higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

MATHEMATICS
(Second paper)
NQF LEVEL 3

(10501053)

24 February 2020 (X-paper)
09:00–12:00

Nonprogrammable scientific calculators may be used.

This question paper consists of 6 pages, 1 answer sheet and a formula sheet of 2 pages.

021Q2S2024

TIME: 3 HOURS
MARKS: 100

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. Clearly show all calculations, diagrams, graphs, etc.
5. Round off answers to THREE decimal places unless stated otherwise.
6. Diagrams are not drawn to scale.
7. Write neatly and legibly.

QUESTION 1

1.1 David manufactures a plastic cone and a plastic sphere. He wants to place the cone on top of the sphere. The cone has a radius of 10 cm and a height of 50 cm whilst the sphere has a radius of 10 cm.

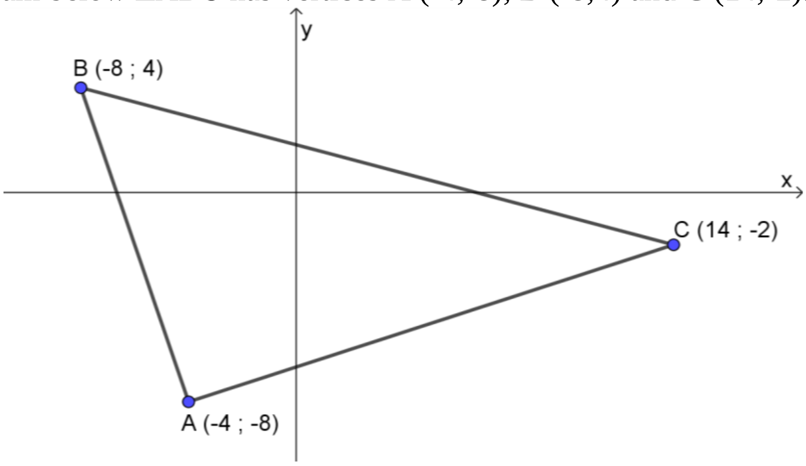
1.1.1 Determine the surface area of the sphere. (2)

1.1.2 Determine the slant height of the cone. Round off to the nearest centimetre. (2)

1.1.3 Determine the surface area of the cone if the cone has no base. (2)

1.1.4 Determine the volume of the cone. (2)

1.2 In the diagram below ΔABC has vertices A (-4;-8); B (-8;4) and C (14;-2).



1.2.1 Prove that ΔABC is a right-angled triangle. (5)

1.2.2 Calculate the area of ΔABC. (4)

1.2.3 Determine the coordinates of midpoint M of BC. (1)

1.2.4 Determine the equation of line MN passing through M which is parallel to AC. (3)

1.2.5 Determine whether the midpoint of AB lies on line MN. (4)
[25]

QUESTION 2

2.1 Simplify the following expression without using a calculator:

$$\frac{\sin 120°.\tan 150°}{\cos^2 315°}$$ (5)

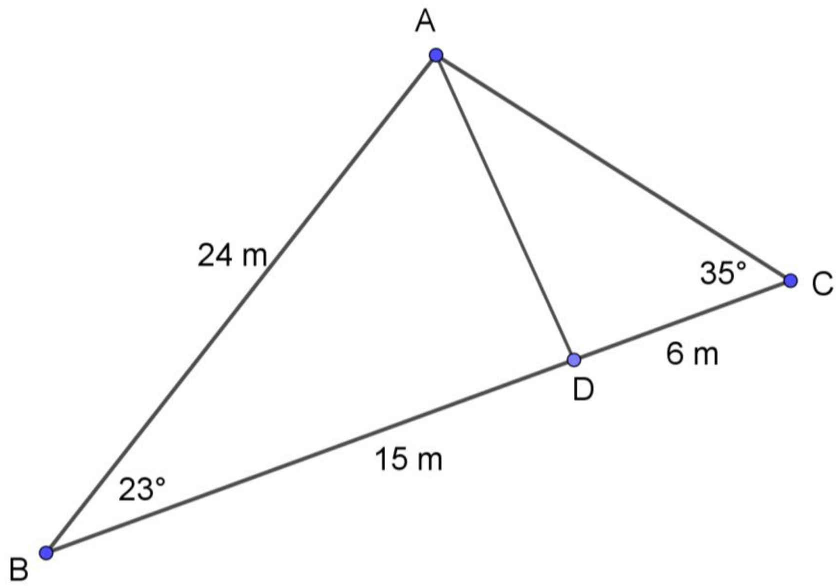
2.2 Use trigonometric identities to prove the following:

2.2.1 $\frac{(\sin x+\cos x)^2}{\cos x}=\frac{1}{\cos x}+2\sin x$ (3)

2.2.2 $\frac{1-2\sin^2 x}{1+2\sin x\cos x}=\frac{1-\tan x}{1+\tan x}$ (5)

2.3 Calculate the value(s) of α if $2\sin^2\alpha=-\sin\alpha$ where α ∈ [0°;360°]. (5)

2.4 Four poles are placed in a field marked as points A, B, C and D. BDC forms a straight line. AB = 24 metres, BD = 15 metres, CD = 6 metres, $A\hat{B}D$ = 23° and $A\hat{C}D$ = 35°.



2.4.1 Use the cosine rule to calculate the distance AD. (4)

2.4.2 Calculate the distance AC. (3)
[25]

QUESTION 3

3.1 During the listeriosis outbreak in March 2018 one of the major outlets recalled certain products. Listed below are the number of products returned for the first 20 days in April.

