higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

# NATIONAL CERTIFICATE (VOCATIONAL)

## MATHEMATICS
(Second paper)
**NQF LEVEL 4**

(10501064)

**23 November 2020 (X-paper)**
**09:00–12:00**

**This question paper consists of 10 pages, 2 answer sheets and a formula sheet of 2 pages.**

029Q2N2023

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**TIME: 3 HOURS**
**MARKS: 100**

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**INSTRUCTIONS AND INFORMATION**

1. Answer all the questions.
2. Read all the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. Start each section on a new page.
5. Use only a black or blue pen.
6. Clearly show all calculations, diagrams, graphs, etc. used in determining answers.
7. Round off answers to THREE decimals, unless stated otherwise.
8. Diagrams are not drawn to scale.
9. Write neatly and legibly.

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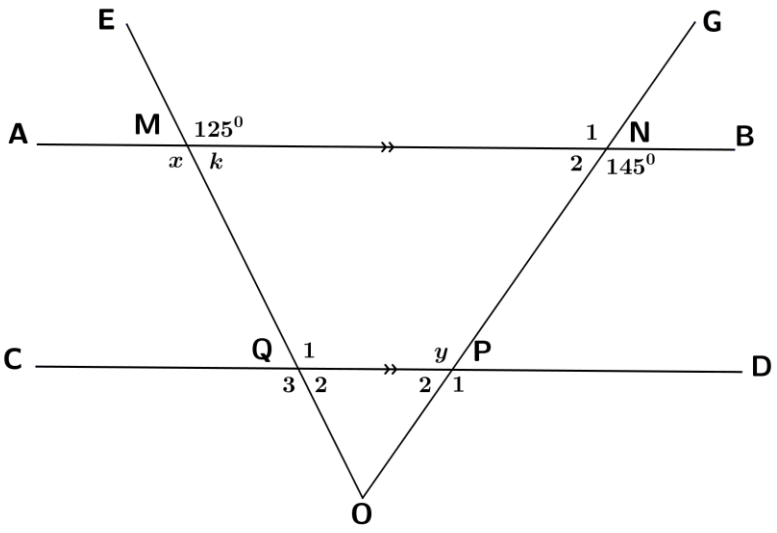
## QUESTION 1

1.1 The diagram below shows AB // CD. Transversals EO and GO which meet at O, also intersect the parallel lines at M, Q, N and P respectively

$E\hat{M}N = 125°$, $B\hat{N}P = 145°$, $A\hat{M}O = x$, $N\hat{M}O = k$ and $N\hat{P}C = y$




1.1.1 Write down the value of $x$. (1)

1.1.2 Write down, with a reason, the value of $y$. (2)

1.1.3 Show, by calculation, that EO ⊥ GO. (2)

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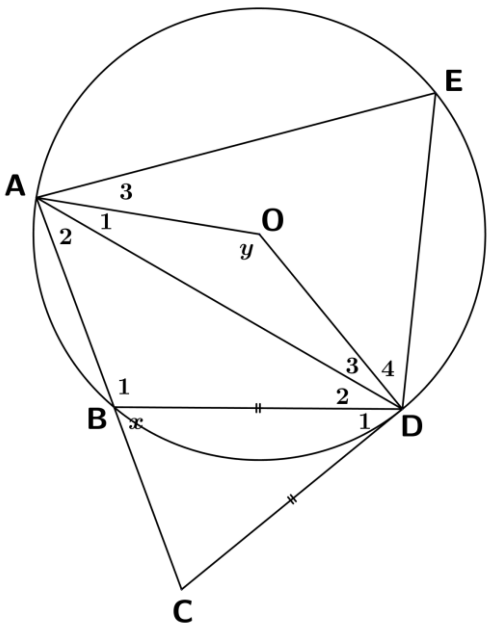
1.2 In the diagram below ABDE is a cyclic quadrilateral and O is the centre of the circle. CD is a tangent to the circle at D and ABC is a straight line.

