

Mathematica Centrum

Together, let's shape the mathematicians of the future

A. You will need:

1. A **blank response** form with the title "Mathematica", identical (except for the title) to the ones which are used for the Contests. Download this form and make as many copies as you need, so that your students can write the preparatory test and learn how to properly fill out a response form. (Remember that these copies cannot be used for the Contests. Your students will use the response forms that will be sent to you. Each student registered for a contest will receive a response form corresponding to the contest that he is writing. The only reason you are doing these copies is to show your students how to properly fill out a response form).
2. The **preparatory test** (this document), which your students can write to become familiar with multiple choice questions. Download this test and make as many copies as you need. (Remember that you are doing this to explain to your students the purpose of the preparatory test. The preparatory test defines the type of problems that appear in the actual contest.)
3. The **answer key**. Download the answer key and make as many copies as you need.

B. How to fill out a response form properly:

Use an **HB pencil** for coding all parts of the form. Do not use a ball point pen or felt-tip marker.

In the box at the top part of the form, tell your students to **PRINT** their school's name in full as well as their city/town and province. To the right of the box, tell them to **PRINT** their date of birth and sign their name to certify that the answers given represent their own work.

In the box on the mid-left of the form, tell your students to **PRINT** their last and first names. Tell them to code each letter by filling in the appropriate circle under each letter. (If your last name is Mathews, first you code the letter M by filling in the circle containing the M right under the letter M of Mathews, then you code the A by filling in the circle containing the A right under the letter A of Mathews. Do this for every other letter of your last name and for each letter of your first name). If the last name of a student is hyphenated, for example Jones-Smith, or if his/her first name is hyphenated, like Carol-Ann, inform the student to simply write Jones Smith and Carol Ann.

The mid-right part of the form outlines important instructions which are a reminder of what to do to code the response form correctly. The lower part of this box shows examples of incorrect coding. Remind your students to **completely** fill in each circle.

The box at the bottom of the form is made of circles which your students will fill in to record their answers to the questions. Again, tell them to fill each circle completely!

C. Problems:

Allow your students to write the preparatory test to be sure that they understand how to properly fill out the response form and to prepare them as to the type of problems that appear in the actual contests. It is important that your students do the problems intended for them :

Pythagoras : all of the problems #1 to #31

Fibonacci : all of the problems except #28 and #31

Byron-Germain : problems #1 to #16 plus # 18 and #27

Thales : problems #1 to #14 and #27

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PREPARATORY TEST 2010

THALES (3rd) – BYRON-GERMAIN (4th) – FIBONACCI(5th) – PYTHAGORAS (6th)

1. The number of vertices of a triangular pyramid is

A) 5 B) 4 C) 3 D) 6 E) 7

2. The value of X in the equation: $X + 13 = 27$ is

A) 32 B) 24 C) 14 D) 40 E) 34

3. What number is eighteen more than twenty-seven?

A) 45 B) 47 C) 55 D) 46 E) 35

4. The vowel closest to the third letter before the 14th letter of the alphabet is

A) O B) U C) E D) I E) A

5. $2 \times 2 \times 10 \times 5 \times 5 = ?$

A) 400 B) 500 C) 100 D) 10 000 E) 1 000

6. When half of 24 is divided by the double of 3, the result is

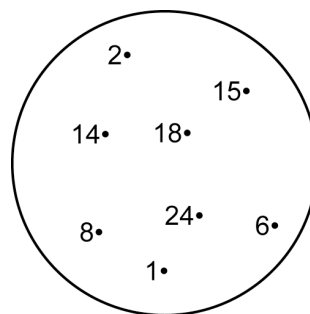
A) 3 B) 6 C) 4 D) 5 E) 2

7. How many nickels are equal in value to 20 quarters?

A) 60 B) 50 C) 100
D) 40 E) 125

8. $8 - 4 \div 2 + 4 = ?$

A) 6 B) 4 C) 10
D) 8 E) 12



9. How many elements of the set shown on the right are not divisors of 36?

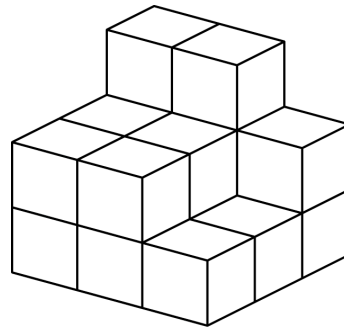
A) 1 B) 2 C) 3 D) 4 E) 5

10. The next number in the sequence: 10, 20, 18, 36, 34, ... is

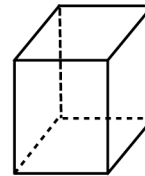
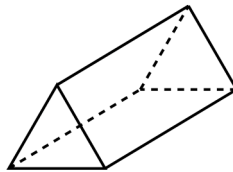
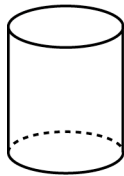
A) 68 B) 48 C) 36 D) 32 E) 64

11. What is the minimum number of blocks that have to be added to, or subtracted from, the pile of 18 blocks to get a pile of blocks that will have the shape of a cube?

