Canadian Open Mathematics Challenge 2018

Official Solutions

A competition of the Canadian Mathematical Society and supported by the Actuarial Profession.

The COMC has three sections:

A. Short answer questions worth 4 marks each. A correct answer receives full marks. Partial marks may be awarded for work shown if a correct answer is not provided.

B. Short answer questions worth 6 marks each. A correct answer receives full marks. Partial marks may be awarded for work shown if a correct answer is not provided.

C. Multi-part full solution questions worth 10 marks each. Solutions must be complete and clearly presented to receive full marks.

COMC exams from other years, with or without the solutions included, are free to download online. Please visit http://comc.math.ca/2018/practice.html

 January 17, 2019

Section A – 4 marks each

A1. Suppose x is a real number such that $x(x+3) = 154$. Determine the value of $(x+1)(x+2)$.

Solution 1: The answer is $\boxed{156}$.

Expanding $x(x+3) = 154$ yields $x^2 + 3x = 154$.

Hence, $(x+1)(x+2) = x^2 + 3x + 2 = 154 + 2 = 156$.

Solution 2: The answer is $\boxed{156}$.

$154 = 11 \times 14 = (-11) \times (-14)$. In the former case $x = 11$ and $12 \times 13 = 156$. In the latter case $x = -14$ and $(-13) \times (-12) = 156$.

A2. Let v, w, x, y, and z be five distinct integers such that $45 = v \times w \times x \times y \times z$. What is the sum of the integers?

Solution: The answer is $\boxed{5}$.

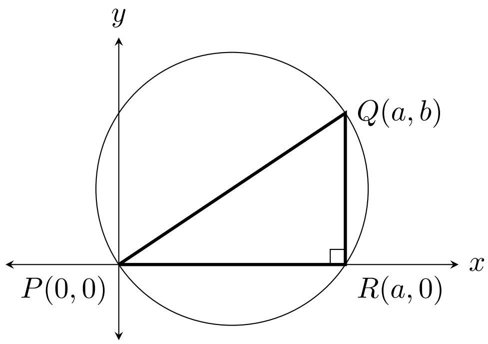
Notice that $45 = 3 \times 3 \times 5$. It stands to reason that, to write 45 as a product of five integer factors, each of its prime factors must appear, along with ± 1 (we can't use fractions). Further, to have exactly 5 distinct integers -3 and -1 must each appear once. We have $45 = (-1) \times 1 \times (-3) \times 3 \times 5$. The sum of these five factors is 5.

A3. Points $(0, 0)$ and $(3\sqrt{7}, 7\sqrt{3})$ are the endpoints of a diameter of circle Γ. Determine the other x intercept of Γ.

Solution 1: The answer is $\boxed{3\sqrt{7}}$.

If $P(0, 0)$ and $Q(a, b)$ are endpoints of a diameter of a circle and R is the other x intercept, then ΔPQR is a right angled triangle with right angle at R.

Since PR is on the x-axis, QR is perpendicular to the x-axis, hence parallel to the y-axis, so R shares x-coordinate with Q, i.e. R is the point $(a, 0)$. So in our case the required x-intercept is $3\sqrt{7}$.



Solution 2: The answer is $\boxed{3\sqrt{7}}$.

The diameter of the circle is equal to the distance from P to Q, that is, $\sqrt{(3\sqrt{7})^2 + (7\sqrt{3})^2} = \sqrt{210}$. The radius of the circle is equal $\sqrt{210}/2$. The centre of the circle is at $(3\sqrt{7}/2, 7\sqrt{3}/2)$, therefore the equation of the circle is $(x - 3\sqrt{7}/2)^2 + (y - 7\sqrt{3}/2)^2 = 210/4$. To find the x-intercepts we set $y = 0$ and obtain $x = 0$ and $x = 3\sqrt{7}$.

A4. In the sequence of positive integers, starting with $2018, 121, 16, ...$ each term is the square of the sum of digits of the previous term. What is the 2018^{th} term of the sequence?

