



## AP<sup>®</sup> Environmental Science 2003 Sample Student Responses

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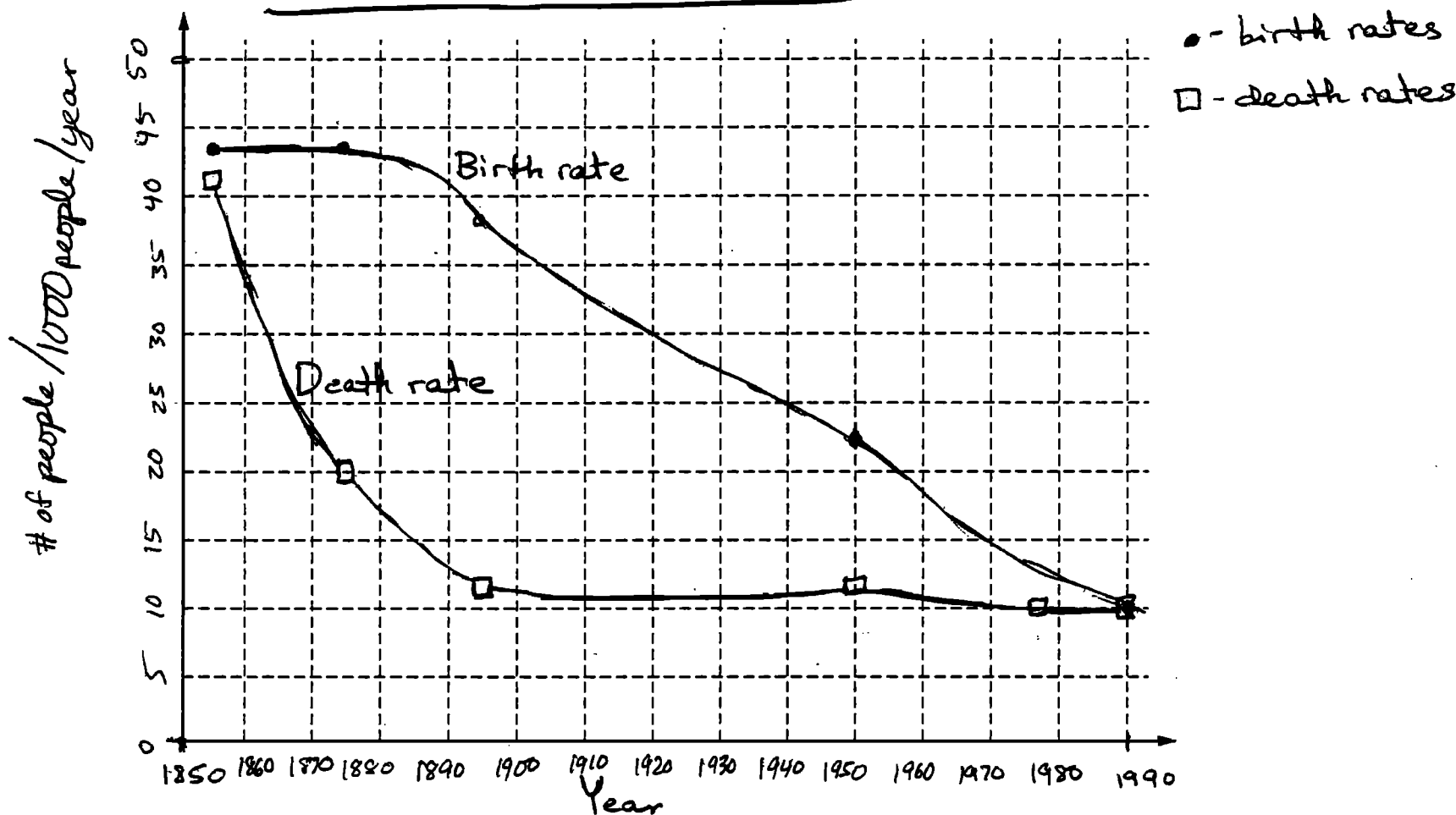
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2. A certain fictional country called Industria is tracking its population data. In 1855, the first year vital statistics were reported for the country, the population was 1.6 million, with a crude birth rate of 43 per 1,000. At that time the population of Industria was growing quite slowly, because of the high death rate of 41 per 1,000. In 1875 the population began to grow very rapidly as the birth rate remained at its 1855 level, while the crude death rate dropped dramatically to 20 per 1,000. Population growth continued to increase in the small country into the late 1800's, even though birth rates began to decline slowly.

