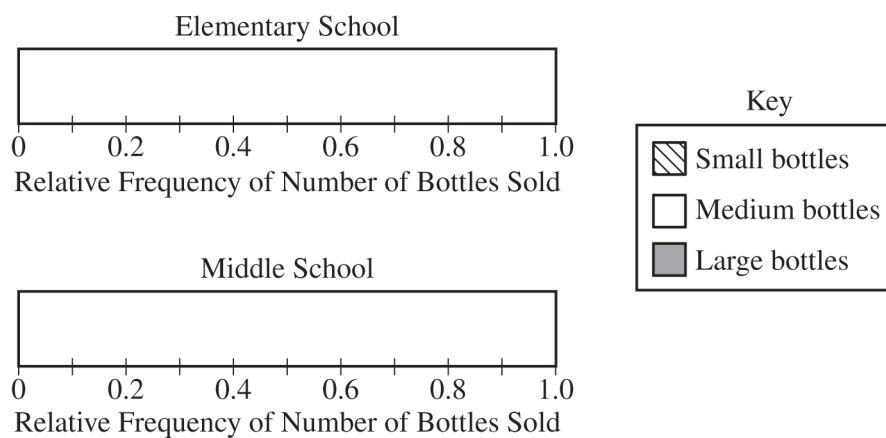


Begin your response to **QUESTION 2** on this page.

2. A local elementary school decided to sell bottles printed with the school district's logo as a fund-raiser. The students in the elementary school were asked to sell bottles in three different sizes (small, medium, and large). The relative frequencies of the number of bottles sold for each size by the elementary school were 0.5 for small bottles, 0.3 for medium bottles, and 0.2 for large bottles.

A local middle school also decided to sell bottles as a fund-raiser, using the same three sizes (small, medium, and large). The middle school students sold three times the number of bottles that the elementary school students sold. For the middle school students, the proportion of bottles sold was equal for all three sizes.

- (a) Complete the segmented bar graphs representing the relative frequencies of the number of bottles sold for each size by students at each school.



- (b) An administrator at the elementary school concluded that the elementary school students sold more small bottles than the middle school students did. Is the elementary school administrator's conclusion correct? Explain your response.

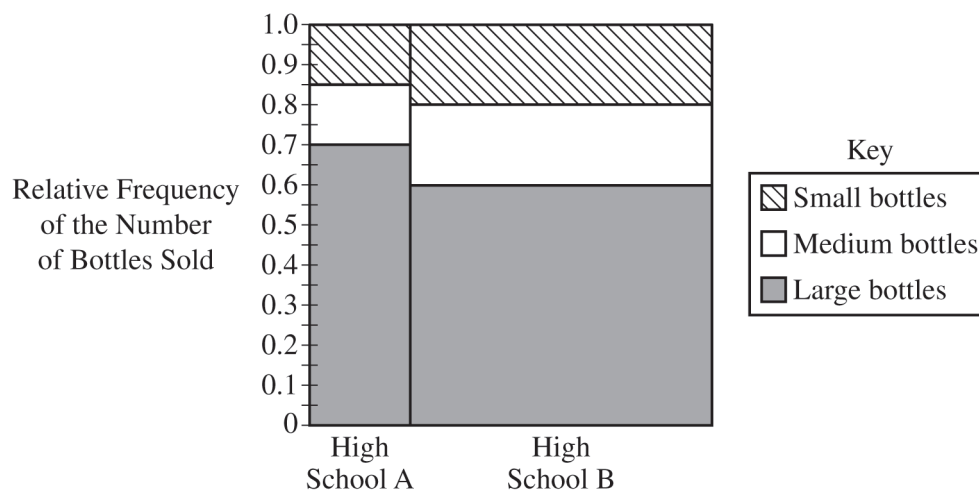
GO ON TO THE NEXT PAGE.

Continue your response to **QUESTION 2** on this page.

Two high schools are also selling the bottles and are competing to see which one sold more large bottles.

(c) A mosaic plot for the distribution of the number of bottles sold by each of the high schools is shown here.