A) 10 B) 9 C) 8
D) 7 E) 11



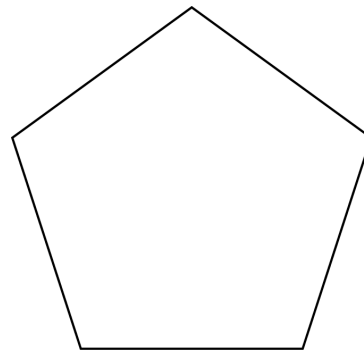
12. How many of the solids shown are not prisms?



A) 1 B) 2 C) 3 D) 4 E) none

13. How many lines of symmetry does the pentagon have?

A) 1 B) 2 C) 3
D) 4 E) 5



14. The number 0 is a square number (because $0 \times 0 = 0$). The numbers 1, 4, 9, and 16 are also square numbers (because $1 \times 1 = 1$, $2 \times 2 = 4$, $3 \times 3 = 9$, and $4 \times 4 = 16$). How many square numbers are there between 0 and 100?

A) 12 B) 8 C) 11
D) 10 E) 9

15. How many seconds are there in 2 hours?

A) 7 200 B) 120 C) 360 D) 6 000 E) 600

16. If the digits 1, 2, 3, and 4 are all used to form 4-digit natural numbers, how many different numbers can be formed?

A) 12 B) 24 C) 4 D) 8 E) 16

17. The first even number is 0, the second is 2, the third is 4, the fourth is 6, the fifth is 8, ... the 15th even number is

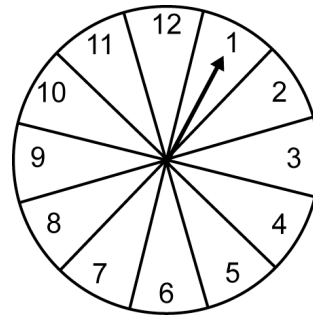
A) 24 B) 28 C) 30 D) 26 E) 32

18. Andrea got home at 1:41 P.M. She read for 30 minutes. Then she ate for 45 minutes and finally, she studied for 1 h 15 min. At what time did she finish studying?

A) 3:52 P.M. B) 4:42 P.M. C) 4:11 P.M. D) 4:41 P.M. E) 3:42 P.M.

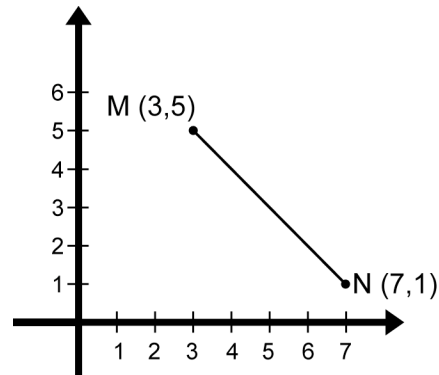
19. Mathilda has made a circular spinner like the one shown in the diagram. If she spins the spinner once, what is the probability that she will get a number that is a prime number?

A) $\frac{1}{2}$ B) $\frac{1}{3}$ C) $\frac{1}{4}$
D) $\frac{5}{12}$ E) $\frac{7}{12}$



20. Which of the following pairs of coordinates represents the mid point on segment MN?

A) (4, 5) B) (5, 4) C) (6, 3)
D) (5, 3) E) (4, 4)



21. The LCM of 12 and 15 is

A) 30 B) 60 C) 180
D) 150 E) 90

22. How many of the following fractions: $\frac{2}{10}$, $\frac{11}{45}$, $\frac{101}{505}$, $\frac{25}{115}$ et $\frac{14}{70}$ are equivalent to $\frac{1}{5}$?

