Task

Cost of Building Portable Classrooms

Strand
Measurement and Geometry

Student Text Pages
68–69

Suggested Timing
80 min

Tools
• scientific calculators

Related Resources
BLM 1-22 Chapter 1 Task Rubric

Accommodations

Language—allow students to work with a partner. Have them provide some responses orally to check for comprehension.

Motor—allow students extra time. Assist students with recording calculations.

Specific Expectations

Solving Problems Involving Measurement and Geometry

GT1.01 perform required conversions between the imperial system and the metric system using a variety of tools (e.g., tables, calculators, online conversion tools), as necessary within applications

GT1.02 solve problems involving the areas of rectangles, triangles, and circles, and of related composite shapes, in situations arising from real-world applications

GT1.03 solve problems involving the volumes and surface areas of rectangular prisms, triangular prisms, and cylinders, and of related composite figures, in situations arising from real-world applications

Teaching Suggestions

- Have students read the Task and ensure they understand what they are being asked to do.
- Have students work in groups to brainstorm strategies for completing the Task. Discuss the strategies and review necessary skills and concepts for completing the problem.
- Remind students to identify any assumptions they make in their solution. For example, do the estimated costs per square unit refer to floor area only or to the area of walls, floor, and roof (as in the sample solution)? Do the prices include taxes?
- Circulate as students complete the Task and assist them as necessary.

Prompts for Getting Started

Ask students the following questions:

- What is the Task asking you to do?
- Is the given information complete enough to answer the questions?
- Where can you find the necessary measurement formulas needed for the calculations?

Hints for Evaluating a Response

Student responses are being assessed for the level of mathematical understanding they represent. As you assess each response, consider the following questions:

- How much assistance did the student need to understand what information was required?
- How much assistance did the student need to search the Internet to find sample templates?
- How much assistance did the student need to complete the Task?
- What parts of the Task did the student complete or not complete?
- Did the student list the assumptions made in the solution?
- Did the student present work that is clear and easy to follow and understand?
- Did the student demonstrate an understanding of the process for creating a complete cost estimate?
- Did the student identify any additional or optional costs not covered by the original specifications?

Level 3 Sample Response

I need to calculate the missing dimensions of the portable and convert all the units to the same measurement system before calculating the building costs.
Calculate the slant height of the roof.

$$\text{Slant height of roof} = \sqrt{0.3^2 + \left(\frac{7.3}{2}\right)^2}$$
$$= 3.66$$

The slant height of the roof is approximately 3.66 m.

Convert all measures to imperial units. (1 m = 3.280 839 9 ft)

length = 32.15 ft	slant height of roof = 12.01 ft
width = 23.95 ft	door width = 2.79 ft
height = 9.51 ft	door height = 6.73 ft
gravel depth = 0.328 ft	window width = 2.62 ft
height roof gable = 0.98 ft	window height = 4.92 ft

Construction Materials

Determine the total area of the walls, roof, and floor for one portable.

$$\text{Total area of front and back walls} = 2 \times \text{length} \times \text{height}$$
$$= 2 \times 32.15 \times 9.51$$
$$= 611.5$$

$$\text{Total area of side walls} = 2 \times (\text{width} \times \text{height}) + 2\left(\frac{1}{2} \times \text{width} \times \text{height of gable}\right)$$
$$= 2 \times (23.95 \times 9.51) + 2\left(\frac{1}{2} \times 23.95 \times 0.98\right)$$
$$= 479$$

$$\text{Total area of roof} = 2 \times \text{length} \times \text{slant height}$$
$$= 2 \times 32.15 \times 12.01$$
$$= 772.2$$

$$\text{Total area of floor} = \text{length} \times \text{width}$$
$$= 32.15 \times 23.95$$
$$= 770$$

Find the total surface area for one portable.

$$\text{Total area of walls, roof, and floor} = 611.5 + 479 + 772.2 + 770$$
$$= 2632.7$$

The total surface area of one portable is 2632.7 ft^2.

Construction materials cost \$6.95/ft^2.

$$\text{Cost of construction materials} = 6.95 \times 2632.7$$
$$= 18\,297.265$$

The total cost of the construction materials for the walls, roof, and floor is \$18 297.27.

Gravel

There will be a bed of gravel 0.328 ft deep under each portable. The area to be covered is the area of the floor, 770 ft^2. Since gravel is sold by the cubic yard, determine the volume of gravel in cubic yards. (3 ft = 1 yd; 9 ft^2 = 1 yd^2)

0.328 ft $\doteq$ 0.109 yd

770 $ft^2 \doteq$ 85.556 yd^2

$$\text{Volume of gravel needed} \doteq 0.109 \times 85.556$$
$$\doteq 9.34$$

Approximately 9.34 yd^3 of gravel are needed.

Gravel costs \$95.00/yd^3.

$$\text{Cost of gravel} = 9.34 \times 95$$
$$= 886.35$$

The total cost of gravel is \$886.35.

