

# THE OLD MUTUAL SOUTH AFRICAN MATHEMATICS OLYMPIAD

Organised by the  
SOUTH AFRICAN MATHEMATICS FOUNDATION

2022 SECOND ROUND  
SENIOR SECTION: GRADE 10 - 12

12 May 2022

Time: 120 minutes

Number of questions: 25

## Instructions

1. The answers to all questions are integers from 000 to 999. Each question has only one correct answer.
2. Scoring rules:
  - 2.1. Each correct answer is worth 3 marks in Part A, 5 marks in Part B and 6 marks in Part C.
  - 2.2. There is no penalty for an incorrect answer or any unanswered question.
3. You must use an HB pencil. Rough work paper, a ruler and an eraser are permitted. **Calculators and geometry instruments are not permitted.**
4. Figures are not necessarily drawn to scale.
5. Indicate your answers on the sheet provided.
6. Start when the invigilator tells you to do so.
7. Answers and solutions will be available at [www.samf.ac.za](http://www.samf.ac.za)

***Do not turn the page until you are told to do so.  
Draai die boekie om vir die Afrikaanse vraestel.***

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Organisations involved: AMESA, SA Mathematical Society,  
SA Akademie vir Wetenskap en Kuns



## HOW TO COMPLETE THE ANSWER SHEET

The answers to all questions are integers from 000 to 999. Consider the following example question:

21. If  $3x - 216 = 0$ , determine the value of  $x$ .

The answer is 72, so you must complete the block for question 21 on the answer sheet as follows: shade 0 in hundreds row, 7 in the tens row, and 2 in the units row:

21	H/H	0	●	①	②	③	④	⑤	⑥	⑦	⑧	⑨
	T/T	7	①	②	③	④	⑤	⑥	●	⑧	⑨	
	U/E	2	①	●	③	④	⑤	⑥	⑦	⑧	⑨	

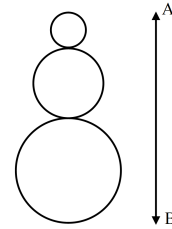
Write the digits of your answer in the the blank blocks on the left of the respective rows, as shown in the example; hundreds, tens and units from top to bottom. The three digits that you wrote down will not be marked, since it is only for your convenience — only the shaded circles will be marked.

**PLEASE DO NOT TURN THE PAGE UNTIL YOU ARE TOLD TO DO SO**

**Part A: Three marks each**

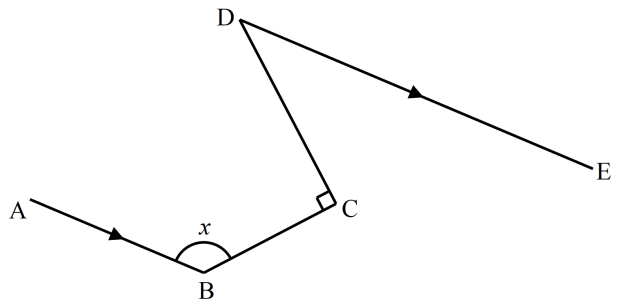
1. Determine the value of  $3 - 5 + 8 \div 2 \times 7$ .
2. How many of the integers  $1, 2, 3, 4, \dots, 100$  are not multiples of 6?

3. A snowman is built by stacking three spheres with their centres aligned vertically. The spheres have radii of 10 cm, 20 cm and 30 cm. How tall is the snowman (in cm)?

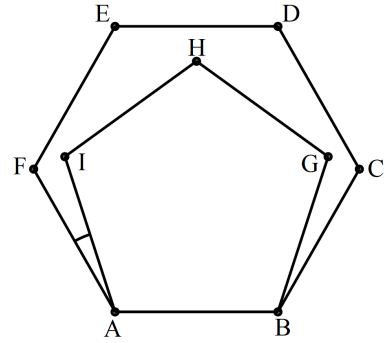


4. Emilia writes down the numbers 5,  $x$  and 9. Valentin calculates the average of each pair of these numbers and obtains 7, 10 and 12. What is the value of  $x$ ?
5. How many factors does the number 600 have (1 and 600 included)?
6. Snappy, the dog, is ill and must get one blue pill and two pink pills every day for 10 consecutive days. A blue pill costs R1 more than a pink pill. The total amount for the pills is R520. What is the cost of one blue and one pink pill together?

