

Emmy Noether - Circle 1 for 2008-2009

Part I: Problems

Problem 1



- Dennis wants a new 4 gigabyte mp3 player for his birthday so he can upload all of his favourite tunes. He knows that a 4-minute song uses 4 megabytes of memory space. How many songs of this length could he upload to the hard drive of the mp3 player? NOTE: 1 gigabyte (gig or GB) = 1000 megabytes (meg or MB)
- When his Mom unexpectedly wins the grand prize at Monday night bingo, Dennis thinks his gift might be a 30 gig mp3 player instead of the smaller 4 gig model. How many 4-minute songs would fit on this model?
- Suppose the 30 gig model plays all the songs on its hard drive before repeating a song. How many 24-hour days would it take to play every song once?

Problem 2

Each square in the Mystery Grid at right contains one of the digits 1, 2, ..., 9. Use the clues below to decide which digit goes where. (Read ALL the clues before you start.)

Clues:

- The four corner squares contain even numbers.
- The greatest number is in the middle.
- Column A contains the second-, third-, and fourth-greatest numbers, in descending order.
- Column C contains all the factors of 4.
- Row 3 contains only factors of 6.

	A	B	C
1			
2			
3			



Check your solution by making sure the clues are all satisfied.

Extension:

- Given the Mystery Grid solution shown at right, and the mathematical words *factor*, *least*, *greatest*, *consecutive*, *ascending*, *descending*, *odd*, *even*, use at least four of these words to create a set of 4 - 6 clues which lead to this solution.

	A	B	C
1	2	7	5
2	8	1	4
3	3	9	6

Problem 3

Below are three calendars, one for the month of March in the year 1596, one for May, 1718, and one for March, 1882. Use these calendars to search for patterns by answering the questions below.

March ~1596						
S	M	T	W	Th	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31*			

* birthdate of Rene Descartes

May ~1718						
S	M	T	W	Th	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16*	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

* birthdate of Maria Gaetana Agnesi

March ~1882						
S	M	T	W	Th	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23*	24	25
26	27	28	29	30	31	

* birthdate of Emmy Noether

- a) Pick a number in the third week of one of the calendars.
- (i) How is it related to the number directly above?
 - (ii) How is it related to the number directly below?
 - (iii) Would this be true of any calendar?

Explain your answers.

- b) Pick a number in the middle of a week in one of the calendars.
- (i) How is it related to the number on the right?
 - (ii) How is it related to the number on the left?
 - (iii) Is this true of any calendar?

Explain your answers.

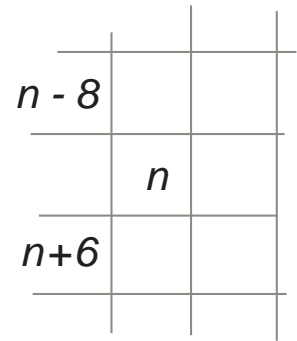
- c) Pick a number somewhere near the middle of one of the calendars; call that number n . There are eight other numbers adjacent to n , forming a square with a total of nine numbers. A sample is shown at right. (Use the same square for (i), (ii), (iii), (iv).)

	6	7	8
	13	14	15
	20	21	22

- (i) From the square of nine numbers, find two sets of three numbers such that the sum of the three numbers is the same for each set, and the average of the three numbers is the number n .
- (ii) Find two more such sets, different from those you found in (i).
- (iii) Would the same choices of such sets work for any 'middle' number n you choose? Discuss this with a friend who picked a different number. Explain your answer.
- (iv) Are there two sets of three numbers in the square which have the same sum, but for which the average is NOT equal to n ? If so, list them.

Extensions:

1. (i) The diagram at right shows a partially completed square of nine numbers from a calendar, like the one you chose above, but in a more general form, with the middle number labelled n . By observing how n is related to the other eight numbers, fill in the rest of the square with numbers written in terms of n .