In 1895 the crude birth rate had dropped to 37, and the death rate to 12 per 1,000. In that year (1895) a complete census revealed that the population of Industria had grown to 2.5 million. By 1950 population growth gradually began to decline as the death rate remained at its 1895 level, while the birth rate continued to decline to 22 per 1,000. In 1977 vital statistics revealed that the death rate was 10 per 1,000, and that population growth had slowed even more to an annual rate of 0.4%. By 1990 Industria had reduced its birth rate to that of its now constant, low death rate, and the population transition was complete.

(a) On the axes below, plot the crude birth-rate data from 1855 to 1990. Now plot the crude death-rate data on the same axes. Clearly label the axes and the curves.

Industria's Birth & Death Rates 1850-1990



- (b) What was the annual growth rate of Industria in 1950? What was the birth rate in Industria in 1977?
- (c) Indicate TWO factors that might have accounted for the rapid decline in the death rate in Industria between 1855 and 1895. Indicate one specific reason why the birth rate might have been so high in 1855 and was so slow to decrease between 1855 and 1950.
- (d) Determine what the population size of Industria would have been in 1951 if the population had continued to grow at the annual rate of growth recorded for Industria in 1895.

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## ADDITIONAL PAGE FOR ANSWERING QUESTION 2

B) Assuming no immigration or emigration occurred, pop. growth rate would be  $\frac{\text{births} - \text{deaths}}{1000 \text{ people}} \cdot 100$  (so it is expressed as a percent).

$$\frac{22 \text{ people} - 12 \text{ people}}{1000 \text{ people}} \cdot 100 = \frac{10}{1000} \cdot 100 = \frac{10}{10} = 1\%$$

The birth rate in 1977 was  $X \frac{\text{babies}}{1000 \text{ people}} - \frac{\text{deaths}}{1000 \text{ people}} \cdot 100 = .4$ .

multiplying both sides by 10,  $X - \text{deaths} = 4$ . The number of deaths in 1977 was 10, so  $X = 4 + 10 = 14$ . The birth rate was 14 ~~babies~~ <sup>babies</sup> / 1000 people.

C) One factor that could have accounted for the rapid decline in death rates would be an agricultural increase (something akin to a Green Revolution) that alleviated malnutrition and undernourishment. Another would be medical advances: Sterilizing or disinfecting hospitals, new medications, or new cures for old diseases would all reduce the death rate. The reason why birth rates are so high in 1855 is probably a high infant mortality rate. This meant women had to have lots of children just to insure survival. The slow decline of birth rates can be attributed to this cultural mindset (have lots of babies), which isn't easy to reject offhand (a demographic transition - death rates ↓ before birth).

d) The growth rate of 1895  $\left( \frac{37 \text{ people} - 12 \text{ people}}{1000 \text{ people}} \cdot 100 = \frac{25}{10} = 2.5\% \text{ growth} \right)$ .

