Grade 9-12 Mathematics CAPT-like Problems

1. Practical Living

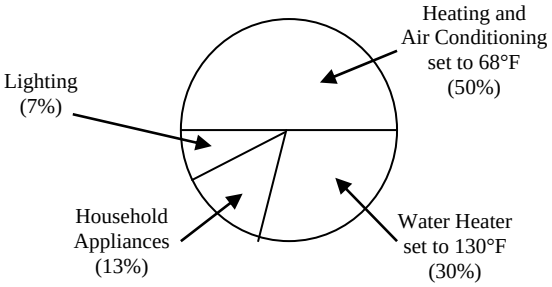
1. During the past year, your average monthly use of electricity has been 1500 kilowatt hours (KWH). The utility company has asked that all customers reduce electricity use by 15%.

    a. Using the information above and in the circle graph below, determine the number of KWH you are currently using in the four specific usage areas.

    b. Using all of the information provided below, decide how you will comply with the utility company's request. Justify your figures and your reasons.

    c. Develop a plan to show how much electricity you will be using for each of the four specific usage areas in your home. (You may use a chart or graph for this purpose.) Justify your figures and your reasons.

Percent of Average Monthly Use of Electricity by Specific Usage Areas



Source: Kentucky Department of Education
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Electricity Saved by Decreasing Use in Specific Usage Areas

USAGE AREA	KWH SAVED PER 30 DAYS
Decreasing Heating or Air Conditioning by 1°F…….	90 KWH
Decreasing Water Temperature by 1°F……..	18 KWH
Decreasing Household Appliance Use by 1 Hour Each Day ……..	60 KWH
Decreasing Lighting by 1 Hour Each Day……..	18 KWH

2. Insect Population

1. Over a one-year time period, an insect population is known to quadruple. The starting population is fifteen insects.

    a. Make a table or graph to show the growth of the population from 0 through 6 years.
    b. How many insects would there be at the end of 10 years?
    c. Write a mathematical statement that would describe this growth.
    d. Would your mathematical statement or formula correctly describe the insect population after 50 years? Justify your conclusion.
    e. What additional questions would your table or graph answer?

Source: Kentucky Department of Education
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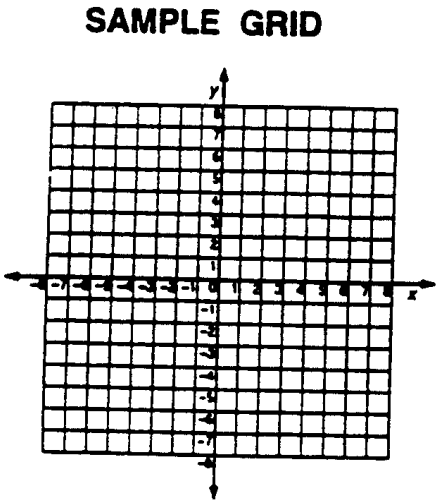
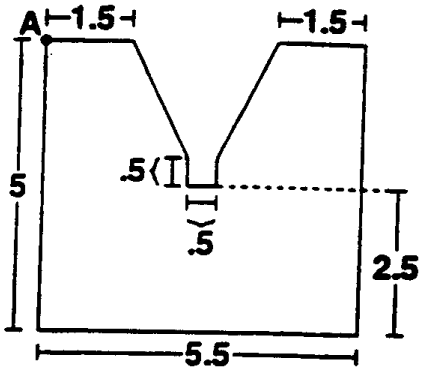
Grade 9-12 Mathematics CAPT-like Problems

3. Computer Aided Design

Computer Aided Design (CAD) is based on the Cartesian Coordinate System. You are to use a grid similar to the one below as if it were the CAD program on a computer.



a. Use graph paper to plot the drawing below. Start point A at (-7, 6)



b. On the same graph paper, draw the figure as a reflection through the x-axis.

c. State the procedure or rule for making a reflection through the x-axis.

Source: Kentucky Department of Education
Used with permission

4. Effective Tax Rates

One plan for a state income tax requires those persons with incomes of $10,000 or less to pay no tax and those persons with income greater than $10,000 to pay a tax of 6 percent only on the part of their income that exceeds $10,000.

A person's effective tax rate is defined as the percent of total income that is paid in tax.

Based on this definition, could any person's effective tax rate be 5 percent? Could it be 6 percent? Explain your answer. Include examples to justify your conclusions.

Show your work and explain your reasoning. You may use drawings, words and numbers in your explanation. Your answer should be clear enough so that another person could read it and understand your thinking. It is important that you show all your work.

Source: [1992 National Assessment of Educational Progress
Used with permission

Grade 9-12 Mathematics CAPT-like Problems

5. M^{c}Donald's Claim

You and a friend read in the newspaper that 7% of all Americans eat at M^{c}Donald's each day. Your friend says, "That's impossible!"

You know that there are approximately 250,000,000 Americans and approximately 9,000 M^{c}Donald's restaurants in the U.S. You think the claim is reasonable.

Show your mathematical work and write a paragraph or two that explains your reasoning.

Source: The Connecticut State Department of Education

6. Classifying Quadrilaterals

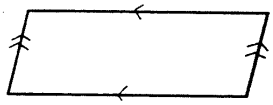
Quadrilateral is the "family" name that is given to closed shapes with *four* sides.

This closed shape has four sides; it is a quadrilateral.

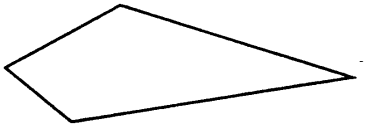
This is not a quadrilateral.

This quadrilateral has one right angle.

This quadrilateral has four right angles.



This quadrilateral has two pairs of parallel sides.



This one has no pairs of parallel sides.