A) 1 B) 2 C) 3

D) 4 E) 5

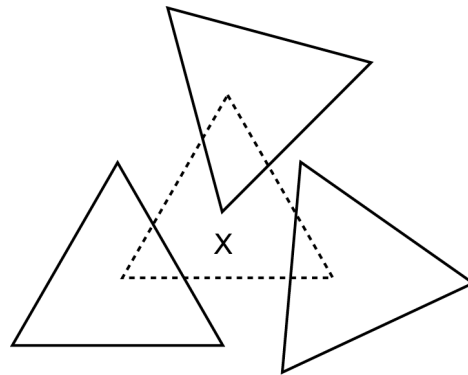
23. The value of N in the equation: $2 \times N - 4 \times 1.3 = 15.2$ is

A) 11.2 B) 10 C) 9.8 D) 10.4 E) 10.2

24. How many natural numbers between 0 and 40 are multiples of 2, 3, and 5?

A) 9 B) 10 C) 1
D) 2 E) 13

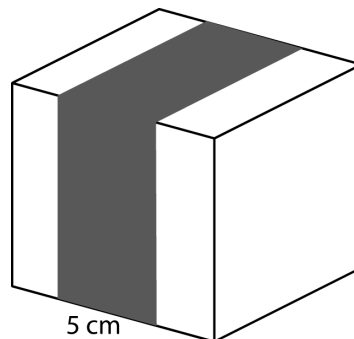
25. Mathilda has 11 identical equilateral triangles that are made of transparent plastic. She takes one and writes an X on it. In the diagram, we can see that Mathilda has placed 3 triangles on triangle X (in dotted lines). What is the maximum number of triangles that she can place on triangle X, if the triangles can touch each other but cannot overlap?



A) 6 B) 9 C) 3
D) 8 E) 4

26. Mathew painted part of a wooden cube (10 cm x 10 cm x 10 cm). He applied a coat of paint perpendicular to the edges of the cube (all around the cube) that looks like a strip of ribbon 5 cm wide. What fraction of the cube's total surface did he paint?

A) $\frac{1}{3}$ B) $\frac{1}{5}$ C) $\frac{2}{7}$
D) $\frac{1}{4}$ E) $\frac{3}{10}$



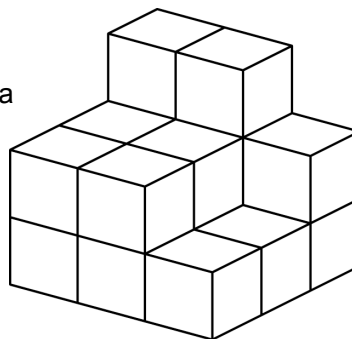
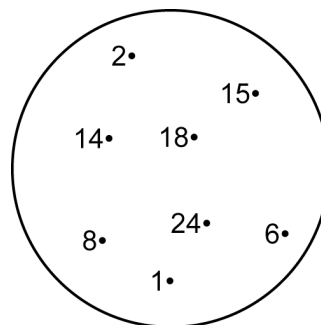
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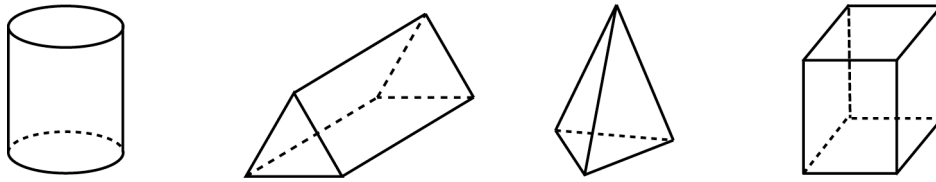
PREPARATORY TEST 2010 COMPLETE SOLUTIONS

THALES (3rd) – BYRON-GERMAIN (4th) – FIBONACCI(5th) – PYTHAGORAS (6th)

