higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

MATHEMATICS

(Second paper)

NQF LEVEL 4

(10501064)

17 February 2025 (X-paper)
09:00–12:00

Non-programmable calculators may be used except where indicated differently.

This question paper consists of 9 pages, 2 addenda and a formula sheet of 2 pages.

029Q2S2517

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)
MATHEMATICS
(Second paper)
NQF LEVEL 4
TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer all the questions.
2. Read all the questions carefully.
3. Number the answers correctly 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. Answer QUESTION 3.1 and 3.2 on ADDENDUM A and QUESTION 3.4 on ADDENDUM B. Detach the ADDENDA and submit them with the answer booklet.
7. Clearly show all calculations, diagrams, graphs, etc. used to determine the answers.
8. Round off answers to THREE decimal places, unless stated differently.
9. Diagrams are NOT drawn to scale.
10. Write neatly and legibly.

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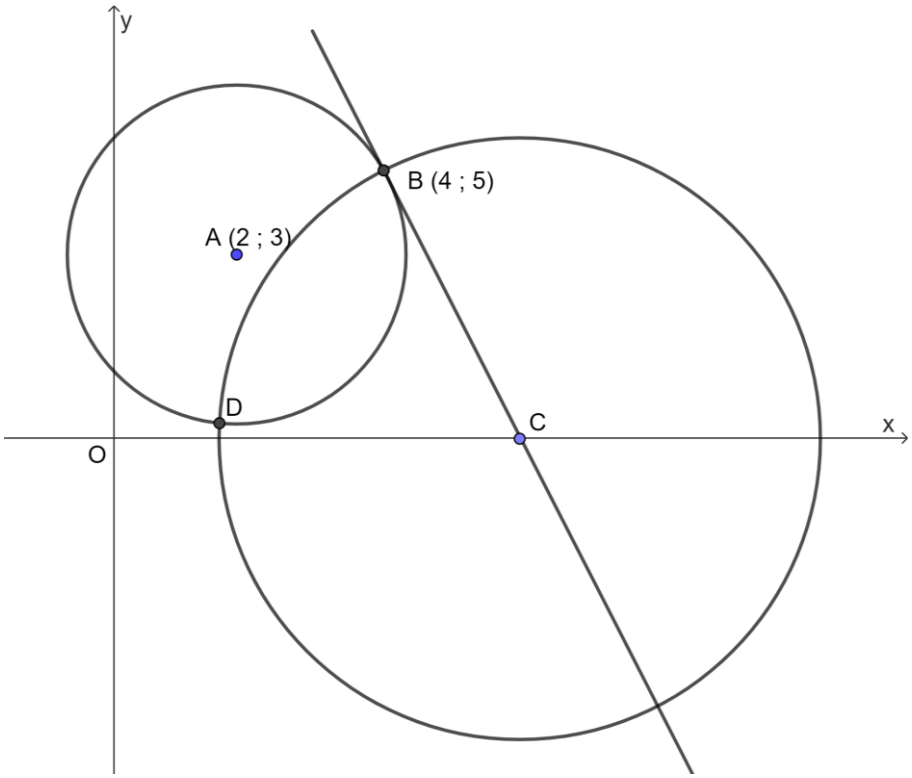
QUESTION 1

1.1 In the figure below, C is the centre of the larger circle and lies on the $x-$ axis. The smaller circle with centre at A (2;3) intersects the larger circle at B (4;5) and at point D. BC is a tangent to the smaller circle at B.



Determine the following:

1.1.1 The equation of the smaller circle in the form:

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

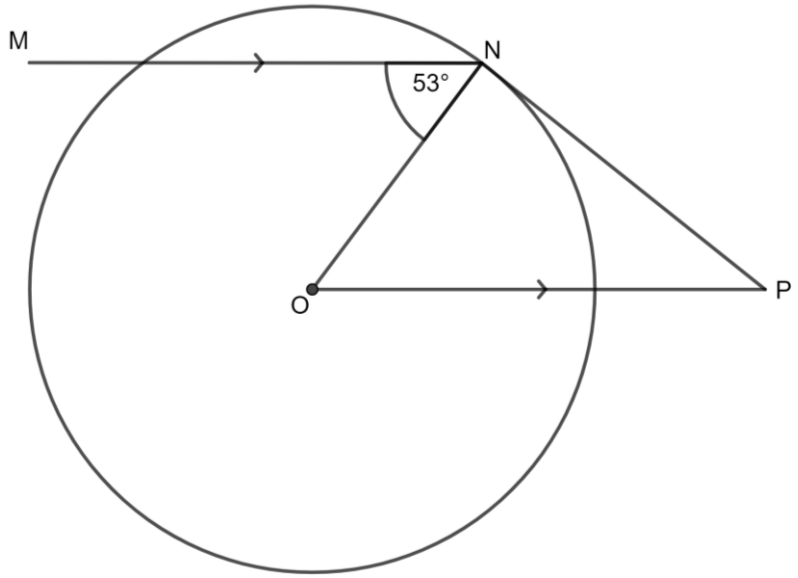
1.1.2 The equation of the tangent BC. (2)