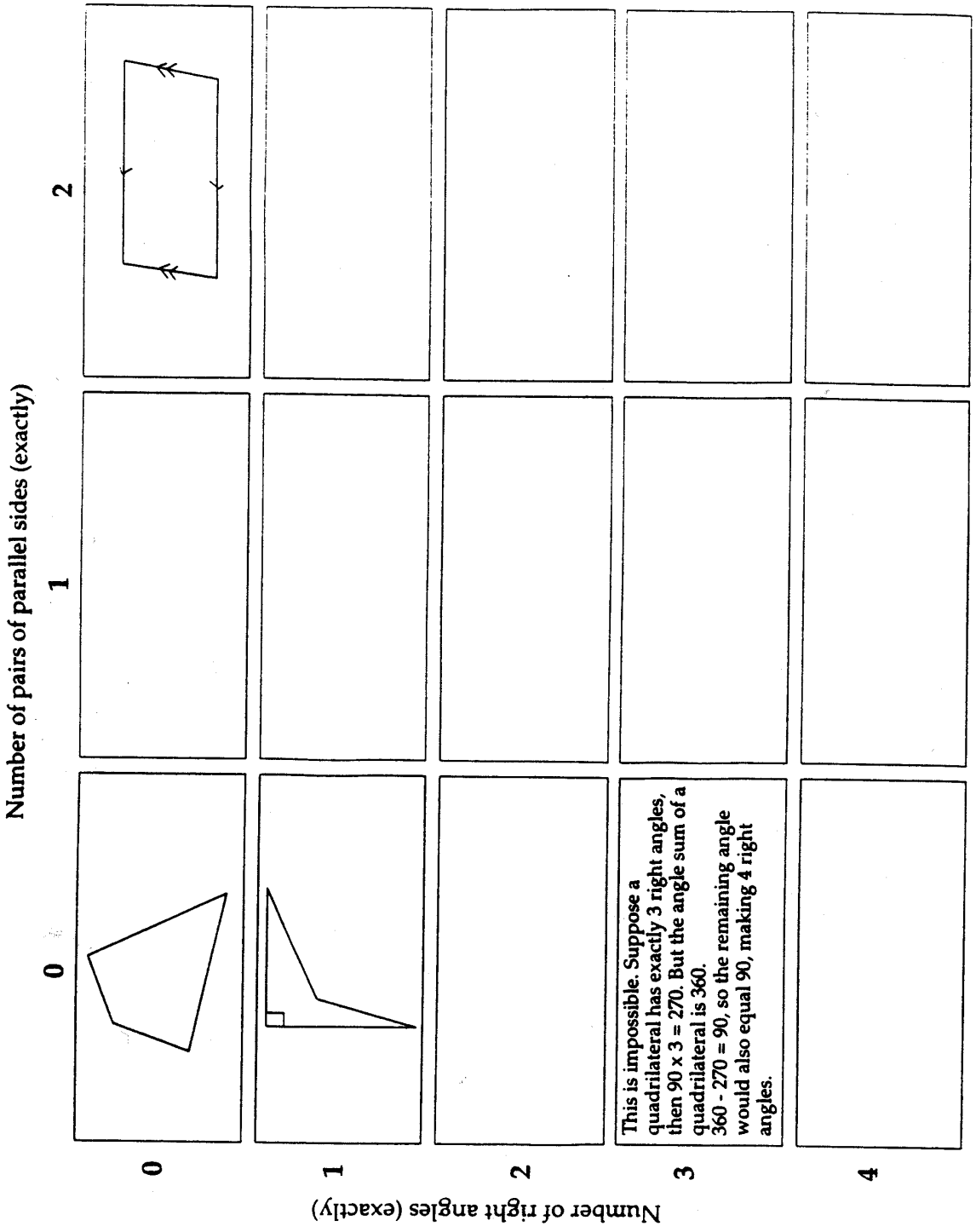
> You can indicate that two segments are parallel by marking them as in the diagram. The marks do *not* mean that two similarly-marked segments are congruent.

In the matrix provided on the next page, sketch a quadrilateral that has both of the properties associated with each box, if possible. Sketch it into the appropriate box. Label the right angles and sides that are parallel.

If it is impossible to fill a box, then justify why you cannot do so.

Some of the boxes have been filled in for you.

Grade 9-12 Mathematics CAPT-like Problems



Grade 9-12 Mathematics CAPT-like Problems

7. Treena's Budget

Treena won a 7-day scholarship worth $1000 to the Pro Shot Basketball Camp. Round-trip travel expenses to the camp are $335 by air or $125 by train. At the camp she must choose between a week of individual instruction at $60 per day or a week of group instruction at $40 per day. Treena's food and other expenses are fixed at $45 per day. If she does not plan to spend any money other than the scholarship, what are all choices of travel and instruction plans that she could afford to make?

Show your work and explain your reasoning. You may use drawings, words and numbers in your explanation. Your answer should be clear enough so that another person could read it and understand your thinking. It is important that you show all your work.

Source: 1992 National Assessment of Educational Programs.
Used with permission.

8. French Fries

You and your friends think that sometimes you get ripped off when you buy fries. Some portions seem to have a lot fewer french fries than others, so you decide to do a study.

For a week, after school, you and your friends count the number of french fries in 20 different orders. Here is what you found:

Portion #	# of Fries	Portion #	# of Fries
1	30	11	40
2	35	12	32
3	35	13	32
4	38	14	30
5	31	15	35
6	43	16	33
7	32	17	33
8	32	18	31
9	29	19	38
10	40	20	31

1. On a separate sheet of paper, construct a graph representing the information from your study.
2. About how many french fries would you expect to get next time? Explain your reasoning.

   _____
   _____
   _____

3. Based on your data, how few fries would you need to get before feeling ripped off? Explain your reasoning.

   _____
   _____
   _____

Source: Connecticut State Department of Education

Grade 9-12 Mathematics CAPT-like Problems

9. The Speeding Ticket

The fine for speeding on the highways of most states is a function of the speed of the car. In Connecticut, the speeding fine can be determined by the formula:

F=10(S-55) + 40

where **F** is the fine in dollars and **S** is the speed your car was going in miles per hour.

1. What would your speeding fine be if you were caught traveling 82 miles per hour (mph)?

   _____

   _____

2. Suppose you received a speeding ticket for $250. How fast were you going? Explain how you arrived at your answer.

   _____

   _____

3. The minimum speeding fine in Connecticut is $90. The maximum speeding fine is $340. What is the range of speeds that correspond to these fines?

   _____

   _____

4. Why is it unlikely for someone to receive a $50 speeding fine in Connecticut?

   _____

   _____

5. Use the information you arrived at above and construct a line graph that shows the speeding fine and the car's speed for all speeds from 55 to 100 mph.

6. In Vermont, the speeding formula is F=4 (S-65) + 10. What is the difference in the cost of a speeding ticket in Vermont and Connecticut for someone caught driving 78 mph?

_____

_____

Source: Connecticut State Department of Education

Grade 9-12 Mathematics CAPT-like Problems

10. The Budget Mystery

In 1990, the maintenance budget for a school was $30,000 out of a total budget of $500,000. In 1991, the figure was $31,200 out of a total budget of $520,000. Inflation between 1990 and 1991 was 8%.

Parents complained that the money spent on maintenance INCREASED.

The maintenance manager complained that the money spent on maintenance DECREASED.

The principal claimed that, in fact, there has been NO CHANGE in spending for maintenance.

1. Write what the parents could say to justify their claim of an increase.

_____

_____

_____

_____

2. Write what the maintenance manager could say to justify his claim of a decrease.

_____

_____

_____

_____

3. Write what the principal could say to justify her claim of no change.

_____

_____

_____

_____

Source: Connecticut State Department of Education

Grade 9-12 Mathematics CAPT-like Problems

11. Planning a Bookcase

At its last meeting, the French Club voted to obtain a bookcase for the club's growing collection of literature. You receive the following memo from Mr. Collins, the faculty sponsor of the club:

To: President of the French Club
Re: Bookcase for the club
From: Mr. Collins

Spradlees offers the lowest prices in the area, but Sally suggested we might save money by making the bookcase in the wood shop here at school. The club's cash reserves are low, so saving money is important. Mr. Howey said we can use the shop tools and supplies at no cost, if we pay for the wood. He will help with construction. The bookcase will go against the wall, between the desk and the file cabinet, in a space a little over 6 feet wide.