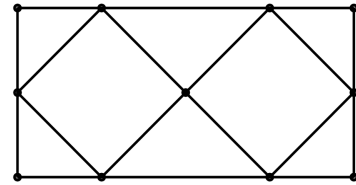
7. Lines  $AB$  and  $DE$  are parallel and  $\angle CDE = 40^\circ$ . What is the size of angle  $x$  in degrees?



8. In the sketch,  $ABGHI$  is a regular pentagon and  $ABCDEF$  is a regular hexagon. What is the size of  $\angle IAF$  in degrees?



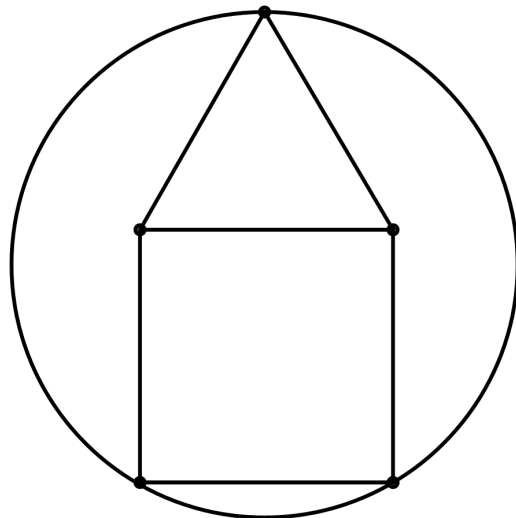
9. Two squares are drawn inside a rectangle, as shown. If each square has an area of 121 square units, what is the area of the rectangle?



10. The distance from Heidelberg to Pietermaritzburg along the N3 highway is 450 km. Two cars head towards each other on the N3, one starting from Heidelberg and the other from Pietermaritzburg, both leave at the same time. The speed of the first car is 40 km/h. The speed of the second car is 50 km/h. In how many hours will the cars meet?
11. Sardines are sold in cylindrical tins. New tins, with the diameters increased by 25%, are designed. By what percentage should the height of the new tins be decreased to keep the volume of the tins the same?
12. Last Thursday, each learner in Ms. Molope's class brought either an apple or a banana or an orange to school. In total, 20% of the learners brought an apple and 35% brought a banana. If 9 learners brought oranges, how many students were in the class?
13. For what value of  $p > 0$  will the triangle with vertices at  $(0, 0)$ ,  $(p, 0)$  and  $(22, 22)$  have an area of  $22^2$ ?
14. Three of the first five positive integers are chosen at random and then arranged in increasing order. The probability that the three chosen numbers are consecutive is  $\frac{p}{q}$  in lowest terms. Find the value of  $p + q$ .

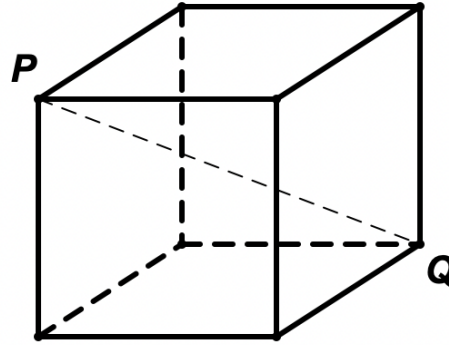
15. A drawer in a darkened room contains a large number of socks of four different colours. A child selects socks from the drawer but is unable to see the colour of the socks drawn. What is the smallest number of socks that must be selected to guarantee that the selection contains at least 10 pairs? (A pair of socks is two socks of the same colour. A sock may be only counted once.)
16. How many four-digit numbers divisible by 12 can be formed using the digits 1, 2, 3, 4 and 5, if a digit may be used only once in each number?
17. Henco forgot to fill his water bottle for a long hike undertaken by him, Connor and Sibiu. Fortunately, Connor had 4 litres and Sibiu had 6 litres of water. The three hikers shared the water so that each got an equal amount. At the end of the hiking trail, Henco gave R50 to Connor and Sibiu to split between them for the water they gave him. If the money is divided fairly between Connor and Sibiu, how much did Connor get?
18. Harry's Hamburger Hangout offers hamburgers with the following choices of toppings: Tomato sauce, mustard, mayonnaise, tomato, lettuce, mushrooms, cheese and onions. A customer can choose one, two or three meat patties and any collection of toppings (including none at all). How many different types of hamburgers can be ordered?