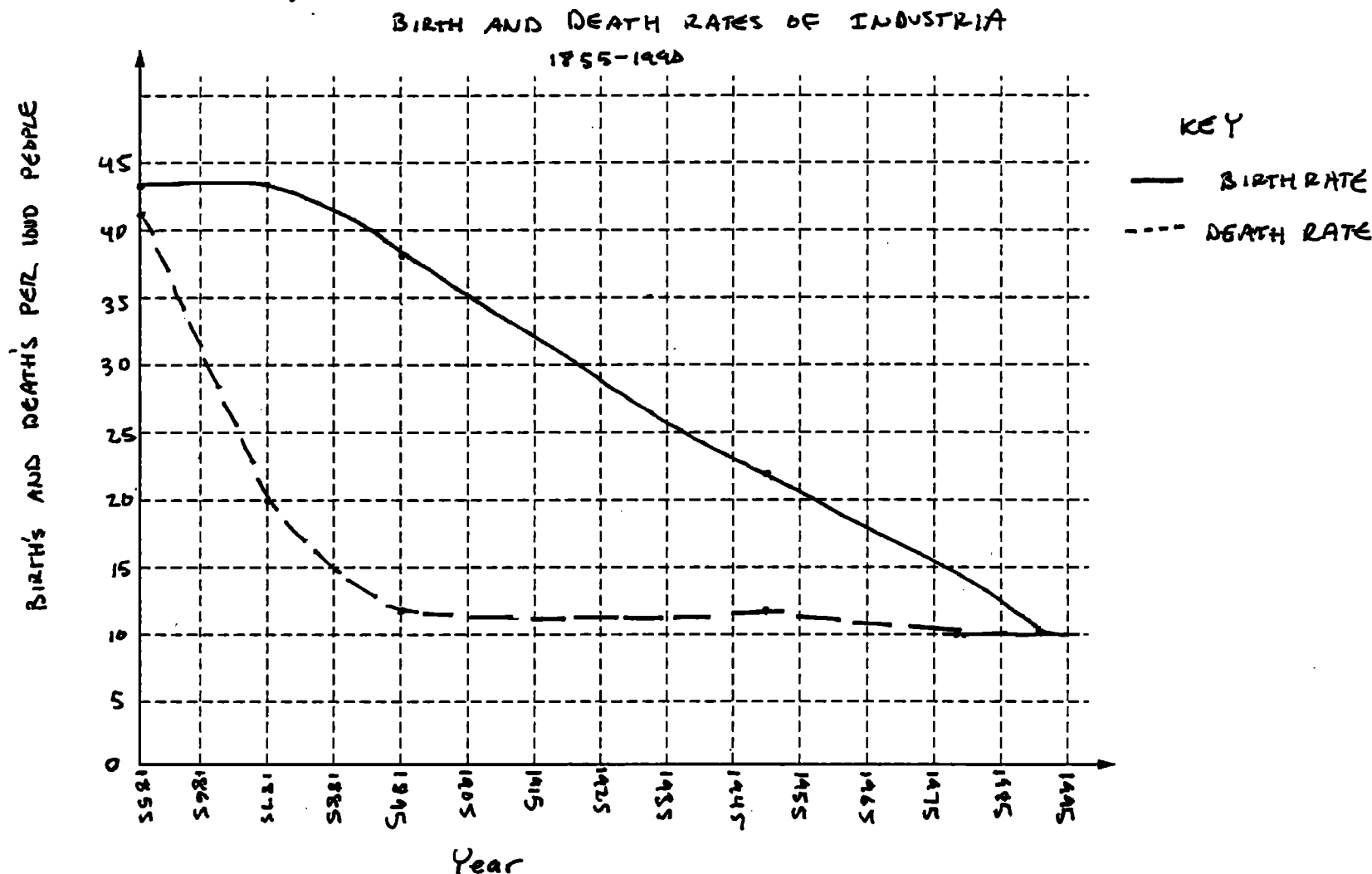
If the population was growing this rapidly, it would have doubled in less than 30 years  $\left( \frac{70 \text{ years}}{2.5} = 28 \right)$ . During the period of 1951 - 1895 (56 years), the population would have doubled twice  $\left( \frac{56 \text{ years}}{28 \text{ years}} = 2 \right)$ . The population <sup>would have</sup> increased from 2.5 million to 5 million and again, to 10 million.  
 $2.5 \text{ million} \times 2 \times 2 = 10 \text{ million}$

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(a) On the axes below, plot the crude birth-rate data from 1855 to 1990. Now plot the crude death-rate data on the same axes. Clearly label the axes and the curves.