Please analyze the situation and determine which is better: making or buying the bookcase. Can we save money by making it ourselves? I have enclosed an ad with lumber prices to help you estimate construction costs.

We need to decide about the bookcases at today's meeting. Since you will not be there, please prepare a written report for the club to use as the basis for our decision. Be sure to include:

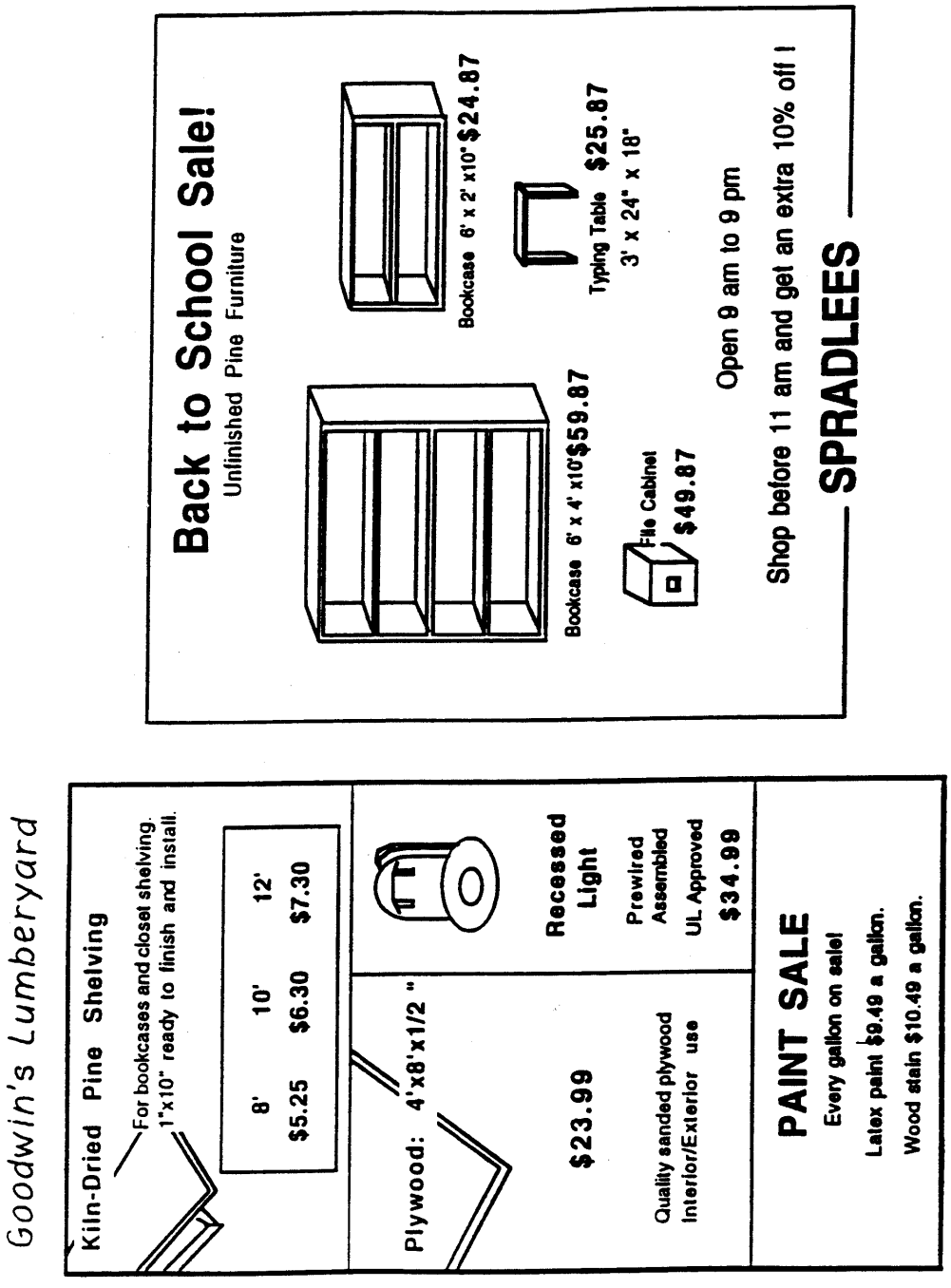
- a clear explanation of the possibilities you considered and how you estimated their costs
- a comparison of relative costs of different possibilities
- your recommendation for what we should do and why

Thanks.

Write a report responding to Mr. Collins' memo. Include drawings or other graphics, if needed, to effectively communicate your findings and your suggested course of action.

Source: Connecticut State Department of Education

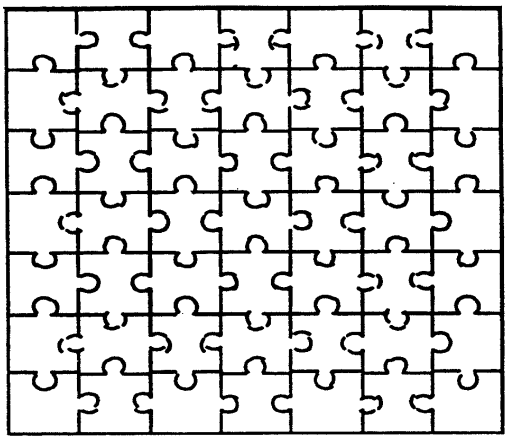
Grade 9-12 Mathematics CAPT-like Problems



Source: Connecticut State Department of Education

Grade 9-12 Mathematics CAPT-like Problems

12. Jigsaw Puzzles

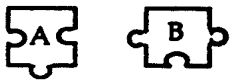


This 7 by 7 jigsaw puzzle is made up of:

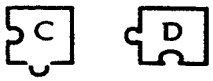
		4	pieces with *two* straight edges
		20	pieces with *one* straight edge
		25	pieces with *no* straight edges
Total	=	49	pieces altogether.

Imagine that all the pieces are colored blue on just the front side.
In this task, you are *not* allowed to flip pieces over so that the blue side is on the table.

1. A square jigsaw puzzle has 2500 pieces.
   How many pieces of each type are used?
   Describe how you obtain your answers.
2. How many pieces of each type would you need for a square puzzle with n^2 pieces? Try to simplify each answer as much as possible.
   a. Show, step by step, that your three answers add up to n^2.
3. There are two different types of pieces with only one straight edge, A and B.

   Explain clearly why you always need an equal number of each type piece for rectangular jigsaws of any size.
4. There are two different types of pieces with two straight edges, C and D.

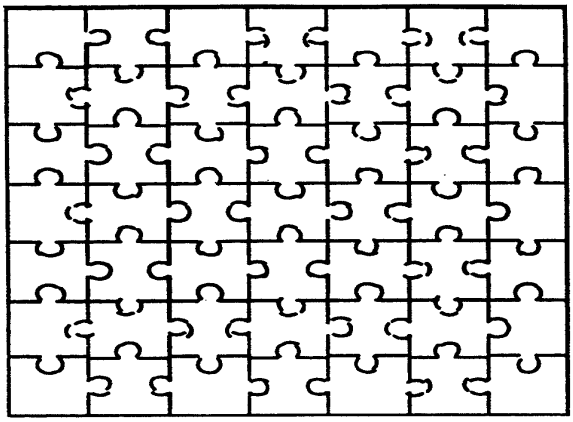
   

   Describe the different rectangles you can make if you only use type C corner pieces, along with other edge and center pieces. Explain your work clearly. Remember that you cannot flip pieces over.