Solution: The answer is $\boxed{256}$.

We will notice that from the 5^{th} term on, the series oscillates between 169 for odd terms and 256 for even terms: $2018, 121, 16, 49, 169, 256, 169, ...$ The 2018^{th} term is thus 256.

Section B – 6 marks each

B1. Let $(1+\sqrt{2})^5 = a + b\sqrt{2}$, where a and b are positive integers. Determine the value of $a+b$.

Solution 1:

Note, if $(1+\sqrt{2})^n = a_n + b_n\sqrt{2}$, then

$$\begin{aligned}(1+\sqrt{2})^{n+1} &= (1+\sqrt{2})(1+\sqrt{2})^n\\ &= (1+\sqrt{2})(a_n + b_n\sqrt{2})\\ &= a_n + b_n\sqrt{2} + a_n\sqrt{2} + 2b_n\\ &= (a_n + 2b_n) + (a_n + b_n)\sqrt{2}\end{aligned}$$

Thus, since $(1+\sqrt{2})^1 = 1 + 1\times\sqrt{2}$, we can conclude that for any $n \in Z^+$, $n > 1$

$$(1+\sqrt{2})^n = a_n + b_n\sqrt{2}$$

where $a_1 = b_1 = 1$ and $a_n = a_{n-1} + 2b_{n-1}$, $b_n = a_{n-1} + b_{n-1}$. Thus we can easily calculate

n	a_n	b_n
1	1	1
2	3	2
3	7	5
4	17	12
5	41	29

Hence $a + b = a_5 + b_5 = 41 + 29 = 70$.

The answer is 70.

Solution 2:

Expanding using the binomial theorem we get

$$\begin{aligned}&(1+\sqrt{2})^5 =\\ &\quad= \binom{5}{0} + \binom{5}{1}\left(\sqrt{2}\right) + \binom{5}{2}\left(\sqrt{2}\right)^2 + \binom{5}{3}\left(\sqrt{2}\right)^3 + \binom{5}{4}\left(\sqrt{2}\right)^4 + \binom{5}{5}\left(\sqrt{2}\right)^5\\ &\quad= \binom{5}{0} + \binom{5}{1}\left(\sqrt{2}\right) + 2\binom{5}{2} + 2\sqrt{2}\binom{5}{3} + 4\binom{5}{4} + 4\sqrt{2}\binom{5}{5}\\ &\quad= \left(\binom{5}{0} + 2\binom{5}{2} + 4\binom{5}{4}\right) + \left(\binom{5}{1} + 2\binom{5}{3} + 4\binom{5}{5}\right)\sqrt{2}\\ &\quad= a + b\sqrt{2}\end{aligned}$$

Hence

$$\begin{aligned} a+b &= \left(\binom{5}{0}+2\binom{5}{2}+4\binom{5}{4}\right)+\left(\binom{5}{1}+2\binom{5}{3}+4\binom{5}{5}\right) \\ &= \binom{5}{0}+\binom{5}{1}+2\binom{5}{2}+2\binom{5}{3}+4\binom{5}{4}+4\binom{5}{5} \\ &= 1+5+2(10)+2(10)+4(5)+4(1) \\ &= 70 \end{aligned}$$

Solution 3:

Using direct calculation, we have:

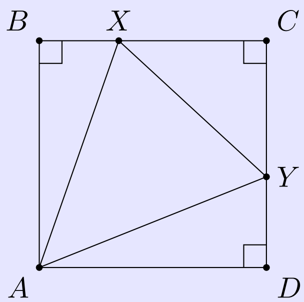
$(1+\sqrt{2})^2 = 1+2\sqrt{2}+2 = 3+2\sqrt{2}$

$(1+\sqrt{2})^4 = (3+2\sqrt{2})^2 = 9+12\sqrt{2}+8 = 17+12\sqrt{2}$

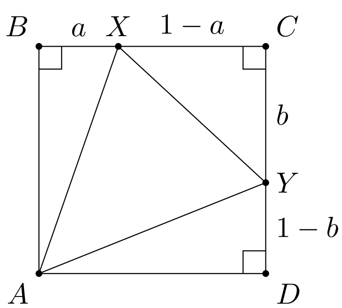
$(1+\sqrt{2})^5 = (17+12\sqrt{2})(1+\sqrt{2}) = 17+24+(17+12)\sqrt{2} = 41+29\sqrt{2}$

The answer is $41+29=70$.

