. **Identify** one other source of oil contamination and **explain** how the oil from this source enters marine waters.

(2 points: 1 point for identification of a source, and 1 point for an explanation of how oil from that source enters the water)

Source	Explanation
Leaks from oil infrastructure	Leaks can occur during the exploration, production, and transport of oil
Oil from boats	Oil can leak from boat engines and during the emptying of bilge tanks
Natural seeps	Crude oil leaks to the surface naturally from the ocean floor
Oil from automobiles	Oil dripped from cars can be washed into water with storm runoff
Oil intentionally dumped	Oil is then carried to water with runoff or directly dumped into the water

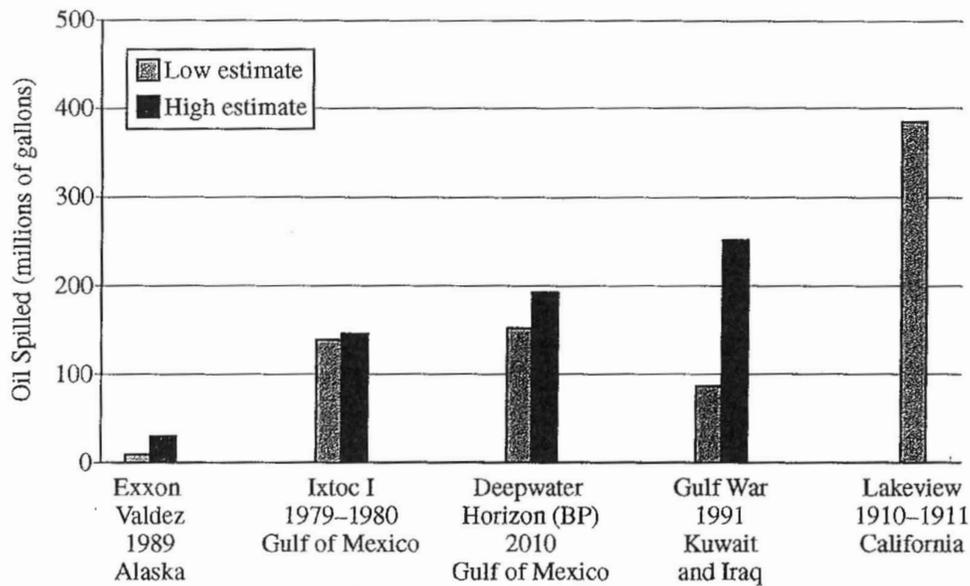
**(f)** Petroleum has many uses as a raw material for consumer goods. Identify one substitute for petroleum in a specific consumer product (other than fuel).

(1 point for identification of a reasonable substitute for petroleum in a product)

- Paper bags
- Corn-based plastic water bottles
- Bamboo or wood storage containers
- Natural fibers (cotton, hemp, bamboo, etc.) in garments, upholstery, etc.

VOLUME OF OIL RELEASED IN SELECTED INCIDENTS

3A1



3. Oil spills can be devastating in scope and damage. Since 1900, there have been many oil spills around the world that have had significant ecological and economic impacts.
- Using the data in the graph above, **determine** the maximum volume of oil estimated to have been spilled during the Deepwater Horizon (BP) incident.
  - Describe** TWO environmental problems that can result from oil spills in coastal areas.
  - Identify** one economic impact that results from oil spills in coastal areas.
  - Chemical dispersants have been used in cleanup efforts following major oil spills.
    - Discuss** both one advantage and one disadvantage of the use of chemical dispersants for oil spill cleanup.
    - Identify** either one biological or one physical method (other than chemical dispersal) used for oil spill cleanup in coastal waters or on beaches and **describe** how the method is used.
  - Catastrophic spills make up less than 20 percent of the oil that pollutes marine waters. **Identify** one other source of oil contamination and **explain** how the oil from this source enters marine waters.
  - Petroleum has many uses as a raw material for consumer goods. **Identify** one substitute for petroleum in a specific consumer product (other than fuel).

a) By looking at the graph, a maximum of 190 million gallons were spilled by the Deepwater Horizon.

b) Oil spills can kill coastal birds by suffocating them, damaging their feathers, and poisoning them. Also, oil spills can kill phytoplankton and algae that rely on sunlight penetrating the ocean water, as oil is dark and can prevent light from reaching these organisms. As producers, a drop in populations of them would also harm consumers.

c) Tourism is a major source of income in many coastal areas, and tourism is less common following oil spills as tourists are not fond of oily beaches. Thus, revenue in the tourism industry is reduced by oil spills.

d) i) Chemical dispersants allow large globs of oil to break apart, increasing the rate at which bacteria break down the oil. However, they also make cleaning the oil with skimmer boats & floating booms more difficult.

ii) Genetically modified bacteria are spread on the oil to break it down. Chemical dispersants are used in this process to increase the oil's surface area, but do not drive the process. The bacteria produce enzymes that digest oil into more benign chemicals. The bacteria are used in the water, on beaches, and in estuaries/wetlands.

