6th International Mathematics Assessments for Schools (2016-2017)

Junior Division Round 2

Time: 120 minutes

Printed Name: ______________ *Code*: __________ *Score*: __________

Instructions:

- Do not open the contest booklet until you are told to do so.
- Be sure that your name and code are written on the space provided above.
- Round 2 of IMAS is composed of three parts; the total score is 100 marks.
- Questions 1 to 5 are given as a multiple-choice test. Each question has five possible options marked as A, B, C, D and E. Only one of these options is correct. After making your choice, fill in the appropriate letter in the space provided. Each correct answer is worth 4 marks. There is no penalty for an incorrect answer.
- Questions 6 to 13 are a short answer test. Only Arabic numerals are accepted; using other written text will not be honored or credited. Some questions have more than one answer, as such all answers are required to be written down in the space provided to obtain full marks. Each correct answer is worth 5 marks. There is no penalty for incorrect answers.
- Questions 14 and 15 require a detailed solution or process in which 20 marks are to be awarded to a completely written solution. Partial marks may be given to an incomplete presentation. There is no penalty for an incorrect answer.
- Use of electronic computing devices is not allowed.
- Only pencil, blue or black ball-pens may be used to write your solution or answer.
- Diagrams are not drawn to scale. They are intended as aids only.
- After the contest the invigilator will collect the contest paper.

The following area is to be filled in by the judges;
the contestants are not supposed to mark anything here.

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total Score	Signature
Score																	
Score																	

Junior Division Round 2

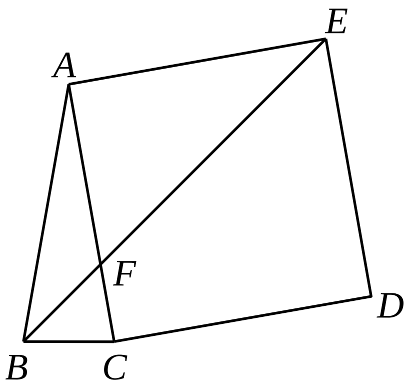
Questions 1 to 5, 4 marks each

1. Which of the numbers below cannot be expressed as a sum of two prime numbers?

（A） 19　（B） 20　（C） 21　（D） 22　（E） 23

Answer：________

2. In $\triangle ABC$, $AB = AC$ and $\angle ACB = 80°$. Construct square $ACDE$ with the given side AC. Lines BE and AC intersect at point F, as shown in the figure. What is the measure of $\angle BFC$?



（A） 55°　（B） 60°　（C） 65°　（D） 70°　（E） 75°

Answer：________

3. Alex and Charles were both sending parcels. The postage rates are as follows: For the first 10 kg and below, the postage price is \$6 per kg; for each successive kilogram after 10 kg, the postage price per kg is slightly lower than that of the first 10kg. It is known that the weight of Alex's parcel is 20% heavier than Charles' parcel, and that the postage prices for Alex and Charles are \$92 and \$80 respectively. How much more is the postage price per kg of the first 10 kg than that of each succeeding kg above 10 kg?

（A） 1.5　（B） 2　（C） 2.5　（D） 3　（E） 3.5

Answer：________

4. It is given that $A = 3x^2 + 3x$, $B = -x^2 + x + 5$ and $C = x^2 + x - 1$. $4A - (B - 2(2B - 3C) + 2A) - 2B = ?$

（A） $-x^2 + x + 11$　（B） $-x^2 - x + 11$　（C） $-x^2 + x + 1$

（D） $-x^2 + x - 1$　（E） $x^2 + x + 11$

Answer：________

5. On the bookshelf of Mar, there are Literature, Mathematics, History and Science books. If the number of Mathematics Books is 5 times that of the Literature books, and the number of Science books is 4 times that of the History books, which of the following is not a possible number for the total number of books on the bookshelf?
（A）21　（B）23　（C）26　（D）29　（E）30

Answer：________

Questions 6 to 13, 5 marks each

6. Fill in the 4×4 box so that the numbers 1, 2, 3, and 4 appear exactly once in each row and column. Referring to the figure below, what is the sum of the values of A and B?

	A	4	
B		1	
1	2	3	4
3	4	2	1

Answer：________

7. The lengths of two sides of a triangle are 6 cm and 13 cm respectively. It is known that the length of the third side is also an integer (in cm). What is the minimum perimeter (in cm) of this triangle?

Answer：________ cm

8. It is given that Figure 1 shows a circle with diameter of 9 cm. Figure 2 shows an Olympic symbol which consists of five circles, each of diameter 9 cm. The distance between two of the tangents to the circles is 4 cm as shown. Find the length of the Olympic symbol (Figure 3)?