B2. Let $ABCD$ be a square with side length 1. Points X and Y are on sides BC and CD respectively such that the areas of triangles ABX, XCY, and YDA are equal. Find the ratio of the area of ΔAXY to the area of ΔXCY.



Solution :



Let $a = BX$ and $b = CY$. The equality of the triangle areas gives us:

$$\frac{a}{2} = \frac{(1-a)b}{2} = \frac{1-b}{2}.$$

The first and third equations give $a + b = 1$, and the second and third thus imply $b^2 + b - 1 = 0$. Solving gives $b = \dfrac{-1 \pm \sqrt{5}}{2}$; since $b > 0$, it follows that $b = \dfrac{-1+\sqrt{5}}{2}$, whence $a = \dfrac{3-\sqrt{5}}{2}$. Thus

$$\text{Area of } \Delta AXY = 1 - 3(\text{Area of } \Delta ABX) = 1 - \frac{3a}{2} = \frac{3\sqrt{5}-5}{4},$$

and so

$$\frac{\text{Area of } \Delta AXY}{\text{Area of } \Delta CXY} = \left(\frac{3\sqrt{5}-5}{4}\right) \Big/ \left(\frac{3-\sqrt{5}}{4}\right) = \sqrt{5}.$$

The answer is $\boxed{\sqrt{5}}$.

B3. The *doubling sum* function is defined by

$$D(a,n) = \overbrace{a + 2a + 4a + 8a + \ldots}^{n \text{ terms}}.$$

For example, we have

$$D(5,3) = 5 + 10 + 20 = 35$$

and

$$D(11,5) = 11 + 22 + 44 + 88 + 176 = 341.$$

Determine the smallest positive integer n such that for every integer i between 1 and 6, inclusive, there exists a positive integer a_i such that $D(a_i, i) = n$.

Solution: Since $D(a,n) = a(2^n - 1)$, we have

$$\begin{aligned}
D(a_1,1) &= a_1 = n \\
D(a_2,2) &= 3a_2 = n \\
D(a_3,3) &= 7a_3 = n \\
D(a_4,4) &= 15a_4 = 3 \times 5 \times a_4 = n \\
D(a_5,5) &= 31a_5 = n \\
D(a_6,6) &= 63a_6 = 3^2 \times 7 \times a_6 = n
\end{aligned}$$

Hence $3^2 \times 5 \times 7 \times 31 = 9765 \mid n$. Thus the smallest solution is $n = 9765$.

Note:

$$\begin{aligned}
D(9765,1) &= 9765 \\
D(3225,2) &= 3255 + 6510 = 9765 \\
D(1395,3) &= 1395 + 2790 + 5580 = 9765 \\
D(651,4) &= 651 + 1302 + 2604 + 5208 = 9765 \\
D(315,5) &= 315 + 630 + 1260 + 2520 + 5040 = 9765 \\
D(155,6) &= 155 + 310 + 620 + 1240 + 2480 + 4960 = 9765
\end{aligned}$$

The answer is $\boxed{9765.}$

B4. Determine the number of 5-tuples of integers $(x_1, x_2, x_3, x_4, x_5)$ such that

1. $x_i \geq i$ for $1 \leq i \leq 5$;
2. $\sum_{i=1}^{5} x_i = 25$.