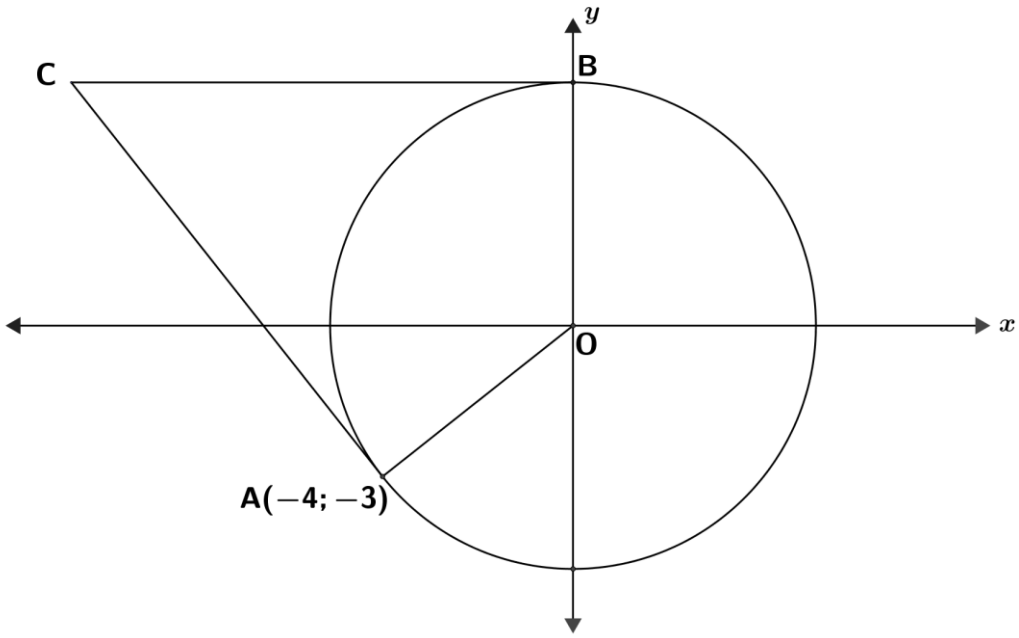
BD = CD and $A\hat{O}D = y$.




1.2.1 If $C\hat{B}D = x$, name THREE other angles that are each equal to $x$. Give reasons in each case. (3 × 2) (6)

1.2.2 If $x = 70°$, prove that ACDO is NOT a cyclic quadrilateral. (4)

1.3 In the diagram below, O is the centre of the circle and points A and B lie on the circle. A is the point (-4; -3), and B lies on the *y*-axis. CB and CA are tangents to the circle.




Determine:

1.3.1 The equation of the circle

1.3.2 The gradient of OA

1.3.3 The equation of tangent AC

1.3.4 The equation of tangent BC

1.3.5 The coordinates of C

(5 × 2) (10)
**[25]**

**QUESTION 2**

2.1 Reduce the following expression to its simplest form:

$$1 - \sin^2\theta + 3 - \cos^2\theta$$ (2)

2.2 Calculate, without using a calculator, the value of the following expression, **showing all working details:**

$$2^{2\sin 210°} \times 2^{3\tan 225°}$$ (3)

2.3 Determine the value of $p$ correct to TWO decimals if $\theta = 41°$ and $2p\tan\theta = \sin 4\theta$. (2)

2.4.1 Write down the compound angle expansions of $\cos(x+y)$ and $\cos(x-y)$ (2)

2.4.2 Hence, or otherwise, prove that $2\cos x \cos y = \cos(x+y) + \cos(x-y)$ (2)

2.5 Prove without using a calculator that:

$$\frac{\cos 160° \,.\, \tan 200°}{-2\sin(10°)} = \cos 10°$$ (3)

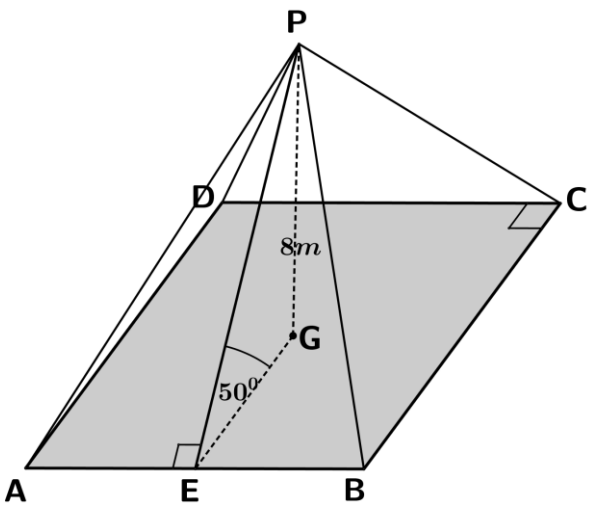
2.6.1 Prove that

$$\frac{2\sin\theta\cos\theta}{2\cos^2\theta - 1} = \tan 2\theta$$ (2)

