Mathematica Centrum

Together, let's shape the mathematicians of the future

A. <u>You will need</u>:

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. <u>How to fill out a response form properly</u>:

Use an **<u>HB pencil</u>** 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. <u>Problems</u>:

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 :

Newton : all of the problems
Lagrange : all of the problems (except #28, #29, and #30)
Euler : all of the problems (except #19, #25, and #28 to #31)

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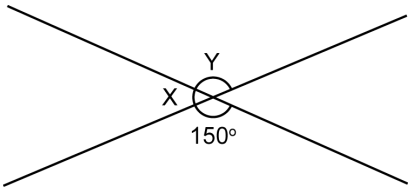
PREPARATORY TEST 2011

EULER (7th) – LAGRANGE (8th) – NEWTON (9th)

1. The sum of the prime factors of 20 is

A) 7 B) 6 C) 4 D) 5 E) 9

2. Two straight lines meet as shown in the diagram. What is the value of 2Y + X?



A) 315° B) 310° C) 330°
D) 230° E) 320°

3. April 14, 2010 was a Wednesday. We can calculate that April 14, 2011 will fall on a

A) Friday B) Tuesday C) Monday D) Thursday E) Wednesday

4. The result of 10% of 10% of 10% of 10 is

A) 1% B) 1 C) 0.01% D) 0.02 E) 0.1%

5. All of the following numbers have 4 factors except

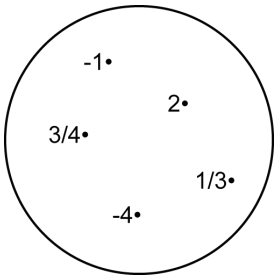
A) 10 B) 15 C) 12 D) 8 E) 6

6. A number divided by 3 leaves a remainder of 1. Another number divided by 3 leaves a remainder of 2. The product of these two numbers could not be

A) 8 B) 25 C) 14
D) 17 E) 35

7. 5 1/3 x 2 1/4 x 3/8 x 4/9 = ?

A) 2 B) 7/11 C) 1
D) 8/7 E) 1 1/4



8. For how many values of the set on the right is $x^2 < -x$?

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

9. It takes 6 circles to completely surround another circle (fig. 1). How many circles does it take to completely surround the 3 tangent circles in fig. 2?

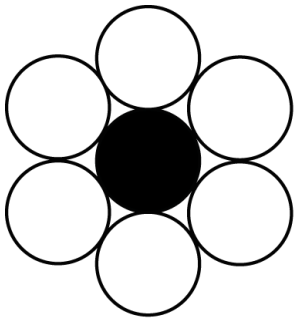


fig. 1

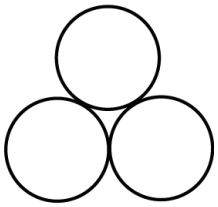


fig. 2

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

10. The 4-digit number 2mn1 is a perfect square. One of the possible values of m + n is

A) 3 B) 4 C) 8 D) 7 E) 5

11. The sum of 2 integers is 1 and their product is -2. Their quotient could be

A) 2/3 B) -3/2 C) -2 D) -1/3 E) 2

12. The number of seconds in one hour is equal to the number of minutes in

A) 72 hours B) 36 hours C) 48 hours D) 60 hours E) 90 hours

13. If $-4 < x < 0$ and $0 < y < 3$, which of the following is always true?

A) $y < x$ B) $x + y < 0$ C) $x + y > 0$ D) $y - x > 0$ E) $xy > 0$

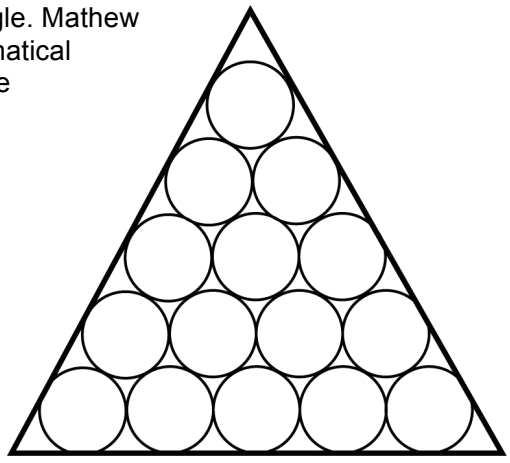
14. The average of -1/2 and 1/3 is equal to

