



# education

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Department:  
Education  
**REPUBLIC OF SOUTH AFRICA**

**NATIONAL  
SENIOR CERTIFICATE**

**GRADE 12**

**MATHEMATICS P2**

**EXEMPLAR 2008**

**MARKS: 150**

**TIME: 3 hours**

**This question paper consists of 12 pages, 2 diagram sheets and a formula sheet.**

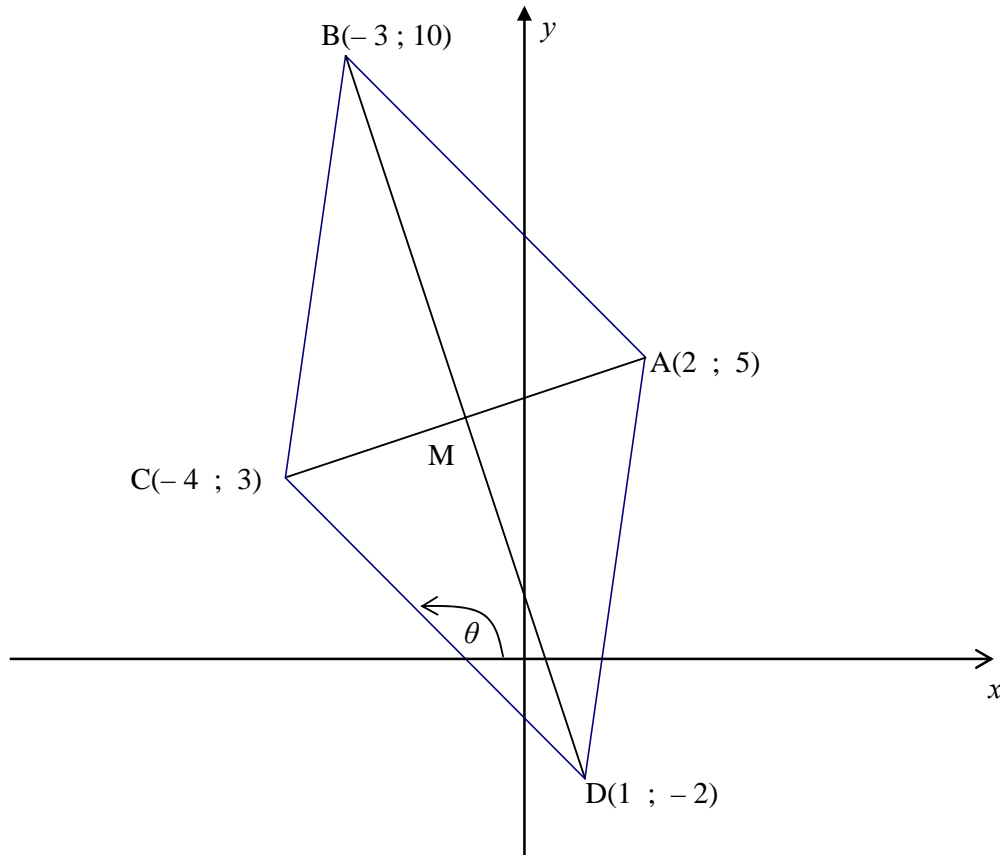
**INSTRUCTIONS AND INFORMATION**

Read the following instructions carefully before answering the questions.

1. This question paper consists of 12 questions. Answer ALL the questions.
2. Clearly show ALL calculations, diagrams, graphs, et cetera which you have used in determining the answers.
3. An approved scientific calculator (non-programmable and non-graphical) may be used, unless stated otherwise.
4. If necessary, answers should be rounded off to TWO decimal places, unless stated otherwise.
5. Number the answers correctly according to the numbering system used in this question paper.
6. Diagrams are NOT necessarily drawn to scale.
7. It is in your own interest to write legibly and to present the work neatly.
8. TWO diagram sheets for answering QUESTION 3.2.1, QUESTION 9.3, QUESTION 10.1 and QUESTION 11.1 are attached at the end of this question paper. Write your name/examination number in the spaces provided and hand them in together with your ANSWER BOOK.

**QUESTION 1**

ABCD is a quadrilateral with vertices  $A(2 ; 5)$ ,  $B(-3 ; 10)$ ,  $C(-4 ; 3)$  and  $D(1 ; -2)$ .

