higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

MATHEMATICS
(Second Paper)

NQF LEVEL 3

(10501053)

5 November 2018 (X-Paper)
09:00–12:00

A nonprogrammable calculator may be used.

This question paper consists of 7 pages and a formula sheet of 2 pages.

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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. which you have used in determining the answers.
5. Answers should be rounded off to THREE decimal places, unless stated otherwise.
6. Diagrams are NOT drawn to scale.
7. Write neatly and legibly.

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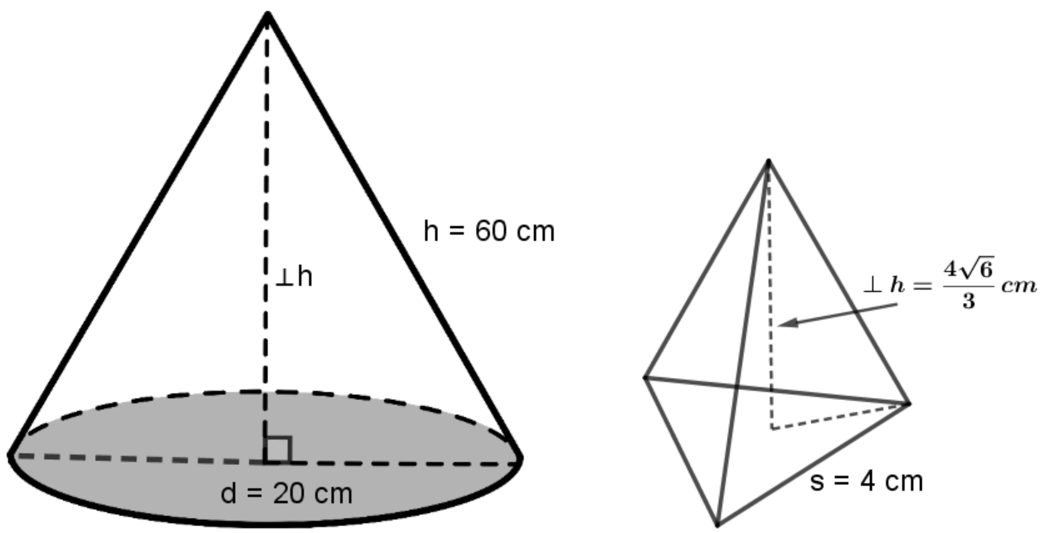
QUESTION 1

1.1 Jenny has two solid shapes (made of lead) in her workshop, a cone and a pyramid. The cone has a diameter of 20 cm and a slant height of 60 cm. The pyramid, with faces that are equilateral triangles (regular tetrahedron), has edges of length 4 cm. The vertical height of the pyramid is $\frac{4\sqrt{6}}{3}$ cm.

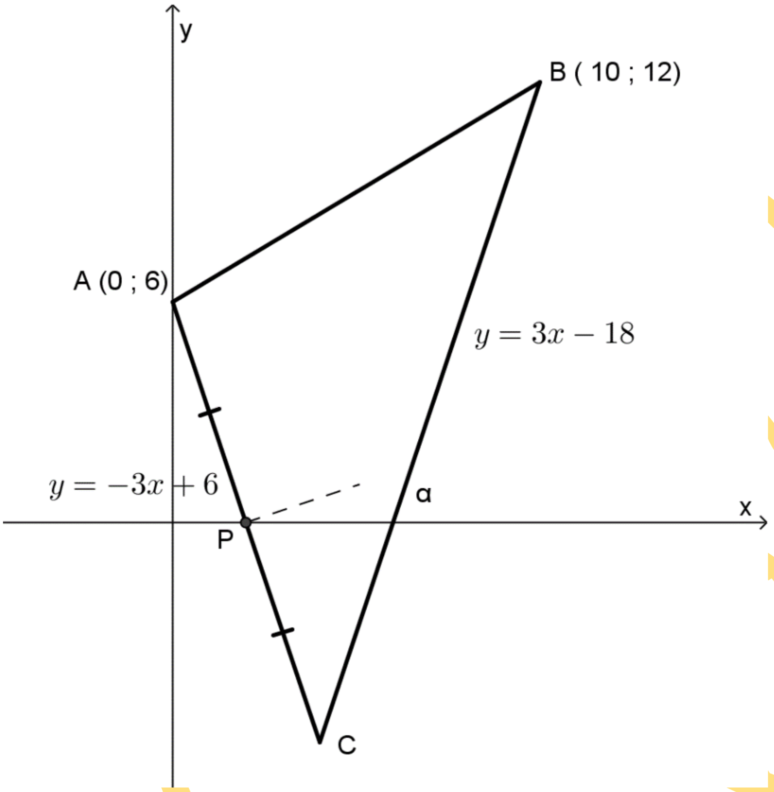


Note: Area of an equilateral triangle = $\frac{\sqrt{3}}{4} \times s^2$

1.1.1 Determine the surface area of the pyramid. (3)

1.1.2 If the cone was melted and recast in the shape of the pyramid with dimensions as given above, how many such pyramids would Jenny be able to make. (6)

1.2 In the diagram below, ΔABC has vertices A(0;6), B(10;12) and C. The equation of line AC is $y = -3x + 6$ and the equation of line BC is $y = 3x - 18$. AC and BC intersect at C.



