

2001-2002

American Computer Science League

All-Star

**1. ACSL THE JUNIOR VAMPIRE SLAYER
5 POINTS**

**IF THIS PROGRAM IS RUN AT THE END OF THE CONTEST, IT HAS A 10 MINUTE TIME
LIMIT**

TEST INPUT

1. 1395
2. 2187
3. 386415
4. 2160
5. 4322

TEST OUTPUT

1. 15,93
2. 27,81
3. 465, 831
4. NONE
5. NONE

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**2. DIOPHANTUS NOTATION
5 POINTS**

TEST INPUT

1. X4MU2
2. MX4U2
3. P3PP2MU6
4. MP3C3U3
5. PP4MCPXU1

TEST OUTPUT

1. $4X - 2$
2. $-4X - 2$
3. $2X^4 + 3X^2 - 6$
4. $-3X^3 - 3X^2 - 3$
5. $4X^4 - X^3 - X^2 - X - 1$

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**3. Play Your Neighbor Solitaire
10 POINTS**

TEST INPUT

1. 7, QS,7C,KH,8C,3C,JC,6H
2. 6, 3C,7C,JC,6D,KD,4H
3. 5, 8D,TS,8C,4S,8S
4. 5, 8C,4S,7S,2D,8H
5. 5, 2D,8H,TS,TH,QH
6. 6, 5S,4D,3S,JH,8S,TH
7. 6, QD,KS,2C,3H,3C,KC
8. 9, 3S,6C,AD,7S,JD,QC,JC,7C,7D
9. 6, 6H,QS,8H,8C,2C,2S
10. 6, AS,AD,2D,8H,QH,QD

TEST OUTPUT

1. QS,7C,KH, JC,6H
2. JC,KD,4H
3. 8S
4. 8C,7S,2D,8H
5. 2D,QH
6. 5S,4D,3S,JH,8S,TH
7. QD,KC
8. 3S,6C,7D
9. 6H,2S
10. QD

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4. BOOLEAN EXPRESSIONS
10/20 POINTS

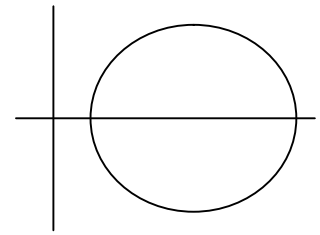
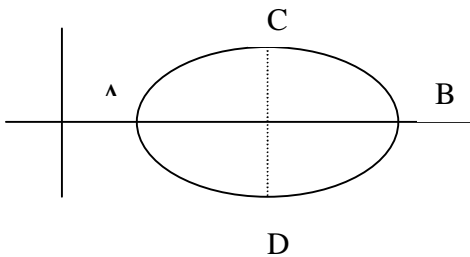
TEST INPUT

1. 2, 1, 0,0,0,1, 12
2. 3, 1, 0,1,1,0,0,1,1,0, 23.
3. 2, 3, 000,110,111, 011, 12, 13, 14
4. 2, 3, 111,011,011, 000, 12, 12, 34 .
5. 2, 2, 01,10,11,10 12, 23 .
6. 3, 2, 00,00, 01, 11,00,00,01,11, 23, 24
7. 3, 1, 0, 1, 1, 0, 0, 1, 1, 0, 32
8. 3, 3, 000, 011, 011, 110, 000, 011, 011, 110, 23, 23, 45
9. 3, 3, 000, 010, 111, 111, 100, 111, 111, 111, 12, 23, 45
10. 3, 3, 001, 001, 100, 100, 100, 111, 001, 010, 12, 13, 45

TEST OUTPUT

1. (A AND B)
2. (B XOR C)
3. (A AND (A OR (A XOR B)))
4. ((A NOR B) OR (A NAND B))
5. (B NAND (A OR B))
6. (B OR (B AND C))
7. (C XOR B)
8. ((B AND C) XOR (B OR C))
9. ((A OR B) AND (B OR C))
10. ((A XOR B) XNOR (A AND C))

HAIRY CONIC JUNIOR



PROBLEM: The figure on the left above is an ellipse and the figure on the right above is a circle. They are related mathematically because the equations used to describe each figure are similar. The **general form** of the equation for both is $Ax^2 + Bxy + Cy^2 + Dx + Ey + F = 0$. For the circle A and C must be equal and B must equal 0. For the ellipse, A and C cannot be equal but must have the same sign. B must equal 0. An example of an equation of a circle is: $x^2 + y^2 + 4x - 6y - 3 = 0$. An example of an equation of an ellipse is: $x^2 + 4y^2 - 6x - 16y - 11 = 0$. In this program you will be given a general form of the equation and must determine if it is a circle or an ellipse. Further, you will have to give certain other information about the figure.

The general equation above is not very useful for determining information about the position of the figure on the coordinate axis system. The equation must be modified. The method commonly used is called “completing the square”. The result is as follows:

$$\begin{aligned} x^2 + 4x + _ + y^2 - 6y + _ &= 3 \\ x^2 + 4x + \mathbf{4} + y^2 - 6y + \mathbf{9} &= 3 + \mathbf{4} + \mathbf{9} \\ x^2 + 4x + 4 + y^2 - 6y + 9 &= \mathbf{16} \\ (x + 2)^2 + (y - 3)^2 &= 16 \end{aligned}$$

In this form, it is easy to find the center of the circle and its radius. The center is at (-2, 3) and the radius is 4 (the principal square root of 16).

Finding information about the ellipse is done in a similar manner. However, since the “completing the square” method only works when the coefficient of the squared term is a +1, the second trinomial must be modified.

$$\begin{aligned} x^2 + 4y^2 - 6x - 16y - 11 &= 0 \\ x^2 - 6x + 9 + \mathbf{4}(y^2 - 4y + \mathbf{4}) &= 11 + 9 + \mathbf{16} \\ (x - 3)^2 + 4(y - 2)^2 &= 36 \end{aligned}$$

In this form, the center of the ellipse can be found to be at (3, 2).

If both sides of the equation are divided by the value on the right side, the equation is now said to be in **standard form**:

$$\frac{(x - 3)^2}{36} + \frac{(y - 2)^2}{9} = 1$$

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Contest #4

Intermediate Division

Programming Problem

In the figure of the ellipse above, line segments AB and CD are axes. Since segment AB is longer it is called the major axis and since segment CD is shorter it is called the minor axis. The bigger denominator above determines the major axis. Its length is found by taking two times the principal square root of the denominator. Here the major axis will have a length of 12 and in a similar manner, the minor axis will have a length of 6.

INPUT: There will be 5 sets of data. Each set will consist of a string representing an equation in general form. The ^ will be used to denote exponents. The string will contain no blank spaces.

OUTPUT: For each set of data, print whether it is a circle or an ellipse. If it is a circle, print the location of its center in ordered pair format (x,y) and its radius. If it is an ellipse, print the location of its center and the length of its major axis.

SAMPLE INPUT

1. $x^2+y^2+4x-6y-3=0$
2. $x^2+4y^2-6x-16y-11=0$

SAMPLE OUTPUT

1. Circle, (-2,3), 4
2. Ellipse, (3,2), 12