

**AP® ENVIRONMENTAL SCIENCE
2016 SCORING GUIDELINES**

Question 2

(a) Use the data below to respond to the following. For each calculation, show all your work.

- (i) **Calculate** the weight (in tons) of rock waste produced globally each year when iron ore is converted to pig iron.

(1 point for the correct answer with work shown)

$$1.6 \text{ billion tons of iron ore} - 1.2 \text{ billion tons of pig iron} = 0.4 \text{ billion tons of waste}$$

OR

$$1.6 \times 10^9 - 1.2 \times 10^9 = 4 \times 10^8$$

- (ii) **Calculate** the weight (in tons) of pig iron that could be produced if all of the estimated global iron ore reserves were used for pig iron production.

(2 points: 1 point for the correct setup and 1 point for the correct answer)

$$\frac{1.2 \text{ billion tons pig iron}}{1.6 \text{ billion tons iron ore}} \times 800 \text{ billion tons iron ore} = 600 \text{ billion tons iron}$$

OR

$$\frac{1.2}{1.6} = 0.75 \quad 0.75 \times 800 \text{ billion} = 600 \text{ billion} \quad \textbf{OR} \quad \frac{1.2}{1.6} = \frac{x}{800}$$

OR

$$\frac{1.2 \times 10^9}{1.6 \times 10^9} \times 8.0 \times 10^{11} = 6.0 \times 10^{11}$$

- (iii) **Calculate** the weight (in tons) of the current global iron ore reserves that would be used to make steel if the current trends continue.

(1 point for the correct answer with work shown)

$$0.95 \times 800 \text{ billion tons of iron} = 760 \text{ billion tons iron ore used to make steel}$$

OR

$$0.95 \times 800 = 760 \text{ billion}$$

OR

$$9.5 \times 10^{-1} \times 8 \times 10^{11} = 7.6 \times 10^{11}$$

- (b) **Calculate** the weight (in tons) of coal that is conserved each year in North America by recycling steel.

(1 point for a correct answer with work shown)

$$\frac{0.7 \text{ fewer tons coal used}}{1 \text{ ton steel recycled}} \times 80 \text{ million tons steel recycled} = 56 \text{ million tons coal saved per year in North America}$$

OR

$$0.7 \times 80 = 56 \text{ million}$$

OR

$$7.0 \times 10^{-1} \times 8.0 \times 10^7 = 5.6 \times 10^7$$

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Question 2 (continued)

- (c) **Describe** TWO environmental problems that are associated with abandoned coal mine sites.

(2 points: 1 point for each correct description of an environmental problem. Only the first two descriptions can earn a point.)

- Subsidence/sinkholes as shafts collapse
- Habitat destruction/slow to recover
- Stream/water quality degradation
- Acid mine drainage
- Heavy metal runoff
- Tailings alter landscape and drainage patterns
- Increased soil erosion
- Particulate/dust pollution
- Animals fall in
- Methane release
- Underground fires difficult to extinguish

- (d) **Describe** one method that can be used to mitigate one of the problems you identified in part (c).

(1 point for a correct description of a mitigation method for one of the two environmental problems described in part (c))

- Plant trees or other plants to restore cover/reduce erosion
- Fill in/fence off abandoned shafts to stop subsidence or reduce access
- Prevent acid mine drainage and leaching from sites using retaining ponds, berms, other BMPs
- Treat acid mine drainage with limestone
- Return tailings to excavation sites
- Recontour the land
- Place gravel on surface to reduce wind erosion

- (e) **Discuss** one reason why surface coal mining is generally less expensive than subsurface mining.

(2 points for correct identification of a reason linked with a discussion of why surface mining is less expensive)

Reason	Economic Discussion
Wages	Fewer workers needed above ground Workers paid less above ground
Healthcare	Workman's compensation Insurance
Safety	Increased likelihood below ground of ○ severe accidents ○ death ○ black lung
Legal costs	Lawsuits from injuries, accidents, rescues

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