GO ON TO THE NEXT PAGE.

e) Oil also enters the ocean through runoff on land. Automobiles, tractors, and industrial sites drip small amounts of oil that are carried by rain into flowing rivers, which drain into the ocean.

f) Petroleum is often used to make plastics for consumer products. Instead, materials not made from petroleum can be used, including paper, wood, and cotton, depending on the purpose. Rather than plastic wrapping, paper could be used, for example. Or cardboard boxes could be used instead of plastic boxes.

GO ON TO THE NEXT PAGE.

- a) 190 million gallons
- b) Oil spills significantly harm the marine life in the area because the oil gets trapped in the gills, shutting down the respiratory systems. Also, it affects bird's eating habits because they either have to find somewhere else to fish or get trapped in the oil spill because the oil would stick their feathers together making it impossible to fly.
- c) Oil spills are extremely expensive and time consuming to clean up. The equipment and amount of people and time it takes to clean an oil spill costs millions and even billions of dollars.
- d)(i) One advantage is that it is ~~an~~ a very effective way of cleaning oil spills fastly. However, chemical dispersants release more chemicals in the water yet again harming marine life and polluting water.
- (ii) One physical method would be to use vacuum tubes that would suck up the oil polluted water and filter the oil from the surface.

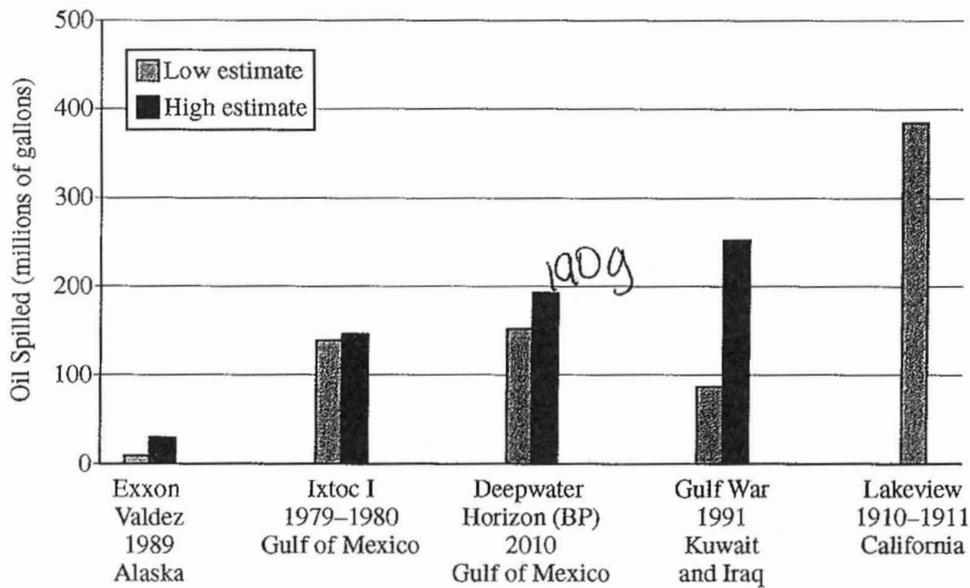
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e) A big source of oil contamination would be ~~industrial abnmal effluents that are carried to the ocean by rivers~~ ~~oil spills that occur from the factories~~ ~~oil spilled from parking lots.~~ Oil that is leaked from cars/trucks onto parking lots is picked up by rain fall to produce runoff that carries the oil into marine waters.

f) Instead of using petroleum to power something like a lawnmower, we can use electricity instead and just recharge the batteries after every use.

GO ON TO THE NEXT PAGE.