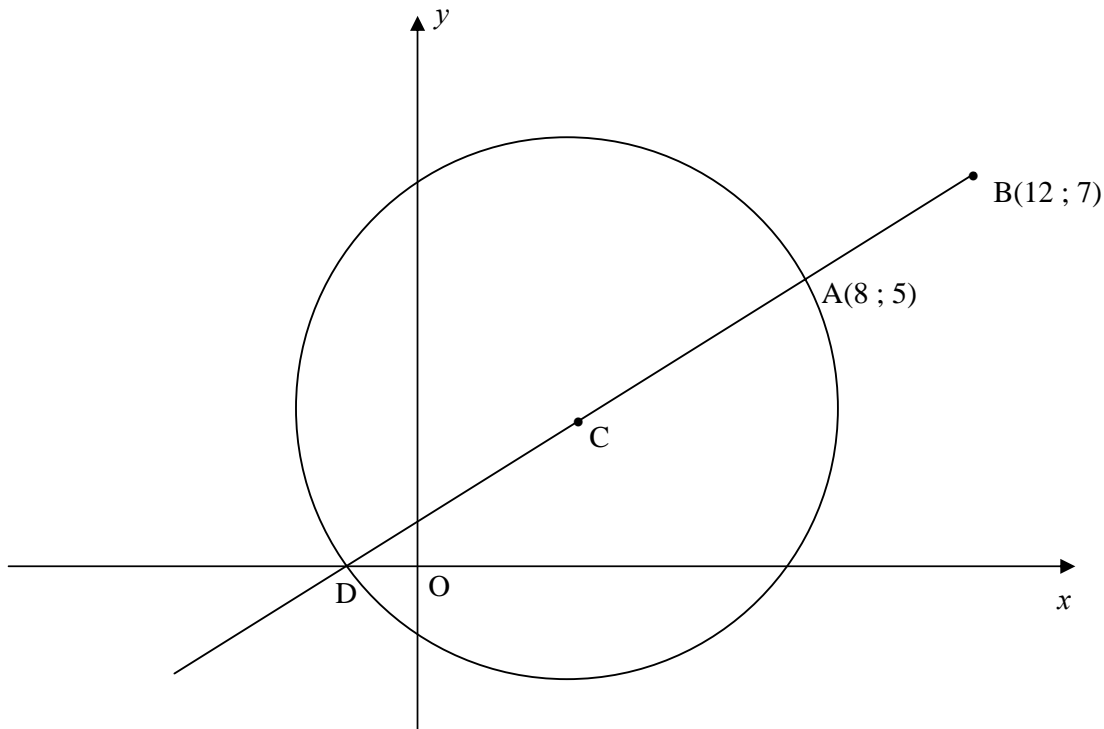


- 1.1 Calculate the length of AC. (Leave the answer in simplest surd form.) (2)
- 1.2 Determine the coordinates of M, the midpoint of AC. (2)
- 1.3 Show that BD and AC bisect each other at right angles at M. (5)
- 1.4 Calculate the area of  $\triangle ABC$ . (4)
- 1.5 Determine the equation of DC. (3)
- 1.6 Determine  $\theta$ , the angle of inclination of DC. (2)
- 1.7 Calculate the size of  $\hat{ADC}$ . (4)

**[22]**

**QUESTION 2**

$A(8 ; 5)$  and  $B(12 ; 7)$  are two points in a Cartesian plane.  $BA$  produced intersects the  $x$ -axis at  $D$ .  $AD$  is a diameter of the circle centred at  $C$ .



- 2.1 Show that the equation of the line through A and B can be given as  $x - 2y + 2 = 0$ . (3)
- 2.2 Determine the coordinates of D. (2)
- 2.3 Determine the coordinates of C. (2)
- 2.4 Determine the equation of the circle. (5)
- 2.5 Determine the equation of the tangent passing through  $A(8 ; 5)$ . (3)
- 2.6 Determine  $A'$ , the image of A reflected about the straight line through C, perpendicular to the  $x$ -axis. (3)
- [18]**

