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## Junior Division Round 2

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### Questions 1 to 5, 4 marks each

1. Michael bought 6 pens and 3 notebooks while Wallace bought 3 pens and 6 notebooks. The pens are identical and so are the notebooks. Michael's bill is 6 dollars higher than Wallace's. How many dollars is the price of a pen higher than the price of a notebook?
- (A) 1                      (B) 2                      (C) 3                      (D) 4                      (E) 5

Answer : \_\_\_\_\_

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2. If all the divisors of 2016 are arranged in decreasing order, by how much is the third divisor larger than the fourth divisor?
- (A) 12                      (B) 48                      (C) 168                      (D) 672                      (E) 2016

Answer : \_\_\_\_\_

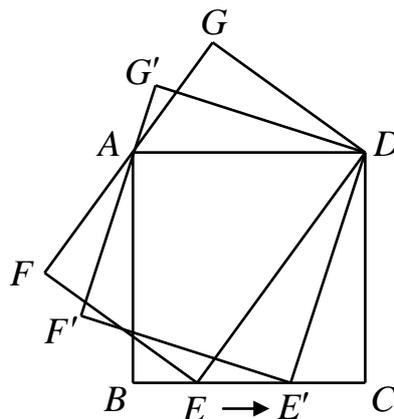
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3. Which of the following is equal to  $xr + ys$  if  $r = 3x + 2y$  and  $s = xy - x - y$ ?
- (A)  $x^2y - x^2 + 2xy + 2y^2$       (B)  $xy^2 + 3x^2 + xy - y^2$       (C)  $x^2y + 2x^2 + xy$   
(D)  $xy^2 + 2x^2 + 2xy$                       (E)  $x^2y^2 + x + y$

Answer : \_\_\_\_\_

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4.  $E$  is a variable point on the side  $BC$  of a square  $ABCD$ .  $DEFG$  is a rectangle with  $FG$  passing through  $A$ . As the point  $E$  moves from  $B$  towards  $C$ , how does the area of  $DEFG$  change?

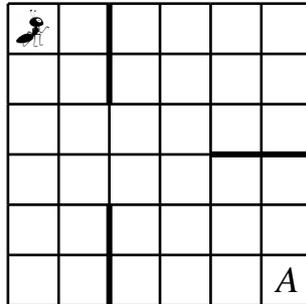


- (A) Steadily increasing                      (B) Steadily decreasing  
(C) Decreasing and then increasing      (D) Increasing and then decreasing  
(E) Remaining constant

Answer : \_\_\_\_\_

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5. The diagram shows a 6 by 6 board with three barriers. An ant is at the top left corner and wishes to reach the bottom right corner. It may only crawl between squares which share a common side, and only towards the bottom or the right. It cannot pass through any barrier. How many different paths can it follow?

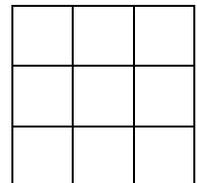


- (A) 88                      (B) 90                      (C) 92                      (D) 96                      (E) 112

Answer : \_\_\_\_\_

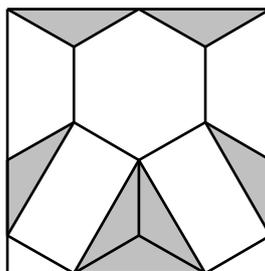
**Questions 6 to 13, 5 marks each**

6. One square in a 3 by 3 board is to be painted black, a second square blue and a third square red. If no two of these three squares are in the same row or in the same column, how many different ways of painting them are there?



Answer : \_\_\_\_\_ ways

7. The diagram shows a tile divided into regular hexagons of side length 1 cm. What is the total area, in  $\text{cm}^2$ , of the parts of the tile which are shaded?