1. The number of vertices of a triangular pyramid is 4 (the 3 vertices of the base triangle and the vertex of the pyramid itself).
2. The value of X in the equation: $X + 13 = 27$ is 24.
3. Eighteen plus twenty-seven is equal to 45.
4. The third letter before the 14th letter of the alphabet is the 11th letter of the alphabet. The vowel closest to this letter is the I.
5. $2 \times 2 \times 10 \times 5 \times 5 = 2 \times 5 \times 2 \times 5 \times 10 = 10 \times 10 \times 10 = 1\,000$.
6. Half of 24 is 12. The double of 3 is 6. The result of $12 \div 6$ is 2.
7. Each quarter is equal in value to 5 nickels. 20 quarters are equivalent to (20×5) 100 nickels.
8. $8 - 4 \div 2 + 4 = 8 - (4 \div 2) + 4 = 8 - 2 + 4 = 10$.
9. The numbers 1, 2, 6, and 18 are divisors of 36. The number of elements of the set that are not divisors of 36 is $(8 - 4)$ 4.
10. The next number in the sequence: 10, 20, 18, 36, 34, ... is 68 ($10 \times 2 = 20$, $20 - 2 = 18$, $18 \times 2 = 36$...). The rule of the sequence is $\times 2 - 2$.
11. Nine blocks have to be added to the pile of blocks to get a cubic pile of 27 blocs ($3 \times 3 \times 3$). Ten blocks have to be subtracted from the pile to get a cubic pile of 8 blocs ($2 \times 2 \times 2$). The minimum number of blocks that have to be added to, or subtracted from, the pile of 18 identical blocks shown on the right to get a pile of blocks that will have the shape of a cube is 9.



12. The first solid is a cylinder, the second is a triangular prism (the two parallel bases are triangles), the third is a triangular pyramid, and the fourth is a rectangular prism. The number of solids that are not prisms is 2.

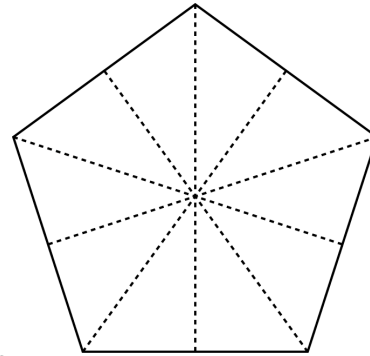


13. The regular pentagon shown has 5 lines of symmetry.

14. The numbers 1, 4, 9, and 16 are square numbers (because $1 \times 1 = 1$, $2 \times 2 = 4$, $3 \times 3 = 9$, and $4 \times 4 = 16$). The square numbers between 0 and 100 are 1, 4, 9, 16, 25, 36, 49, 64, and 81. There are 9 square numbers between 0 and 100.

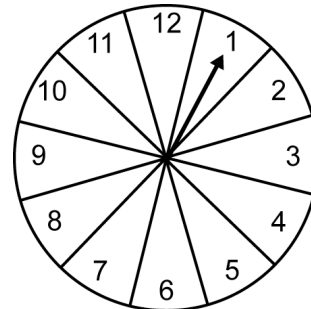
15. In 2 hours there are (2×60) 120 minutes. In 120 minutes there are (120×60) 7 200 seconds.

16. The largest of these numbers is 4 321. The 2nd largest is 4 312. In all, there are 6 numbers that start with the digit 4 (4 321, 4 312, 4 231, 4 213, 4 132, and 4 123). There are 6 other numbers that start with the digit 3, six others whose first digit is a 2, and finally, 6 others whose first digit is a 1. In all, 24 different numbers can be formed.



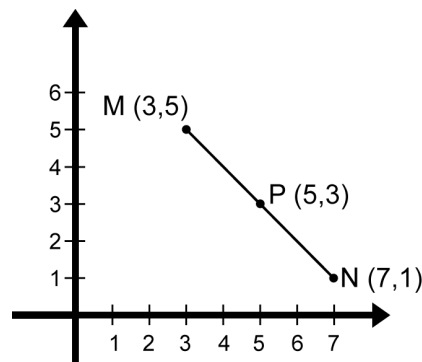
17. The first even number is 0 ($1 \times 2 - 2$), the second is 2 ($2 \times 2 - 2$), the third is 4 ($3 \times 2 - 2$), the fourth is 6 ($4 \times 2 - 2$), the fifth is 8 ($5 \times 2 - 2$), ... the 15th even number is $(15 \times 2 - 2)$ 28.

18. Andrea got home at 1:41 P.M. She read for 30 minutes. Then she ate for 45 minutes and finally, she studied for 1 h 15 min. She finished studying $(30 + 45 + 75)$ 150 minutes later. She finished studying at $(13 \text{ h } 41 \text{ min} + 2 \text{ h } 30 \text{ min})$ 4:11 P.M.