A) 1/6 B) -5/24 C) -1/24 D) -1/6 E) -1/12

15. A car is moving on a speed track. The diameter of the tires is 1 metre. Approximately what distance does the car cover when each tire makes 100 revolutions?

A) 265 m B) 314 m C) 290 m D) 333 m E) 413 m

16. Fifteen billiard balls are inside a wooden triangle. Mathew and Mathilda use these balls to play a mathematical game. Each in turn takes out one, two, or three balls from the triangle. The player who takes out the 14^{th} ball from the triangle (leaving the last one for the other player) wins the game. They already started a game and there are 5 balls left in the triangle. It is Mathilda's turn to play. How many balls should she remove from the triangle to be in a position to win?

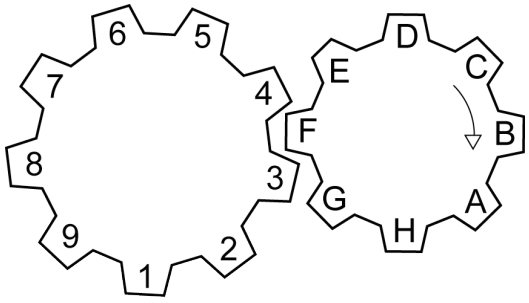


A) 1 B) 2 C) 3
D) Mathilda cannot win this game.
E) None of the above is true.

17. The result of the series 1 + 3 + 5 + 7 + … + 41 is

A) 439 B) 440 C) 441 D) 484 E) 400

18. A gear is made of 2 cog-wheels. The gear on the right has 8 teeth (or cogs), the one on the left, 9 teeth. The wheel with 8 cogs turns in the direction of the arrow and controls the movement of the other. In the diagram, the 3 teeth meshed together are 3F4. Which teeth will mesh together, if the cog-wheel with 8 teeth turns until tooth A falls into the position now occupied by tooth F?



A) 7A8 B) 1A9 C) 1A2
D) 6A7 E) 8A9

19. Four neighbours have bought a snow blower and have shared the cost equally. If only three of these neighbours had bought the snow blower and had shared the cost equally, each one would have paid $105 more. If 5 neighbours had bought the blower and had shared the cost equally, how much would each one have paid?

A) $252 B) $288 C) $240 D) $246 E) $260

20. The radius of a circle is 2. What is the length of a quarter-circle?

A) 2π B) π/2 C) 3π/2 D) 4π E) π

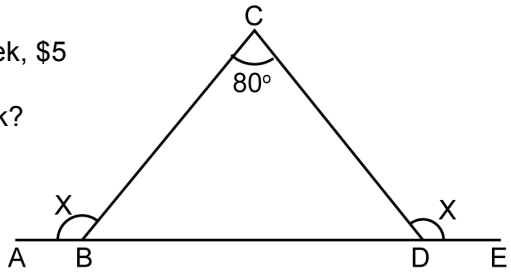
21. A plane covers a distance of 150 km in 15 minutes. It's average speed is

A) 15 km/min B) 600 km/h C) 1 km/min
D) 500 km/h E) 10 km/h

22. Mathew has received $1 the first week, $3 the 2nd week, $5 the 3rd week and so on until he has received a total of $1 000 000. What amount did he receive the last week?

