KMMC 2

Official Solutions

Karate Masters Mathematics Competitions 2

1st Annual

KMMC 2 B

Saturday, January 15, 2022

This official solutions booklet gives at least one solution for each problem on this year's competition and shows that all problems can be solved without the use of a calculator. When more than one solution is provided, this is done to illustrate a significant contrast in methods. These solutions are by no means the only ones possible, nor are they necessarily superior to others the reader may devise.

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Questions and complaints about this competition should be sent by private message to

DeToasty3, **pandabearcat**, and **pog**.

The problems and solutions for this KMMC 2 were prepared by the KMMC 2 Editorial Board under the direction of

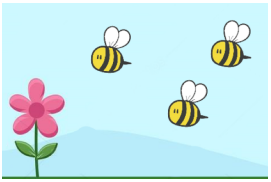
DeToasty3, pandabearcat, & pog

Answer Key:

1. (C)	2. (E)	3. (B)	4. (D)	5. (C)
6. (A)	7. (C)	8. (B)	9. (C)	10. (E)
11. (B)	12. (D)	13. (A)	14. (E)	15. (D)
16. (A)	17. (E)	18. (D)	19. (D)	20. (B)
21. (D)	22. (C)	23. (B)	24. (D)	25. (E)

Problem 1:

(pandabearcat & DeToasty3) How many bees are in the picture?



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

Answer (C):

There are three bees in the picture, so the answer is (C) 3. ■

Problem 2:

(pandabearcat) Karate has 2 bags of candy, Judo has 5 bags of candy, and Aki has 3 bags of candy. How many bags of candy do they have all together?

(A) 6 **(B)** 7 **(C)** 8 **(D)** 9 **(E)** 10

Answer (E):

Adding up the three numbers, we get that they have $2 + 5 + 3 =$ (E) 10 bags of candy all together. ■

Problem 3:

(pog & DeToasty3) How many letters of the word $YUKI$ also appear in the word $KARATE$?

(A) 0 **(B)** 1 **(C)** 2 **(D)** 3 **(E)** 4

Answer (B):

Inspecting each of the letters Y, U, K, and I, we get that only the letter K appears in the word $KARATE$. Thus, the answer is (B) 1. ■

Problem 4:

(DeToasty3) Which of these numbers becomes larger when the digits of the number are put in backwards order (from right to left)?

(A) 7 **(B)** 42 **(C)** 65 **(D)** 78 **(E)** 121

Answer (D):

Each of the answer choices in backwards order (from A to E) are 7, 24, 56, 87, and 121. Of these, only 87 is larger than the original number, for an answer of (D) 78. ■

Problem 5:

(DeToasty3) Judo is grilling steak for dinner. He wants the steak to be grilled for at least five minutes, but no longer than seven minutes. Which of these choices is a good number of minutes for Judo to grill his steak?

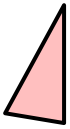
(A) 2 **(B)** 4 **(C)** 6 **(D)** 8 **(E)** 10

Answer (C):

Judo must grill his steak for more than 5 minutes and less than 7 minutes. Of the answer choices, the only possible answer is (C) 6 minutes. ■

Problem 6:

(DeToasty3) Haruka has an unfinished square puzzle with a red piece, a yellow piece, a blue piece, and a green piece. Haruka wants to complete her puzzle by using one pink piece. Which of these pink pieces should Haruka use? (Haruka can turn and flip over pieces, but she cannot break them apart.)

(A)  **(B)**  **(C)**  **(D)**  **(E)** 

Answer (A):

Inspecting each of the pieces, if we were to flip over the piece in answer choice A and turn it clockwise, it will fit the puzzle. Thus, the answer is (A). ■

Problem 7:

(DeToasty3) Which of the following is true about the number 4?

(A) It is greater than 6. **(B)** It is less than 1. **(C)** It is equal to $1 + 3$.
(D) It is an odd number. **(E)** It is a two-digit number.

Answer (C):

Since 4 is not greater than 6, we get that **(A)** is not true.

Since 4 is not less than 1, we get that **(B)** is not true.