Distribution of the Number of Bottles Sold by High School



(i) Which of the two high schools sold a greater proportion of large bottles? Justify your answer.

(ii) Which of the two high schools sold a greater number of large bottles? Justify your answer.

GO ON TO THE NEXT PAGE.

Begin your response to **QUESTION 3** on this page.

3. A car maker produces four different models of cars: A, B, C, and D. A group of researchers is investigating which model of car has the longest distance traveled per gallon of gas (mileage). Higher mileage is considered better than lower mileage. The researchers will conduct a study in which they contact several owners of each model of car and ask them to estimate their mileage.

(a) Is this an observational study or an experiment? Justify your answer in context.

Model D has an autopilot feature, in which the car controls its own motion with human supervision. James owns a Model D car and will investigate whether using the autopilot feature results in higher mileage than not using the autopilot. James will drive his car on 70 different days to and from work, using the same route at the same time each day. James will record the mileage each day.

- (b) James will use a completely randomized design to conduct his investigation. Describe an appropriate method James could use to randomly assign the two treatments, driving using the autopilot feature and driving without using the autopilot feature, to 35 days each.

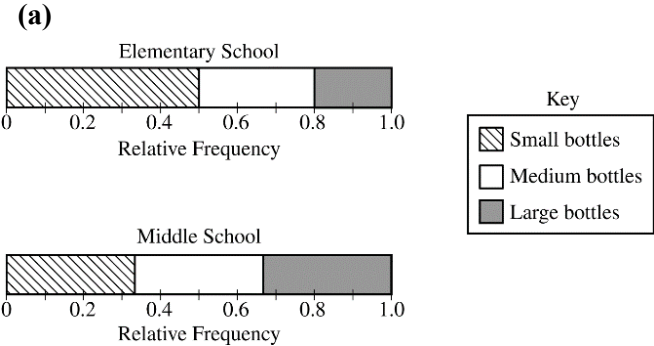
GO ON TO THE NEXT PAGE.

Question 2: Focus on Exploring Data

4 points

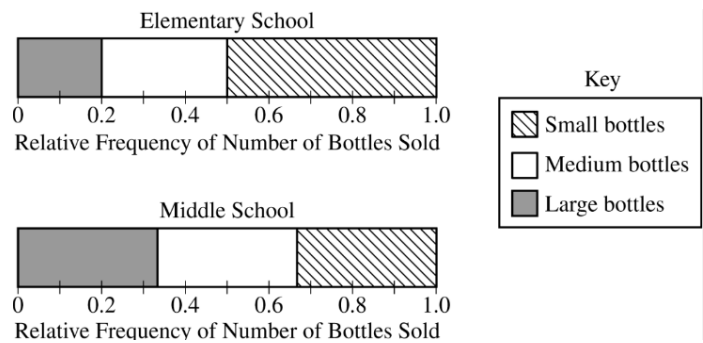
General Scoring Notes

- Each part of the question (indicated by a letter) is initially scored by determining if it meets the criteria for essentially correct (E), partially correct (P), or incorrect (I). The response is then categorized based on the scores assigned to each letter part and awarded an integer score between 0 and 4 (see the table at the end of the question).
- The model solution represents an ideal response to each part of the question, and the scoring criteria identify the specific components of the model solution that are used to determine the score.

Model Solution	Scoring
<p>(a)</p> 	<p>Essentially correct (E) if the response satisfies the following two components:</p> <ol style="list-style-type: none">The elementary school’s segmented bar graph is correctly partitioned according to the given proportionsThe middle school’s segmented bar graph is correctly partitioned to create three equal areas <p>Partially correct (P) if the response only satisfies one of the two components required for E.</p> <p>Incorrect (I) if the response does not meet the criteria for E or P.</p>

Additional Notes:

- Responses that do not use the key given may still satisfy both components as long as a new key is provided that defines small, medium, and large bottles.
- Responses that do not use the key given and do not define a new key may receive credit for component 2 as long as the bar is vertically partitioned to create three equal areas, but do not satisfy component 1.
- Responses need to be within ± 0.05 of the actual cutoff to be acceptable for demonstrating equal areas.
- Responses do not need to be drawn in the order from smallest bottles to largest bottles as shown in the model solution. For example, the graph could be drawn from largest bottles to smallest bottles.