19. An equilateral triangle is placed on top of a square of area 64, as shown. The base of the triangle is equal to the side of the square. A circle passes through the vertices not shared by the square and triangle, as shown. Find the square of the radius of the circle.

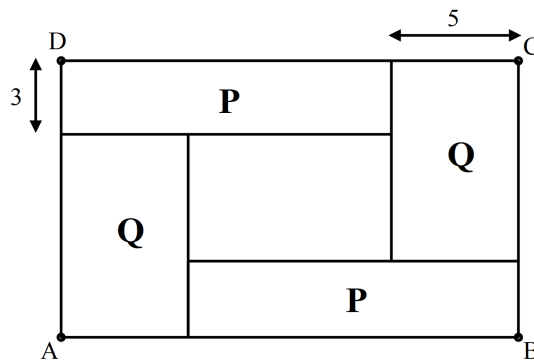


20. What is the 50th decimal digit of  $\frac{1}{7}$ ?

21. Find the volume of a cube whose diagonal is  $PQ = \sqrt[3]{17} \cdot \sqrt{3}$ .

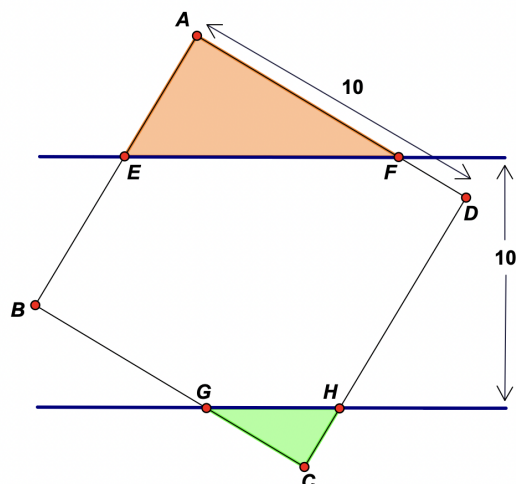


22. Rectangle  $ABCD$  is made up of five smaller, disjoint rectangles. The four outer rectangles have the same area, but the area of the inner rectangle is half that of the others. The width of each rectangle  $P$  is 3 and the width of each rectangle  $Q$  is 5. Find the area of rectangle  $ABCD$ .

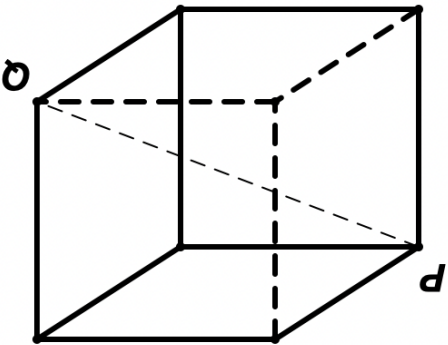


23. Positive integers are written on all the faces of a cube, one on each face. At each corner (vertex) of the cube, the product of the numbers on the faces that meet at the corner is written. The sum of the numbers written at the corners is 2022. What is the sum of the numbers on all the faces?
24. We define  $S(n)$  as the sum of the digits of a positive integer,  $n$ , for example  $S(7) = 7$ ,  $S(19) = 1 + 9 = 10$  and  $S(1099) = 1 + 0 + 9 + 9 = 19$ . Find the value of  $S(1) - S(2) + S(3) - S(4) + \dots + S(1011)$ .

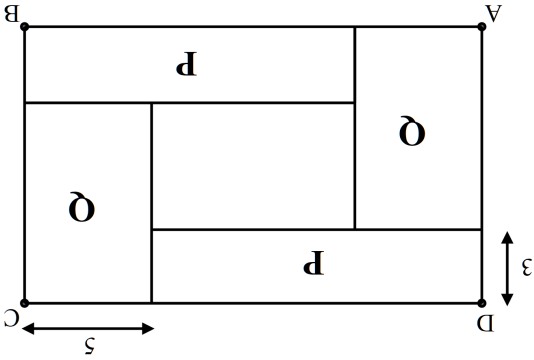
25. Square  $ABCD$  has sides of length 10 units, and is placed over two parallel, horizontal lines that are 10 units apart. What is the sum of the perimeters of triangles  $AEF$  and  $CGH$ ?



