THE HARMONY SOUTH AFRICAN
MATHEMATICS OLYMPIAD

organised by the SUID-AFRIKAANSE AKADEMIE VIR WETENSKAP EN KUNS
in collaboration with HARMONY GOLD MINING, AMESA and SAMS

FIRST ROUND 2004
JUNIOR SECTION: GRADES 8 AND 9
18 MARCH 2004
TIME: 60 MINUTES
NUMBER OF QUESTIONS: 20

Instructions :
1. Do not open this booklet until told to do so by the invigilator.
2. This is a multiple choice question paper. Each question is followed by answers marked A, B, C, D and E. Only one of these is correct.
3. Scoring rules :
   Each correct answer is worth 5 marks. There is no penalty for an incorrect answer or an unanswered question.
4. You must use an HB pencil.
   Rough paper, a ruler and a rubber are permitted.
   Calculators and geometry instruments are not permitted.
5. Diagrams are not necessarily drawn to scale.
6. The centre page is an information and formula sheet. Please tear it out for your use.
7. Indicate your answer on the sheet provided.
8. Start when the invigilator tells you to.
   You have 60 minutes to complete the question paper.
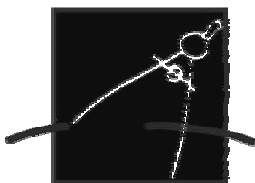9. Answers and solutions are available at http://science.up.ac.za/samo/

DO NOT TURN THE PAGE

UNTIL YOU ARE TOLD TO DO SO.

DRAAI DIE BOEKIE OM VIR DIE AFRIKAANSE VRAESTEL

PRACTICE EXAMPLES

1. $23 + 6 - 4 =$

A) 6   B) 23   C) 25   D) 29   E) 33

2. $\dfrac{1}{5} + \dfrac{2}{3} \times \dfrac{1}{2}$ equals

A) $\dfrac{1}{15}$ B) $\dfrac{3}{11}$ C) $\dfrac{21}{50}$ D) $\dfrac{8}{15}$ E) $9\dfrac{4}{5}$

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UNTIL YOU ARE TOLD TO DO SO.**

1. Which one of the following numbers is the smallest?

A) 0,068   B) 0,07   C) 0,2   D) 0,087   E) 0,2443
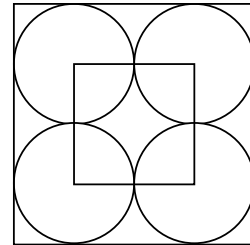
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2. $0,9(0,4+0,6)$ equals

A) 0,09   B) 0,96   C) 1,9   D) 9   E) 0,9

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3. Find the value of ☐ if

$1008 \div$ ☐ $= 24$

A) 32   B) 42   C) 52   D) 62   E) 72

---

4. In the diagram, four equal circles fit perfectly inside a square; their centres are the vertices of the smaller square. The area of the smaller square is 4.
The area of the larger square is

A) 4   B) 8   C) 12   D) 16   E) 20

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5. Jackie said that 12% of the oranges were not sold.
Pam said that is the same as 360 oranges!
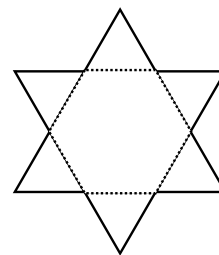
How many oranges were sold?

A) 2 400   B) 2 640   C) 3 000   D) 3 600   E) 4 320

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6. If $b = 3a$ and $c = 2b$, then $a + b + c$ is equal to

A) $6a$ B) $8a$ C) $10a$ D) $12a$ E) $14a$

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7. A regular six point star is formed by extending the sides of a regular hexagon.
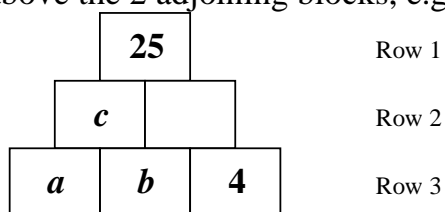
If the perimeter of the star is 96 cm then the perimeter of the hexagon (in cm) is

A) 30   B) 36   C) 42   D) 48   E) 54

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8. The last digit of $2^{2004} - 2$ is

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

---

9. The game Pyramaths works as follows: 2 adjoining blocks' sum is equal to the block above the 2 adjoining blocks, e.g. $a + b = c$.

