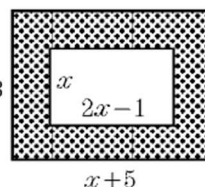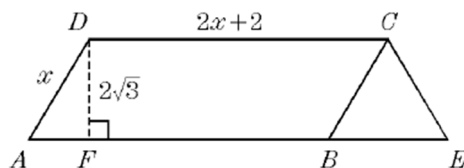Q1:

In the accompanying diagram, the width of the
inner rectangle is represented by x and the length $x+3$
by $2x - 1$. The width of the outer rectangle is
represented by $x + 3$ and the length by $x + 5$.

a) Express the area of

   1) the inner rectangle as a binomial in
      terms of x

   2) the outer rectangle as a trinomial in
      terms of x

   3) the shaded region as a trinomial in
      terms of x

b) If the perimeter of the outer rectangle is 24,
what is the value of x?

Q2:

In the accompanying diagram, $ABCD$ is a
parallelogram with $\overline{AB}$ extended through B
to E. Segment EC is drawn forming equilateral
triangle BEC. The length of $\overline{DC}$ is two units
more than twice the length of $\overline{AD}$. Altitude
$DF = 2\sqrt{3}$ and the perimeter of parallelogram
$ABCD$ is 28.

a) If the length of $\overline{AD}$ is represented by x, find
the measure of

   1) $\overline{AD}$

   2) $\overline{DC}$

   3) $\overline{AE}$

b) Find the area of $\triangle BEC$. [Answer may be
left in radical form.]

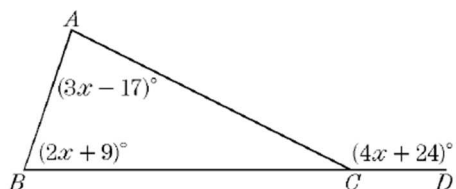c) Find the area of trapezoid $AECD$. [Answer
may be left in radical form.]

Q3:

In rhombus $ABCD$, the measure of angle A and the measure of angle B are in the ratio $2:1$, $AB = 2x + 8$, and $BC = 5x - 10$.

   a) Find the measures in degrees of angle A and of angle B.
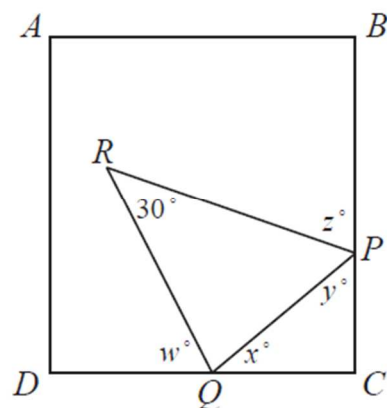
   b) Find the perimeter of rhombus $ABCD$.

Q4:

   a) In the diagram of $\triangle ABC$, $\overline{BC}$ is extended to D, $m\angle A = 3x - 17$, $m\angle B = 2x + 9$, and $m\angle ACD = 4x + 24$. Find $m\angle ACD$.

   b) In $\triangle DEF$, $m\angle D$ is 1 degree more than twice $m\angle E$, and $m\angle F$ is 7 degrees less than $m\angle D$. Find the number of degrees in the measure of *each* angle of the triangle.

Q5: CIMC 2021

In the diagram, $ABCD$ is a rectangle, P is on BC, Q is on CD, and R is inside $ABCD$. Also, $\angle PRQ = 30°$, $\angle RQD = w°$, $\angle PQC = x°$, $\angle CPQ = y°$, and $\angle BPR = z°$. What is the value of $w + x + y + z$?

5. A list of numbers is created using the following rules:

  - The first number is 3 and the second number is 4.

  - Each number after the second is the result of adding 1 to the previous number and then dividing by the number before that. In other words, for any three consecutive numbers in the list, a, b, c, we have $c = \dfrac{b+1}{a}$.

  The rules tell us that the third number in the list is $\dfrac{4+1}{3}$ which equals $\dfrac{5}{3}$.

  What is the smallest positive integer N for which the sum of the first N numbers in the list is equal to an odd integer that is greater than 2021?

1. The *range* of a list of numbers is the difference between the largest number and the smallest number in the list. For example, the range of the list $1, 5, 1, 6, 3$ is $6 - 1 = 5$.

   (a) Determine the range of the list $7, 13, 4, 9, 6$.

   (b) The list $11, 5, a, 13, 10$ has a range of 12. Determine the two possible values of a.

   (c) The list $6 + 2x^2, 6 + 4x^2, 6, 6 + 5x^2$ has a range of 80. Determine the two possible values of x.

   (d) The list $5x + 3y, 0, x + y, 3x + y$ has a range of 19. If x and y are integers with $x > 0$ and $y > 0$, determine the values of x and y.

The symbol $n!$ represents the product of the positive integers from 1 to n. That is, $n! = n \times (n-1) \times (n-2) \times \cdots \times 3 \times 2 \times 1$. (The symbol $n!$ is read "n factorial".) For example, the value of 4! is 24 because $4 \times 3 \times 2 \times 1 = 24$.

(a) Determine the value of $\dfrac{7!}{5!}$.

(b) Determine the positive integer n for which $98! \times 9900 = n!$.

(c) Determine the positive integer m for which $\dfrac{(m+2)!}{m!} = 40\,200$.

(d) Suppose that q is a positive integer and that r is the number for which $(q+2)! - (q+1)! = (q!) \times r$. Show that, for every positive integer q, the number r is an integer which is a perfect square.

In the table, the numbers in each row form an arithmetic sequence when read from left to right. Similarly, the numbers in each column form an arithmetic sequence when read from top to bottom. What is the sum of the digits of the value of x?

(An *arithmetic sequence* is a sequence in which each term after the first is obtained from the previous term by adding a constant. For example, $3, 5, 7, 9$ are the first four terms of an arithmetic sequence.)

				18
	43			
		40		
x			26	

(A) 5 (B) 2 (C) 10

(D) 7 (E) 13