(b) What was the annual growth rate of Industria in 1950? What was the birth rate in Industria in 1977?

$22 - 12 = 10 / 1000 = 1/100 = 1\%$        $43 - 17.57 = 25.43 \times 100 = 2.54\%$

(c) Indicate TWO factors that might have accounted for the rapid decline in the death rate in Industria between 1855 and 1895. Indicate one specific reason why the birth rate might have been so high in 1855 and was so slow to decrease between 1855 and 1950.

(d) Determine what the population size of Industria would have been in 1951 if the population had continued to grow at the annual rate of growth recorded for Industria in 1895.

1895 = 2.5 million

BR = 37  
DR = 12

GR =  $25 / 1000 = 2.5\%$

$n = (2.5 \text{ million} \times 2.5\%)^{55}$

2,500,000  
38,750,000

$2,500,000 \times 55$   
125,000  
125,000,000  
137,500,000

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-8-  
1375,000  
2500,000

## ADDITIONAL PAGE FOR ANSWERING QUESTION 2

The annual growth rate of Industria in 1950 was 1%. The birth rate in Industria in 1977 was 3%.

One factor that might have led to a dramatic decrease in death rate between 1855 and 1895 could have been increases in medical technology and distribution. For example, a vaccine for a harmful disease would dramatically reduce the mortality rate of that disease. Also many countries can experience decreases in death rates if ~~an~~ already known medical technology is successfully distributed to the population. Another factor that could have led to decreases in death rate could be an increase in crop yield. If Industria had a high mortality rate due to malnutrition, advances in agriculture would help feed all the countries hungry. This can be seen and applied today when compared the South Asian Green Revolution. Where advances in high yield crops were developed to feed a growing and malnourished population.

One reason why the birth rate could have been so high in 1855 could be due to Industria's reliance on agricultural industry. If this were the case as is in many developing countries, there would be a strong dependence on many children. In this type of country it is often the mentality that the more hands that are available the more work that can be done in the fields. ~~Because of this mentality~~ this mentality is often very strong in many countries and is part of tradition. Therefore it would take several decades to educate people

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## ADDITIONAL PAGE FOR ANSWERING QUESTION 2

of the benefits of having less children. Also as long as  
Indonesia is an agricultural country the people would have  
several children. It wouldn't be until a transition in industry  
until families reduced their number of kids. The time  
for an Industrial Revolution to take place can take  
several decades to occur which is one reason why  
Indonesia's birth rates took so long to level off.