Solution: Let $y_i = x_i - i$ for $1 \leq i \leq 5$. Then we wish to find the number of 5-tuples $(y_1, y_2, y_3, y_4, y_5)$ of nonnegative integers such that:

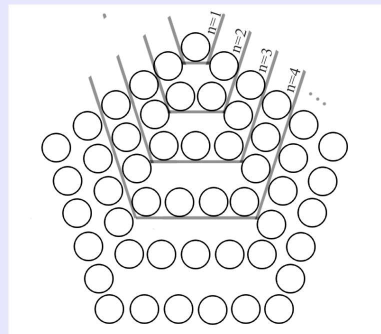
$$\sum_{i=1}^{5} y_i = 25 - (1 + 2 + 3 + 4 + 5) = 10.$$

Consider $10 + 5 - 1 = 14$ boxes in a row. Cross out $5 - 1 = 4$ of them. Starting from the left, let there be y_1 boxes before the first crossed out one, y_2 between the first and second crossed out box, continuing to y_5 boxes between the 4^{th} crossed out box and the end of the row. Then the y_i are nonnegative integers, and $\sum_{i=1}^{5} y_i = 10$. So this is an 5-tuple that we want! Note that given an 5-tuple $(y_1, y_2, \ldots, y_5)$, we cross out boxes according to the above procedure to get a bijection between the two. There are $\binom{14}{4}$ ways of crossing out boxes, hence the number of 5-tuples is $\binom{14}{4} = \frac{14 \times 13 \times 12 \times 11}{2 \times 3 \times 4} = 7 \times 13 \times 11 = 1001$.

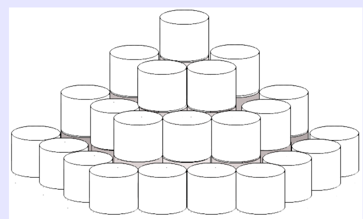
The answer is $\boxed{1001}$.

Section C – 10 marks each

C1. At Math-e^e-Mart, cans of cat food are arranged in an pentagonal pyramid of 15 layers high, with 1 can in the top layer, 5 cans in the second layer, 12 cans in the third layer, 22 cans in the fourth layer etc, so that the k^{th} layer is a pentagon with k cans on each side.



top view

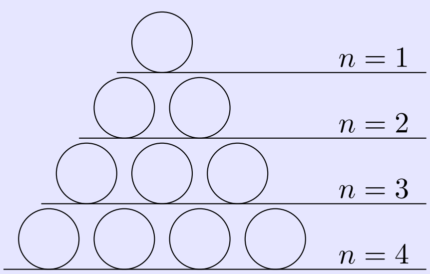


front view

(a) How many cans are on the bottom, 15^{th}, layer of this pyramid?

(b) The pentagonal pyramid is rearranged into a prism consisting of 15 identical layers. How many cans are on the bottom layer of the prism?

(c) A triangular prism consist of identical layers, each of which has a shape of a triangle. (The number of cans in a triangular layer is one of the triangular numbers: 1,3,6,10,...) For example, a prism could be composed of the following layers:



Prove that a pentagonal pyramid of cans with any number of layers $l \geq 2$ can be rearranged (without a deficit or leftover) into a triangular prism of cans with the same number of layers l.

Solution for (a):

One can derive the general formula for the n^{th} pentagonal number. Let there be p_n cans in the n^{th} layer. Note that the n^{th} layer is formed from the $n-1^{\text{st}}$ layer by adding three lines of n cans, with 2 cans in two lines. Therefore we have the recurrence $p_n = p_{n-1} + 3n - 2$, as well as $p_1 = 1$. Therefore we get

$$p_n = (3n-2) + (3(n-1)-2) + \cdots + (3*2-2) + (3*1-2)$$

$$= 3(1+2+\cdots+n) - 2n = \frac{3n^2-n}{2}.$$

In particular, $p_{15} = \frac{3*15^2-15}{2} = 330$.

Alternatively, one can reconstruct the sequence from the first four terms $1, 5, 12, 22$ by noticing the first differences $4, 7, 10$ and concluding that the second common difference is 3. So we have

1,5,12,22,35,51,70,92,117,145,176,210, 247,287,330.