2.6.2 Hence, or otherwise, solve the following equation for $\theta$ in the interval $[0^0; 180^0]$:

$$\frac{2\sin\theta\cos\theta}{2\cos^2\theta - 1} = \sqrt{3}$$ (3)

2.7 In the diagram, a pyramid on a square base ABCD, has a vertical height (PG) of 8 metres. The slant height, PE, makes an angle of 50° with the base of the pyramid. Answer the questions below:




2.7.1 Determine the slant height PE of the pyramid, correct to one decimal place. (1)

2.7.2 Calculate the length of EG correct to one decimal place, and hence write down the length of BC. (2)

2.7.3 If PC = 12,4 metres calculate the measure of $B\hat{P}C$. (3)

**[25]**

## QUESTION 3

3.1 A group of young learners attended a course in basic mathematics every Saturday over a period of 10 months. The number of Saturdays on which students were absent was recorded against the final mark the students obtained. The information is shown in the table below and the scatter plot for the data is drawn on ANSWER SHEET 2 (attached).

| Number of Saturdays absent | 0 | 1 | 2 | 2 | 3 | 3 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|---|
| Final marks in % | 96 | 91 | 78 | 83 | 75 | 62 | 70 | 68 | 56 |

3.1.1 Calculate the equation of the least squares regression line using one of the tables on ANSWER SHEET 1 (attached). (6)

3.1.2 Use the equation obtained in 3.1.1 to draw the least squares regression line on ANSWER SHEET 2 (attached). Work out and plot the coordinates of at least two points. (3)

3.1.3 Is there a positive or negative relationship between the number of days absent and final mark? (1)

3.1.4 Comment on the trend of the data with respect to attendance. (1)

3.1.5 Predict the final mark of a student who was absent for four Saturdays. (2)

3.2 Data sets A and B are given below. Both sets have a mean of 55 and a median of 58.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Set A | 35 | 47 | 66 | 72 | 38 | 56 | 60 | 66 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Set B | 18 | 27 | 35 | 63 | 55 | 61 | 91 | 90 |

Which data set has the greater standard deviation? Give a reason for your answer. (2)

**[15]**

## QUESTION 4

4.1 Explain mutually exclusive events with the aid of a Venn diagram. (2)

4.2 A study of the number of male and female offspring (children) in a certain population is being carried out. It is found that the first child in any family is equally likely to be male or female, but that for any subsequent offspring, the probability that the offspring will be of the same sex as the previous child is $\frac{3}{5}$. There are no twins, triplets, quadruplets, etcetera.

4.2.1 Determine the probability that the first child of the family will be a female. (1)

4.2.2 Determine the probability that the first two children of a family will be female. (2)

4.2.3 Determine the probability that a family will have two females followed by two males (in that order). Leave the answer in simplified fraction form. (3)

4.3 Half of the 150 Level 4 learners at a college study agriculture and 30% study animal production. Of those who study agriculture, 40% study animal production.

4.3.1 Calculate the number of learners studying agriculture. (1)

4.3.2 Calculate the number of learners studying animal production. (1)

4.3.3 Calculate the number of learners studying agriculture **and** animal production. (1)

4.3.4 Draw a Venn diagram to represent the relevant information (2)

4.3.5 If a learner is chosen at random, determine the probability that the learner is not studying agriculture **and** animal production. (2)

**[15]**

## QUESTION 5

5.1 Margret wants to buy a house that costs R850 000. She is required to pay a deposit of 12% and will borrow the balance from a bank.

Calculate the amount that Margret must borrow from the bank. (2)

5.2 An amount of R1 430,77 was invested with an insurance company at a certain interest rate compounded monthly. After 18 months the money had a value of R1 711,41.

Calculate the interest rate that the insurance company paid its clients. (4)

5.3 A motorbike is sold for R15 000 four years after it was purchased.

What was the purchase price if the depreciation was 25% per annum on a reducing balance? (4)

5.4 How long would it take a sum of money to treble at 16% interest per annum simple interest. (4)

5.5 Given below is the individual rate table obtained from the South African revenue Services (SARS). Use this information to answer the questions on the next page.