	25		Row 1
	c		Row 2
a	b	4	Row 3

If the sum of the numbers in row 3 is 17, then the value of a is

A) 2   B) 3   C) 4   D) 5   E) 7

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10. In a mathematics class, the learners voted to have a new operation on numbers called "super op" and used the symbol # for the operation.

They defined it as: $a(\#)b = \dfrac{1}{a} + \dfrac{1}{b} + ab$

The value of $\dfrac{1}{3}(\#)6$ is

A) $5\dfrac{1}{6}$ B) 18   C) $2\dfrac{1}{2}$ D) 2   E) $8\dfrac{1}{3}$

11. Vishnu has displayed his technology project as a mobile and hung it from the classroom ceiling. It is perfectly balanced (figure 1).
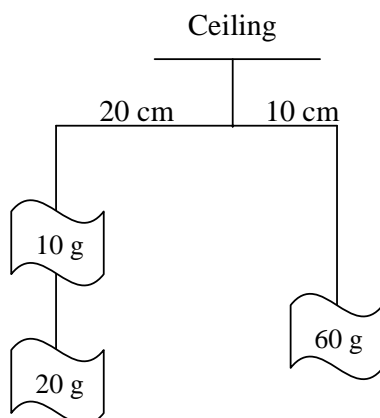
Ceiling

20 cm   10 cm

10 g

60 g

20 g

Figure 1

Sipho wants to display his project in the same way (figure 2).

Ceiling

25 cm x cm
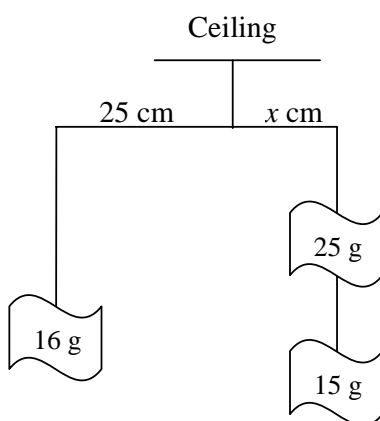
25 g
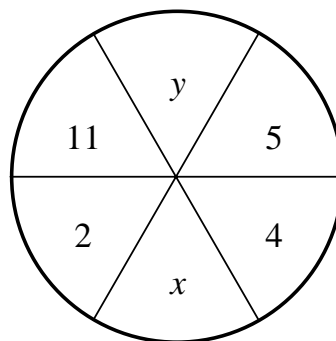
Figure 2

16 g

15 g

What must the length (x) of the wire be for his mobile to be perfectly balanced?   [Ignore the mass of the wire]

A) 5   B) 10   C) 15   D) 20   E) 25

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12. In the diagram, the numbers occupying opposite sectors are related in the same way.
The relationship of y in terms of x is

A) $y = 3x - 1$

B) $y = 2x + 1$

C) $y = 2x + 2$

D) $y = x - 1$

E) $y = 2x - 1$
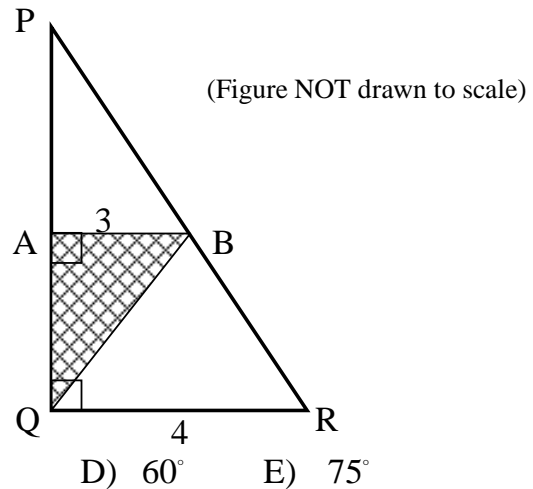
y

11   5

2   4

x

13. Kelly took 60 minutes to cycle 25 kilometres after which she increased her average speed by 5 kilometres per hour.

How long will it take her to cover the next 25 kilometres if she maintains the new average speed?