Since $1 + 3 = 4$, we get that **(C)** is true.

Since 4 is even, we get that **(D)** is not true.

Since 4 is a one-digit number, we get that **(E)** are not true.

Hence, our answer is (C) It is equal to $1 + 3$. ■

Problem 8:

(pandabearcat) If Aki has 78 friends including Karate, Judo, and Ayaka, how many friends besides Karate, Judo, and Ayaka does Aki have?

(A) 74 **(B)** 75 **(C)** 76 **(D)** 77 **(E)** 78

Answer (B):

Karate, Judo, and Ayaka count as three of Aki's 78 friends, so Aki has $78 - 3 =$ (B) 75 friends besides Karate, Judo, and Ayaka. ■

Problem 9:

(DeToasty3) Karate and Judo play a game where each round, either one player wins and the other player loses, or they tie. After seven rounds, Karate won three rounds, and two rounds ended in a tie. How many rounds did Judo lose?

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

Answer (C):

Since Karate won three rounds, we know that Judo most have lost those three rounds, so the answer is (C) 3. ■

Problem 10:

(DeToasty3) If $1 + 2 + \square + \triangle = 10$, what is the value of $\square + \triangle$?

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

Answer (E):

We have that $\square + \triangle = 10 - 1 - 2 = 10 - 3 =$ (E) 7. ■

Problem 11:

(DeToasty3) What is the fifth smallest whole number which has at least one 1 as a digit?

(A) 12 **(B)** 13 **(C)** 14 **(D)** 15 **(E)** 16

Answer (B):

Inspecting small whole numbers, we see that the five smallest whole numbers which have at least one 1 as a digit, in increasing order, are 1, 10, 11, 12, and 13. Thus, the answer is (B) 13. ■

Problem 12:

(DeToasty3) Ayaka has four empty bowls. For each bowl, she can put either one or two scoops of ice cream in it. If the four bowls have a combined total of seven scoops in them, how many of the four bowls have two scoops in them?

(A) 0 **(B)** 1 **(C)** 2 **(D)** 3 **(E)** 4

Answer (D):

We see that if all four bowls had two scoops each, the four bowls would have a combined total of eight scoops in them. Thus, if we let one of the bowls have only one scoop in it, the four bowls would have a combined total of seven scoops in them. This leaves the three other bowls having two scoops in them. Thus, the answer is (D) 3. ■

Problem 13:

(pandabearcat & DeToasty3) Aki has a triangle and a square where all of the triangle's and the square's sides have the same length. If Aki glues together a side of the triangle and a side of the square so that they exactly line up and the shapes do not overlap, he will form a new shape. How many sides will this new shape have?

(A) 5 **(B)** 6 **(C)** 7 **(D)** 8 **(E)** 9

Answer (A):

We see that one of the sides of each of the triangle and the square will not be included as a side of the new shape. Thus, the answer is $3 + 4 - 1 - 1 = 7 - 2 =$ (A) 5. ■

Problem 14:

(pog) What is the value of $99 + 89 + 1 + 1$?

(A) 150 **(B)** 160 **(C)** 170 **(D)** 180 **(E)** 190

Answer (E):

Rearrange the numbers in the sum as $99+1+89+1$. This is equal to $100+90$, which is equal to $\boxed{\text{(E) } 190}$. ■

Problem 15:

(DeToasty3, pandabearcat, & pog) The composers Johann Sebastian Bach and Franz Joseph Haydn share the same birthday, where Bach was born in the year 1685, and Haydn was born in the year 1732. How many years before Haydn was born was Bach born?

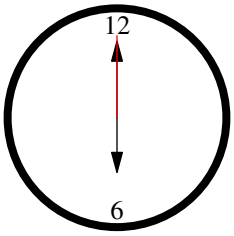
(A) 41 **(B)** 43 **(C)** 45 **(D)** 47 **(E)** 49

Answer (D):

Since Bach and Haydn share the same birthday, Bach was born exactly $1732-1685=$ $\boxed{\text{(D) } 47}$ years before Haydn was born. ■

Problem 16:

(DeToasty3) Karate sees an analog clock showing the time 6:00. Karate will then look at the clock for the next 30 minutes. During those 30 minutes, how many times will Karate see the hour hand and the minute hand meet each other?