Released by Balanced Assessment

Grade 9-12 Mathematics CAPT-like Problems

13. Jigsaw Puzzle Two



Imagine that all the pieces are colored blue on just the front side. In this task, you are not allowed to flip pieces over so that the blue side is on the table.

1. A square jigsaw puzzle has 625 pieces. It is made with pieces that have one straight edge, two straight edges, or no straight edges. How many of each of these type pieces are used to make the puzzle? Describe how you obtained your solution.

2. How many of each type of the puzzle pieces would you need for a square puzzle of any size?

3. In the puzzle above there are two different types of pieces with only one straight edge, A and B. There are also two different types of corner pieces, C and D.

   a. Explain clearly why you always need an equal number of A and B pieces for rectangular jigsaw puzzles of any size, **regardless** of what corner pieces you use.

4. Another square jigsaw puzzle has 2500 pieces. How many of **each type** of the pieces **(A, B, C, D, and center piece)** do you need to make a puzzle of 2500 pieces?

Released by Balanced Assessment

Grade 9-12 Mathematics CAPT-like Problems

14. Colin's Columns

	COLUMNS			
	A	B	C	D
1st Row	1	2	3	4
2nd Row	5	6	7	8
3rd Row	9	10	11	12
4th Row	13	14	15	16
5th Row	17	18	___	___
6th Row	___	___	___	___

Imagine that the table goes on like this forever!

a. Complete the 5th and 6th **rows** in the table.

b. What numbers are in the 10th **row**?_____

c. What numbers are in the 100th **row**?_____

d. What numbers are in the *n*th **row**?_____

e. In which **column** will the number 39 be found? _____

f. In which **column** will the number 2,683 be found? Describe your method for answering this question.

g. Colin says, "If you add *any* number from column A to *any* number from column B, you will find the answer ***somewhere*** in column C."

Is Colin correct? _____

Describe how you can be sure. (Use algebra if this helps.)

h. Colin's statement is shown in the table below ("a" is any number from column A; "b" is any number from column B, and so on).

+	a	b	c	d
a		c		
b				
c				
d				

Complete the table, and describe how you completed it.

Describe any patterns and number properties in the table. Explain why they occur.

Grade 9-12 Mathematics CAPT-like Problems

15. The Gambler's Rental Agreement

by Irving Lubliner

Suppose your landlord allows you to choose from among these payment plans. Which would give you the lowest average rent? Explain your answer. Can you design another rental plan so that the average rent is lower than any of the other plans?

Rental Plan #1

You pay $375 per month

Rental Plan #2

Each month, you flip a coin. Get "HEADS" and you pay $300. Get "TAILS" and you pay $400.

Rental Plan #3

Each month, you pick a card, at random, from a standard deck (no jokers). If it is an ace, you pay $600. If it is a face card, you pay $500. Otherwise, you pay just $300.

Rental Plan #4

Each month, the landlord comes and watches you put a $5 bill, a $50 bill, a $100 bill, and a $500 bill into a bag. The bag is shaken and then he gets to reach in and pick two bills, at random. What he picks, he keeps.

Rental Plan #5

Each month, you get to roll two dice. If your total is 4 or less, you pay $300. If it is 9 or more, you pay $1000. Otherwise, you pay nothing.

Rental Plan #6

Each month, you pick a card, at random, from a standard deck (no jokers). If it is an ace, you pay $2000. If it is a numbered card (2 through 10), your rent is the number you picked multiplied by 50. If you pick a face card, you pay nothing.

Grade 9-12 Mathematics CAPT-like Problems

16. *Tacks*

Sarah has 100 congruent square pieces of paper to tack up on a bulletin board. Papers must be tacked at all corners. What is the fewest number of tacks she will need to tack the 100 papers? Draw a diagram and explain your thinking at each step and your answer(s).

17. *Horse Nails*

(This problem is from a 16th century arithmetic book.) "If I sold unto you a horse having four shows, and in every shoe 6 nails, with this condition, that you shall pay for the first nail one *ob*, for the second nail two *ob*, for the third nail four *ob*, and so forth, doubling until the end of all the nails: Now I ask you how much would the price of the horse come unto?" Explain your thinking at each step and your answer(s).

18. *Book Covers*

Ron's class of 23 students is making book covers for their creative writing out of special matboard with dimensions 4 feet by 3 feet. The book covers have to be 9 ½ inches by 12 ½ inches. Determine the number of pieces of matboard that Ron's class will need to purchase in order to ensure that they have enough matboard for all the students to have a front and back cover. Determine the amount and percent of waste on each board. Explain your thinking at each step and your answer(s).

19. *Taking a Trip*

Randy is driving from Prosser to Sunnyside. To get to Sunnyside on time he needs to drive at an average speed of 50 miles per hour. He was halfway to Sunnyside when he noticed that bad roads had limited his speed to an average of 25 miles per hour. How fast much he drive to average 50 miles per hour for the whole trip? Explain your thinking at each step and your answer(s).

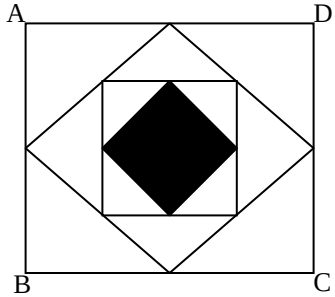
20. *Which Way Out?*

An auditorium has eight doors. Show how many ways it is possible for Kent to enter by one door and leave by another? Explain your thinking at each step and your answer(s).

Grade 9-12 Mathematics CAPT-like Problems

21. *Midpoints and Percents*

Each smaller square is made by joining the midpoints of the sides of the larger surrounding square. What percent of the area of square ABCD is the shaded square? Explain your thinking at each step and your answer(s).