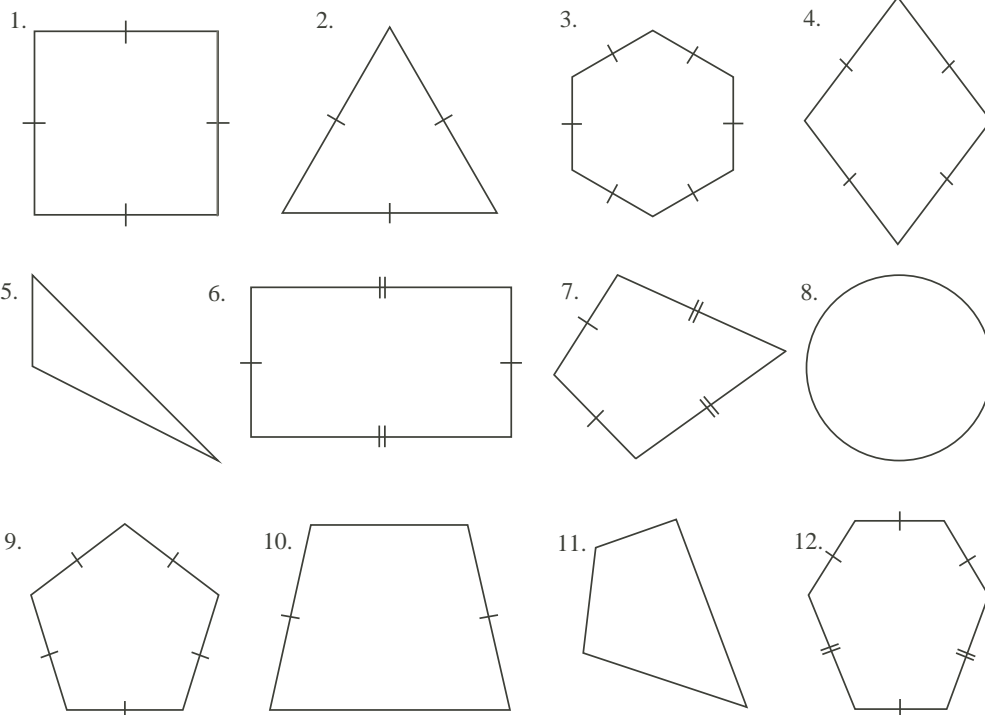
HINT: Use your results from a) and b) above.

- (ii) Using your completed square, explain why sets of three numbers picked in the way you chose in c)(i),(ii) above, will always have an average of n , while those from c(iv) will not.

2. Write a brief paragraph on each of the mathematicians Rene Descartes, Marie Agnesi and, Emmy Noether. Research your facts on the web or in reference books.

Problem 4

In the set of figures below, sides of equal length are indicated by a ‘|’ or ‘||’.