21. Bepaal die volume van 'n kubus met 'n hoeklyn  $PQ = \sqrt[3]{17} \cdot \sqrt{3}$ .



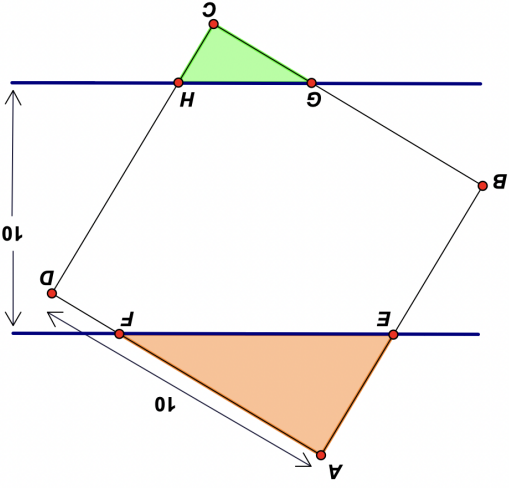
22. Reghoek ABCD bestaan uit vyf kleiner reghoeke wat nie oorleuel nie. Die vier reghoeke buite-om het dieselfde oppervlakte, maar die oppervlakte van die reghoek aan die binnekant is die helfte van die van die ander. Die breedte van elke reghoek  $P$  is 3 en die breedte van elke reghoek  $Q$  is 5. Vind die oppervlakte van reghoek ABCD.



23. Positiewe heelgetalle word op al die vlakke van 'n kubus geskryf, een getal op elke vlak. By elke hoek (hoekpunt) van die kubus word die produk van die getalle van die vlakke wat by daardie hoek ontmoet, geskryf. Die som van die getalle op die vlakke is 2022. Wat is die som van die getalle op al die vlakke?

24. Ons definieer  $S(n)$  as die som van die syfers van 'n positiewe heelgetal  $n$ , byvoorbeeld  $S(7) = 7$ ,  $S(19) = 1 + 9 = 10$  en  $S(1099) = 1 + 0 + 9 + 9 = 19$ . Vind die waarde van  $S(1) - S(2) + S(3) - S(4) + \dots + S(1011)$ .

25. Vierkant ABCD het sylengtes van 10 eenhede, en is bo-oor twee ewewydige horisontale lyne geplaas wat 10 eenhede uitmekaar is. Wat is die som van die omtrekkere van driehoeke AEF en CGH?



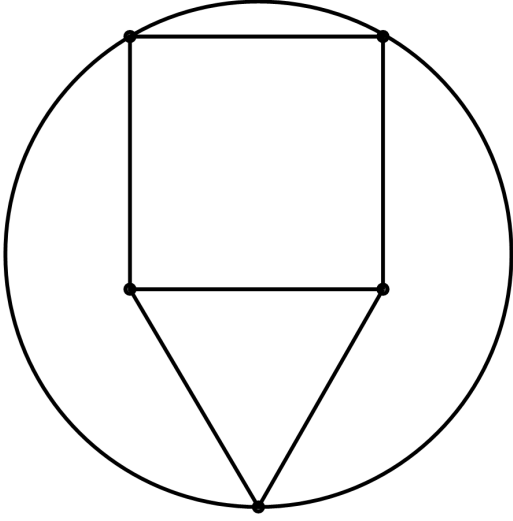
15. 'n Laai in 'n donker kamer is vol kouse van vier verskillende kleure. 'n Kind soek kouse in die laai, maar kan nie sien watter kleur die kouse is wat hy uithaal nie. Wat is die kleinste getal kouse wat hy moet uithaal om seker te wees dat hy ten minste 10 paar kouse uitghaal het? (Een paar kouse is twee kouse van dieselfde kleur. 'n Kous mag slegs een keer getel word.)

16. Hoeveel vier-syfergetalle, wat deelbaar is deur 12, kan met die syfers 1, 2, 3, 4 en 5 gevorm word as elke syfer slegs een keer in 'n getal gebruik mag word?