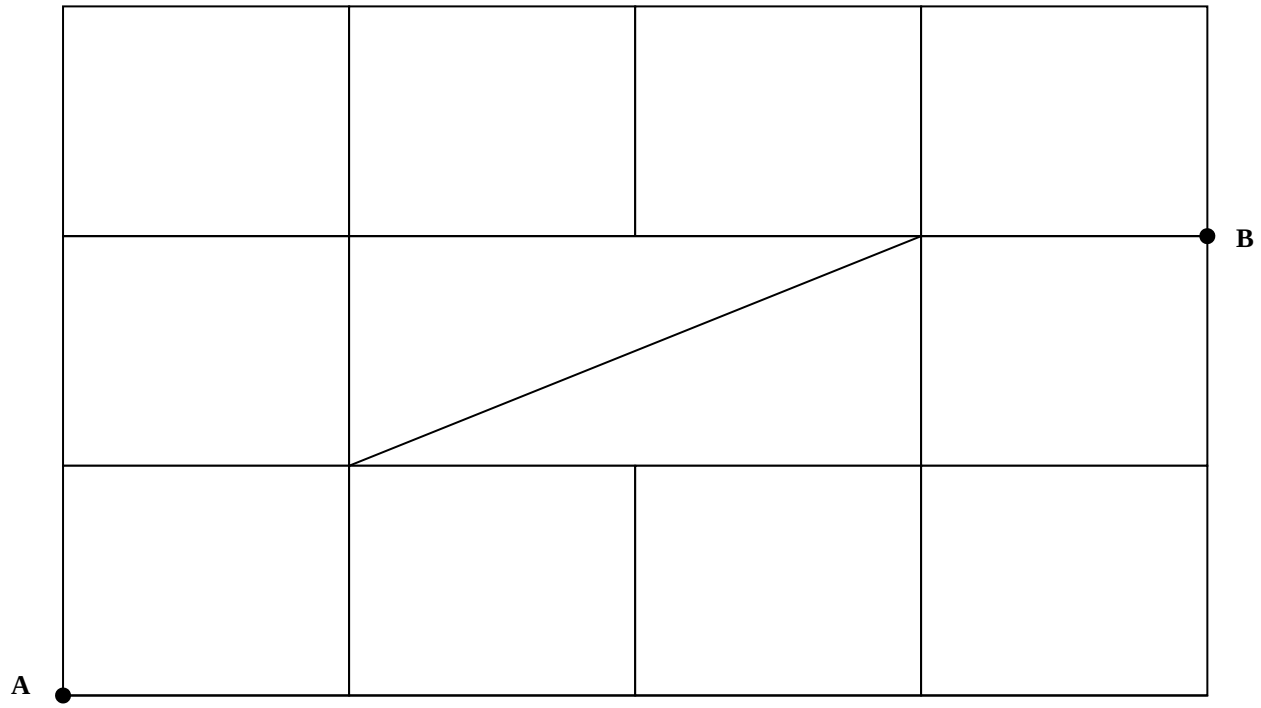


Released by the Oregon Department of Education

22. *Shortest Route*

A section of a map showing city streets is provided below

SCALE: 1 inch = 40 yards



Assume there are no one-way streets on this map. What is the approximate length in yards of the shortest route a person can take in driving along the streets shown from point A to point B? You may use your ruler to help you answer this question.

Released by the New Jersey Department of Education

Grade 9-12 Mathematics CAPT-like Problems

23. *Working at Farrah's Fast Food*

Use the table and information below to answer the question below. The table indicates the hourly receipts for Farrah's Fast Food on a typical day.

6–7 a.m.	……..	$65	12 – 1 p.m.	……..	$320	6–7 p.m.	……	$305
7–8 a.m.	……	$105	1-2 p.m.	……..	$240	7-8 p.m.	……	$200
8–9 a.m.	……	$230	2-3 p.m.	……..	$150	8-9 p.m.	……	$170
9–10 a.m.	……	$190	3-4 p.m.	……..	$125	9-10 p.m.	……	$110
10-11 a.m.	……	$110	4-5 p.m.	……..	$150	10-11 p.m.	……	$70
11-12 a.m.	……	$195	5-6 p.m.	……..	$220	11-12 p.m.	……	$45

Farrah's is open from 6 a.m. to 12 midnight; a manager is always present. Farrah, the owner, has 8 counterpersons working for her every day during the hours Farrah's is open. Each counterperson works 7 consecutive hours sometime during the day. Typically, each counterperson takes in up to $80 per hour while working.

Based on only the information in this problem, develop a master schedule for 8 counterpersons for a typical day. Ignore any breaks taken by the counterpersons. The master schedule should satisfy the following conditions:

1. The schedule indicates the 7-hour block of time during which each counterperson is working.
2. There are always enough counterpersons working to handle the typical volume of business.
3. There will be times when more counterpersons are working than are needed. However, those times are minimized.

Released by the New Jersey Department of Education

24. *Discount Coupons*

Just for the summer, Giant Amusement Park offers two types of discount coupons for the purchase of admission tickets to that park. The "BUY ONE, GET ONE FREE!" type of coupon is good for exactly one free basic admission ticket when another admission ticket of equal or greater value is purchased on ANY TUESDAY OR THURSDAY. The "SAVE $6!" type of coupon is good for a $6 discount on any kind of admission ticket to that park on any day of the week. You decide to go to Giant Amusement Park and buy an admission ticket regularly priced at $11.95. Which of these two types of discount coupons should you use to get the "better" deal? Present a convincing argument to support your answer so that the reader can understand your solution to the problem. You may wish to include one or more simple, specific examples as part of your argument.

Released by the New Jersey Department of Education

Grade 9-12 Mathematics CAPT-like Problems

25. *Triangular Rotations*

Plot the following points on a grid.

A(0,0) , B(3,0) , C(0,4)

Then draw triangle ABC on the grid.

Rotate triangle ABC 90° clockwise about the origin to get a new triangle. Sketch that new triangle on the grid and label its vertices with their coordinates.

What is the area of that new triangle, and how does it compare with the area of triangle ABC?

Released by the New Jersey Department of Education

26. Kathy's Option

When Kathy bought a new bicycle, she was given a choice of one of two discount options for buying accessories, such as a bike rack, water bottle, air pump, helmet, or gloves. The options are:

Option 1: A certificate for $5 off a total purchase of $25 or more.
Option 2: 10% off any one accessory

What advice would you give to Kathy to help her determine which option she must choose to save the most money? Show the mathematics you used to decide what your advice would be.