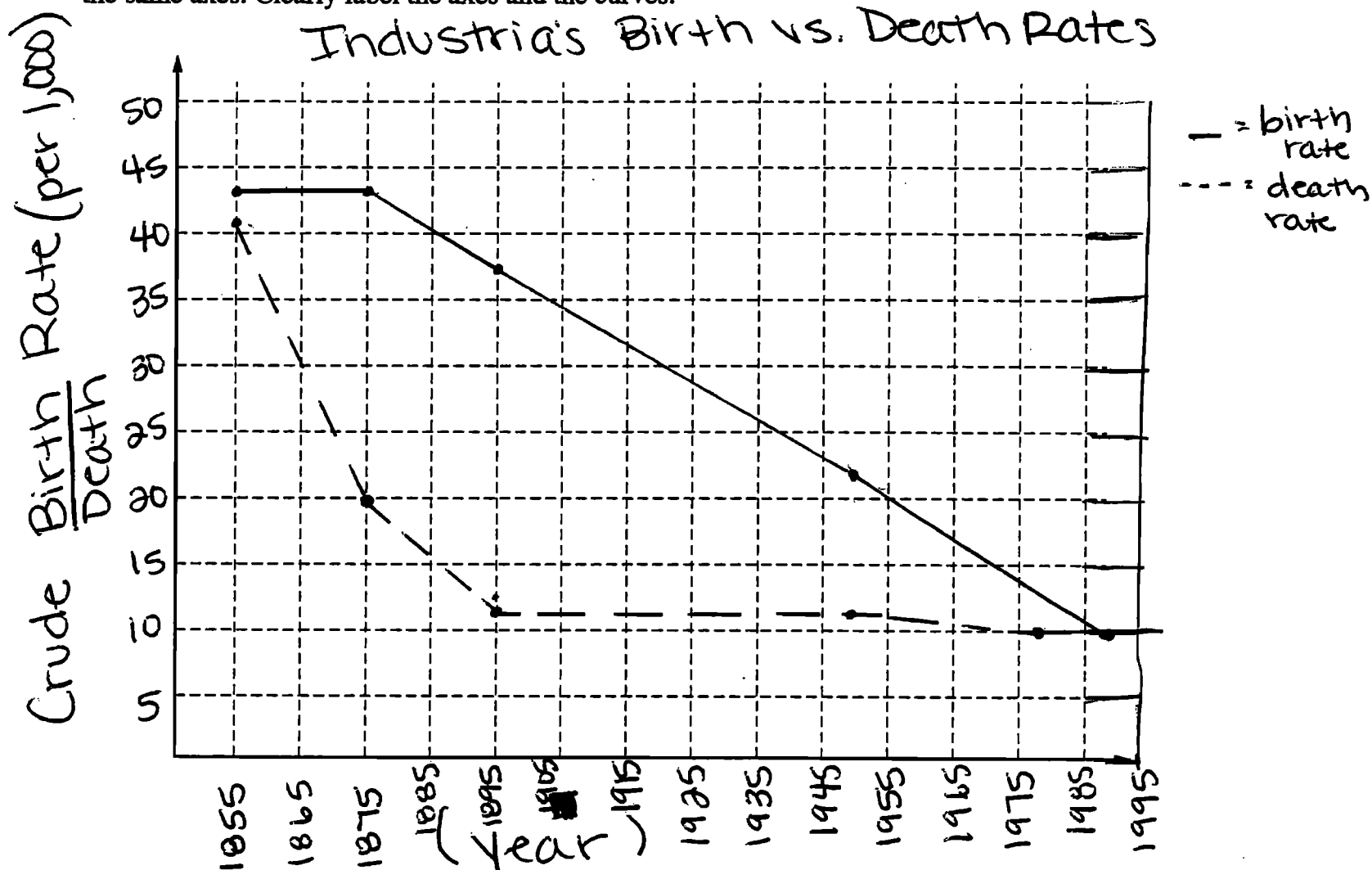
If Indonesia were to continue growing at its 1995  
rate until 1951 its population would be approximately  
4 million people.

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(b) The annual growth rate of Industria in 1950 was 22 people per 1,000 people (22/1000). The birth rate<sup>in 1977</sup> was 0.4%. (c) Two factors that might have accounted for the rapid decline in death rate between 1855 and 1895 are that food production may have become more efficient, thus more people were able to be fed and remain healthy. The other factor could be new advancements in healthcare/medicine, because if the people are able to build up resistance/prevent diseases then they can survive and maintain their population. The birth rate might have been so high in 1855, because since Industria was just developing they may not have had contraceptives, thus many of the younger population was having kids, but as time passed new advancements came along and slowed down birth rates. (d) If the population had continued to grow at the annual rate of growth recorded for 1895, then the population would be 4-5 times larger, because the population slowly decreased from 1895 on, but if it stayed the same ~~the~~ population numbers would have dramatically increased.

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