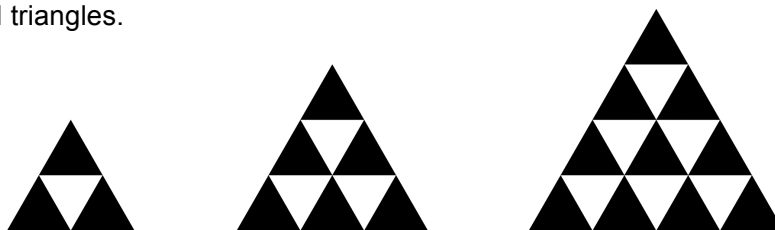
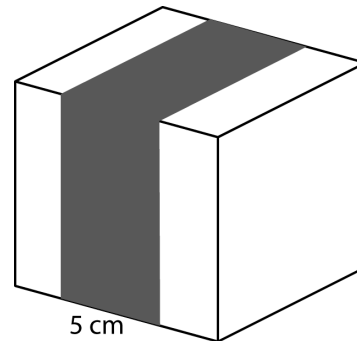
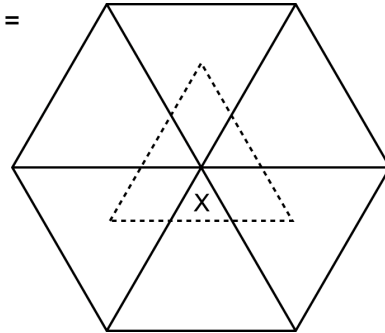


19. There are 5 prime numbers on the spinner (2, 3, 5, 7, and 11). If she spins the spinner only once, she will have 5 chances to get a prime number. The probability that she will get a prime number is $5/12$.

20. The mid point P on segment MN is represented in the diagram. Its coordinates are (5, 3). The x coordinate of this point must be midway between 3 and 7 ($3 + 7 = 10$, $10 \div 2 = 5$). The y coordinate of this point must be midway between 1 and 5 ($1 + 5 = 6$, $6 \div 2 = 3$).



21. The prime factors of 12 are $(2 \times 2 \times 3)$. The prime factors of 15 is (3×5) . The LCM of 12 and 15 are $(2 \times 2 \times 3 \times 5)$ 60.
22. The fractions that are equivalent to $1/5$ ($2/10$, $101/505$, and $14/70$) are all those whose denominator is 5 times greater than the numerator ($10 = 5 \times 2$, $505 = 5 \times 101$, ...). Three fractions are equivalent to $1/5$.
23. The equation $2 \times N - 4 \times 1.3 = 15.2$ becomes $2 \times N - 5.2 = 15.2$ then $2 \times N = 20.4$, and finally $N = 10.2$. The value of N in this equation is therefore 10.2.
24. The only natural number between 0 and 40 that is a multiple of 2, 3, and 5 is $(2 \times 3 \times 5)$ 30.
25. The maximum number of triangles that she can place on triangle X (to cover it completely) is $(360 \div 6)$ 6, because each angle of an equilateral triangle is equal to 60° and each circle has 360° . The six triangles are placed as shown in the diagram.
26. The area of one of the cube's faces is $(10 \text{ cm} \times 10 \text{ cm})$ 100 cm^2 . The cube's total surface is 600 cm^2 . On each face, Mathew applied $(5 \text{ cm} \times 10 \text{ cm})$ 50 cm^2 of paint. In all, he painted a surface of (4×50) 200 cm^2 . He painted $(200 \text{ cm}^2 \div 600 \text{ cm}^2)$ $1/3$ of the total surface of the cube.
27. The numbers 6, 120, 24, and 60 can all be written as the products of 3 natural consecutive numbers ($6 = 1 \times 2 \times 3$, $120 = 4 \times 5 \times 6$, $24 = 2 \times 3 \times 4$, and $60 = 3 \times 4 \times 5$). It is impossible to write the number 12 as the product of 3 consecutive natural numbers.
28. The product of $9 \times 10 \times 11 \times 101$ can be written as $9 \times 11 \times 101 \times 10 = 99 \times 101 \times 10 = 9\,999 \times 10$. This number is smaller than $10\,000 \times 10$ (which is 10^5) and larger than $1\,000 \times 10$ (which is 10^4). This product lies between 10^4 and 10^5 .
29. All the numbers are the products of 2 prime numbers, except 20, which is the product of 3 prime numbers ($2 \times 2 \times 5$).
30. The first 3 figures in a sequence are represented in the diagram. The first figure is composed of **3** shaded triangles, the second figure is composed of **6** shaded triangles (**3** + **3**), and the third is composed of **10** triangles (**6** + **4**). The 4th is composed of (**10** + **5**) **15**, the 5th of (**15** + **6**) **21** shaded triangles, ... the 10th figure in the sequence has **66** shaded triangles.