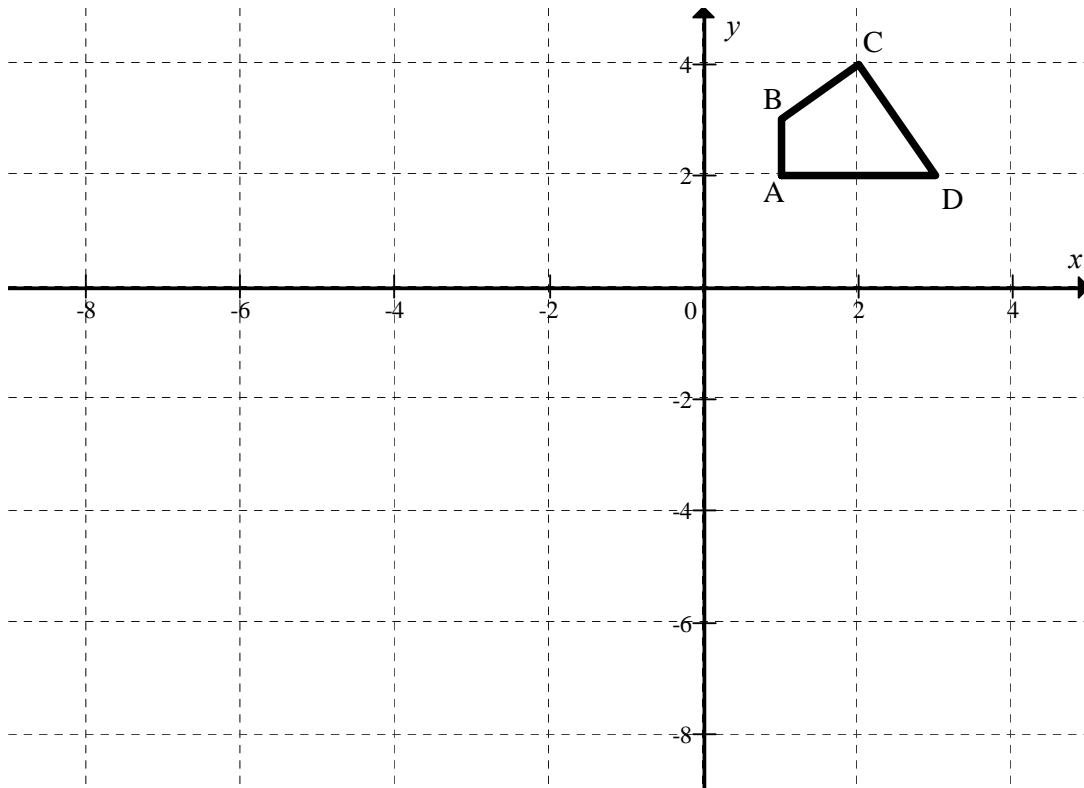
**QUESTION 3**

3.1 The point  $P(2 ; \sqrt{3})$  lies in a Cartesian plane. Determine the coordinates of the image of P if:

3.1.1 P is reflected across the  $x$ -axis (2)

3.1.2 P has been rotated about the origin through  $90^\circ$  in an anticlockwise direction (2)

3.2 A transformation T of the Cartesian plane is described as follows: A point is first rotated about the origin through  $180^\circ$  in the anticlockwise direction. Thereafter it is enlarged through the origin by a factor of 2. In the diagram below quadrilateral ABCD is given with  $A(1 ; 2)$ ,  $B(1 ; 3)$ ,  $C(2 ; 4)$  and  $D(3 ; 2)$ .



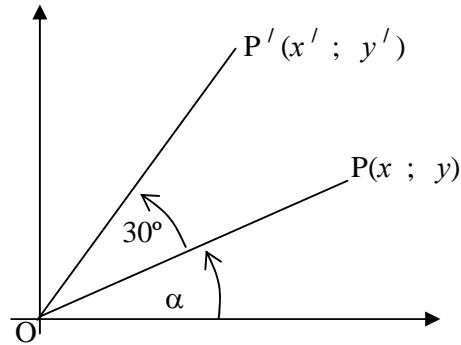
3.2.1 Use the grid on the attached DIAGRAM SHEET 1 to sketch and label PQRS, the image of ABCD under the transformation T. (4)

3.2.2 Write down the image of  $(x ; y)$  in terms of  $x$  and  $y$ . (4)

3.2.3 Write down the ratio of area ABCD : area PQRS. (1)

- 3.3 Show that the coordinates of  $P'$ , the image of  $P(x; y)$  rotated about the origin through an angle of  $30^\circ$  in the anticlockwise direction, is given by

$$\left( \frac{\sqrt{3}}{2}x - \frac{y}{2} ; \frac{\sqrt{3}}{2}y + \frac{x}{2} \right)$$



(8)

- 3.4  $K'$  and  $L'$  are the images of  $K(4; 3)$  and  $L(3; 6)$  under a rotation of  $30^\circ$ , in the anticlockwise direction, about the origin.

Using the results in QUESTION 3.3, determine the coordinates of  $K'$  and  $L'$ .