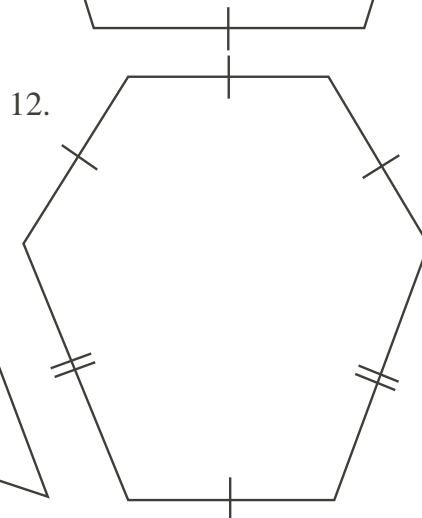
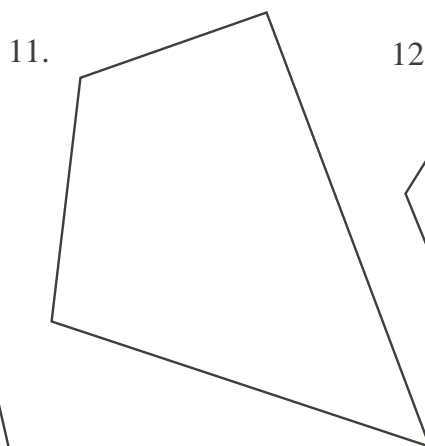
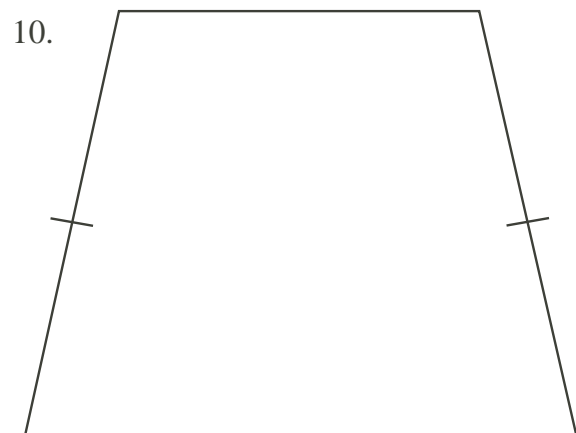
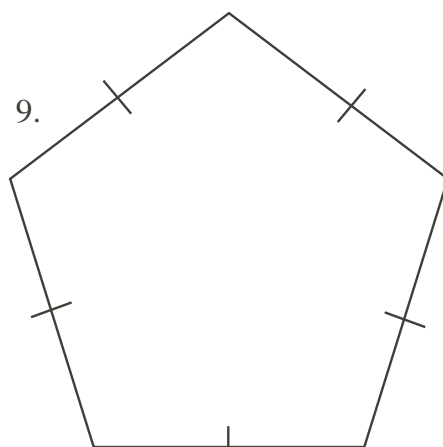
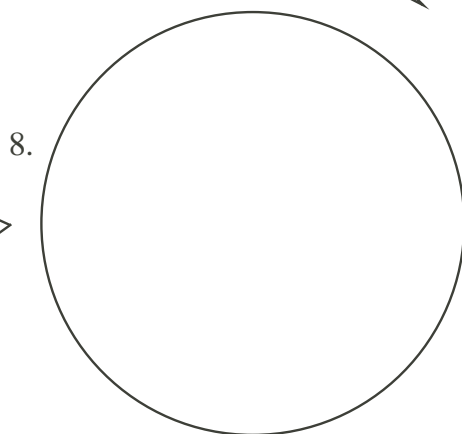
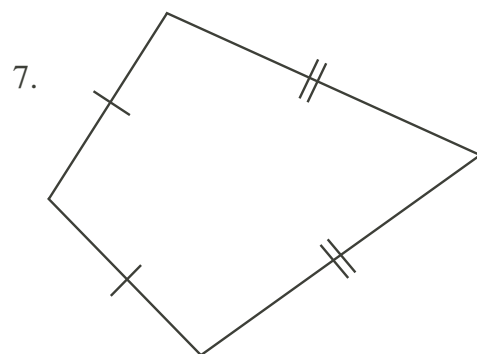
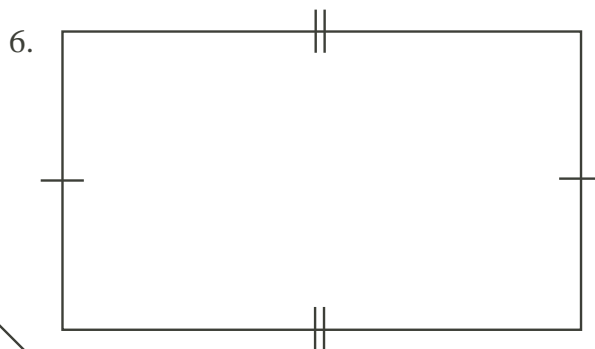
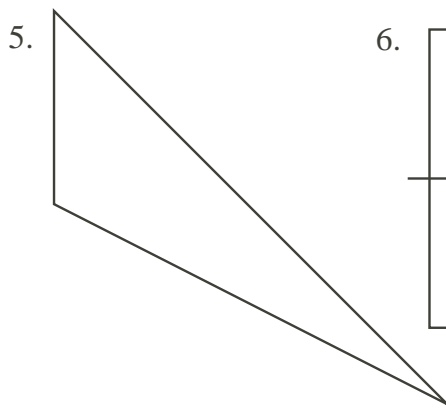
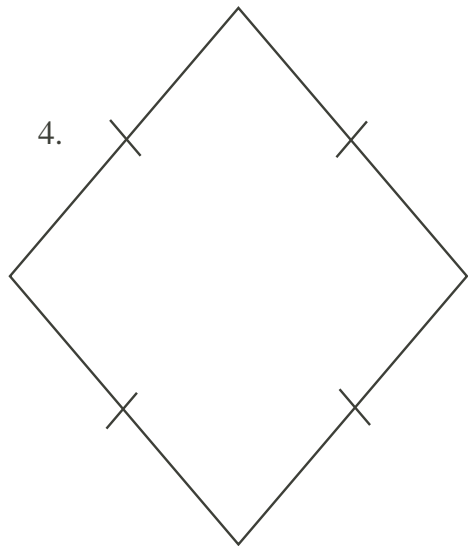
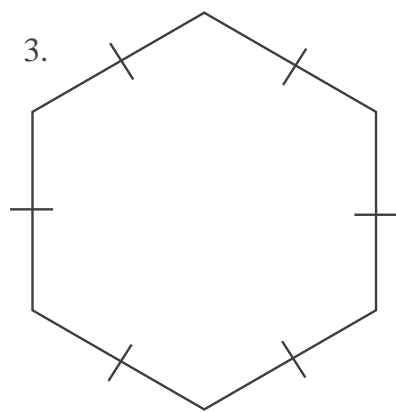
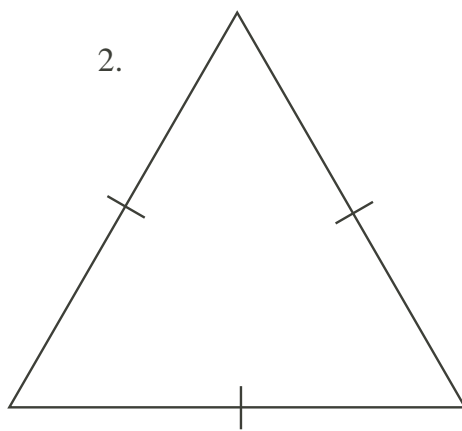
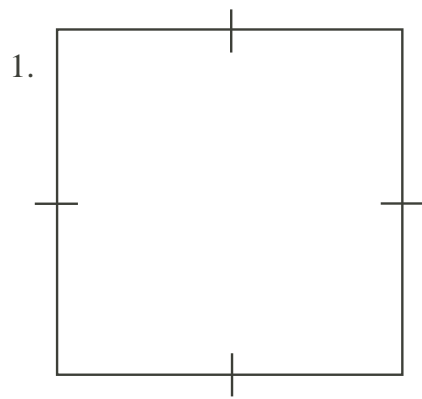