Solution for (b):

One can calculate the sum of the numbers found in (a):

1+5+12+22+35+51+70+92+117+145+176+210+ 247+287+330=1800

Alternatively, one can use the general formula for pentagonal numbers and evaluate

$$\sum_{k=1}^{15} p_k = \sum_{k=1}^{15} \frac{3k^2 - k}{2} = \frac{3}{2} \sum_{k=1}^{15} k^2 - \frac{1}{2} \sum_{k=1}^{15} k$$
$$= \frac{3}{2} \left(\frac{15 \times 16 \times 31}{6} \right) - \frac{1}{2} \left(\frac{15 \times 16}{2} \right) = 1860 - 60 = 1800$$

Since the prism has 15 identical layers, the number of cans in each layer is 1800/15=120.

Solution for (c):

The n^{th} triangular number is $t_n = 1 + 2 + \cdots + n = \frac{n(n+1)}{2}$. In the pentagonal pyramid with n layers, we have

$$\begin{aligned}\sum_{k=1}^{n} p_k = \sum_{k=1}^{n} \frac{3k^2 - k}{2} &= \frac{3}{2} \sum_{k=1}^{n} k^2 - \frac{1}{2} \sum_{k=1}^{n} k \\ &= \frac{3}{2} \left(\frac{n(n+1)(2n+1)}{6} \right) - \frac{1}{2} \left(\frac{n(n+1)}{2} \right) \\ &= \frac{1}{4}(n(n+1)(2n+1-1)) \\ &= \frac{n^2(n+1)}{2} \\ &= n \times \frac{n(n+1)}{2} \\ &= n \times t_n.\end{aligned}$$

Thus we can rearrange this into n layers with $\frac{n(n+1)}{2} = t_n$ cans in each layer, which is what we desire.

C2. Alice has two boxes A and B. Initially box A contains n coins and box B is empty. On each turn, she may either move a coin from box A to box B, or remove k coins from box A, where k is the current number of coins in box B. She wins when box A is empty.

(a) If initially box A contains 6 coins, show that Alice can win in 4 turns.

Solution:

Let moving a coin from box A to B be operation 1, and removing coins from box A be operation 2.

The sequence 1112 does the job.

(b) If initially box A contains 31 coins, show that Alice cannot win in 10 turns.

Solution:

We may consider all possible partitions of 10= 1+9=2+8=3+7=...=9+1 and corresponding sequences of operations 1222222222, 1122222222, etc. where all the 1's are before the 2's. Observe that each transposition of operation 1 and 2 would increase the number of coins left in A by 1. For example the sequence 1112222222 results in $31 - 1 - 1 - 1 - 3 \times 7 = 31 - 24 = 7$ coins left in box A, while the sequence 1121222222 results in $31 - 1 - 1 - 2 - 1 - 3 \times 6 = 31 - 23 = 8$ coins left in box A and the sequence 1211222222 results in $31 - 1 - 1 - 1 - 1 - 3 \times 6 = 31 - 22 = 9$ coins left in box A.

The most optimal results comes from either sequence 1111122222 (5 moves and then 5 removals) or 1111112222 but it still leaves one coin in A. Thus it is impossible to win in 10 turns.

(c) What is the minimum number of turns needed for Alice to win if box A initially contains 2018 coins?

Solution:

If Alice does operation 1 L times, and then operation 2 M times, she removes $L(M + 1)$ coins from box A. Now every time she transposes an operation 2 to an operation 1, she remove one fewer coin from box A, so indeed with L uses of operation 1 and M uses of operation 2 she can remove any number of coins between L and $L(M + 1)$. Now note that when $L = 45$, $M = 44$, we have $L(M + 1) = 2025 > 2018$.