(4)  
[25]

#### QUESTION 4

4.1 Simplify, without the use of a calculator:  $\frac{\sin 140^\circ \cdot \tan(-315^\circ)}{\cos 230^\circ \cdot \sin 420^\circ}$  (6)

4.2 Simplify:  $\tan(180^\circ + x) \cdot \cos(540^\circ + x) \left( \sin(-x) + \frac{\sin^2(90^\circ - x)}{\cos(90^\circ + x)} \right)$  (8)

4.3 Show, without the use of a calculator:  $\sin 15^\circ = \frac{\sqrt{2}(\sqrt{3}-1)}{4}$  (5)

4.4 4.4.1 Show that  $\cos 2\theta + 3\cos \theta - 1 = 2\cos^2 \theta + 3\cos \theta - 2$ . (2)

4.4.2 Hence determine the general solution for:  
 $\cos 2\theta + 3\cos \theta - 1 = 0$  (4)  
[25]

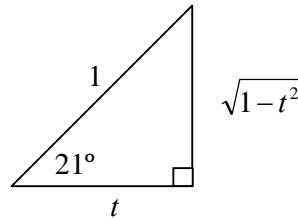
**QUESTION 5**

The following question was given to candidates to answer:

If  $\cos 21^\circ = t$ , determine, without the use of a calculator, the value of  $\sin 66^\circ$  in terms of  $t$ .

Joyce gave the following solution:

$\sin 66^\circ$	
$= \sin(45^\circ + 21^\circ)$	line 1
$= \sin 45^\circ + \sin 21^\circ$	line 2
$= \frac{\sqrt{2}}{2} + \sqrt{1-t^2}$	line 3
$= \frac{\sqrt{2} + 2\sqrt{1-t^2}}{2}$	line 4

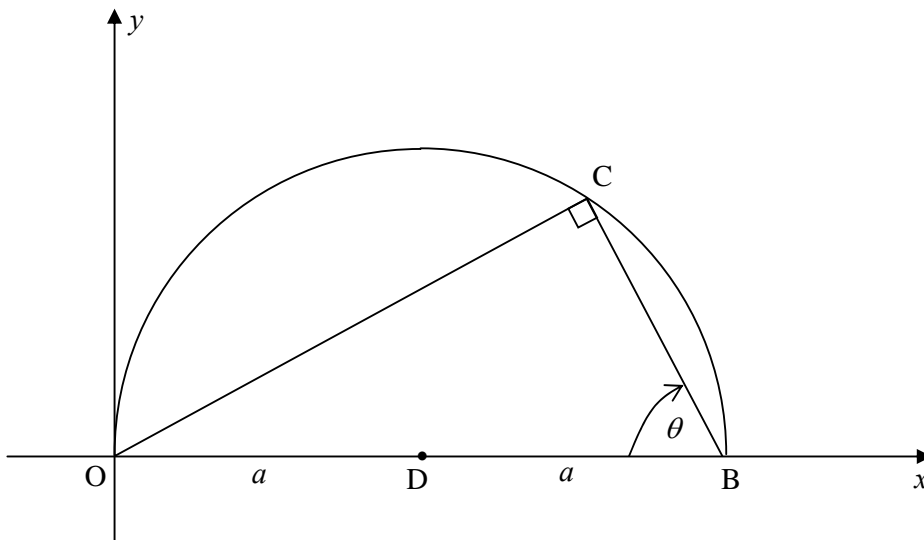


Unfortunately, Joyce's answer is incorrect.

- 5.1 Explain why Joyce's answer is incorrect. (1)
  - 5.2 Give a correct solution to Joyce's problem. (4)
- [5]**

**QUESTION 6**

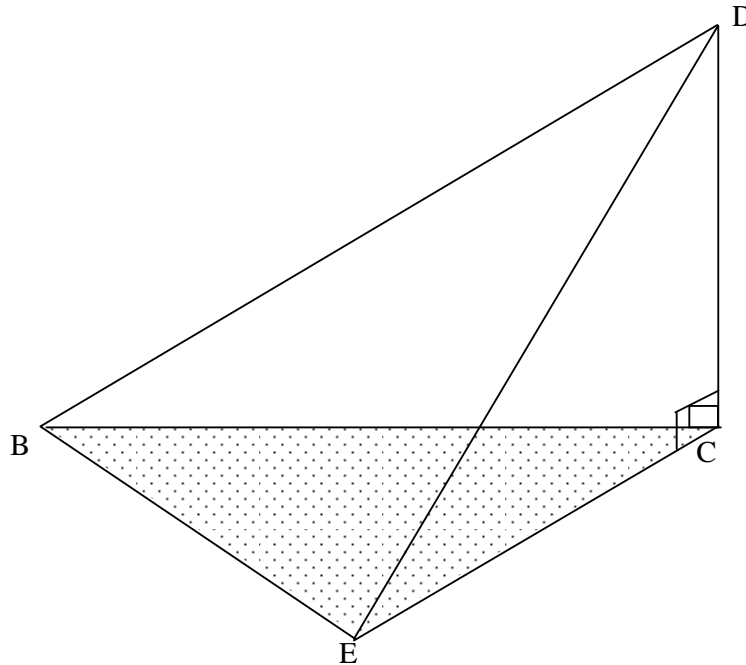
OCB is a semicircle with centre D and radius  $a$ .  $\hat{O}CB = 90^\circ$  and  $\hat{D}BC = \theta$