17. Henco het vergeet om sy waterbottel vol te maak vir die stapog wat hy, Connor en Sibn onderneem het. Gelukkig het Connor 4 liter en Sibn 6 liter water by hulle gehad. Die drie stappers het die water tussen hulle verdeel sodat elkeen dieselfde hoeveelheid gekry het. Aan die einde van die roete het Henco vir Connor en Sibn R50 gegee vir die water wat hulle met hom gedeel het. Hulle twee moes die bedrag tussen hulle deel. As hulle twee die geld regverdig verdeel het, hoeveel geld het Connor gekry?

18. Harry se Hamburgeter-Uitspan bied hamburgers aan met 'n kouse uit die volgende garnerings: Tamatiesous, mosterd, mayonnaise, tamatie, slaablare, sampioene, kaas en uie. 'n Klant kan een, twee of drie vleispatties kies en enige kouse van garnering (ook geen indien verkies). Hoeveel verskillende soorte hamburgers kan bestel word?

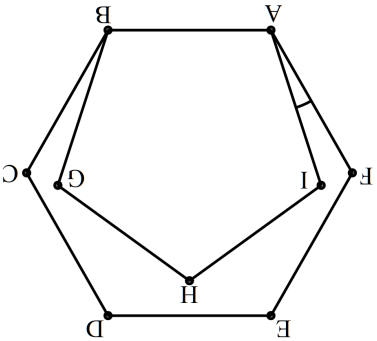
19. 'n Gelykkydige driehoek word bo-op 'n vierkant, met oppervlakte 64, gesit, soos aangetoon. Die basis van die driehoek is gelyk aan die sy van die vierkant. 'n Sirkel gaan deur die hoekpunte wat nie deur die vierkant en driehoek gedeel word nie, soos aangetoon. Vind die kwadraat van die radius van die sirkel.



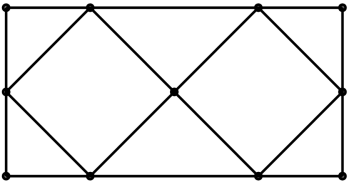
20. Wat is die 50ste desimale syfer van  $\frac{1}{7}$ ?



8. In die skets is  $ABGHI$  'n reëlmatige vyfhoek en  $ABCDE$  'n reëlmatige ses-vyhoek. Hoe groot is  $\angle IAF$  in grade?



9. Twee vierkante is binne 'n reghoek geteken soos aangetoon. Elke vierkant het 'n oppervlakte van 121 vierkante eenhede. Wat sal die oppervlakte van die reghoek wees?



10. Die afstand van Heidelberg na Pietermaritzburg langs die N3-snelweg is 450 km. Twee motors ry na mekaar toe op die N3, waar die een motor uit Heidelberg en die ander motor op dieselfde oomblik uit Pietermaritzburg vertrek. Die eerste motor se spoed is 40 km/h, terwyl die tweede motor teen 'n spoed van 50 km/h ry. Na hoeveel uur sal die twee motors ontmoet?

11. Sardientjies word in silindriese blikkies verkoop. Nuwe blikkies word ontwerp waar die deursnee met 25% vergroot is. Met watter persentasie moet die hoogte van die nuwe blikkies verminder word sodat die volume van die blikkies dieselfde bly?

12. Verlede Donderdag het elke leerder in Me. Molope se klas 6 'n appel of 'n piesang of 'n lemoen skool toe gebring. Altesaam 20% van die leerders het 'n appel gebring en 35% het 'n piesang gebring. As 9 leerders lemoene gebring het, hoeveel leerders was daardie dag in die klas?

13. Vir watter waarde van  $p > 0$  sal die driehoek met hoekpunte by  $(0, 0)$ ,  $(p, 0)$  en  $(22, 22)$  'n oppervlakte van  $22^2$  hê?

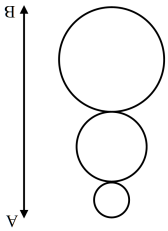
14. Drie van die eerste vyf positiewe heelgetalle word ewekansig gekies en dan in stygende orde gerangskik. Die waarskynlikheid dat die drie gekose getalle opeenvolgend is, is gelyk aan  $\frac{b}{d}$  in eenvoudigste vorm. Vind die waarde van  $p + q$ .