1.1.3 A student claims that the coordinates of point D is $\left(2;\frac{1}{8}\right)$.

Is the student's claim true or false? Substantiate your answer by showing calculations. (2)

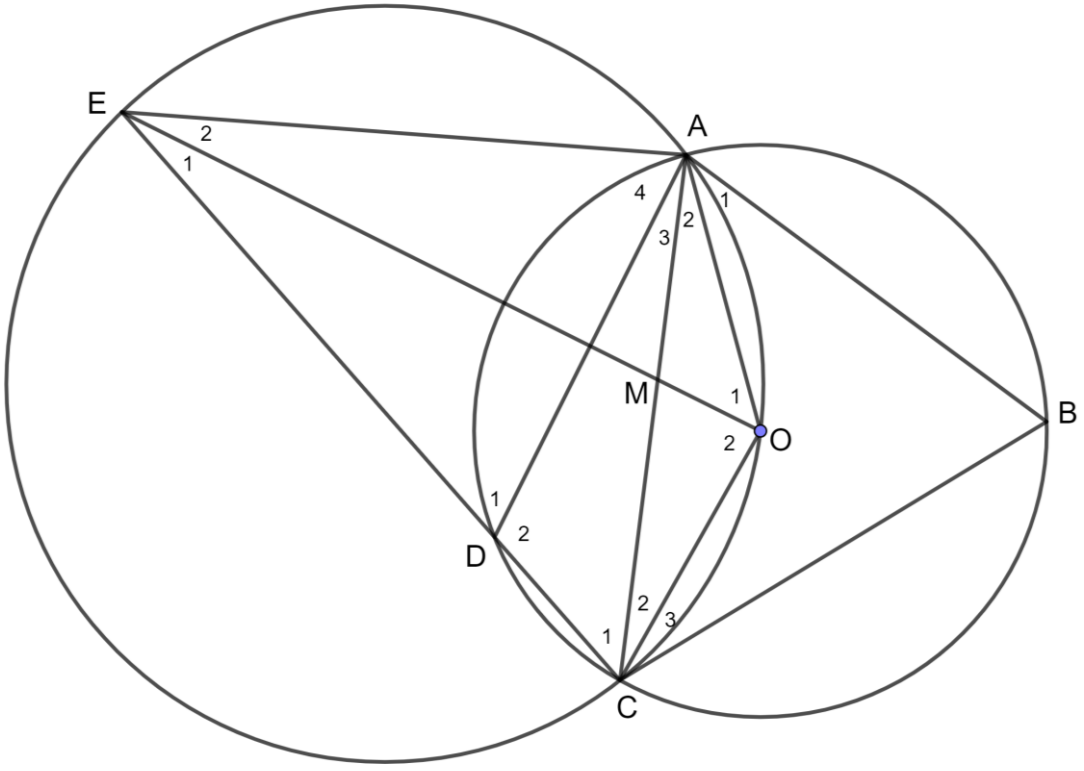
1.2 In the figure below, N is a point on the circle with centre at O. PN is a tangent to the circle at N, $M\hat{N}O = 53°$ and OP || MN.

Calculate the magnitude of $O\hat{P}N$.



(3)

1.3 In the figure below, O is the centre of the smaller circle ABCD.
DC is produced to meet the larger circle AOCE at point E. The chords AC and EO intersect at point M. Let $\widehat{E_1} = y$.