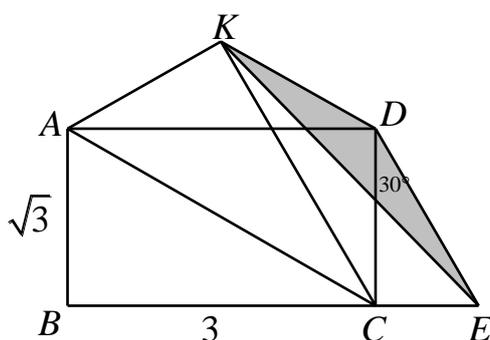
Answer : \_\_\_\_\_  $\text{cm}^2$

8. Let  $a$ ,  $b$ ,  $c$  and  $d$  be real numbers such that  $|a+b|$ ,  $|a-b|$ ,  $|c+d|$  and  $|c-d|$  are 6, 7, 8 and 9 in some order. What is the value of  $a^2 + b^2 + c^2 + d^2$ ?

Answer : \_\_\_\_\_

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9. A rectangle  $ABCD$  with  $BC = 3$  cm and  $AB = \sqrt{3}$  cm is folded along  $AC$  so that the point  $B$  lands on the point  $K$  symmetric to it about  $AC$ . What is the area, in  $\text{cm}^2$ , of triangle  $KDE$ , where  $E$  is the point on the extension of  $BC$  such that  $\angle CDE = 30^\circ$ ?



Answer : \_\_\_\_\_  $\text{cm}^2$

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10. In the expression  $((10 \square 2) \square 2) \square 2 \square 2$ , each  $\square$  is to be replaced by a different one of  $+$ ,  $-$ ,  $\times$  and  $\div$ . How many different values can this expression take?

Answer : \_\_\_\_\_

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11. Let  $a$ ,  $b$  and  $c$  be real numbers such that  $abc = 1$ ,  $(a+1)(b+1)(c+1) = 16$  and  $(a+2)(b+2)(c+2) = 53$ . What is the value of  $(a-1)(b-1)(c-1)$ ?

Answer : \_\_\_\_\_

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12. The area of triangle  $ABC$  is  $120 \text{ cm}^2$  and  $BC = 16$  cm. What is the minimum length, in cm, of the perimeter of  $ABC$ ?

Answer : \_\_\_\_\_ cm

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13. Let  $a, b, c$  and  $d$  be four different non-zero digits. The greatest common divisor of the four-digit numbers  $\overline{abcd}$  and  $\overline{acbd}$  is  $n$ . What is the largest possible value of  $n$ ?

Answer : \_\_\_\_\_

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**Questions 14 to 15, 20 marks each**

**Detailed solutions are needed for these two problems**

14. The first diagram shows a 6 by 6 board, and the second diagram shows an L-shaped piece consisting of four 1 by 1 squares. Paint as few of the squares of the 6 by 6 board black so that wherever the L-shaped piece is placed on the board covering four squares, at least one of the squares will be black. The L-shaped piece may be turned about or flipped over

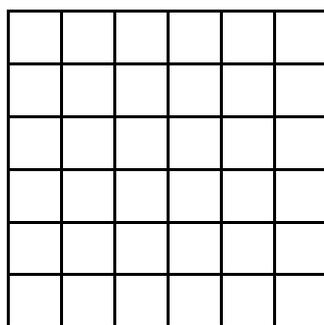


Fig. 1

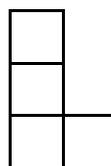
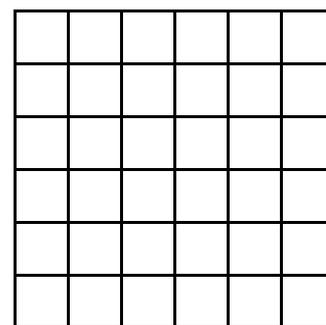


Fig. 2



Answer : At least paint                      squares black,

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15.  $P$  and  $Q$  are points on the bisector of the exterior angle at  $A$  of triangle  $ABC$ , with  $A$  between  $P$  and  $Q$ , such that  $BP$  is parallel to  $CQ$ .  $D$  is the point on  $BC$  such that  $DP=DQ$ . Prove that  $AB$  is parallel to  $DQ$ .