higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

MATHEMATICS

(Second paper)

NQF LEVEL 4

(10501064)

6 November 2024 (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.

025Q2N2406

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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 a blue pen.
6. Clearly show all calculations, diagrams, graphs, etc. used to determine the answers.
7. Round off answers to THREE decimal places, unless stated differently.
8. Diagrams are NOT drawn to scale.
9. Write neatly and legibly.

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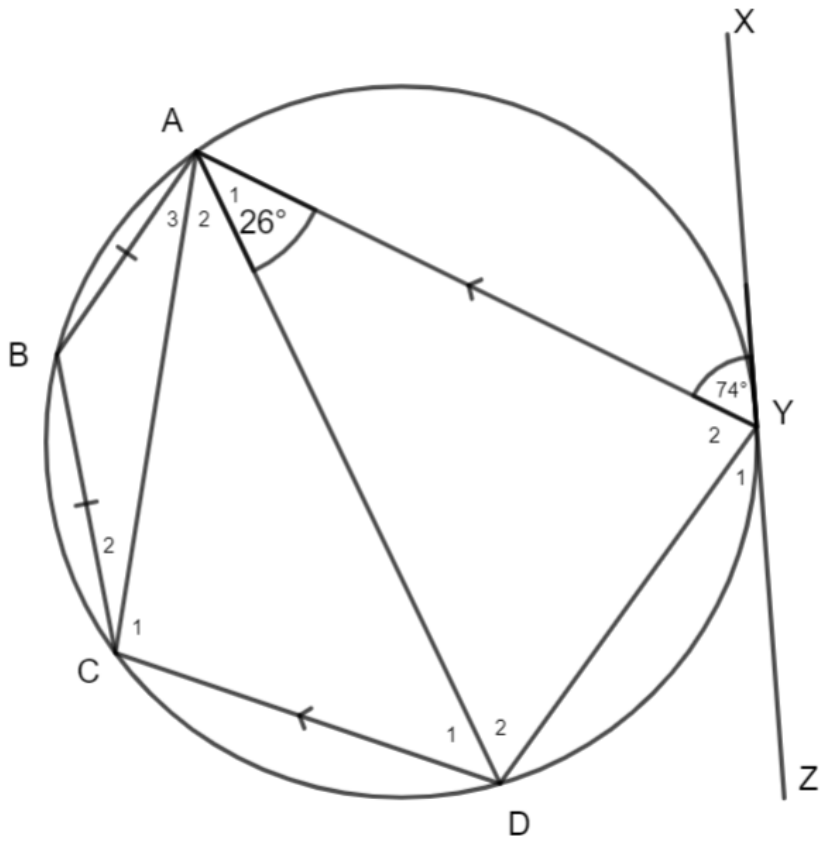
QUESTION 1

1.1 In the figure below, XYZ is a tangent to the circle AYDCB at point Y. $AY||CD$, $AB = BC$, $\hat{A}_1 = 26°$, $X\hat{Y}A = 74°$ and ADCB is a cyclic quadrilateral.



Determine the size of the following angles giving reasons:

1.1.1 $\hat{Y}_1$

1.1.2 $\hat{D}_1$

1.1.3 $\hat{B}$

1.1.4 $\hat{C}_2$

(4×2) (8)