3	4	5	6	7	8	9	10	11	
3	6	10	15	21	28	36	45	55	66

31. In the first race, Mathilda finished 5 m ahead of Mathew. When Mathilda finished the race, Mathew had covered $(95/100)$ 95% of Mathilda's distance. If they run a second race of 99 m at exactly the same speed they ran the first one, Mathilda will again finish the race when Mathew will have covered 95% of Mathilda's distance. In the second race, when Mathilda crosses the finish line, Mathew will have covered (0.95×99) 94.05 m. Mathilda will finish $(99 - 94.05)$ 4.95 m ahead of Mathew.

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PREPARATORY TEST 2010

THALES (3rd) – BYRON-GERMAIN (4th) – FIBONACCI (5th) – PYTHAGORAS (6th)

- | | | | | |
|---|---|---|---|--|
| 1 ☐ A ☒ B ☐ C ☐ D ☐ E | 11 ☐ A ☒ B ☐ C ☐ D ☐ E | 21 ☐ A ☒ B ☐ C ☐ D ☐ E | 31 ☐ A ☐ B ☐ C ☒ D ☐ E | 41 ☐ A ☐ B ☐ C ☐ D ☐ E |
| 2 ☐ A ☐ B ☒ C ☐ D ☐ E | 12 ☐ A ☒ B ☐ C ☐ D ☐ E | 22 ☐ A ☐ B ☒ C ☐ D ☐ E | 32 ☐ A ☐ B ☐ C ☐ D ☐ E | 42 ☐ A ☐ B ☐ C ☐ D ☐ E |
| 3 ☒ A ☐ B ☐ C ☐ D ☐ E | 13 ☐ A ☐ B ☐ C ☐ D ☒ E | 23 ☐ A ☐ B ☐ C ☐ D ☒ E | 33 ☐ A ☐ B ☐ C ☐ D ☐ E | 43 ☐ A ☐ B ☐ C ☐ D ☐ E |
| 4 ☐ A ☐ B ☐ C ☒ D ☐ E | 14 ☐ A ☐ B ☐ C ☐ D ☒ E | 24 ☐ A ☐ B ☒ C ☐ D ☐ E | 34 ☐ A ☐ B ☐ C ☐ D ☐ E | 44 ☐ A ☐ B ☐ C ☐ D ☐ E |
| 5 ☐ A ☐ B ☐ C ☐ D ☒ E | 15 ☒ A ☐ B ☐ C ☐ D ☐ E | 25 ☒ A ☐ B ☐ C ☐ D ☐ E | 35 ☐ A ☐ B ☐ C ☐ D ☐ E | 45 ☐ A ☐ B ☐ C ☐ D ☐ E |
| 6 ☐ A ☐ B ☐ C ☐ D ☒ E | 16 ☐ A ☒ B ☐ C ☐ D ☐ E | 26 ☒ A ☐ B ☐ C ☐ D ☐ E | 36 ☐ A ☐ B ☐ C ☐ D ☐ E | 46 ☐ A ☐ B ☐ C ☐ D ☐ E |
| 7 ☐ A ☐ B ☒ C ☐ D ☐ E | 17 ☐ A ☒ B ☐ C ☐ D ☐ E | 27 ☐ A ☐ B ☐ C ☐ D ☒ E | 37 ☐ A ☐ B ☐ C ☐ D ☐ E | 47 ☐ A ☐ B ☐ C ☐ D ☐ E |
| 8 ☐ A ☐ B ☒ C ☐ D ☐ E | 18 ☐ A ☐ B ☒ C ☐ D ☐ E | 28 ☐ A ☐ B ☒ C ☐ D ☐ E | 38 ☐ A ☐ B ☐ C ☐ D ☐ E | 48 ☐ A ☐ B ☐ C ☐ D ☐ E |
| 9 ☐ A ☐ B ☐ C ☒ D ☐ E | 19 ☐ A ☐ B ☐ C ☒ D ☐ E | 29 ☐ A ☐ B ☐ C ☐ D ☒ E | 39 ☐ A ☐ B ☐ C ☐ D ☐ E | 49 ☐ A ☐ B ☐ C ☐ D ☐ E |
| 10 ☒ A ☐ B ☐ C ☐ D ☐ E | 20 ☐ A ☐ B ☐ C ☒ D ☐ E | 30 ☐ A ☒ B ☐ C ☐ D ☐ E | 40 ☐ A ☐ B ☐ C ☐ D ☐ E | 50 ☐ A ☐ B ☐ C ☐ D ☐ E |