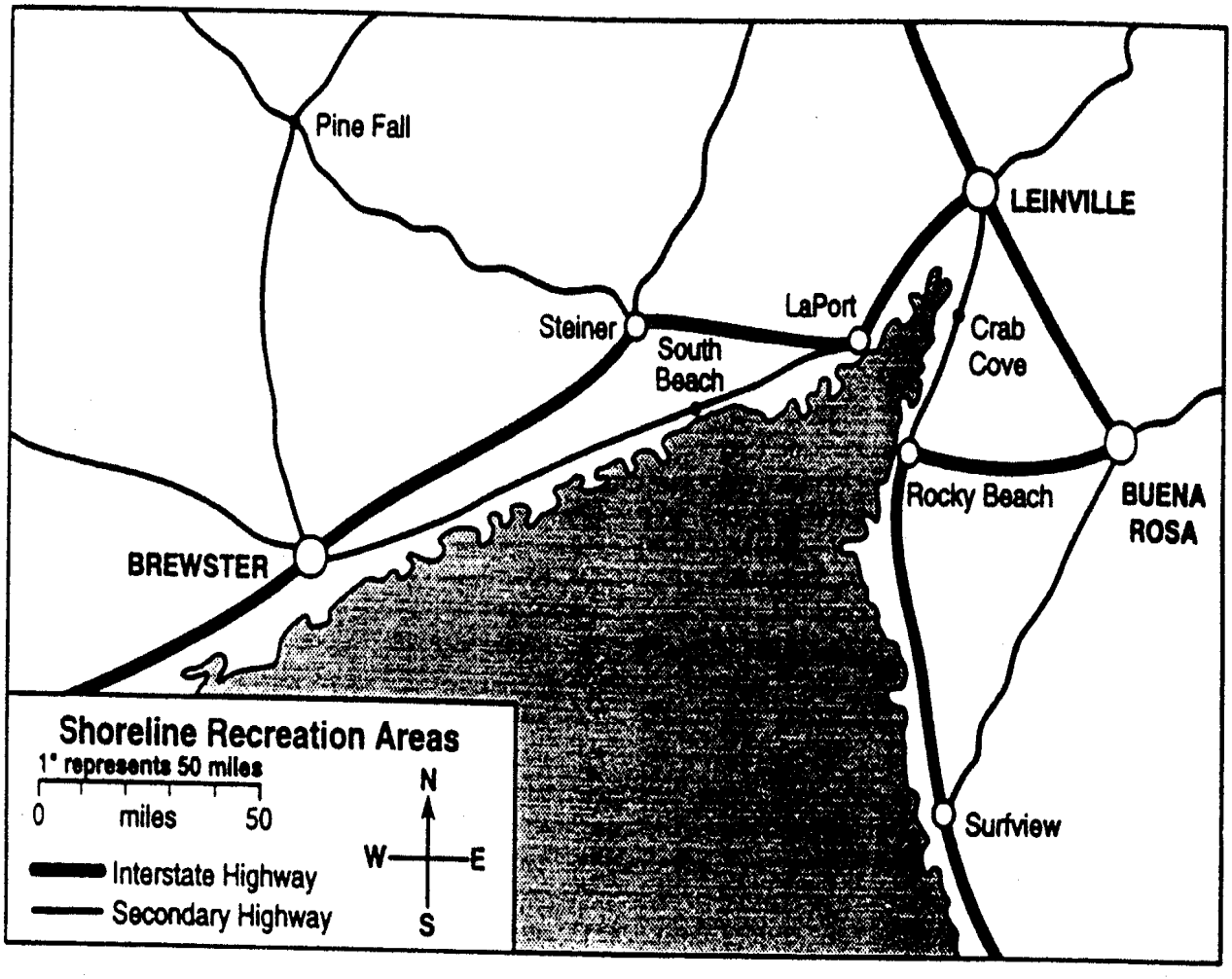
From "A Sample of Mathematics Assessment – 1994",
developed by the California Department of Education

Grade 9-12 Mathematics CAPT-like Problems

27. The Camping Trip

Use the information below to answer questions 1-3.

Alberto, Luis, David and Mike all live in Brewster. They are planning a trip to the state campground at Rocky Beach. A map of the area is shown below.



Grade 9-12 Mathematics CAPT-like Problems

28. The Camping Trip (cont'd)

a. Cost of Gasoline

The group is thinking about taking the new interstate highway all the way to Rocky Beach. Their car averages 24 miles per gallon and gas costs $1.29 per gallon.

Use the map to make a reasonable estimate for how much the gasoline will cost for a trip to the campground and back assuming they travel only on the interstate. Show the mathematics you use to make a reasonable estimate and explain how you arrived at your estimate.

b. Arrival Time

The group plans to leave Brewster at 7 A.M. and travel only on the interstate. If they can average 50 miles per hour on the interstate and if they stop once for 45 minutes for a snack, what is a reasonable estimate of the time of their arrival at Rocky Beach? Show the mathematics you use to make a reasonable estimate of the time of arrival and explain how you arrived at your estimate.

c. Shortest Time

In addition to an average of 50 miles per hour on the interstate, the group also knows that they can travel at an average of 30 mils per hour on the secondary roads. To get to Rocky Beach in the shortest time, Mike suggests that they take the route that covers the fewest miles. David suggests that they just stay on the interstate. Whose suggestion will get the group to Rocky Beach first?

Compare the suggestions of Mike and David and decide which route will take the least time. Justify your decision.

Grade 9-12 Mathematics CAPT-like Problems

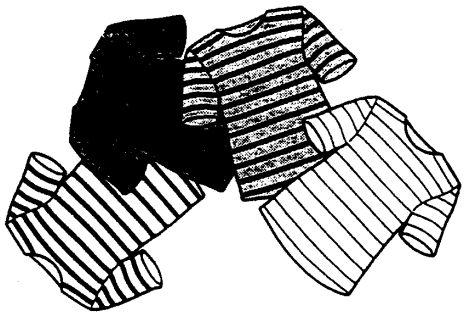
29. Catalog Order

Below is a page from a mail order catalog. The order form is located on the next page.

Striped Tee-Shirts

Cool and colorful! Our 100% cotton tee-shirts feature bold, contrasting stripes and a super-relaxed fit.

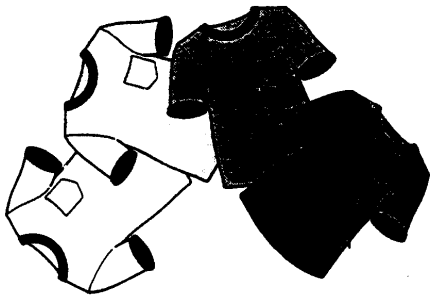
shipping wt. 1.2 lbs **$12.95**

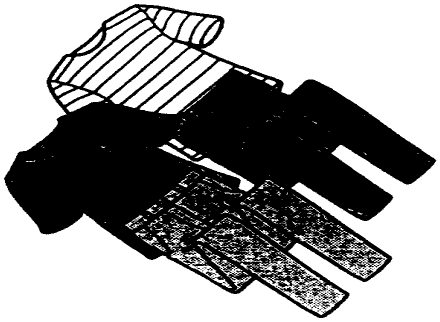


Rugged Tee-Shirts

Suitable for work or the weekend, this heavy-duty, cotton polyester blend tee-shirt comes with reinforced sleeves and neck and a handy front pocket.

shipping wt. 1.7 lbs **$16.95**





Casual Jeans

The perfect complement to our Striped Tee-Shirts or our Rugged Tee-Shirts. These stone-washed, cotton denim blue jeans can't be beat for appearance, comfort and durability

shipping wt. 3 3lbs **$32.95**

Northeastland Outfitters

Grade 9-12 Mathematics CAPT-like Problems

30. Catalog Order (cont'd)

1. Order Form

Northeastland Outfitters
Catalog Order Form

Description	How Many?	Price Each	Total Amount	Weight Each	Total Weight
		Subtotal		Total Wt.	
		Sales Tax[1]			
		Shipping & Handling[2]			
		Total Enclosed			

[1] Add 6% Sales Tax

[2]	Total Shipping Wt.	1-10.0 lbs.	10.1-15.0 lbs	15.1-25.0 lbs	25.1-50.0 lbs	50.1-100 lbs	over 100 lbs
	Shipping & Handling	$5.00	$6.00	$8.00	$10.00	$15.00	15¢ per lb.