Note if S is fixed and $L + M = S$, the function $f_S(L) = L(M + 1) = L(1 + S - L) = (1 + S)L - L^2$ achieves its maximum at $L_{max} = (1 + S)/2$, and $f_S(L_{max}) = L^2_{max} = (1 + S)^2/4$. So when $L + M \leq 88$, we must have $L(M + 1) \leq (44.5)^2 < 2018$. So 89 turns are needed.

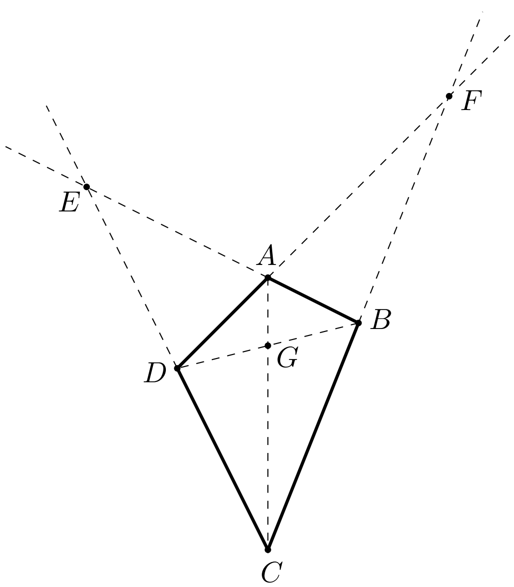
Here is an explicit example of how Alice wins in 89 turns starting from 2018 coins in box A: she does operation 1 38 times, then operation 2, then operation 1 7 times, then operation 2 43 times. Indeed, $2018 - 38 - 38 - 7 - (38 + 7) \times 43 = 0$.

C3. Consider a convex quadrilateral $ABCD$. Let rays BA and CD intersect at E, rays DA and CB intersect at F, and the diagonals AC and BD intersect at G. It is given that the triangles DBF and DBE have the same area.

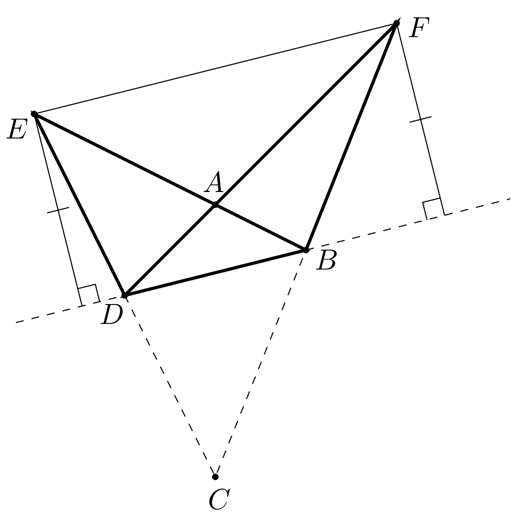
(a) Prove that EF and BD are parallel.

Solution:

First we draw the figure.



Triangles EBD and FBD have the same area, so the heights from E and F to line BD are of equal length. Therefore, EF and BD are parallel.



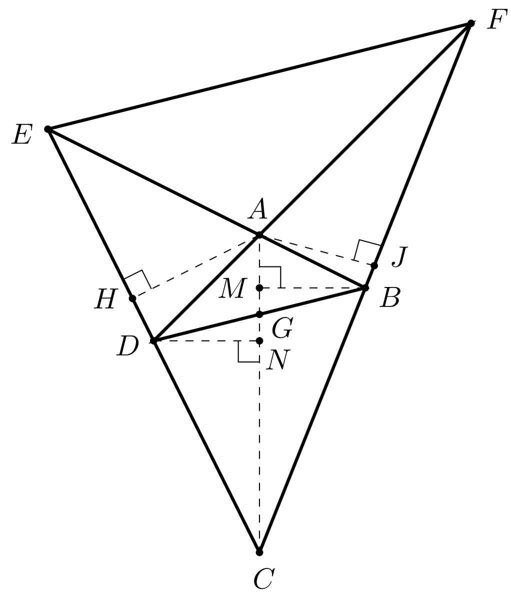
(b) Prove that G is the midpoint of BD.