VOLUME OF OIL RELEASED IN SELECTED INCIDENTS



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  - (c) **Identify** one economic impact that results from oil spills in coastal areas.
  - (d) Chemical dispersants have been used in cleanup efforts following major oil spills.
    - (i) **Discuss** both one advantage and one disadvantage of the use of chemical dispersants for oil spill cleanup.
    - (ii) **Identify** either one biological or one physical method (other than chemical dispersal) used for oil spill cleanup in coastal waters or on beaches and **describe** how the method is used.
  - (e) Catastrophic spills make up less than 20 percent of the oil that pollutes marine waters. **Identify** one other source of oil contamination and **explain** how the oil from this source enters marine waters.
  - (f) Petroleum has many uses as a raw material for consumer goods. **Identify** one substitute for petroleum in a specific consumer product (other than fuel).

a) The maximum volume of oil spilled during the Deepwater Horizon oil spill was 200 million gallons.

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GO ON TO THE NEXT PAGE.

b) One environmental problem that can occur from an oil spill is biodiversity loss. The oil will coat many fish and birds which can cause them to not be able to breathe or it can get into their stomach eventually killing large amount of the coastal animal populations.

Another problem is the oil can cause coastal algae depletion. So even if a coastal aquatic animal is physically untouched by the oil, its environment may no longer be suitable for it which will cause many deaths.

d) i) Chemical dispersants are a very quick way to clean up a oil spill ~~because~~ because it runs through oil and wipes it all out but it is extremely bad for everything else because it ~~can~~ can kill aquatic life ~~with~~ with its toxicity.

ii) Another way ~~that~~ to clean up an oil spill is using a boat with a specialized net to clean up the big chunks ~~of~~ of oil and trash in the ocean.

Although this is not very effective because it does not have a huge impact on the oil spill and <sup>has</sup> ~~does~~ minimal effect.

c) One economic impact is the amount of money that will be needed not only to ~~to~~ clean up the oil spill but to bail out which ever companies

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oil spill that it was

e) Another way oil enters marine life is by companies purposely and illegally dumping their oil waste into the water because that is a cheaper way to dispose of it.

f) a substitute for petroleum would be ~~natural gas~~

GO ON TO THE NEXT PAGE.

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## 2015 SCORING COMMENTARY

### Question 3

#### Overview

The intent of this question was to determine knowledge level regarding oil spills and oil spill cleanups. The question required the student interpret a graph, discuss problems associated with oil spills, discuss the advantages and disadvantages of oil spill response methods, explain other ways that oil enters aquatic ecosystems, and to identify a replacement for petroleum in consumer goods.

#### Sample: 3A

**Score: 10**

One point was earned in part (a) for correctly determining the maximum oil volume spilled during the “BP” oil spill to be 190 million gallons. Two points were earned in part (b): 1 point for a description of the impact of oil spills on birds and 1 point for a description of the disruption of food webs by oil spills. One point was earned in part (c) for a description of the decline in tourism due to oil spills. Two points were earned in part (d)(i): 1 point for discussion of dispersants breaking down oil and 1 point for discussion of the increased difficulty of oil removal following the application of dispersants. One point was earned in (d)(ii) for describing the microbial breakdown of oil. Two points were earned in part (e): 1 point for identification of automobile leaks and 1 point for describing runoff as the process that carried the oil to the ocean. One point was earned in part (f) for discussing paper as a replacement for petroleum-based plastic in packaging materials.

#### Sample: 3B

**Score: 8**

One point was earned in part (a) for correctly determining the maximum oil volume oil spilled during the “BP” oil spill to be 190 million gallons. Two points were earned in part (b): 1 point for a description of the damage that is done to fish gills and 1 point for the impact on bird feathers and the ability to fly. One point was earned in part (c) for describing the monetary cost of oil spill cleanup. Two points were earned in part (d): 1 point in part (d)(i) for discussion of the toxicity of dispersants to marine life and 1 point in (d)(ii) for describing vacuuming as a physical method of oil spill cleanup. Two points were earned in part (e): 1 point for identification of automobiles as an oil source and 1 point for the description of runoff as the process that carried oil to the ocean. No points were earned in part (f).

#### Sample: 3C

**Score: 6**

No points were earned in part (a). One point was earned in part (b) for describing the smothering of birds by oil. One point was earned in part (c) for describing the monetary cost of oil spill cleanup. One point was earned in (d)(ii) for describing the potential toxicity of dispersants and its impact on living organisms. One point was earned in (d)(ii) for describing a physical method for cleaning oil spills. Two points were earned in part (e) for describing intentional dumping as a source and description of oil entering the ocean.