Instructions: Answer each question, and explain your answer. An answer alone is not enough for full credit. Your explanation must be clear and show how to get the answer. Each problem is worth 5 points, for a total of 30 points. [**The actual quiz will have only 6 problems.**] Do not put your answers on the quiz handout; use additional sheets of paper. This is an open book quiz.

[1] The UPC code on a can of Alpo dog food is 0 11132 00361 "?". What should the check digit be? (Remember: the UPC code is such that when you add every other digit starting with the first, triple the result and then add the remaining digits, you get an even multiple of 10.)

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 0  1  1  1  3  2  0  0  3  6  1  x


(0 + 1 + 3 + 0 + 3 + 1)3 +
( 1 + 1 + 2 + 0 + 6 + x) = 24*3 + 10 + x = 34 + x
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For this to be a multiple of 10 we need x = 6.

[2] The Postnet bar code shown here has a single error in which either one vertical bar which should be long is short or vice versa:

$$|||_{....}|.|_{...}||_{..}||.|.|_{...}|_{..}|.|_{..}|_{..}||_{...}|_{...}|_{...}|||$$

Express the correct zip code in ordinary characters. (Remember: the outside bars are framing bars which you ignore; also, the digit Postnet bar codes are as follows:
1: ...|| 2: ..|.| 3: ..||. 4: .|..| 5: .|.|. 6: .||.. 7: |...| 8: |..|. 9: |.|.. 0: ||...
Moreover, the digits in a valid Postnet code must sum to an even multiple of 10.)

$$||_{...} \quad _{..}|.| \quad _{...}|| \quad _{..}||. \quad |.|_{..} \quad _{.}|..| \quad _{..}|.. \quad ||_{...} \quad |_{...}| \quad _{...}||$$
   0   2   1   3   9   4   ?   0   7   1
The sum of the digits is 27 + ?, so to get a multiple of 10 we need ? to be 3.

[3] What is n for a regular n-gon if the sum of the measures of all but one of the n vertex angles is 3795 degrees?

((n-2)180/n) is a single vertex angle so ((n-2)180/n)*(n-1) = 3795.
Thus (n-2)((n-1)/n) = 3795/180 = 21.08. But (n-1)/n is close to but a little less than 1,
so (n-2)((n-1)/n) = 21.08 is close to but a littel less than n-2; i.e., n-2 > 21.08. Thus n is
at least 24. Now start checking: n=24, n= 25, etc. Plugging n=24 into ((n-2)180/n)*(n-1)
gives ((24-2)180/24)*(24-1) = 3795, so n = 24 works.

[4] Show how to tile the plane with the shaded quadrilateral:

Do this with a drawing in which the given polygonal tile is surrounded by 8 additional tiles, one for each vertex and side.(Use a separate piece of paper, tracing the given tile by placing the paper over it, and sliding the paper to a new position and tracing again, etc.)
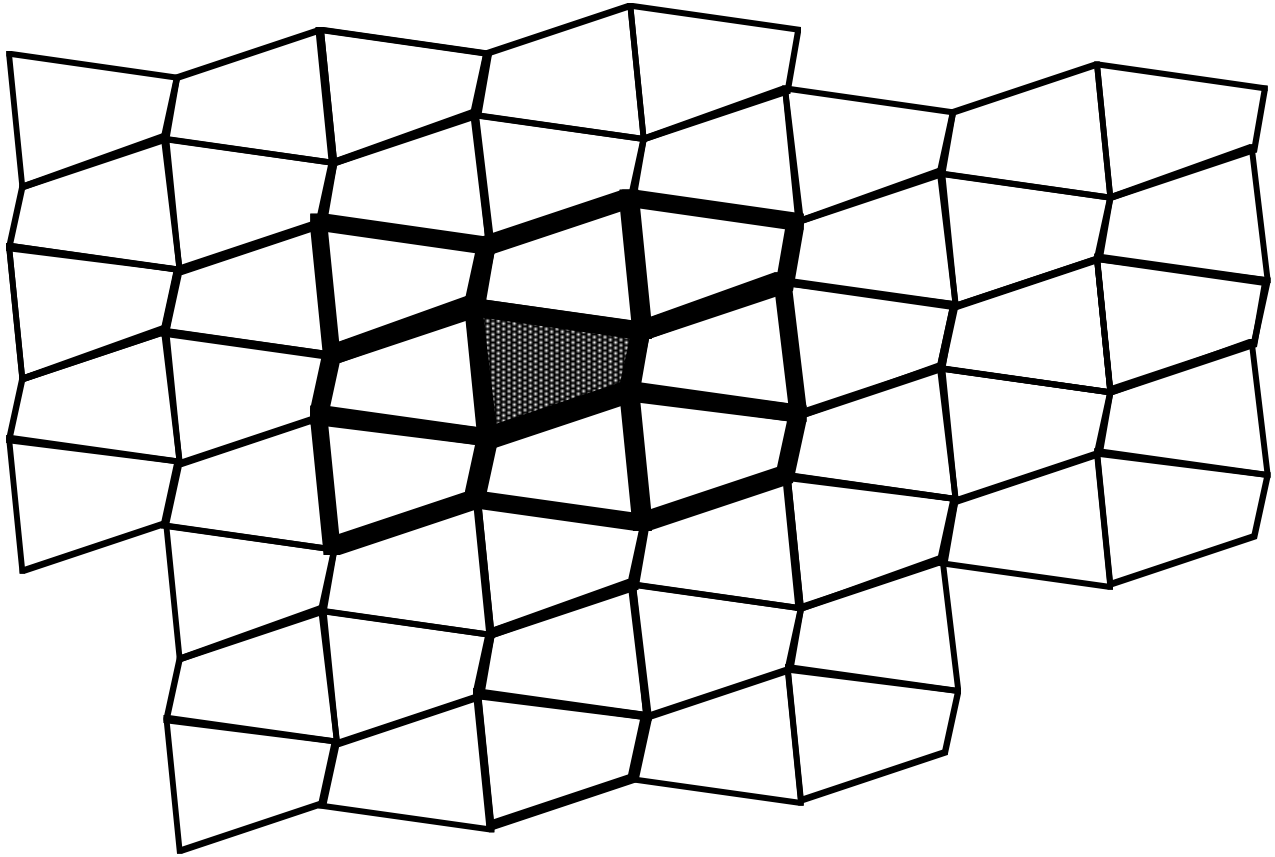
[5] If 8 and 17 are the legs then the hypotenuse is the square root of 8*8 + 17*17 = 353, which is about 18.8. If 17 is the hypotenuse, then the third side is the square root of 17*17 - 8*8 = 225, which is 15.

[6] Some example: [a] Make an actual count using an aerial photo. This can be very accurate but it is time consuming and it doesn't take into account participants who left before or who arrive later. [b] Estimate the crowd density (in square feet per person) and multiply by the area the crowd occupies. This is fairly easy to do but estimates of the crowd density are likely to be inaccurate. [c] Weigh the garbage the crowd produced. This does not give a direct measure of the size of the crowd, and different occasions may produce different amounts of garbage, but it may be a convenient way to comepar annual events in different years.

[7] If a, b and c are consecutive Fibonacci numbers, then a+b = c. Here we have a = 3524578 + b = 9227465, so b is 5702887.

[8] Determine the symmetries of the following strip pattern (which you should imagine as extending indefinitely to the right and left), and use crystallographic notation to classify the pattern:

Z   Z   Z   Z   Z   Z
    Z   Z   Z   Z   Z   Z
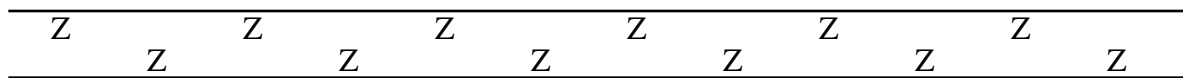
If you reflect this strip across a horizontal or vertical line, the Z's face the wrong way, as shown below:
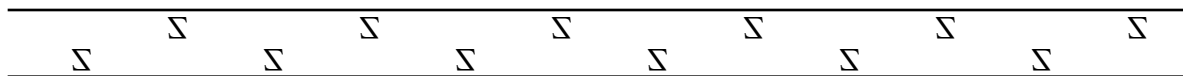
Thus the strip has no reflection symmetries nor a glide symmetry, since sliding the reflected strip sideways can never make the Z's face the correct way. But rotating the strip by 180º around the shaded dot shown below leaves the strip unchanged:
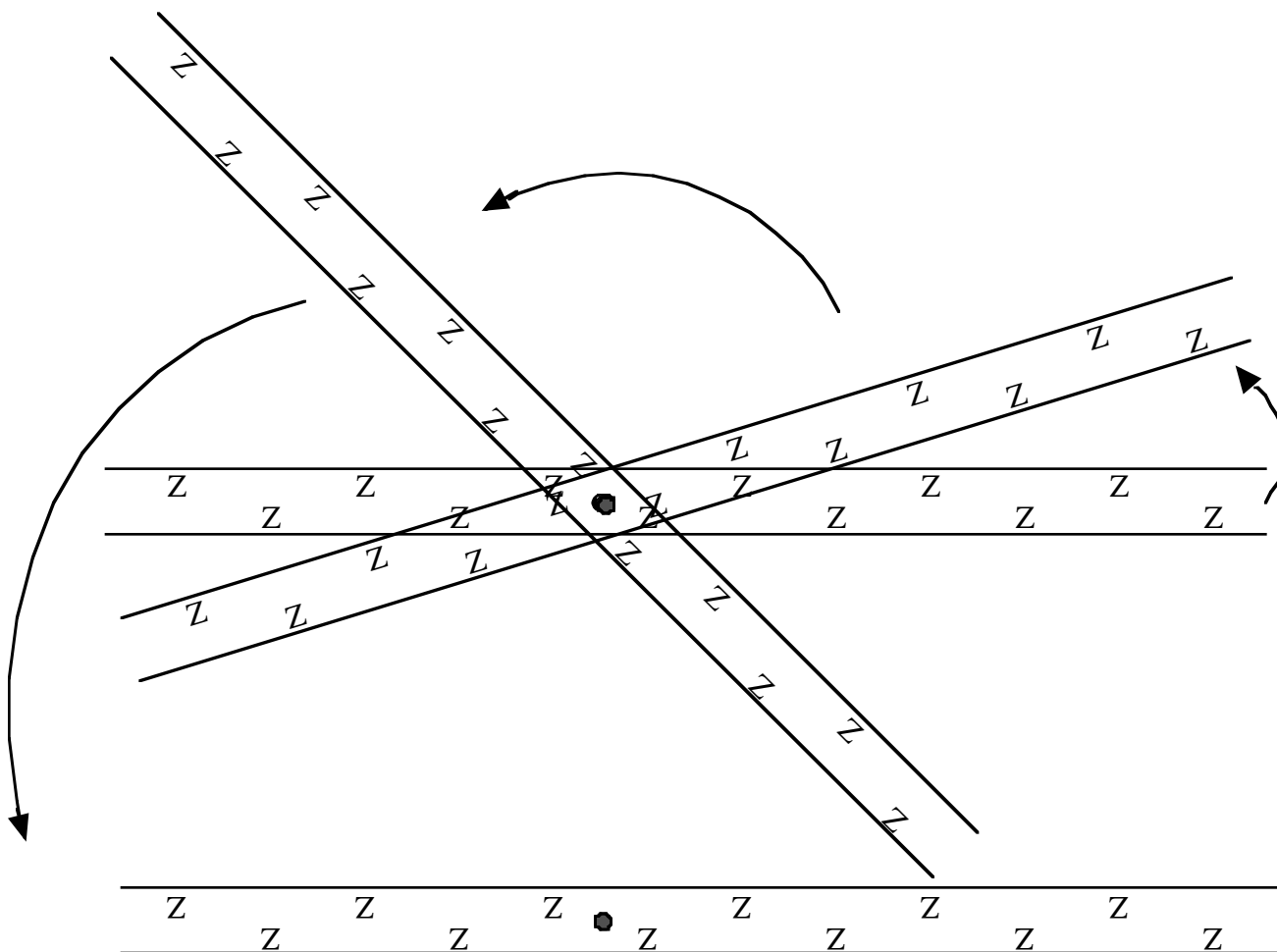
The crystallographic notation denoting the symmetries of this strip is given by p112.