1.3.1 With reasons, name THREE other angles that are equal to y. (5)

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1.3.2 Express $A\widehat{O}C$ in terms of y. Provide a reason for your answer. (2)

1.3.3 Calculate $\widehat{B}$ in terms of y. Provide a reason for your answer. (2)

1.3.4 Prove that EA = ED. Provide a reason at each stage of your answer. (4)

1.3.5 Is AOCD a cyclic quadrilateral? Substantiate your answer. (3)

[25]

QUESTION 2

2.1 Simplify $\sqrt{2\cos 2B + 2}$ (3)

2.2 Without using a calculator, determine the value of x in the following for $x \in [0°; 90°]$

2.2.1 $\cos 87° \cos 23° + \sin 87° \sin 23° = 1 - 2\sin^2 x$ (3)

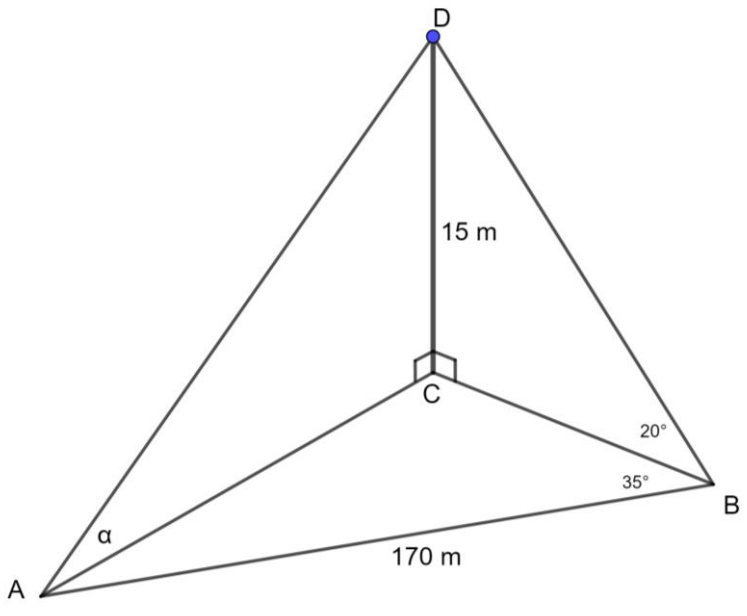
2.2.2 $\sqrt{(1-\cos x)(1+\cos x)} = \frac{1}{2}$ (3)

2.3 Prove the following trigonometric identities:

2.3.1 $$\frac{1+\sin 2x+\cos 2x}{\sin x+\cos x} = 2\cos x$$ (3)

2.3.2 $$\frac{\sin 3x}{\sin x} - \frac{\cos 3x}{\cos x} = 2$$ (4)

2.4 In the figure below, the straight line distance between A and B is 170 m. DC is a vertical tower 15 m high with A, B and C being points on the same horizontal plane. The angles of elevation of point D from points A and B are α and $20°$ respectively. $A\widehat{B}C = 35°$.



Calculate the following:

2.4.1 The length of BC (2)

2.4.2 The value of α correct to 2 decimal places. (4)

2.4.3 The size of $A\hat{C}B$ (correct to 2 decimal places) if $A\hat{C}B$ is an obtuse angle. (3)
[25]

QUESTION 3

A scientist is comparing the interval $(y \text{ in seconds})$ between the mating calls of a certain species of tree frogs and the surrounding temperature $(x\ °C)$. The results are shown in the table below:

Temperature in °C (x)	8	13	14	15	15	20	25	30
Interval in seconds (y)	6,5	4,5	6	5	4	3	2	1

3.1 Use ADDENDUM A (attached) to draw a scatter plot for the above information. (3)

3.2 Draw a line of best fit (i.e. eyeball method) on the scatter plot on ADDENDUM A (attached). (1)

3.3 Name the type of relation between x and y. (1)

3.4 Use the information above to calculate the sample regression equation by the method of least squares. Use ADDENDUM B (attached). (5)

3.5 Use the regression equation calculated in QUESTION 3.4 to estimate the interval between mating calls of a tree frog if the surrounding temperature is 17 °C. (2)

3.6 Calculate the standard deviation for the temperature values. (3)
[15]

QUESTION 4

4.1 The contingency table below contains a record of the different dog types in a city that visited a veterinary doctor for treatment in a given month. The doctor keeps a record of the dogs' colour as well.

	Bulldog (B)	Havanese (H)	Mastiff (M)	Total
Grey (G)	S	10	17	33
White (W)	U	T	4	40
Total	11	41	21	V

4.1.1 Calculate the values of S, T, U and V. (2)

4.1.2 Calculate the probability that a dog chosen at random is not a white Mastiff. (2)

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4.1.3 Are the events "Grey" and "Havanese" independent? Do a calculation to substantiate your answer. (3)

4.1.4 Represent all the information from the contingency table above in a Venn diagram with the main events being "White" and "Mastiff". (2)

4.2 Zungu is planning on spending the evening out with his friends but he is undecided on what to wear. He can choose from the following items he placed on his bed:

- Two pairs of pants: Blue jeans (J) and White pants (W).
- Two tops: Yellow T-shirt (Y) and Green T-shirt (G).
- Two pairs of shoes: Black shoes (B) and red shoes (R).