| **RATES OF TAX FOR INDIVIDUALS**<br>**2019 tax year (1 March 2018–28 February 2019)** | |
|---|---|
| **Taxable income (R)** | **Rates of tax (R)** |
| 0–95 850 | 18% of taxable income |
| 195 851–305 850 | 35 253 + 26% of taxable income above 195 850 |
| 305 851–423 300 | 63 853 + 31% of taxable income above 305 850 |
| 423 301–555 600 | 100 263 + 36% of taxable income above 423 300 |
| 555 601–708 310 | 147 891 + 39% of taxable income above 555 600 |
| 708 311–1 500 000 | 207 448 + 41% of taxable income above 708 310 |
| 1 500 001 and above | 532 041 + 45% of taxable income above 1 500 000 |

**Tax rebates 2019 tax year (1 March 2018–28 February 2019)**

| Tax rebate | Tax year 2019 |
|---|---|
| Primary | R14 067 |
| Secondary (65 and older) | R7 713 |
| Tertiary (75 and older) | R2 574 |

**Tax thresholds 2019 tax year (1 March 2018–28 February 2019)**

| Age | Tax year 2019 |
|---|---|
| Under 65 | R78 150 |
| 65 an older | R121 000 |
| 75 and older | R135 300 |

**Medical tax credit rates from 2013 tax year onwards:**

| Per month (R) | 2019 |
|---|---|
| For the taxpayer who paid the medical scheme contributions | R310 |
| For the first dependent | R310 |
| For each additional dependent(s) | R209 |

[Source: *http://www.sars.gov.za/Tax-Rates/Income-Tax/Pages/Rates%20of%20Tax%20for%20Individuals.aspx*]

Ricardo has just started working and has never paid tax before. He goes to a SARS office and registers as a taxpayer on eFiling. He is given a username and password. He must complete his 2019 tax returns which runs from 1 March 2018 to 28 February 2019 on his own. Ricardo is 23 years old and not married.

Below are the details of Ricardo regarding his income and deductions:

| | |
|---|---|
| Gross monthly salary | R46 000,00 |
| 13th cheque | R45 000,00 |
| Monthly pension contribution (non-taxable) | R1 500,00 |
| Monthly UIF contribution (non-taxable) | R148,72 |
| Total tax deducted as per IRP5 | R195 000,00 |

Ricardo belongs to a medical aid and pays for himself and both his parents.

Calculate the following using the SARS tax table and the earnings and deductions for Ricardo.

5.5.1 Calculate Ricardo's taxable income. (2)

5.5.2 Calculate the amount that Ricardo must pay or receive from SARS after assessment. (4)

**[20]**

**TOTAL: 100**

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**ANSWER SHEET 1** **EXAMINATION NUMBER:**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |

**QUESTION 3.1.1 (Option 1)**

| Number of Saturdays absent ($x$) | Final marks in % ($y$) | $x.y$ | $x^2$ |
|---|---|---|---|
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| $\sum x =$ | $\sum y =$ | $\sum x.y =$ | $\sum x^2 =$ |
| $\bar{x} =$ | $\bar{y} =$ | | |

**QUESTION 3.1.1 (Option 2)**

| Number of Saturdays absent ($x$) | Final marks in % ($y$) | $(x-\bar{x})(y-\bar{y})$ | $(x-\bar{x})^2$ |
|---|---|---|---|
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| $\sum x =$ | $\sum y =$ | $\sum(x-\bar{x})(y-\bar{y}) =$ | $(\sum x-\bar{x})^2 =$ |
| $\bar{x} =$ | $\bar{y} =$ | | |