1.2.1 Determine the coordinates of point C. (4)

1.2.2 Calculate the size of α, the angle between line segment BC and the x-axis. (2)

1.2.3 Prove that triangle ABC is a scalene triangle.
[Hint: A scalene triangle has all unequal sides.] (4)

1.2.4 Determine the coordinates of P, the midpoint of AC. (2)

1.2.5 Determine the equation of the perpendicular bisector of AC. (4)
[25]

QUESTION 2

2.1 Simplify the following expression without the use of a calculator:

$$\frac{\sin 120^0 . \tan 300^0 . \cos(90^0 - x)}{\cos 30^0 . \sin(180^0 - x)}$$ (4)

2.2 Make use of trigonometric identities to prove the following:

$$\frac{\sin x . \cos x - \sin x}{1 - \sin^2 x - \cos x} = \tan x$$ (4)

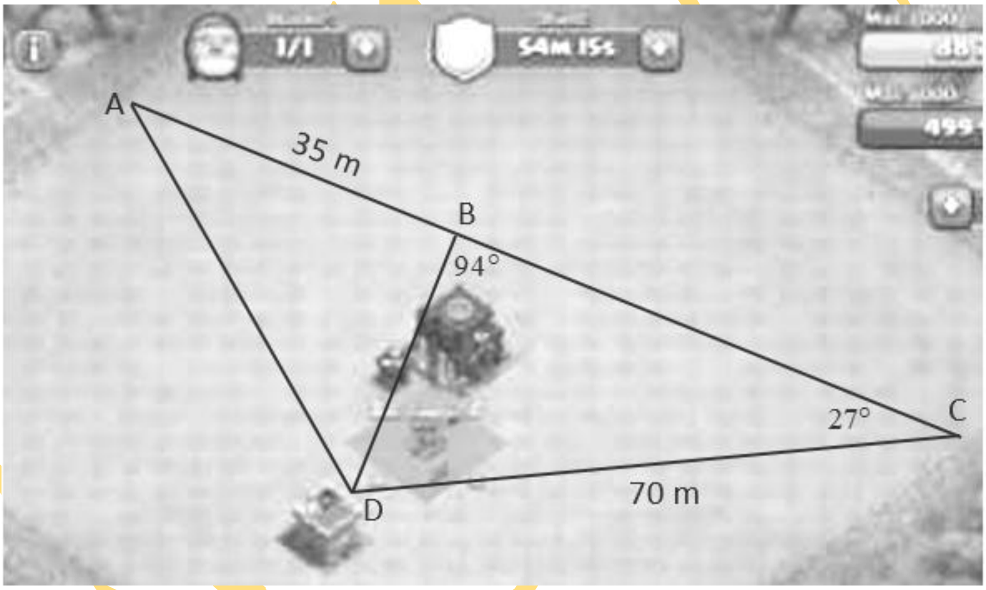
2.3 Calculate the value/s of α if $2\sin^2\alpha + \cos\alpha = 1$ where $\alpha \in [0°;360°]$. (5)

2.4 If $5\cos\theta - 3 = 0$ and θ is acute, determine the value of the following:

2.4.1 $\tan\theta$ (3)

2.4.2 $\sin(900^0 - \theta)$ (3)

2.5 During a game of 'Clash of Clans' the captain, stationed at point D found himself surrounded by enemies. Three infiltrators were found at points A, B and C which form a straight line. Their positions are represented by the following diagram, where $AB = 35\,\text{metres}$, $CD = 70\,\text{metres}$, $C\hat{B}D = 94°$ and $B\hat{C}D = 27°$.



2.5.1 Determine the distance BD correct to 3 decimal places. (2)

2.5.2 Use the cosine rule to calculate the distance AD if BD = 32 metres. (4)
[25]

QUESTION 3

3.1 During a javelin throwing competition at the sports day of a local school, twenty participants threw the following distances in metres:

32	64	67	80	50
102	74	68	70	60
62	64	57	67	66
70	78	76	69	70

3.1.1 Determine the median distance of the participants. (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 above information, showing any outliers. (5)

3.2 The frequency distribution table below represents the numbers of Easter eggs collected by 50 children during an Easter egg hunt.