A) $1 000 B) $999 C) $2 000
D) $715 E) $1 999

23. If A, B, D, and E are 4 points of a line segment, what is the value of X?



A) 140° B) 150° C) 130° D) 165° E) 260°

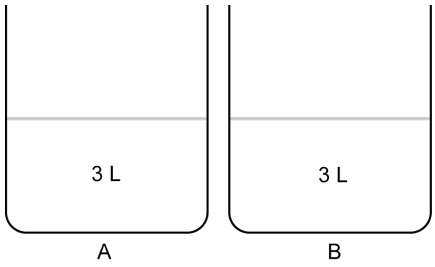
24. The value of 2^5 is 32. Which of the following answers is closest to 2^{25}?

A) 10^9 B) 10^8 C) 10^{10} D) 10^7 E) 10^{11}

25. Pythagoras' theorem states that, in a right triangle, if c is the length of the hypotenuse and a and b are the lengths of the other two sides, then $a^2 + b^2 = c^2$. If a = 3 and b = 4, then $c^2 = 3^2 + 4^2 = 25$ and c = 5. What is the length of the diagonal of a square whose side has a value of 1?

A) √2 B) 1.5 C) 2.1 D) √3 E) 2

26. Container A holds 3 litres of water. Container B holds a homogeneous mixture of 2 litres of wine and 1 litre of water. One litre of mixture B is poured in container A. What fraction of the mixture in container A does wine represent?

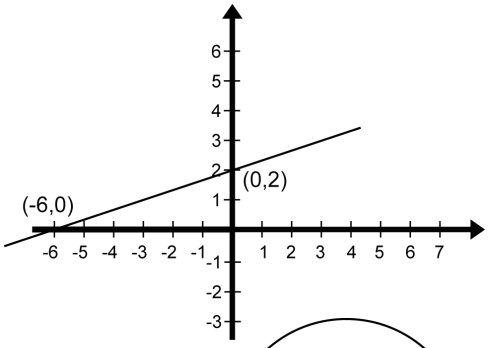


A) 1/5 B) 1/3 C) 1/6
D) 1/7 E) 1/4

27. I'm thinking of a natural number between 150 and 200. If I divide it by 2, I get a remainder of 1. If I divide it by 3, I also get a remainder of 1. If I divide it by 4 or 5, I still get a remainder of 1. What is the sum of the digits of this number?

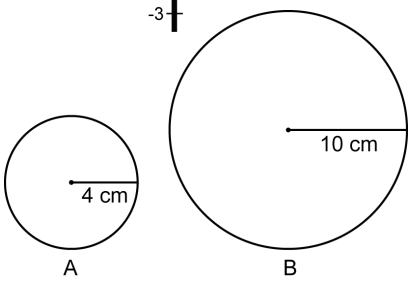
A) 8 B) 12 C) 9 D) 10 E) 11

28. The graph of the line 3y - x = 6 is shown in the diagram. How many grid points (a grid point is a point whose coordinates are integers) are there on this line for the interval -6 ≤ x ≤ 4?



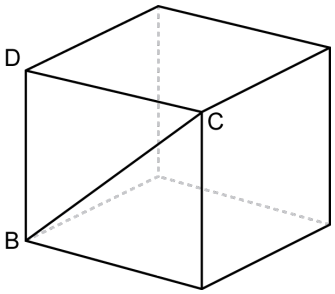
A) 3 B) 4
C) 5 D) 6
E) 7

29. Two right cylinders have the same volume. If the radius of cylinder A is 4 cm and its height is 20 cm, what is the height of cylinder B?



A) 3 cm B) 3.2 cm
C) 4 cm D) 2.5 cm
E) 3.6 cm

30. The edges of the cube shown in the diagram have a value of 1. Points B, C, and D are 3 vertices of the cube. What is the length of the height of side BC in triangle BDC?



A) √2/2 B) √2
C) 1/4 D) 1/2
E) 3/2

31. A family of 5 (A, B, C, D, and E) eats pizza at a restaurant. The radius in centimetres of the pizza of each family member is given in the diagram. 'A' eats a $10 pizza, 'B' a $12 pizza, 'C' a $17 one, 'D' a $21one, and 'E' a $33 one. The pizzas have the same toppings and their thickness is the same. Which family member made the best buy?