Each item has an equal chance of being chosen.

4.2.1 Draw a tree diagram to illustrate all possible outcomes. (4)

4.2.2 Calculate the probability that Zungu will wear his white pants, yellow T-shirt and red shoes. (2)
[15]

QUESTION 5

5.1 Do assets lose their value faster under the straight line depreciation method or reducing balance depreciation method? (1)

5.2 A man bought a brand new car for R400 000 and decided that he will only use it for 10 years and sell it. For the first 7 years the car depreciated on the reducing balance basis at a rate of 8,5% per annum and for the last 3 years the car depreciated on the straight line basis at a rate of 4,5% per annum. Calculate the value/worth of the car after 10 years. (4)

5.3 A consumer buys a washing machine valued at R15, 000 on higher purchase. The deposit is 20% of the cash price. The balance is repaid over 36 months at a simple interest rate of 18% per annum. A mandatory monthly insurance of R 50 must be paid each month for the duration of the hire purchase agreement. Calculate:

5.3.1 The deposit amount. (2)

5.3.2 The outstanding balance after the deposit. (1)

5.3.3 The monthly instalment (4)

5.4 Define the following terminology used in taxation:

5.4.1 Tax threshold

5.4.2 Tax credit

(2 × 1) (2)

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5.5 Alfrida, a 20-year-old woman with no dependents, has the following earnings and deductions:

Gross monthly salary : R20 000
Monthly pension fund contribution: R5 000(non-taxable)
Monthly tax deductions : R5 000
UIF : 1% of gross monthly salary

The individual tax rate tables obtained from the South African Revenue Services (SARS) for the financial year 2024 are presented below:

RATES OF TAX FOR INDIVIDUALS 2024 tax year (1 March 2023 – 29 February 2024)	
Taxable income (R)	**Rates of tax (R)**
0 – 237 100	18% of taxable income
237 101– 370 500	42 678 + 26% of taxable income above 237 100
370 501– 512 800	77 362 + 31% of taxable income above 370 500
512 801– 673 000	121 475 + 36% of taxable income above 512 800
673 001– 857 900	179 147 + 39% of taxable income above 673 000
857 901– 1 817 000	251 258 + 41% of taxable income above 857 900
1 817 000 and above	644 489 + 45% of taxable income above 1 817 000

Tax Rebates for 2024 tax year (1 March 2023 – 29 February 2024)	
Tax Rebate	**Tax Year 2024**
Primary	R17 235
Secondary (65 and older)	R9 444
Tertiary (75 and older)	R3 145

Tax Thresholds for 2024 tax year (1 March 2023 – 29 February 2024)	
Age	**Tax Year 2024**
Under 65	R95 750
65 and older	R148 217
75 and older	R165 689

Medical tax credit rates for 2024 tax year (1 March 2023 – 29 February 2024)	
Per Month(R)	**Tax Year 2024**
For the taxpayer	R364
For the first dependent	R364
For each additional dependent	R246

[Source: *sars.gov.za/tax-rates/income-tax/rates-of-tax for individuals/*]

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5.5.1 Calculate Alfrida's annual tax liability. (5)