Classes (eggs)	Frequency(f_i)	Midpoint (x_i)	$f_i \times x_i$	< Cumulative frequency
$0 \leq x < 10$	2	5	10	2
$10 \leq x < 20$	4	15	60	6
$20 \leq x < 30$	20	25		
$30 \leq x < 40$	5	35		
$40 \leq x < 50$	9	45		
$50 \leq x < 60$	10	55		
Total	50		$\sum f_i x_i =$	

3.2.1 Copy and complete the frequency distribution table, shown above, in your ANSWER BOOK. (5)

3.2.2 Calculate the mean number of eggs collected. (2)

3.2.3 Determine the modal number of eggs collected using the formula:

$$Mo = l + \frac{f_m - f_{m-1}}{2f_m - f_{m-1} - f_{m+1}} \times c$$ (4)

3.2.4 Calculate the median number of eggs collected using the formula:

$$Me = l + \frac{\left(\frac{n}{2} - F\right)}{f} \times c$$ (4)

[30]

QUESTION 4

4.1 Given below are the actual income and expense figures against the projected budget figures at the end of the financial year for a social club.

Write the missing values next to the question number (4.1.1–4.1.7) in the ANSWER BOOK.

ITEM	BUDGETED AMOUNT	ACTUAL AMOUNT	VARIANCE
INCOME			
Membership fees	30 000	**(4.1.1)**	-1000
Sponsorships	4 000	4 500	**(4.1.2)**
Donations	7 500	7 500	**0**
TOTAL	**(4.1.3)**	**41 000**	**-500**
EXPENSES			
Rent	2 500	2 500	0
Water and electricity	1 600	1 900	-300
Telephone	900	900	0
Honorarium	3 500	3 500	0
Prize-giving function	9 000	9 600	**(4.1.4)**
Catering	5 000	5 000	0
Year-end function	**(4.1.5)**	7 300	+1400
Refreshments	4 300	4 200	**(4.1.6)**
TOTAL	**35 500**	**(4.1.7)**	**+600**
SURPLUS/DEFICIT	**6 000**	**6 100**	**-100**

(7)

4.2 Doctor Mkhize invested R50 000 for a period of seven years. The total amount accumulated in the fund at the end of seven years is R83 568.

Calculate the interest rate per annum compounded annually that will yield this return. (5)

4.3 Simon takes a loan from Ayanda to the value of R25 000 to start up a new business. Ayanda charges him interest at 12% per annum compounded semi-annually. Three years after he took out the loan, Simon repays an amount of R12 000. Ayanda then changes the loan agreement and charges Simon interest at the rate of 15% per annum compounded monthly for a further 2 years. At the end of the first year of this new agreement, Simon borrows a further R10 000.

4.3.1 Draw a time-line for the loan as described above. (3)

4.3.2 Calculate the amount of money that Simon owes after 5 years. (5)

[20]

TOTAL: 100

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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. $s = \frac{1}{2}(a+b+c)$ *and* a, b, c *are the sides of the triangle*
9. $A = \sqrt{s(s-a)(s-b)(s-c)}$
10. Circumference of circle = $2\pi r$
11. Area of curved surface of a cone = $\pi r l$ or $\pi r h_s$
12. Slant height of a cone = $l = \sqrt{h^2 + r^2}$ or $h_s = \sqrt{{}_\perp h^2 + r^2}$
13. Volume of cone = $V_{cone} = \frac{1}{3} \pi r^2 \times_\perp h$
14. Area of a sphere = $A = 4\pi r^2$
15. Volume of a sphere = $V = \frac{4}{3} \pi r^3$
16. $m = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}$
17. $(x_m ; y_m) = \left(\frac{x_1 + x_2}{2} ; \frac{y_1 + y_2}{2} \right)$
18. $\theta = \tan^{-1} m$
19. Distance = $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
20. $\frac{\sin\theta}{\cos\theta} = \tan\theta$
21. $\sin^2\theta + \cos^2\theta = 1$
22. $\frac{\sin \hat{A}}{a} = \frac{\sin \hat{B}}{b} = \frac{\sin \hat{C}}{c}$
23. $a^2 = b^2 + c^2 - 2bc \cos \hat{A}$

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

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

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

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

28. $Q_i = Q_3 - Q_1$

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

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

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

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

33. $I = A_0 \times \frac{r}{100} \times t$ or $I = \frac{Prt}{100}$ or $A_t = P(1+in)$

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

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

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