12	54	18	79	150
112	64	69	70	62
82	85	69	63	65
80	98	86	69	68

3.1.1 Determine the median number of products returned. (2)

3.1.2 Determine the upper and lower quartiles of the data. (4)

3.1.3 Determine the upper and lower fence values. (4)

3.1.4 Construct a box-and-whisker diagram for the given information showing any outliers. (5)

3.2 The frequency distribution table below shows the age categories and number of people that were infected with the listeriosis virus in a small town in 2018.

Classes (Ages)	Frequency (f_i)	Midpoint (x_i)	$f_i \times x_i$	< Cumulative frequency
$0 \le x < 10$	27	5	135	27
$10 \le x < 20$	6	15	90	33
$20 \le x < 30$	30	25		
$30 \le x < 40$	5	35		
$40 \le x < 50$	12	45		
$50 \le x < 60$	20	55		
Total	100		$\sum f_i x_i =$	

3.2.1 Complete the frequency distribution table above on the ANSWER SHEET (attached). (5)

3.2.2 Calculate the mean number of listeriosis infections. (2)

3.2.3 Calculate the median number of listeriosis infections using the formula:

$$Me = l + \frac{\left(\frac{n}{2} - F\right)}{f} \times c$$

(4)

3.2.4 Determine the modal number of listeriosis infections using the formula:

$$Mo = l + \frac{f_m - f_{m-1}}{2f_m - f_{m-1} - f_{m+1}} \times c$$

(4)

[30]

QUESTION 4

4.1 Roy invests R12 000 into a savings account.

Calculate the value of his investment after six years if simple interest is calculated at 9,8% per annum. (2)

4.2 Joseph received an amount of R2 700 after three years in an investment. He initially invested R1 200 which was compounded annually.

Determine the interest rate of his investment. (3)

4.3 An amount of money was invested seven years ago and is now worth R150 000. The interest rate for the savings period was 12% per annum compounded monthly.

Determine the initial investment of this savings plan. (5)

4.4 Lindelane decided to start saving money for his son's education. He immediately deposited R15 000 into a savings plan. Four years later he deposits a further R12 000. Two years later he withdrew R2 000 to pay SARS. He left the investment for a total period of 10 years. The interest rate for the first four years was 12% per annum compounded quarterly. The interest rate for the remaining six years of the investment was at 10% compounded monthly.

4.4.1 Draw a time line for the loan as described above. (4)

4.4.2 Calculate the value of the investment after 10 years. (6)

[20]

TOTAL: 100

ANSWER SHEET

EXAMINATION NUMBER:

QUESTION 3.2.1

Classes (Ages)	Frequency (f_i)	Midpoint (x_i)	$f_i \times x_i$	< Cumulative frequency
$0 \leq x < 10$	27	5	135	27
$10 \leq x < 20$	6	15	90	33
$20 \leq x < 30$	30	25		
$30 \leq x < 40$	5	35		
$40 \leq x < 50$	12	45		
$50 \leq x < 60$	20	55		
Total	100		$\sum f_i x_i =$	

(5)

FORMULA SHEET

1. Slant surface area of a pyramid = $\frac{1}{2}a\,l\,n$ **OR** $\frac{1}{2}l\,h_s\,n$ (where n = number of sides)

2. Surface area of triangular pyramid = $\frac{1}{2}bh+\frac{1}{2}pl$ where p=perimeter of the base

3. Surface area of a pyramid with an equilateral triangle as base = $\frac{\sqrt{3}}{4}s^2+\frac{1}{2}pl$

4. Surface area of an equilateral triangular pyramid = $4\times\frac{\sqrt{3}}{4}s^2$

5. Surface area of square pyramid = $b^2+\frac{1}{2}pl$

6. Surface area of a regular hexagonal pyramid = $\frac{3\sqrt{3}}{2}b^2+\frac{1}{2}pl$

7. Volume of a pyramid = $\frac{1}{3}$(area of base) $\times\perp$ height

8. $A=\sqrt{s(s-a)(s-b)(s-c)}$ where $s=\frac{1}{2}(a+b+c)$ and a, b, c are the sides of the triangle

9. Circumference of circle = $2\pi r$

10. Area of curved surface of a cone = $\pi r l$ **OR** $\pi r h_s$

11. Slant height of a cone = $l=\sqrt{h^2+r^2}$ **OR** $h_s=\sqrt{{}_\perp h^2+r^2}$

12. Volume of cone = $V_{cone}=\frac{1}{3}\pi r^2\times_\perp h$

13. Area of a sphere = $A=4\pi r^2$

14. Volume of a sphere = $V=\frac{4}{3}\pi r^3$

15. $m=\frac{\Delta y}{\Delta x}=\frac{y_2-y_1}{x_2-x_1}$

16. $(x_m\,;y_m)=\left(\frac{x_1+x_2}{2}\,;\,\frac{y_1+y_2}{2}\right)$

17. $\theta=\tan^{-1} m$

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

19. $\frac{\sin\theta}{\cos\theta}=\tan\theta$

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

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

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

23. $A = \frac{1}{2} ab \sin \hat{C}$

24. $\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$

25. $\bar{x} = \frac{\sum f_i x_i}{n}$

26. $Q_{j\ position} = \frac{j}{4}(n+1)$

27. $Q_i = Q_3 - Q_1$

28. Fence = $Q_3 + 1{,}5(Q_i)$

29. Fence = $Q_1 - 1{,}5(Q_i)$

30. $Me = l + \frac{\left(\frac{n}{2} - F\right)}{f} \times c$

31. $Mo = l + \frac{f_m - f_{m-1}}{2f_m - f_{m-1} - f_{m+1}} \times c$

32. $I = A_0 \times \frac{r}{100} \times t$ **OR** $I = \frac{P\,r\,t}{100}$ **OR** $A_t = P(1 + in)$

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

34. $A_t = A_o (1 - \frac{r}{100})^t$ **OR** $A_t = P(1-i)^n$