Calculations

Grade 9-12 Mathematics CAPT-like Problems

31. Catalog Order (cont'd)

a. Order Form

Complete the order form on the previous page to order 3 pairs of Casual Jeans, 3 Striped Tee Shirts and 2 Rugged Tee-Shirts from Northeastland Outfitters.

b. School Band

As the school band treasurer you are responsible for ordering Striped Tee-Shirts for the members of the school band. Northeastland Outfitters gives a 10% discount on orders larger than 50 items. The discount is figured on the cost of the item before shipping and handling charges are added. Find the total cost of 100 Striped Tee-Shirts for the members of the school band, including tax, and shipping and handling charges. Show how you arrived at this cost.

c. Cathy or Jim

The Casual Jeans advertised in the catalog for $32.95 are available at the local mall for $36.99 with no sales tax. Cathy says the catalog is the better deal even with tax, and shipping and handling costs. Jim says the mall is the better deal even with the added costs of time and gasoline getting to the mall. Decide who you think is right and write what either Cathy or Jim could say to justify their positions.

Grade 9-12 Mathematics CAPT-like Problems

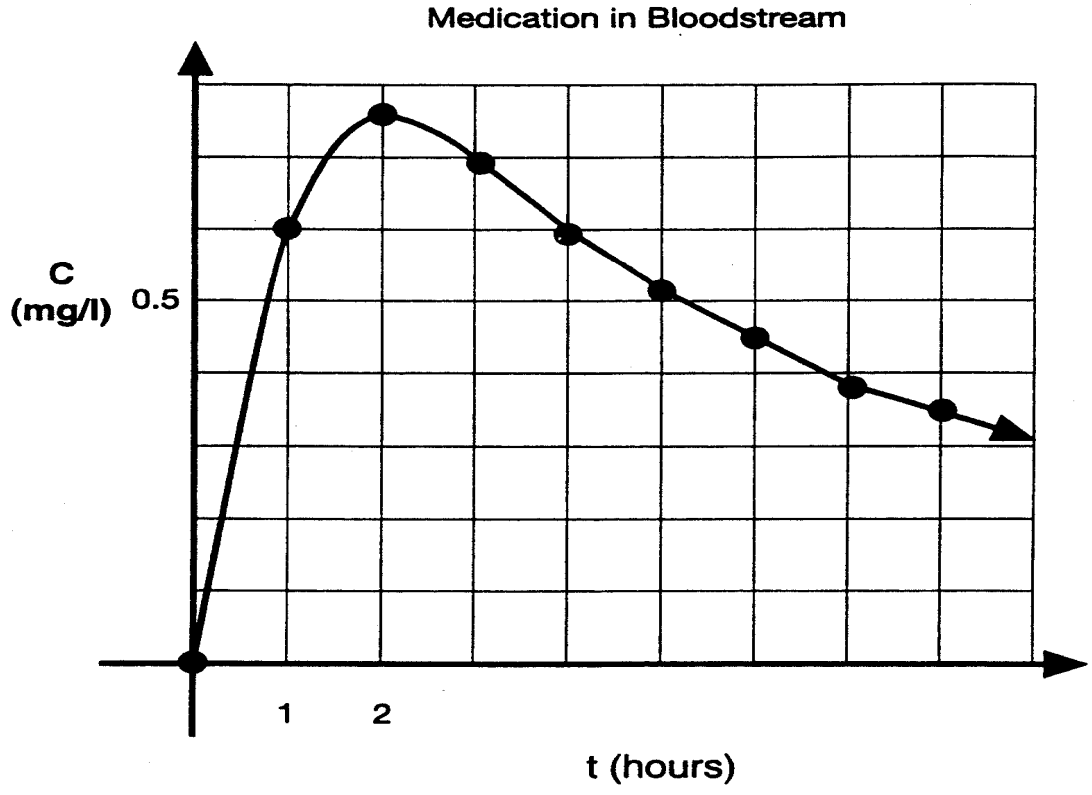
32. Concentration of Medication in the Bloodstream

The effect of certain pain-killing medications can be described by mathematical formulas. Doctors often use the formulas and their graphs to show how the concentration of medication in the bloodstream changes as time passes. This information can be used to decide when additional doses should be given.

In the formulas represented in questions 1 through 3, *t* represents the time in hours since the medication was given, and *C* represents the concentration of the medication in milligrams per liter of blood.

Use the information below to answer questions 1-2.

To analyze the effect of another medication, a doctor displayed the graph of its concentration over time in a graphing calculatpr. The concentration formula for this medication is $C = \frac{3t}{4 + t^2}$. The graph is shown below.



Grade 9-12 Mathematics CAPT-like Problems

33. Concentration of Medication in the Bloodstream (cont'd)

a. Drawing Conclusions

What conclusions about the concentration of medication in the bloodstream can you make for the period of time included on the graph? Use the graph to support your conclusions.

b. Concentration Over Time

Suppose that the doctor gives only one dose of the medication. Use the graph and formula to explain what happens to the concentration of the medication after the time period shown on the graph (e.g., $t > 9$ hours). Support your conclusion by substituting two or more values for time.

c. Aspirin Relief

When aspirin is taken orally, the amount of relief that it provides can be modeled by the equation

$$r = 4t - t^2$$

where r is the amount of relief provided and t is the number of hours that have elapsed since taking the aspirin.

After how many hours is the obtained relief at a maximum? Explain your reasoning.

[You may use any method to determine your answer, but be sure to show the mathematics you use to determine your answer. The graph is provided for your convenience.]

d. The Blood Test

Olympic Clinic Blood Test Schedule (Appointment Required)	
1 P.M.	5 P.M.
2 P.M.	6 P.M.
3 P.M.	7 P.M.
4 P.M.	8 P.M.

An olympic athlete must have his blood tested for the presence of illegal substances. At 6 P.M. on the evening before the test, an athlete took a prescription medication whose formula is

$$C = \frac{3}{t^2}$$

Because the medication can interfere with the blood test, its concentration must be less than 0.01 mg/1 when the athlete's blood is tested.

