International Online Math Challenge
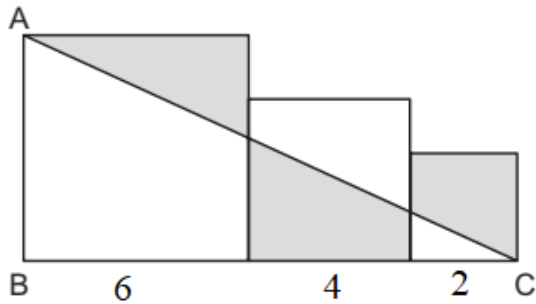
Only challengers can make a change!

PAST PAPERS 2023
Category 3

1. In the figure below, ABC is right triangle at which its base is on a side of each square. If the sides of the squares are 6, 4 and 2 respectively.

What is the area (square units) of the shaded region?

A) 20   B) 18   C) 16   D) 14

2. A ball is dropped from a height of 5 m. Each time it bounces it reaches 0.6 times its previous height. How many times must the ball bounce until its height reaches less than 50 cm?

A) 5 times   B) 6 times   C) 3 times   D) 10 times

3. I want to purchase a famous Iran carpet for my room. The carpet is 2.75 m wide and 3.25 m long, and the cost is $15.5 per square meter. How much should be my budget to buy carpet?

A) $130   B) $120   C) $100   D) $140

4. An investigation of a number car accidents showed the following:

 13 accidents involved alcohol and excessive speed,

21 accidents involved alcohol,

12 accident involved excessive speed but not alcohol, and

19 of the accidents involved neither alcohol nor excessive speed.

How many accidents were investigated?

A) 44   B) 46   C) 52   D) 65

5. Calculate:

$$1 + \cfrac{1 - \cfrac{1}{1 - \cfrac{1}{2}}}{1 - \cfrac{1}{2}}.$$

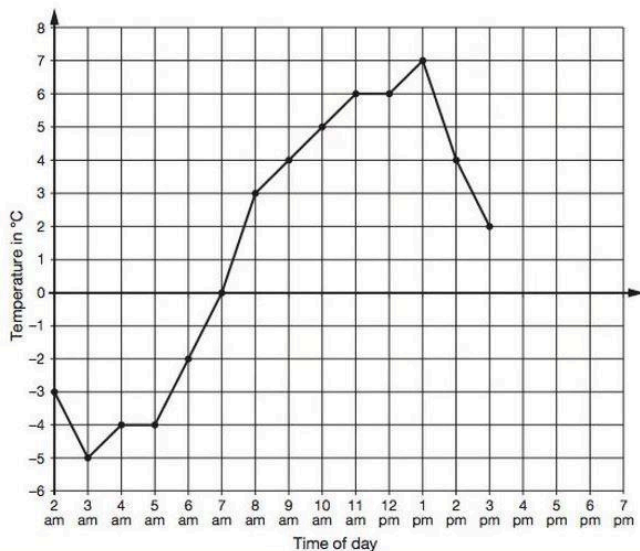A) -1 B) 1 C) 3 D) 2

6.

The perimeter of the rectangular table above left is equal to the perimeter of the square table at the right. Find the side length of the square table.

A) 52   B) 105   C) 210   D) 110

7. This graph shows the temperature in ^0C from 2 am to 3 pm on a cold day. How many degrees colder was it at 5 am than at 1 pm?

A) 11^0C   B) $7\ ^0$C   C) $3\ ^0$C   D) $4\ ^0$C

8. Find x.

$$\cfrac{1}{3-\cfrac{1}{1-\cfrac{1}{x}}}=1$$

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

9. Calculate $24\div3\times4-2\times3+15\div3$.

A) 31   B) 5   C) -8   D) 1

10. Calculate.

$$\frac{(-1)^{1001}\times(-1)^{2002}\times(-1)^{3003}}{(-1)^{2022}\div(-1)^{2033}}$$

A) 0   B) 6006   C) 1   D) -1

11. Calculate $\left(1-\dfrac{1}{2}\right)\left(1-\dfrac{1}{3}\right)\left(1-\dfrac{1}{4}\right)\cdots\left(1-\dfrac{1}{100}\right)$.

A) $\dfrac{1}{99}$ B) $\dfrac{1}{100}$ C) $\dfrac{99}{100}$ D) $\dfrac{101}{99\times100}$

12. Calculate $\sqrt[4]{8\times\sqrt{1-\sqrt[3]{-27}}}$.

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

13. Kevin found a cubic box with an open top. Each side is 8 cm long. If he fills this box with identical cubes with $2cm×2cm×2cm$, how many of these cubes will be touching the box?