- 6.1 Show that  $BC = 2a \cdot \cos \theta$  (1)
  - 6.2 Show that the area  $\Delta OCB = a^2 \cdot \sin 2\theta$  (3)
  - 6.3 Determine the coordinates of C such that the area of  $\Delta OCB$  is a maximum. (1)
- [5]**

**QUESTION 7**

CD is a vertical mast. The points B, C and E are in the same horizontal plane. BD and ED are cables joining the top of the mast to pegs on the ground.  $DE = 28,1$  m and  $BC = 20,7$  m. The angle of elevation of D from B is  $43,6^\circ$ .  $\hat{CBE} = 63^\circ$ ;  $\hat{BDE} = 35,7^\circ$ .



Give your answers correct to ONE decimal place in each of the following questions:

7.1 Calculate the length of BD. (3)

7.2 Show that the length of BE rounds to 17,4 m. (4)

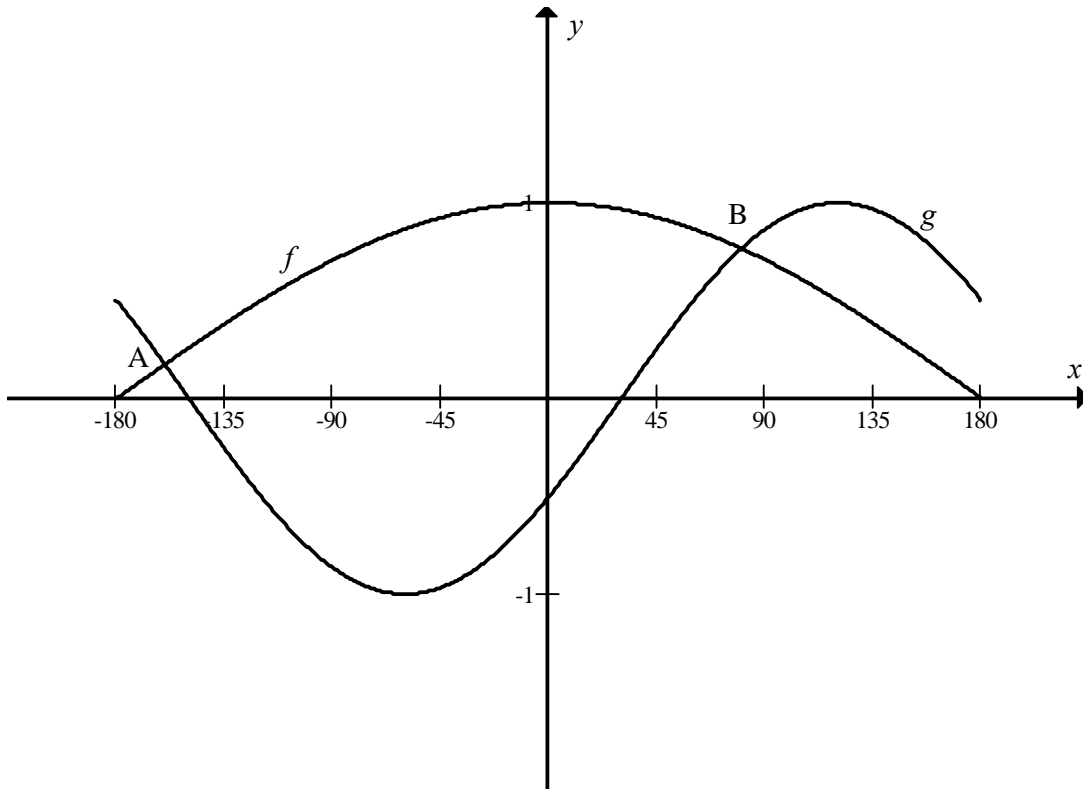
7.3 Calculate the area of  $\triangle BEC$ . (2)

**[9]**



**QUESTION 8**

Sketched below are the graphs of the functions  $f(x) = \cos \frac{x}{2}$  and  $g(x) = \sin(x - 30^\circ)$  for  $x \in [-180^\circ; 180^\circ]$ . The curves intersect at points A and B.