Solution:

In trapezoid $BDEF$, A is the intersection of diagonals, and C is the intersection of legs. We first note that triangles ADE and ABF have the same area by subtracting triangle ABD from the original condition. Let AJ and AH be altitudes of triangles ADE and ABF respectively. Then we have $DE \cdot AH = BF \cdot AJ$ or $DE/BF = AJ/AH$.

Then, because triangles DBC and EFC are similar, we have that DE/DC and BF/BC are equal. Consequently, $DE/BF = CD/BC$. We obtain $AJ/AH = CD/BC$ (since both of them are equal to DE/BF), so $AJ \cdot BC = CD \cdot AH$, and thus ACB and ACD have the same area.

Let M and N be points on segment AC such that BM and DN are both perpendicular to AC. From equity of areas of ACB and ACD we conclude that $BM = DN$. Since BM and DN are parallel, the right triangles GBM and GDN are congruent. Thus G is the midpoint of BD.



(c) Given that the area of triangle ABD is 4 and the area of triangle CBD is 6, compute the area of triangle EFG.

Solution:

Denote by $[ABC]$ the area of a triangle ABC. We have

$$[ABC] = [ACD] = \frac{1}{2}([ABD] + [CBD]) = \frac{4+6}{2} = 5.$$

Let the area $[ADE]$ be x. We have the equation

$$\frac{x}{4} = \frac{[ADE]}{[ADB]} = \frac{AE}{AB} = \frac{[AEC]}{[ABC]} = \frac{x+5}{5},$$

so we get $x = 20$.

Now, we have

$$[EFG] = [EFD] = [FDC]\frac{DE}{DC} = [FDC]\frac{[ADE]}{[ADC]} = (x+10)\frac{x}{5} = 120.$$

C4. Given a positive integer N, Matt writes N in decimal on a blackboard, without writing any of the leading 0s. Every minute he takes two consecutive digits, erases them, and replaces them with the last digit of their product. Any leading zeroes created this way are also erased. He repeats this process for as long as he likes. We call the positive integer M *obtainable* from N if starting from N, there is a finite sequence of moves that Matt can make to produce the number M. For example, 10 is obtainable from 251023 via

$$2510\underline{23} \to \underline{25}106 \to 1\underline{06} \to 10$$

(a) Show that 2018 is obtainable from 2567777899.

Solution: Consider the process

$$25677778\underline{99} \to 2567777\underline{81} \to 25677\underline{77}8 \to 256\underline{77}98 \to 256\underline{99}8 \to 2\underline{56}18 \to 2018.$$

All valid solutions will be essentially a rearrangement of this process.

(b) Find two positive integers A and B for which there is no positive integer C such that both A and B are obtainable from C.

Solution:

Let us first note a few observations:

- If the number N has a 0, it cannot disappear from N except if it becomes a leading zero (and is therefore dropped). In particular, it will break up N into two parts which cannot interact via Matt's actions.
- The only way to produce the number 5 is to multiply an odd number with 5. Thus the number of 5s is non-increasing, and will go down every time Matt multiplies two 5s together, or multiplies a 5 with an even number to produce a zero.
- Similarly, the only way to produce a non-zero even number is to multiply a non-zero even number by any number besides 0 or 5.

Take $A = 2$ and $B = 5$, and assume that we have a C for which both $2, 5$ are obtainable from C. Write $C = c_1 c_2 \cdots c_n$ in decimal, so c_i is an integer between 0 and 9 with $c_1 \neq 0$. Since 5 is obtainable from C, at least one of the c_i must be equal to 5; let k be the largest index such that $c_k = 5$. It follows that $c_{k+1}, c_{k+2}, \ldots, c_n$ must all be odd, as otherwise the units digit would never be able to be 5. However 2 is obtainable from C, so let m be the largest index for which c_m is even; this must exist, and $m < k$. When Matt applies the process, the furthest right 5 will always stay to the right of the furthest right even number, unless Matt takes their product. Since 2 is obtainable from C and 2 does not share this property, at some point Matt must do this multiplication, producing 0. However all numbers to the right of this 0 are odd, so there is no way to produce an even non-zero number to the right of this zero, contradicting the fact that 2 is obtainable. Therefore it is impossible to obtain both 2 and 5 from the same number.