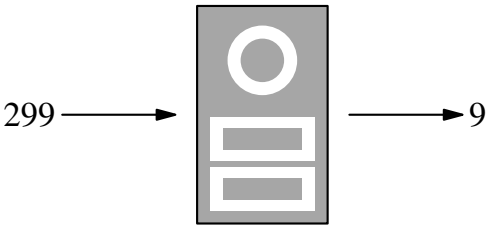
(A) 0 **(B)** 1 **(C)** 2 **(D)** 29 **(E)** 30

Answer (A):

We see that the minute hand will move from 12 to 6 in 30 minutes, while the hour hand moves from 6 to halfway from 6 to 7. Thus, the hands will never meet each other in 30 minutes, so the answer is $\boxed{\text{(A) } 0}$. ■

Problem 17:

(DeToasty3) A machine reads the digits of a number and outputs the largest digit that it read. (For example, putting the number 299 into the machine would output the digit 9.) When put into the machine, how many two-digit numbers would output the digit 2?



(A) 0 **(B)** 1 **(C)** 2 **(D)** 3 **(E)** 4

Answer (E):

Inspecting two-digit numbers where 2 is the largest digit, we find that the numbers 12, 20, 21, and 22 will output the digit 2 when put into the machine. Thus, the answer is (E) 4. ■

Problem 18:

(DeToasty3) Ayaka is skip-counting by threes and fives. She starts by saying the number 13, then the number 16, then the number 21, then the number 24, and so on, where she switches between going up by three and going up by five with each number. Which number will Ayaka **not** eventually say?

(A) 29 **(B)** 32 **(C)** 37 **(D)** 42 **(E)** 45

Answer (D):

Continuing Ayaka's skip-counting, we obtain the numbers $24 + 5 = 29$, $29 + 3 = 32$, $32 + 5 = 37$, $37 + 3 = 40$, and $40 + 5 = 45$. Of the five answer choices, the only one not included in Ayaka's skip-counting is (D) 42. ■

Problem 19:

(DeToasty3) Which of these numbers can be added to each of the numbers 17, 23, and 35 so that all three of the resulting numbers only have even digits?

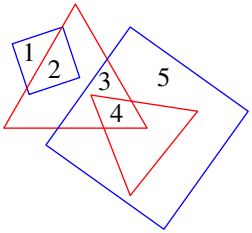
(A) 2 **(B)** 3 **(C)** 4 **(D)** 5 **(E)** 6

Answer (D):

Since 17, 23, and 35 are all odd numbers, we need the number to be added to each of them to be odd as well in order to make the resulting numbers' unit digits all even. Testing 3, we get the numbers $17 + 3 = 20$, $23 + 3 = 26$, and $35 + 3 = 38$. However, 38 contains the digit 3, which is odd. Testing 5, we get the numbers $17 + 5 = 22$, $23 + 5 = 28$, and $35 + 5 = 40$, which works. Thus, the answer is (D) 5. ■

Problem 20:

(DeToasty3, pandabearcat, & pog) How many of the five numbers are **not** inside of any red triangles?



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

Answer (B):

Inspecting the picture, we see that the numbers 1 and 5 are not inside of any red triangles, but the numbers 2, 3, and 4 are. Thus, the answer is (B) 2. ■

Problem 21:

(DeToasty3) In 40 minutes of nonstop work time, Karate can either draw two self-portraits or bake one pie. In 240 minutes of nonstop work time, Karate baked four pies. How many self-portraits did Karate draw during that time?

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

Answer (D):

In order for Karate to have baked four pies, it must have taken him $40 + 40 + 40 + 40 = 160$ minutes. Then, Karate had $240 - 160 = 80$ minutes to have drawn self-portraits. We see that $80 = 40 + 40$, so Karate must have drawn $2 + 2 =$ (D) 4 self-portraits during this time. ■

Problem 22:

(pandabearcat) At recess, Karate sees ten students in line to go down a slide. Judo is the first student in the line. Haruka is somewhere after Judo, but she is not last in the line. Ayaka is somewhere before Haruka and after Judo. What is the largest number of people that can be between Ayaka and Haruka?