Use the enlarged diagrams on the following page in answering questions a) to d).

- a) Give a name for each figure.
- b) Which figures have only one line of symmetry? Draw the line on each such figure.
- c) Which figures have exactly two lines of symmetry? Draw the lines on each such figure.
- d) Are there any figures with more than four lines of symmetry? If so, which figures?

Extension:

1. Which figures would you describe as having a centre point? Why?



Problem 5

- a) Melanie has 16 metres of fencing and wants to build a pen for her Dachshund (weiner) dog, Franz. On the attached grid paper, outline as many rectangles as possible with perimeters of 16 metres, and sides lying on grid lines and having lengths equal to whole numbers. Write down the area of each rectangle.
- b) Which pen should Melanie build if she wants Franz to have the greatest possible play area? How is the shape of this pen area different from all the other pens?
- c) If Melanie wants her dog to have the longest ‘run’ (i.e., length) possible, which pen should she build? (Remember that the dog must be able to turn around!)
- d) Suppose Melanie has 36 metres of fencing. Based on your results in a) and b), make a hypothesis (an educated guess) about what would be the dimensions of the pen of greatest area that Melanie can make with a perimeter of 36 metres, and sides having lengths equal to whole numbers. Then prove your hypothesis by writing down all the possible dimensions and areas (width x length) in a table. (No diagrams are necessary.)



Problem 6: What’s My Number? (A game for pairs of students)

Decide who will go first (Player 1).

- a) Here are the basic steps in the game:
 - Player 1: Pick a number from 1 to 10 and write it on a piece of paper. Then fold the paper in half so the number is hidden from Player 2.
 - Player 2: Try to guess the number. Keep track of how many guesses you need to get the correct number.
 - Player 1: Respond to each guess only by saying “greater” or “less”, meaning the number you picked is greater than, or less than, the guess made by Player 2.

Once Player 2 has made a correct guess, answer the following questions:

- (i) How many guesses did it take Player 2 to determine the number?
- (ii) Do you think Player 2 could have got the correct number with fewer guesses? Explain.

Switching roles each time, repeat the game several times, recording the number of guesses needed each time to get the correct number.

- b) Repeat part a), but this time use a number from 1 to 50.
- c) With your partner, discuss possible strategies to minimize the number of guesses needed to determine the unknown number.
- d) Now try part b) again, using whatever strategies you devised in part c). Did you use fewer guesses?