Remark: *Take A to be any odd multiple of 5 and B to be any even number not divisible by 10, and the same proof will work. A false argument would be to claim that the product of all the digits of the number modulo 10 stays constant, as this is not true. For example, $\underline{25}1 \to 1$, but the first has product $0 \pmod{10}$ and the second has product $1 \pmod{10}$ (the dropping of leading 0's is the phenomenon at play).*

(c) Let S be any finite set of positive integers, none of which contains the digit 5 in its decimal representation. Prove that there exists a positive integer N for which all elements of S are obtainable from N.

Solution:

It will suffice to prove the statement when S is the set of all positive integers not containing the digit 5 whose decimal expansion contains at most k digits. Define the number $C = 233\ldots3$, which is a two followed by $4k$ threes. Let $X = a_1 \cdots a_r$ be the decimal expansion of a positive integer such that: $r \le k$, and all r digits are odd and coprime to 5. I claim that there exists an $e \in \{2, 4, 6, 8\}$ for which eX (the decimal concatenation) is obtainable from C. Indeed, any non-five odd number can be constructed from between 1 and 4 threes, so X can be constructed from the rightmost $4k$ threes. Combine the unused threes with the leading two to obtain the result.

Take the number D to be $10333C333C \cdots 333C$, which is 10 followed by k instances of the string $333C$. For any $X \in S$ not containing the digit 0, we can write $X = c_1c_2 \cdots c_r$ ($r \le k$), where c_i is a string consisting of a non-zero even number followed by a sequence of non-five odd numbers for $2 \le i \le r$ (c_1 either takes this form or is all odd numbers). From the last C in X we can construct c_r, though the first digit may be wrong. Use any of the next three 3s to correct this even digit. Repeat with the remaining digits of X, forming the number $Mc_2c_3 \cdots c_r$, where M consists of the unused leading digits. Since $r \le k$ there is at least one more C left in M, so we form c_1, correct the first digit (if it is even), kill off the unnecessary preceding digits with the 2nd digit of our number (which is 0), and finally kill off the leading digits 10 to form X.

How can we construct all numbers in S? Well, we take N to be $10D0D0 \cdots D$, which is 1 followed by $k-1$ copies of $0D$. If there are $z \le k-1$ zeroes in $X \in S$, then we use the right most $z+1$ D's in N to form the sequences before the first zero, between the subsequent zeroes, and after the last zero. Any extra digits can be killed off by these zeroes, and as before the second digit of our number (0) kills off any remaining leading terms, before we reach X by combining 10. Therefore all elements of S are obtainable from this choice of N.

Remark: *There are many different ways to do this; for example one could use $C = 87...7$ instead of 23...3.*

Premier Sponsors

CAS — Expertise. Insight. Solutions.

SOCIETY OF ACTUARIES

in association with crowdmark

Sponsors:

Aqueduct
Banff International Research Station
Centre de recherche mathématiques
The Fields Institute
Maplesoft
The McLean Foundation
Popular Book Company
RBC Foundation
S.M. Blair Foundation
The Samuel Beatty Fund

Academic Partners:

University of British Columbia
University of Calgary
Dalhousie University
University of Manitoba
Memorial University
University of New Brunswick
University of Prince Edward Island
Dept. of Mathematics & Statistics, (University of Saskatchewan)
University of Toronto
York University
ASDAN China

Government Partners:

Alberta Education
Manitoba
New Brunswick
Northwest Territories
Nova Scotia
Nunavut
Ontario
Prince Edward Island