**Deel A: Drie punte elk**

1. Bepaal die waarde van  $3 - 5 + 8 \div 2 \times 7$ .

2. Hoeveel van die heelgetalle  $1, 2, 3, 4, \dots, 100$  is nie veelvoude van 6 nie?

3. 'n Sneeman is gebou deur drie sfere bo-op mekaar te stapel met hulle middelpunte vertikaal inlyn. Die radii van die sfere is 10 cm, 20 cm en 30 cm. Hoe hoog is die sneeman (in cm)?

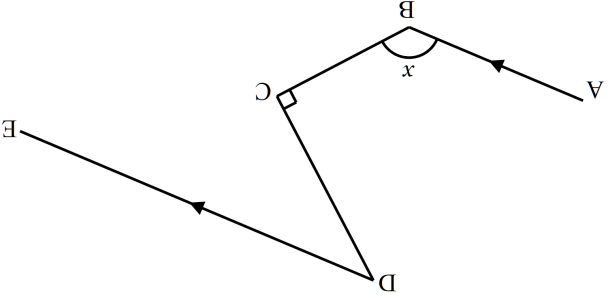


4. Emilia skryf die getalle 5,  $x$  en 9 neer. Valentin bereken die gemiddelde van elke twee (elke paar) van hierdie getalle en kry 7, 10 en 12. Wat is  $x$  se waarde?

5. Hoeveel faktore het die getal 600 (1 en 600 ingesluit)?

6. Snippy, die hond, is siek en moet elke dag een blou pil en twee pienk pille kry vir 10 agtereenvolgende dae. 'n Blou pil kos R1 meer as 'n pienk pil. Die totale bedrag vir die pille is R520. Wat kos een blou en een pienk pil saam?

7. Lyne  $AB$  en  $DE$  is ewewydig en  $\angle CDE = 40^\circ$ . Hoe groot is hoek  $x$  in grade?



**MOET ASSEBLIEF NIE OMBLAAI VOORDAT JY  
GEVRA WORD OM DIT TE DOEN NIE**

Skryf die syfers van jou antwoord in die lee blokkies aan die linkerkant van elke betrokke ry soos aangetoon in die; honderde, tiene en ene van bo na onder. Die drie syfers wat jy neerskryf word nie gemerk nie omdat dit slegs vir jou eie gerief is — slegs die ingekleurde sirkels word gemerk.

<b>21</b>	<b>H/H</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>
	<b>T/T</b>	<b>7</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>8</b>	<b>9</b>
	<b>U/E</b>	<b>2</b>	<b>0</b>	<b>1</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>

Die antwoord is 72, en dus moet jy die blok vir vraag 21 op die antwoordblad as volg voltooi: kleur 0 in die honderde-ry in, 7 in die tiene-ry, en 2 in die ene-ry:

**21.** As  $3x - 216 = 0$ , bepaal die waarde van  $x$ .

voorbeeldvraag:

Die antwoorde van al die vrae is heelgetalle van 000 tot 999. Beskou die volgende

**HOE OM DIE ANTWOORDBLAD TE VOLTOOI**

# DIE OLD MUTUAL SUID-AFRIKAANSE WISKUNDE-OLIMPIADE

Georganiseer deur die  
SOUTH AFRICAN MATHEMATICS FOUNDATION



## 2022 TWEEDE RONDTE SENIOR AFDELING: GRAAD 10-12

12 Mei 2022 Tyd: 120 minute Aantal vrae: 25

### Instrukties

1. Die antwoorde op al die vrae is heelgetalle van 000 tot 999. Elke vraag het slegs een korrekte antwoord.
2. Punttoekennings:
  - 2.1. Elke korrekte antwoord tel 3 punte in Afdeling A, 5 punte in Afdeling B en 6 punte in Afdeling C.
  - 2.2. Geen punte word afgetrek vir foutiewe antwoorde of onbeantwoorde vrae nie.
3. Gebruik 'n HB potlood. Papier vir rofwerk, 'n linaal en nitveër word toegelaat. Sakrekenaars en meetkunde-instrumente word nie toegelaat nie.
4. Figure is nie noodwendig volgens skaal geteken nie.
5. Beantwoord die vrae op die antwoordblad wat voorsien word.
6. Begin sodra die toetsigrouer die teken gee.
7. Antwoorde en oplossings sal beskikbaar wees by [www.samf.ac.za](http://www.samf.ac.za).

*Moenie omblaaï voordat dit aan jou gesê word nie.  
Turn the booklet over for the English paper.*



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