Model Solution	Scoring
<p>(b) No, the segment for small bottles for the elementary school is wider than the segment for small bottles for the middle school; however, the middle school students sold three times as many bottles as the elementary school students. So, if the elementary school sold x number of bottles, the middle school sold $3x$ number of bottles.</p> <p>For example, if the elementary students sold 100 bottles total, then they sold $0.5(100)$ or 50 small bottles. However, because the middle school students sold three times the total number of bottles as the elementary students, they would have sold 300 bottles total and $(0.\bar{3})(300) = 100$ small bottles. Because $100 > 50$, the middle school sold more small bottles, and the elementary school's administrator is not correct.</p>	<p>Essentially correct (E) if the response satisfies the following three components:</p> <ol style="list-style-type: none"> 1. States that the elementary school's administrator is incorrect 2. Provides correct mathematical support verifying the middle school sold more small bottles than the elementary school, consistent with the response to component 1 3. Includes context <p>Partially correct (P) if the response satisfies only two of the three components required for E.</p> <p>Incorrect (I) if the response does not meet the criteria for E or P.</p>

Additional Notes:

- A response that shows mathematical support by showing the inequalities $0.5x < 0.\bar{3}(3x)$, $0.5x < x$, $0.5(1) < 0.\bar{3}(3)$, or $(0.5)\left(\frac{1}{4}\right) < (0.\bar{3})\left(\frac{3}{4}\right)$ may satisfy component 2.
- In order to satisfy component 3, a response must include “elementary,” “middle,” and “bottles.”
- Part (b) should be scored consistent with the response to part (a).

Model Solution	Scoring
<p>(c) (i) The mosaic plot shows that the proportion of large bottles sold by High School A was 0.7 and the proportion of large bottles sold by High School B was 0.6. High School A sold a greater proportion of large bottles because $0.7 > 0.6$.</p> <p>(ii) The number of bottles sold is represented by the area of the shaded region. The area of the rectangle representing large bottles sold by High School B is clearly larger than the area of the rectangle representing large bottles sold by High School A. Therefore, High School B sold more large bottles than High School A.</p>	<p>Essentially correct (E) if the response satisfies the following four components:</p> <ol style="list-style-type: none"> 1. In part (c-i) the response indicates that High School A sold a greater proportion of large bottles 2. In part (c-i) the response bases reasoning on the height of the rectangles or the relative frequencies representing large bottles 3. In part (c-ii) the response indicates that High School B sold a greater number of large bottles 4. In part (c-ii) the response indicates that the area of the rectangle representing large bottles sold by High School B is larger than the area of the rectangle representing large bottles sold by High School A <p>Partially correct (P) if the response satisfies two or three of the four components required for E.</p> <p>Incorrect (I) if the response does not meet the criteria for E or P.</p>

Additional Notes:

- If a response refers to “proportions” rather than relative frequencies in part (c-i), the values 0.7 and 0.6 must be provided to satisfy component 2.
- If the response bases reasoning on the heights of rectangles in part (c-i), the response must clearly state that the rectangles representing large bottles are referenced.
- If the response bases reasoning on the areas of rectangles in part (c-ii), the response must clearly state that the areas representing large bottles are referenced.
- A response that provides reasonable estimates of the large bottle areas may satisfy component 4.

Scoring for Question 2	Score
Complete Response Three parts essentially correct	4
Substantial Response Two parts essentially correct and one part partially correct	3
Developing Response Two parts essentially correct and no part partially correct <i>OR</i> One part essentially correct and one or two parts partially correct <i>OR</i> Three parts partially correct	2
Minimal Response One part essentially correct and no part partially correct <i>OR</i> No part essentially correct and two parts partially correct	1