Paint

Only the inside walls will be painted. The doors and windows will not be painted.

$$\text{Area of doors} = 2 \times 2.79 \times 6.73$$
$$= 37.55$$

$$\text{Area of windows} = 4 \times 2.62 \times 4.92$$
$$= 51.56$$

Area to be painted = area of long walls + area of side walls − area of doors − area of windows
= 611.49 + 479 − 37.55 − 51.56
= 1001.38
The total area to be painted is 1001.38 ft^2.

Each gallon of paint will cover 400 ft^2.
Amount of paint = 1001.38 ÷ 400
= 2.5
Approximately 2.5 gal of paint are needed for each coat, 5.0 gal in total.

1.

Description	Cost/Unit	Quantity	Total Cost ($)
Materials for walls, floor, roof (studs, insulation, drywall, siding), in square feet	$6.95/$ft^2$	2632.7 ft^2	18 297.27
Gravel, in cubic yards	$95.00/$yd^3$	9.33 yd^3	886.35
Paint (two coats), in gallons	$26.00/gal	5.0 gal	130.00
Doors	$110.00 each	2	220.00
Windows	$90.00 each	4	360.00
Subtotal			19 893.62
Hardware	5% of materials cost		994.68
Electrical	10% of materials cost		1989.36
Labour	$30.00/h	80 h	2400.00
TOTAL			25 277.66

2. My school has 430 students now.
20% × 430 = 86
There would be 86 additional students.

The problem does not say how many students can fit in one portable. I will assume each portable can accommodate 30 students.

86 ÷ 30 ≐ 3

Three portables would be required for my school.

3. Multiply the total cost for one portable by three.
3 × 25 277.66 = 75 832.98
The total cost of portables would be $75 832.98.

4. I found templates on the Internet. This link shows a detailed construction estimate for a kitchen renovation:
http://www.independentweb.com/archive/residential_construction_services/detail.htm.

5. This is my written estimate.

March 15, 2009
To: Ryerson High School
From: Hill Construction Company
Re: Estimate of Portable Construction Costs
You have asked us for a written estimate of the costs of constructing three (3) portable classrooms for your school.

Specifications
We looked at the plans you supplied in the textbook. The measures of all portable dimensions are as follows.

length = 32.15 ft	slant height of roof = 12.01 ft
width = 23.95 ft	door width = 2.79 ft
height = 9.51 ft	door height = 6.73 ft
gravel depth = 0.328 ft	window width = 2.62 ft
height roof gable = 0.98 ft	window height = 4.92 ft

We estimate the total dimensions related to the construction of one portable to be:
total surface area of building = 2632.7 ft^2
total volume of gravel = 9.34 yd^3
total area to be painted = 1001.38 ft^2

Cost
We estimate the total cost of the project will be approximately $85 692. A breakdown of the costs follows.

CONSTRUCTION MATERIALS	Cost/Unit	Quantity/ Portable	Total Cost/ Portable ($)	Total Cost for Project ($)
Materials for walls, floor, roof (studs, insulation, drywall, siding)	$6.95/ft^2	2632.7 ft^2	18 297.27	54 891.81
Gravel	$95.00/yd^3	9.33 yd^3	886.35	2 659.05
Paint (two coats)	$26.00/gal	5 gal	130.00	390.00
Doors	$110.00 each	2	220.00	660.00
Windows	$90.00 each	4	360.00	1 080.00
Materials Sub Total				**59 680.86**
Hardware	5% of materials cost			2 984.04
Electrical	10% of materials cost			5 968.08
Total Materials				**68 632.98**
Labour	$30.00/h	80 h	2 400.00	7 200.00
Sub Total			25 277.66	75 832.98
Taxes (13%)			3 286.10	9 858.29
Grand Total			**28 563.76**	**85 691.27**

Thank you,
Mackie Hill

Level 3 Notes

Look for the following:

- chooses correct formulas to solve the problems
- identifies the given values for each question
- copies and completes estimate template with minor errors
- substitutes values correctly into formulas with very few errors in the calculations
- has understanding of problem-solving techniques
- has organised solution and a clear justification for responses

What Distinguishes Level 2

Look for the following:

- chooses some correct formulas to solve the problems
- identifies most of the given values for each question
- copies and completes estimate template with some errors
- substitutes some values correctly into formulas with some errors in the calculations
- has some understanding of problem-solving techniques but difficulty in applying the techniques
- has a somewhat organised solution and some justification for responses

What Distinguishes Level 4

Look for the following:

- chooses correct formulas to solve the problems
- identifies the given values for each question and clearly identifies any assumptions made in the solution
- copies and completes estimate template with no errors
- has a highly effective use of problem-solving techniques
- has a highly organised solution and clear, accurate, and detailed justification for responses
- has a highly effective use of mathematical terms
- has a solution that discusses information that may be missing from the question and/or that discusses alternatives for the school accommodation problem

Ongoing Assessment

- Use **BLM 1-22 Chapter 1 Task Rubric** to assess student achievement.