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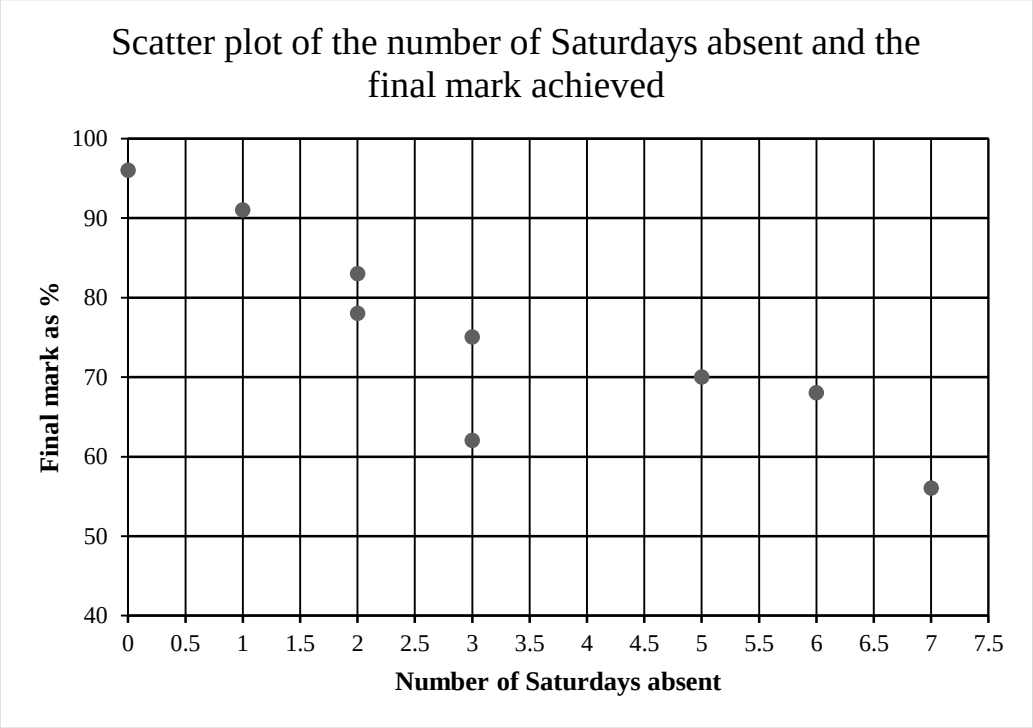
**ANSWER SHEET 2** **EXAMINATION NUMBER:**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |

**QUESTION 3.1.2**

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FORMULAE SHEET

NOTE: Some of the formulae in this formulae sheet may not be generally true, but may hold under certain conditions. The candidate is required to select the appropriate formulae for a given situation.

1. $y = mx + c$

2. $m = \dfrac{y_2 - y_1}{x_2 - x_1}$

3. $y - y_1 = m(x - x_1)$

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

5. $M\left(\dfrac{x_1 + x_2}{2}; \dfrac{y_1 + y_2}{2}\right)$

6. $m = \tan\theta$

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

8. $\dfrac{\sin\theta}{\cos\theta} = \tan\theta$

9. $\sin^2\theta + \cos^2\theta = 1$

10. $\sin(\alpha \pm \beta) = \sin\alpha\cos\beta \pm \sin\beta\cos\alpha$

11. $\cos(\alpha \pm \beta) = \cos\alpha\cos\beta \mp \sin\alpha\sin\beta$

12. $\sin 2\theta = 2\sin\theta\cos\theta$

13. $\cos 2\theta = \cos^2\theta - \sin^2\theta$

14. $\cos 2\theta = 1 - 2\sin^2\theta$

15. $\cos 2\theta = 2\cos^2\theta - 1$

16. $\dfrac{\sin\hat{A}}{a} = \dfrac{\sin\hat{B}}{b} = \dfrac{\sin\hat{C}}{c}$

17. $a^2 = b^2 + c^2 - 2bc\cos\hat{A}$

18. $\bar{x} = \dfrac{\sum_{i=1}^{n} x_i}{n}$

19. Variance $= s^2 = \dfrac{\sum (x_i - \bar{x})^2}{n}$

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20. Standard deviation (sample): $s = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n-1}}$

21. Standard deviation (population): $s = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n}}$

22. $\hat{y} = a + bx$

23. $b = \frac{\sum(x-\bar{x})(y-\bar{y})}{\sum(x-\bar{x})^2}$ or $b = \frac{n\sum xy - \sum x \sum y}{n\sum x^2 - (\sum x)^2}$

24. $a = \bar{y} - b\bar{x}$

25. $I = A_0 \times \frac{r}{100} \times t$ or $I = \frac{P\,r\,t}{100}$ or $A = P(1+in)$

26. $A_t = A_0\left(1 + \frac{r}{100 \times m}\right)^{t \times m}$ or $A_t = P\left(1 + \frac{r}{100}\right)^n$ or $A = P(1+i)^n$

27. $A_t = A_o\left(1 - \frac{r}{100}\right)^t$ or $A = P(1-in)$ or $A = P(1-i)^n$

28. $i = \frac{r}{100}$

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

30. $\mathrm{P(A\ and\ B)} = \mathrm{P(A)} \times \mathrm{P(B)}$

31. $\mathrm{P(A\ or\ B)} = \mathrm{P(A)} + \mathrm{P(B)}$

32. $\mathrm{P(A\ or\ B)} = \mathrm{P(A)} + \mathrm{P(B)} - \mathrm{P(A\ and\ B)}$

33. $\mathrm{P(A/B)} = \frac{\mathrm{P(A\ and\ B)}}{\mathrm{P(B)}}$

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