5.5.2 Calculate Alfrida's monthly take-home pay. (1)
[20]

TOTAL: 100

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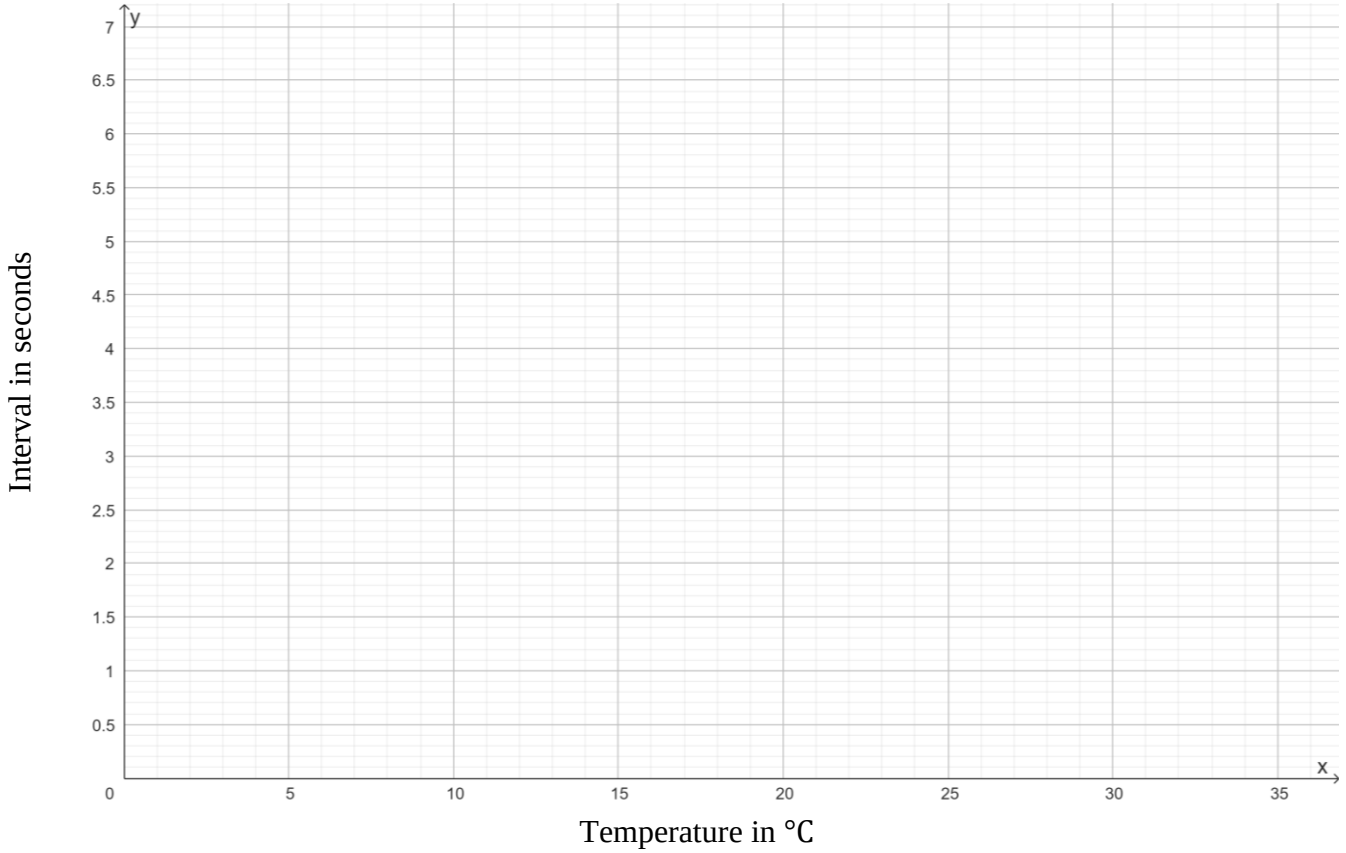
ADDENDUM A

EXAMINATION NUMBER: | | | | | | | | | | | | |

CENTRUM NUMBER: | | | | | | | | | | | |

3.1

3.2



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ADDENDUM B

EXAMINATION NUMBER: | | | | | | | | | | | | |

CENTRUM NUMBER: | | | | | | | | | | | |

3.4

OPTION 1

Temperature in °C (*x*)	**Interval in seconds (*y*)**	xy	x^2
8	6.5		
13	4.5		
14	6		
15	5		
15	4		
20	3		
25	2		
30	1		
$\sum x =$	$\sum y =$	$\sum xy =$	$\sum x^2 =$
$\overline{x} =$	$\overline{y} =$		

OPTION 2

Temperature in °C (*x*)	**Interval in seconds (*y*)**	$(x-\overline{x})(y-\overline{y})$	$(x-\overline{x})^2$
8	6.5		
13	4.5		
14	6		
15	5		
15	4		
20	3		
25	2		
30	1		
$\sum x =$	$\sum y =$	$\sum (x-\overline{x})(y-\overline{y}) =$	$\sum (x-\overline{x})^2 =$
$\overline{x} =$	$\overline{y} =$		

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FORMULA SHEET

NOTE: Some of the formulae in this formula sheet may not be generally true, but may apply 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 $= \sqrt{\frac{\sum (x_i - \bar{x})^2}{n}}$

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

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

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

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

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

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

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

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

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

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

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

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

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