A) 35 min   B) 40 min   C) 45 min   D) 50 min E) 55 min

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14. The area of the shaded triangle is $4\frac{1}{2}\ cm^2$. Angles PQR and QAB are right angles (90°). QR = 4 and AB = 3.

The size of angle ABQ is

P

(Figure NOT drawn to scale)

3

A   B

Q   4   R

A) 15° B) 30° C) 45° D) 60° E) 75°

---

15. Two 3-digit numbers are multiplied. A star (*) represents any digit.

$$
\begin{array}{r}
**5 \\
1** \\
\hline
2**5 \\
13*00 \\
***00 \\
\hline
**77* \\
\end{array}
$$

**5 — 1st 3-digit number
1** — 2nd 3-digit number

The second 3-digit number is

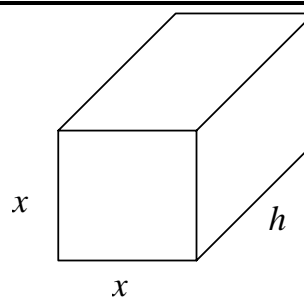A) 140   B) 189   C) 180   D) 155   E) 147

4

16. Below is a list of numbers with their corresponding codes. Determine the three digit number **w**.

Number	Code
589	524
724	386
1346	9761
w	485

A) 945   B) 543   C) 425   D) 623   E) 925

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17. A rectangular right prism has the dimensions x cm by x cm by h cm. The surface area of the prism is $14x^2$ cm^2

Find h in terms of x.

A) $3x$ B) $\dfrac{x}{2}$ C) $4x$ D) $2x$ E) x

**18.** Zama used six digits, 3; 7; 4; 6; 2 and 5 to make two-digit numbers e.g. 37; 44 etc.

If 7 cannot be used as the ten's digit and 3 cannot be used as the units' digit, then the sum of all possible two digit numbers is

A) 1 000   B) 1 040   C) 1 080   D) 1 120   E) 1 160

19. Four one-centimetre squares are joined as in the figure alongside. One or two one-centimetre squares may be added to this figure.
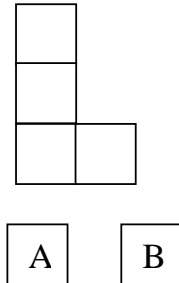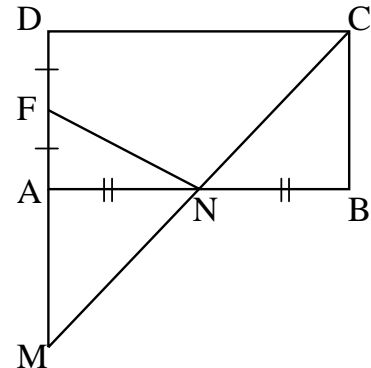
Example: The sides of the added blocks must fit against the sides of a block in the original figure.

Line of symmetry

A   B
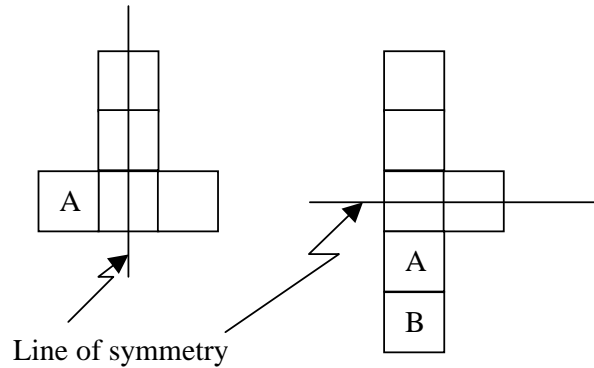
What is the maximum number of ways this can be done to create different figures which are symmetrical about a line of symmetry?

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

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20. ABCD is a rectangle. N is the midpoint of AB. F is the midpoint of DA. DA produced meets CN produced at M.