8.1 Determine the coordinates of the points A and B. (7)

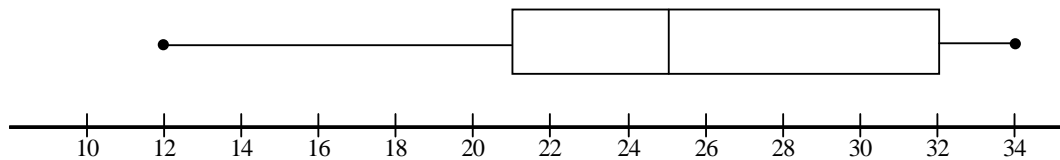
8.2 For which values of  $x$  is  $f(x) > g(x)$ ? (2)  
[9]

**QUESTION 9**

Geoff, a driver of a courier motorcycle, recorded the distances he travelled (in kilometres) on 15 trips. The data is given below:

24	19	21	27	20	17	32	22
26	18	13	23	30	10	13	

- 9.1 What is the median for the above-mentioned data? (2)
- 9.2 Write down the upper and lower quartiles. (2)
- 9.3 Draw a box and whisker diagram for the data of Geoff's travels, in the space provided on the attached diagram sheet 1. (5)
- 9.4 Another driver, Thabo, in the same company had also travelled and recorded (in kilometres) the distance he travelled on 15 trips. The five number summary of his data is (12 ; 21 ; 25 ; 32 ; 34). The box and whisker diagram is shown below.



Carefully analyse the box and whisker diagrams, on the diagram sheet, of Geoff and Thabo's travels and comment on the differences or similarities, if any, between the distances covered by each on the 15 trips.

(2)  
**[11]**

**QUESTION 10**

A company that rents out cars calculated the average cost per kilometre of maintaining a new car for different distances covered during the first year. The data gathered is given in the table below.

<b>Annual mileage (in thousands of kilometres)</b>	5	10	15	20	25	30
<b>Cost per kilometre (in rand)</b>	2,50	2,46	2,42	2,37	2,31	2,25

- 10.1 Draw a scatter diagram to represent the above data on DIAGRAM SHEET 2. (3)
- 10.2 Decide which of the following graphs fit the above-mentioned data best: straight line, parabola or exponential. (2)
- 10.3 Estimate, by using a suitable graph, the average cost per kilometre of operating a new car if it is driven 8 000 kilometres during the first year. (1)  
[6]

**QUESTION 11**

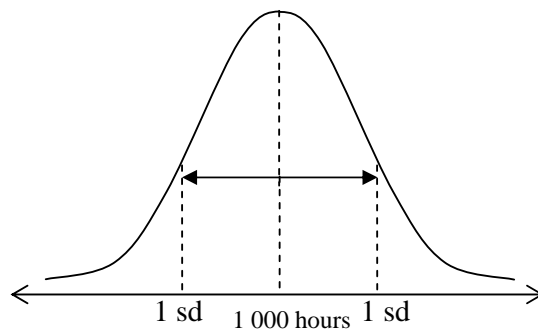
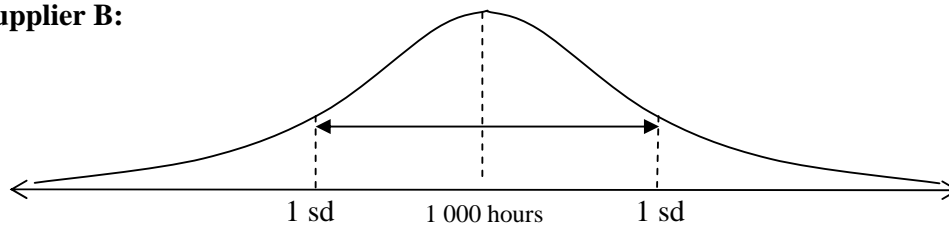
- 11.1 Fifty shoppers were asked what percentage of their income they spend on groceries. Six answered that they spend between 10% and 19%, inclusive. The full set of responses is given in the table below.

<b>PERCENTAGE</b>	<b>FREQUENCY (<i>f</i>)</b>
10 – 19	6
20 – 29	14
30 – 39	16
40 – 49	11
50 – 59	3

- By using the table on DIAGRAM SHEET 2, calculate the mean percentage of family income allocated to groceries. (5)
- 11.2 The marks of 8 learners in a test for which the maximum mark is 10, were:  
7, 4, 9, 4, 9, 5, 4, 6.  
Calculate the standard deviation of this data. (7)  
[12]

**QUESTION 12**

Your school makes use of two suppliers of light bulbs. Both companies claim that on average their light bulbs last 1 000 hours. The graphs below show the distribution of time taken in hours before a light bulb from each supplier burnt out. The horizontal and vertical scales of the two graphs are the same.