A) 40   B) 48   C) 52   D) 56

14. At the end of a banquet, 6 people shake hands with each other. How many handshakes will there be in total?

A) 10   B) 12   C) 15   D) 18

15. If the lines $y = 5x + 31$ and $y =- 2x - 25$ intersect at point$(h, \; k)$, what is the value of k?

A) -7   B) 9   C) -8   D) -9

16. A restaurant has two types of tables, rectangular ones that can each seat 4 people and circular tables that can each seat 8 people. If all 30 tables at the restaurant can seat 144 people exactly, how many rectangular tables does the restaurant have?

A) 12   B) 16   C) 20   D) 24

17. A train travels from town A to town B at an average speed of 70 km/h. On the return journey, the train travels at an average speed of 80 km/h. If the total travel times for the round trip is 5 hours, what is the distance between the two towns to the nearest natural number?

A) 187 km   B) 157 km   C) 177 km   D) 167 km

18. A triangle has side lengths of 6 cm, 9 cm and 12 cm. Is it a right triangle? If yes, which of those lengths is hypotenuse?

A) Yes, 12 cm   B) No   C) Yes, 6 cm   D) Yes, 9 cm

19. If $\{2x - 3y = 6 \quad 3x - 2y + z = 9$ then $x + y + z$

A) 8   B) 5   C) 3   D) 1

20. In a class of 25 students, the average score on a final test calculated for 20 students was 75. Five students missed the test day with cold symptoms and were scheduled for a make-up. The average score of these five students was eventually 80. What is the average score of the class?

A) 80   B) 79   C) 78   D) 76

21.

x	$f(x)$
0	m
1	40
2	n

If $f(x)$ is a linear function defined according to the table above, what is the value of $m + n$?

A) 160   B) 40   C) 120   D) 80

22. A sequence is defined by $a_0 = 0$ and $a_{n+1} = \dfrac{a_n - 3}{a_n - 2}$ for all integers $n \geq 0$ and $a_n \neq 2$ for all natural numbers n. Find the a_{2020}.

A) 0   B) 1   C) $\dfrac{3}{2}$ D) none of these

23. If $n^3 = x$ and $n^4 = 20x$, where $n > 0$, what is the value of x?

A) 20   B) 400   C) 4000   D) 8000

24. A 3×4×5 solid block is made up of 1×1×1 unit cubes. The outside surface of the block is painted black. How many unit cubes have exactly one face painted black?

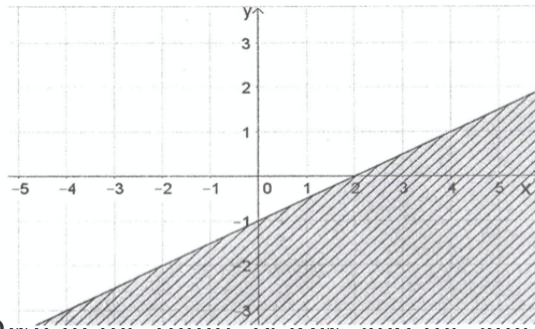A) 16   B) 18   C) 20   D) 22

25. Determine the inequality corresponding to the graph.
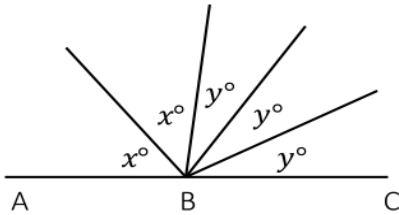
A) $y - 3x + 6 \geq 0$

B) $y - 3x + 6 \leq 0$

C) $0.5x - 1 \geq y$

D) $0.5x - 1 \leq y$

26. If ABC is a straight line as shown in the figure below, and the angles x° and y°
are integer multiples of 20, what is the value of x°?

A) 20°   B) 40°   C) 60°   D) 80°

27. The chemical solution contains 40% salts. If you add 120 g of salt, the solution
will contain 70% salt. Find the mass of salt in the initial solution.

A) 50 g B) 42 g C) 40 g D) 48 g

28. Which of the following shows the numbers $2^{1/2}$, $3^{1/3}$ and $6^{1/6}$ in increasing
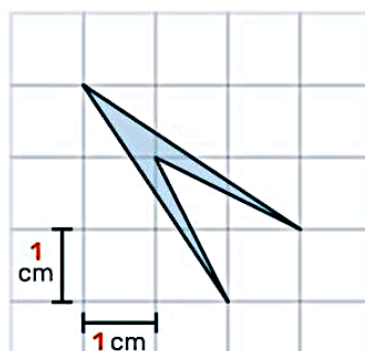order?