The area of ΔFNM, as a fraction of the area of rectangle ABCD is

A) $\dfrac{1}{8}$ B) $\dfrac{3}{8}$ C) $\dfrac{5}{8}$ D) $\dfrac{1}{4}$ E) $\dfrac{1}{2}$

THE END

Formula and Information Sheet

1.1 The natural numbers are 1; 2; 3; 4; 5; …

1.2 The whole numbers (counting numbers) are 0; 1; 2; 3; 4; 5; …

1.3 The integers are   …; –4; –3; –2; –1; 0; 1; 2; 3; 4; 5; …

2. In the fraction $\dfrac{a}{b}$, a is called the numerator and b the denominator.

3.1 Exponential notation:

$$2\times2\times2\times2\times2 = 2^5$$
$$3\times3\times3\times3\times3\times3 = 3^6$$
$$a\times a\times a\times a\times \ … \times a = a^n \qquad (n \text{ factors of } a)$$

(a is the base and n is the index (exponent))

3.2 Factorial notation:

$$1\times2\times3\times4 = 4!$$
$$1\times2\times3\times \ … \times n = n!$$

4 Area of a

4.1	triangle is:	$\dfrac{1}{2}\times$ (base $\times$ height) $= \dfrac{1}{2}(b.h)$
4.2	rectangle is:	length $\times$ width $= lw$ length $\times$ breadth $= lb$
4.3	square is:	side $\times$ side $= s^2$
4.4	rhombus is:	$\dfrac{1}{2}\times$ (product of diagonals)
4.5	trapezium is:	$\dfrac{1}{2}\times$(sum of parallel sides)$\times$ height
4.6	circle is:	πr^2 ($r =$ radius)
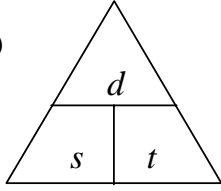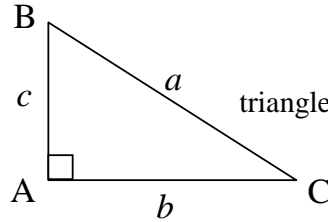
5   Surface area of a:

5.1   rectangular prism is: $2lb + 2lh + 2bh\,(h = \text{height})$

5.2   sphere is: $4\pi r^2$

6   Perimeter of a:

6.1   rectangle is: $2 \times \text{length} + 2 \times \text{breadth}$
                             $2l + 2b$
                             or $2l + 2w$ $(w = \text{width})$

6.2   square is: $4s$

7.   Circumference of a circle is: $2\pi r$

8.   Volume of a:

8.1   cube is: $s \times s \times s = s^3$

8.2   rectangular prism is: $l \times b \times h$

8.3   cylinder is: $\pi r^2 h$

9.1   Volume of a right prism is: area of cross-section $\times$ perpendicular height
                         or   area of base $\times$ perpendicular height

9.2   Surface area of a right prism is: (perimeter of base $\times$ h) + (2 $\times$ area of base)

10.   Sum of the interior angles of a polygon is: $180°\,(n-2)$ [$n = \text{number of sides}$]

11.   Distance   =   speed $\times$ time $(d = s \times t)$

        Speed =   distance $\div$ time $(s = \dfrac{d}{t})$

        Time   =   distance $\div$ speed $(t = \dfrac{d}{s})$

$$d = s \times t$$
$$s = \frac{d}{t}$$
$$t = \frac{d}{s}$$

12   Pythagoras:

If $\triangle ABC$ is a right-angled triangle, then $a^2 = b^2 + c^2$

13.   Conversions:
$1\ cm^3 = 1\ m\ell$; $1000\ cm^3 = 1\ \ell$
$1000\ m = 1\ km$; $1000\ g = 1\ kg$; $100\ cm = 1\ m$

PRACTICE EXAMPLES	POSITION
1	C
2	D

NUMBER	POSITION
1	A
2	E
3	B
4	D
5	B
6	C
7	D
8	E
9	D
10	A
11	B
12	A
13	D
14	C
15	E
16	E
17	A
18	D
19	C
20	B

DISTRIBUTION	
A	4
B	4
C	3
D	5
E	4
TOTAL	20