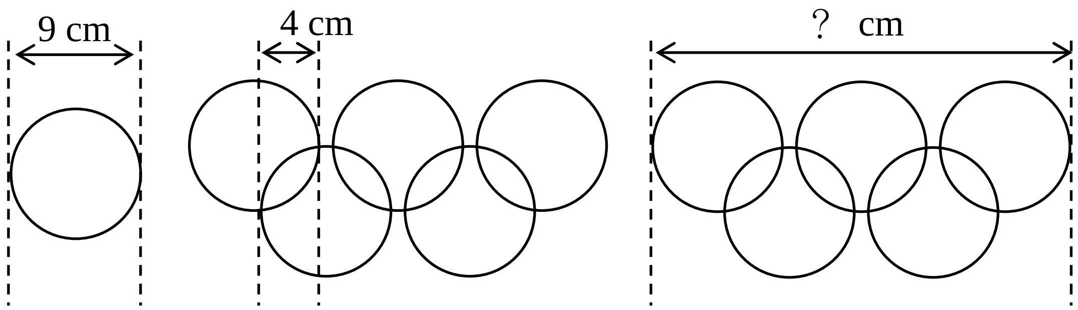
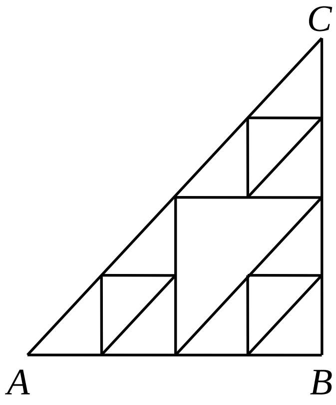


Figure 1　Figure 2　Figure 3

Answer：________ cm

9. The diagram below is composed of many right angled isosceles triangles. Suppose an ant wants to travel from point A to point C, in how many ways can this be done if the ant is only allowed to move up, right or diagonally?



Answer： ______ ways

10. Among the 1000 positive integers from 1 to 1000 inclusive, find the number of positive integers n such that n^3+n^2+n is divisible by 8.

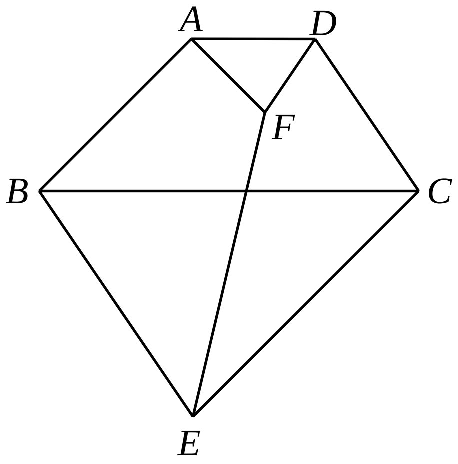
Answer： ______ numbers

11. Given that $a^2+b^2+c^2=(a+b+c)^2$, where a, b and c are non-zero real numbers.

What is the value of $\frac{b+c}{a}+\frac{c+a}{b}+\frac{a+b}{c}$?

Answer： ______

12. Refer to the diagram below, in trapezium $ABCD$, $AD//BC$. The line passing through B and parallel to CD intersects the line passing through C and parallel to AB at point E. Point F lies inside $ABCD$ such that $\angle FAD=\angle ABC$ and $\angle FDA=\angle DCB$. Given that the area of $ABEF$ is 20 cm^2 and the area of $DCEF$ is 16 cm^2, what is the area of $ABCD$?



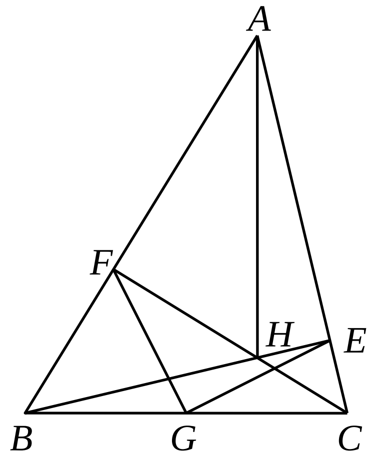
Answer： ______ cm^2

13. A 4-digit number is said to be 'good' if it uses exactly 3 different digits from the set {2, 0, 1, 7} (at most one of the digits used can be repeated). For example, 8712 and 7200 are said to be 'good' numbers, while 2017 and 7175 are not. How many 'good' numbers are there?

Answer: ________ numbers

Questions 14 to 15, 20 marks each
(Detailed solutions are needed for these two problems)

14. In $\triangle ABC$, point G is the midpoint of segment BC, $BE \perp AC$, $CF \perp AB$ and lines BE and CF intersects at point H. If $\angle EGF = 90°$, prove that $AH = BC$.



15. It is known that the equation $x^2 + (x+k)^2 = y^2$ has positive integers solutions (x, y), where x and y are relatively prime. If k is a positive integer greater than 1, what is the minimum value of k?

Answer： ______________