**Supplier A:****Supplier B:**

12.1 Compare the graphs above. Which company supplies bulbs that has a higher deviation from the mean? (1)

12.2 The clerk asks for your assistance in selecting the supplier from which he will purchase 100 light bulbs for the school. Which supplier would you select? Explain the reason for your choice. (2)  
[3]

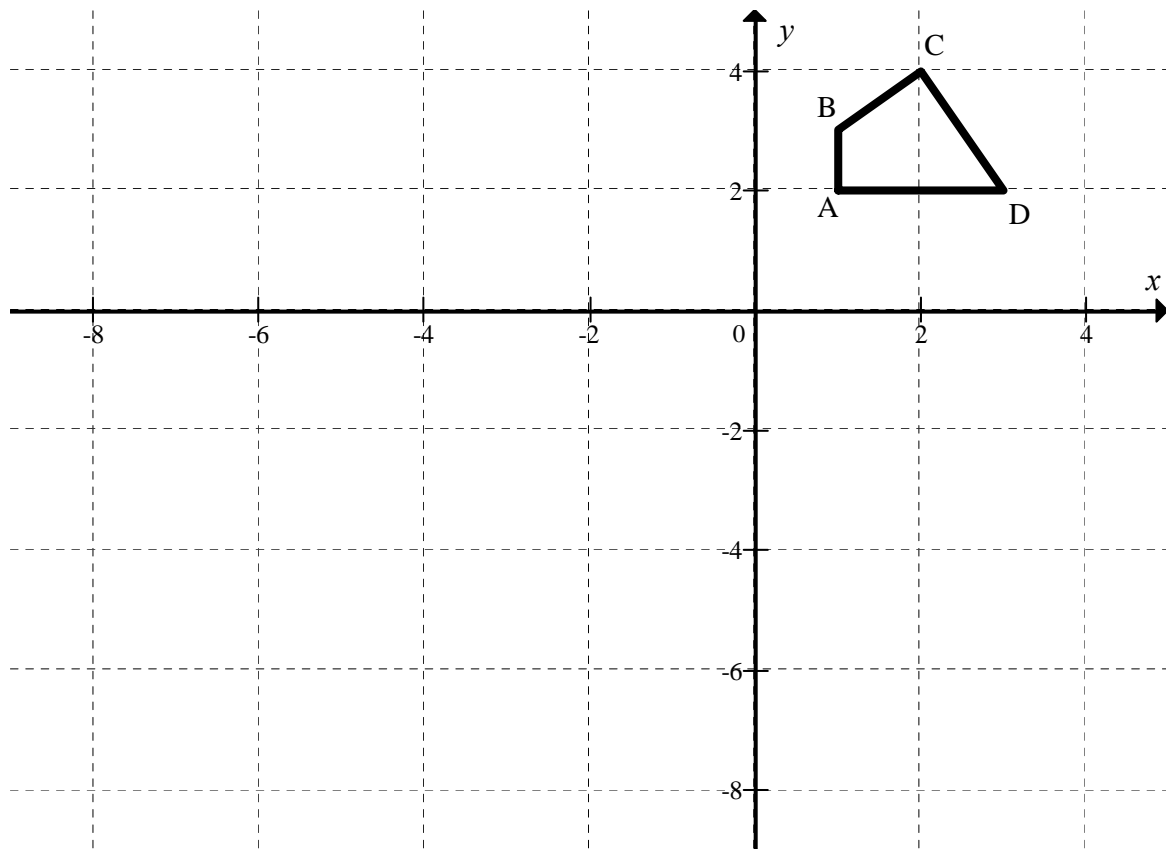
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NAME/EXAMINATION NUMBER:

**DIAGRAM SHEET 1**

**QUESTION 3**

**3.2.1**

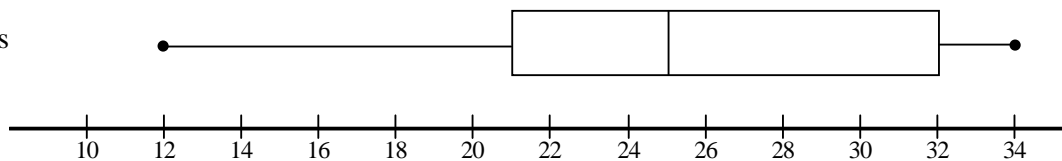


**QUESTION 9**

**9.3**

Geoff's travels

Thabo's travels

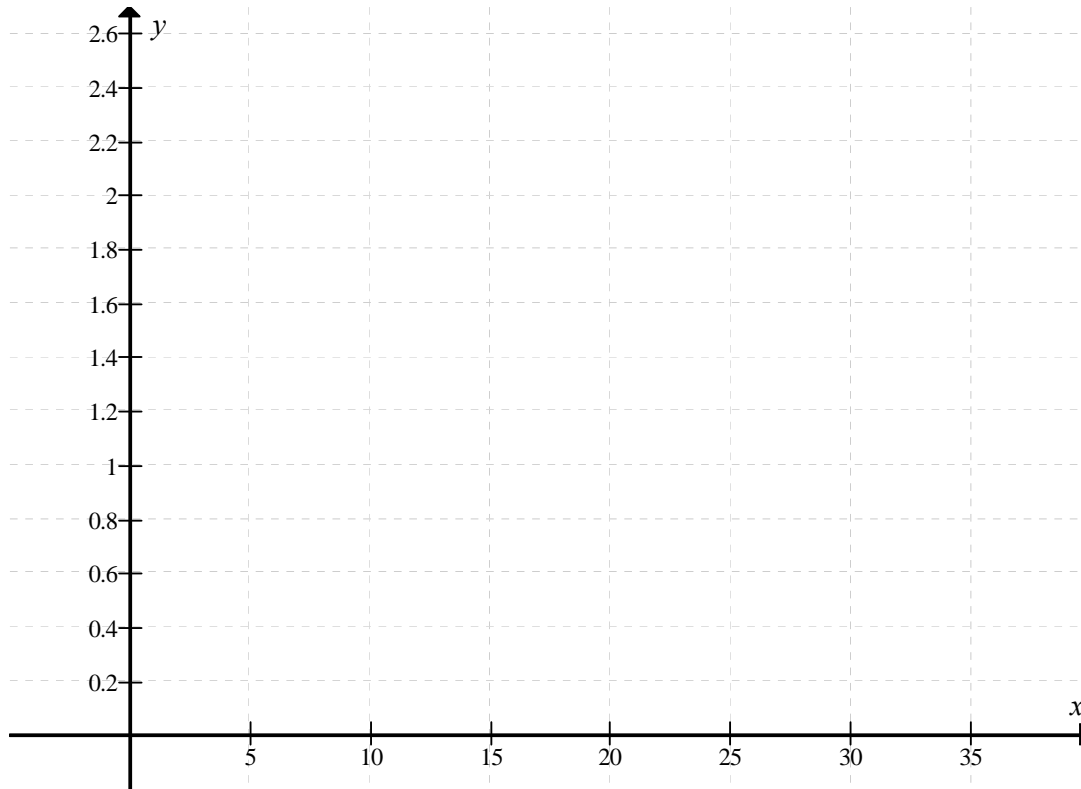


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**DIAGRAM SHEET 2**

**QUESTION 10**

10.1



**QUESTION 11**

11.1

PERCENTAGES	FREQUENCY ( $f$ )		
10 – 19	6		
20 – 29	14		
30 – 39	16		
40 – 49	11		
50 – 59	3		

Mean = .....

**FORMULA SHEET: MATHEMATICS**  
**FORMULEBLAD: WISKUNDE**

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$A = P(1 + ni)$$

$$A = P(1 - i)^n$$

$$F = \frac{x[(1+i)^n - 1]}{i}$$

$$\sum_{i=1}^n 1 = n$$

$$\sum_{i=1}^n ar^{i-1} = \frac{a(r^n - 1)}{r - 1} ; \quad r \neq 1$$

$$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$y = mx + c$$

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$(x - a)^2 + (y - b)^2 = r^2$$

In  $\triangle ABC$ :

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cdot \cos A$$

$$\text{area } \triangle ABC = \frac{1}{2} ab \cdot \sin C$$

$$\sin(\alpha + \beta) = \sin \alpha \cdot \cos \beta + \cos \alpha \cdot \sin \beta$$

$$\sin(\alpha - \beta) = \sin \alpha \cdot \cos \beta - \cos \alpha \cdot \sin \beta$$

$$\cos(\alpha + \beta) = \cos \alpha \cdot \cos \beta - \sin \alpha \cdot \sin \beta$$

$$\cos(\alpha - \beta) = \cos \alpha \cdot \cos \beta + \sin \alpha \cdot \sin \beta$$

$$\cos 2\alpha = \begin{cases} \cos^2 \alpha - \sin^2 \alpha \\ 1 - 2\sin^2 \alpha \\ 2\cos^2 \alpha - 1 \end{cases}$$

$$\sin 2\alpha = 2 \sin \alpha \cdot \cos \alpha$$

$$\bar{x} = \frac{\sum fx}{n}$$

$$\sigma^2 = \frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n}$$

$$P(A) = \frac{n(A)}{n(S)}$$

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$