(A) 4 **(B)** 5 **(C)** 6 **(D)** 7 **(E)** 8

Answer (C):

In order to maximize the number of people between Ayaka and Haruka, we want to make Haruka as late in the line as possible and Ayaka as early in the line as possible. Since Haruka cannot be last in the line, she must be ninth in the line. Since Haruka cannot be first in the line as Judo is already there, Haruka must be second in the line. Then, the third up to the eighth student in the line will be between Ayaka and Haruka. This gives us an answer of $8 - 3 + 1 =$ (C) 6. ■

Problem 23:

(DeToasty3 & pandabearcat) On the first Thursday of January, Judo learns that the next issue of his favorite comic series, *Karate the K-Pop Star*, will come out on the fourth Saturday of January. If the first Saturday of January was before the first Thursday of January, how many days will Judo have to wait before the issue comes out?

(A) 15 **(B)** 16 **(C)** 19 **(D)** 22 **(E)** 23

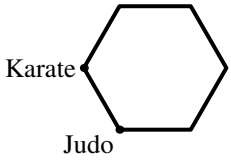
Answer (B):

Since the first Saturday of January was before the first Thursday of January, the second Saturday of January would be two days after the first Thursday of January. From here, we can add on two more weeks, or 14 days, to land on

the fourth Saturday of January. Thus, the answer is $2 + 14 =$ **(B) 16**. ■

Problem 24:

(pandabearcat & pog) Karate and Judo each stand at one of the six different corners of a hexagon, but not the same corner. In how many ways can Karate and Judo stand on corners which are next to each other? (One way is shown in the picture.)



(A) 3 **(B)** 6 **(C)** 9 **(D)** 12 **(E)** 18

Answer (D):

We will look at Karate and Judo's corners separately. For each of the six corners that Karate can be on, we see that Judo can either be to the left of Karate or to the right of Karate. Since there are six corners and two ways for each corner for Karate and Judo to stand on corners which are next to each other, the answer is $2 + 2 + 2 + 2 + 2 + 2 =$ **(D) 12**. ■

Problem 25:

(DeToasty3) Karate tells Judo that his favorite whole number is greater than 7 and less than 12. Judo asks Karate, "Is your number odd?" Karate replies, "No, it is not." Judo can ask one more question to Karate. Which question should Judo ask in order to figure out Karate's favorite number without a doubt?

(A) Is your number less than 11? **(B)** Is your number greater than 10?
(C) Is your number even? **(D)** Does your number end with a 2?
(E) Does your number have two digits?

Answer (E):

If Karate's favorite whole number is greater than 7 and less than 12, we know that it can be one of 8, 9, 10, and 11. After Judo asks Karate the first question and Karate says "no" to it, we can figure out that the number cannot be 9 or 11. Thus, it can either be 8 or 10. Next, we take a look at each of the five answer choices.

If Judo asks Karate, "Is your number less than 11?", then since 8 and 10 are both less than 11, Judo will not know Karate's favorite number without a doubt. Thus, **(A)** is not correct.

If Judo asks Karate, "Is your number greater than 10?", then since neither 8 nor 10 are greater than 10, Judo will not know Karate's favorite number without a doubt. Thus, **(B)** is not correct.

If Judo asks Karate, "Is your number even?", then since 8 and 10 are both even, Judo will not know Karate's favorite number without a doubt. Thus, **(C)** is not correct.

If Judo asks Karate, "Does your number end with a 2?", then since neither 8 nor 10 end with a 2, Judo will not know Karate's favorite number without a doubt. Thus, **(D)** is not correct.

If Judo asks Karate, "Does your number have two digits?", then since 8 has one digit and 10 has two digits, Karate responding with "yes" will mean that his favorite number is 10, and Karate responding with "no" will mean that his favorite number is 8. Thus, Judo will know Karate's favorite number without a doubt, so **(E)** Does your number have two digits? is the answer. ■