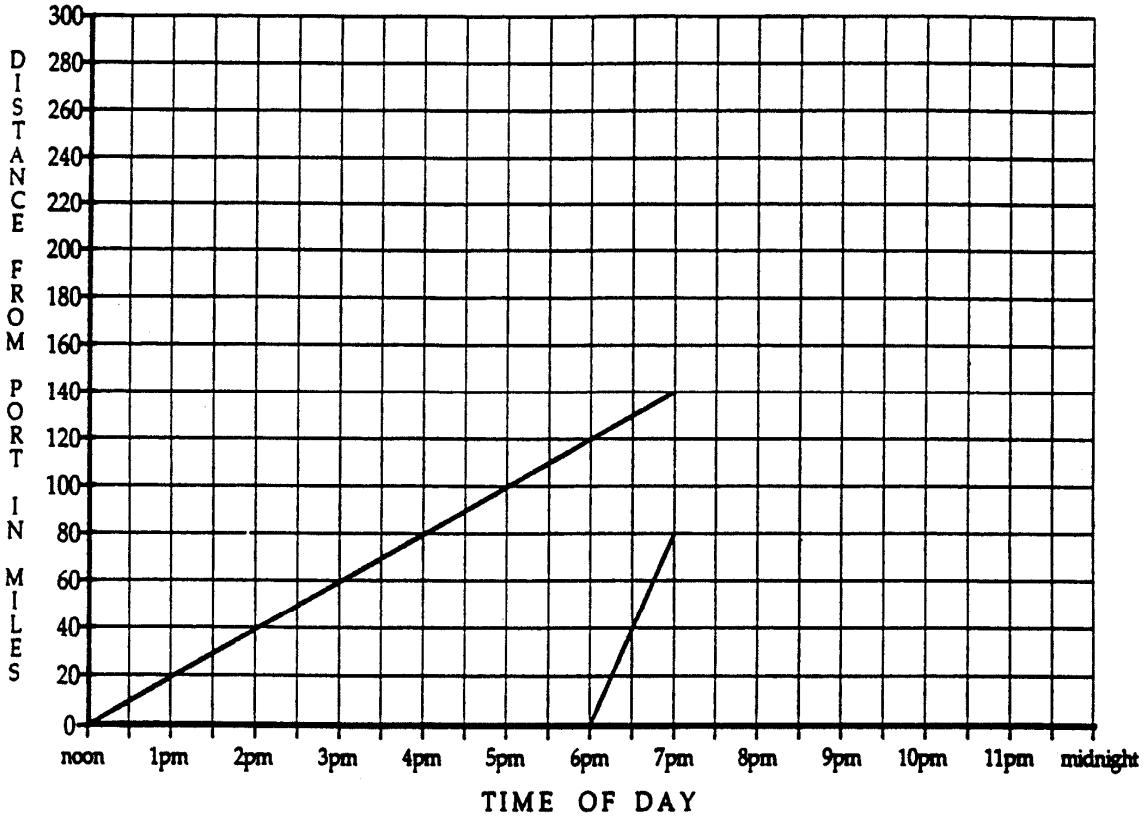
Of the times shown in the Blood Test Schedule, what is the earliest time at which the concentration of the medication will be below the required level? Show the mathematics you use to determine your answer.

Grade 9-12 Mathematics CAPT-like Problems

34. Missing the Boat

The situation:

Lucy, Ricky, Fred and Ethel were leaving on a cruise to Europe. But when the cruise ship left the port, Lucy had missed it! Lucy decided she had to catch the cruise ship. It took hours, but she finally hired a helicopter at the port. By the time she and the pilot took off in the helicopter, the cruise ship had a good head start, going due east. Use the graph below to help you answer the questions that follow.



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Grade 9-12 Mathematics CAPT-like Problems

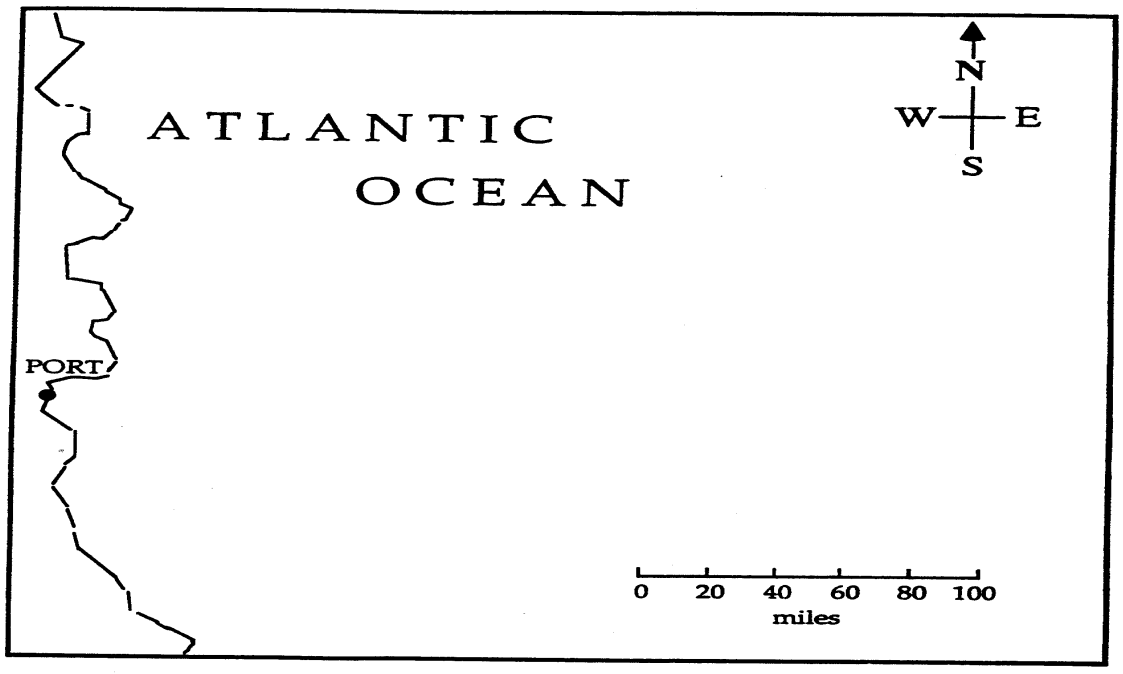
35. Missing the Boat (cont'd)

a. On the next page is a map which shows the coastline, the ocean and the port. Add the cruise ship and the helicopter to the map. Show their positions, accurately and to scale, at 7:00 p.m.

b. At what time will the helicopter be exactly halfway between the port and the cruise ship? Get the most exact answer you can. Describe how you did this.

Suppose the helicopter and the cruise ship continue at the same speeds and direction until the helicopter catches up to the cruise ship. As soon as it does, both the cruise ship and helicopter stop moving. Lucy is put into a harness and lowered to the deck of the cruise ship. This takes 15 minutes. Then the cruise ship resumes its trip at its original speed and the helicopter returns to the port, this time going just 60 mph.

c. Complete the graph to show these events. Then answer these questions:
   1) When does the helicopter catch the ship?
   2) When does the helicopter arrive back at port?
   3) How far will the cruise ship be from the port when the helicopter arrives back at the port?



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Grade 9-12 Mathematics CAPT-like Problems

36. Shoelaces

You work in a factory that makes shoes.
You have to decide what length of shoelace to select when you know the number of lace holes in a shoe.
The shoes can have up to ten pairs of lace holes.

1. Estimate the length of shoelace you need for the shoe shown on the next page. (It is shown full size.) Remember to allow enough extra length for tying a bow.

2. Create a rule that will tell you the length of shoelace you need when the number of pairs of lace holes in a shoe is given.

3. Now design three signs that can be displayed in the factory to help people select the correct length of shoelaces if they know the number of pairs of lace holes.

   Your sign should describe your rule as clearly and simply as possible.

   a. One sign must use a table.

   b. One sign must use a graph.

   c. One sign must use a formula.

4. Which of these signs do you think would be the most useful in the factory? Give reasons for your answer.

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Grade 9-12 Mathematics CAPT-like Problems

37. Shoelaces (cont'd)