A) $2^{1/2} < 3^{1/3} < 6^{1/6}$

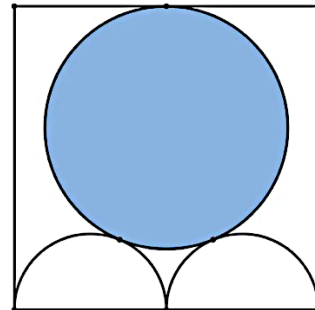B) $6^{1/6} < 3^{1/3} < 2^{1/2}$

C) $6^{1/6} < 2^{1/2} < 3^{1/3}$

D) $3^{1/3} < 2^{1/2} < 6^{1/6}$

29. Find the area of the shaded region.

A) 1   B) $\frac{3}{2}$ C) $\frac{2}{3}$ D) $\frac{1}{2}$

30. Side of the square is 8 cm. If the two semicircles are identical, find the area of the shaded circle.

A) $11.56\pi \ cm^2$ B) $10.89\pi \ cm^2$

C) $10.24\pi \ cm^2$ D) $9.61\pi \ cm^2$

31. If x, y, x+y and x-y are not zero, then simplify the expression

$$\left(\frac{x}{x+y}-\frac{x-y}{x}\right)\div\left(\frac{x}{x-y}-\frac{x+y}{x}\right).$$

A) y B) x C) $\frac{x+y}{x-y}$ D) $\frac{x-y}{x+y}$

32. If $x=\dfrac{1}{y+2}$ where y $\neq$ 2, then evaluate the expression $y+yx+2x-\dfrac{1}{x}+3$.

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

33. If $x<0$, then evaluate $|x-1|+|x|+3$.

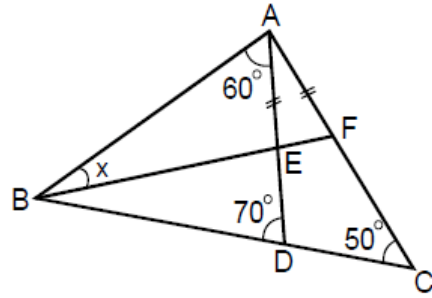A) $x+2$ B) $4-2x$ C) $2x-2$ D) $2x+2$

34. ABC is a triangle, |AE| = |AF| and

∠ BAD = 60º

∠ADB = 70º

∠ ACB = 50º

Find x .

A) 20°   B) 30°   C) 50°   D) 35°

35. Simplify $3\sqrt{8}+2\sqrt{2}-(\sqrt{8}+\sqrt{2})$.

A) $\sqrt{2}$ B) $5\sqrt{2}$ C) $3\sqrt{2}$ D) $\sqrt{8}$
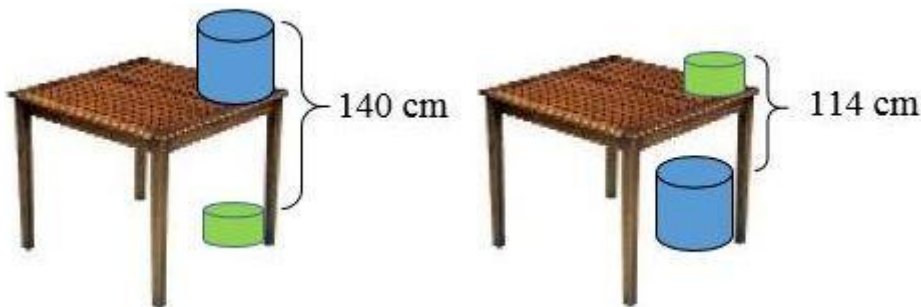
36. If $\dfrac{x}{y}=\dfrac{7}{4}$ and $x-y=\dfrac{3}{2}$, then find y .

A) -4   B) -1   C) 2   D) 6

37. In a class of 25 students, 20 study physics, 15 study chemistry and 10 study both subjects. How many students study only one of the two subjects?

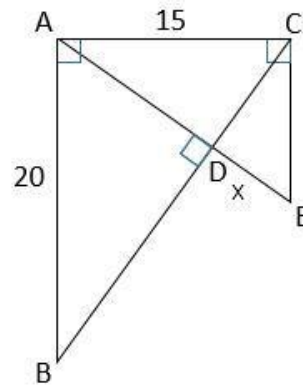A) 20   B) 10   C) 15   D) 25

38. Find the height of the table.

140 cm   114 cm

A) 54 cm   B) 81 cm   C) 127 cm   D) 254 cm

39. Find the value of x.

A) $7\frac{1}{2}$ B) $8\frac{1}{3}$ C) $6\frac{3}{4}$ D) $7\frac{1}{5}$

40. Find x×y , if $2^{x}+2^{y}=320$ where x, y are natural numbers.

A) 35   B) 63   C) 48   D) 24