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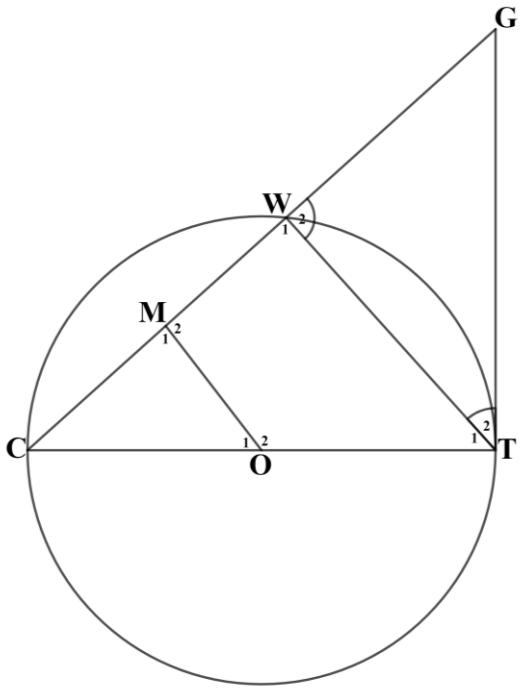
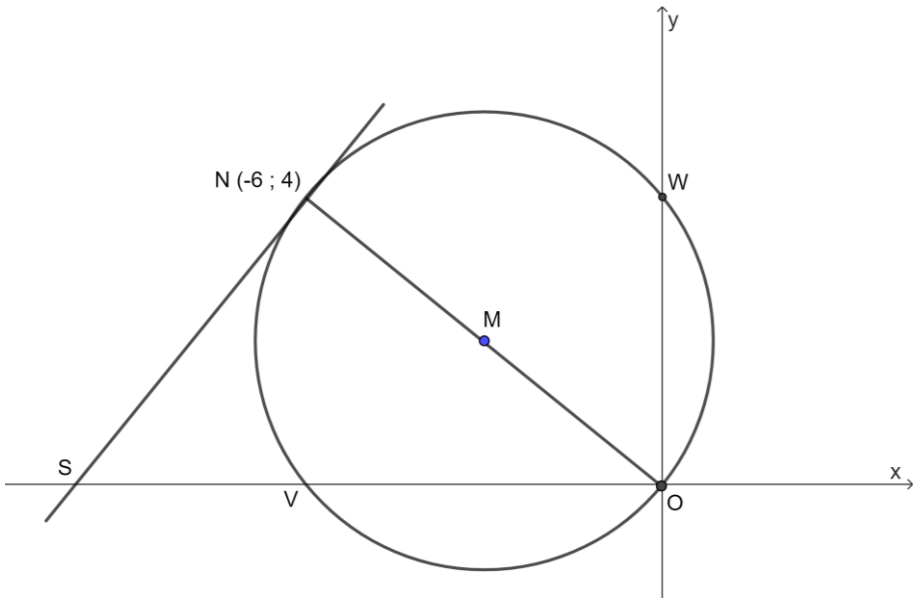
1.2 In the figure below, COT is the diameter of the circle centred at O. TG is a tangent to the circle at T and GC cuts the circle at W. M is the midpoint of CW. Prove, giving reasons that OTGM is a cyclic quadrilateral.



(5)

1.3 In the figure below, the circle with centre M passes through the origin O and intersects the $x-$ axis at V and the $y-$ axis at W. The tangent to the circle at $N(-6;4)$ intersects the $x-$ axis at S.



1.3.1 Calculate the coordinates of M. (2)

1.3.2 Calculate the length of the radius of the circle (Leave your answer in surd form). (3)

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1.3.3 Determine the equation of the circle in the form:
$(x-a)^2+(y-b)^2=r^2$ (2)

1.3.4 Determine the equation of the tangent SN to the circle in the form:
$y=mx+c$ (3)

1.3.5 Determine the coordinates of S. (2)

[25]

QUESTION 2

2.1 Simplify the following without using a calculator:

2.1.1 $1-2\sin^2 15°$ (2)

2.1.2 $\sin 96°\cos 24°-\sin 24°\cos 276°$ (3)

2.1.3 $\cos(75°)$ (4)

2.2 Calculate the values of x given that $\sin 2x+\sin x=6\cos x+3$, where $x\in[0°;360°]$. (4)

2.3 Prove the following trigonometric identities:

2.3.1 $\dfrac{1+\sin 2x}{\sin^2 x}=\left(1+\dfrac{\cos x}{\sin x}\right)^2$ (3)

2.3.2 $\dfrac{2\sin x\cos x}{\cos^4 x-\sin^4 x}=\tan 2x$ (3)

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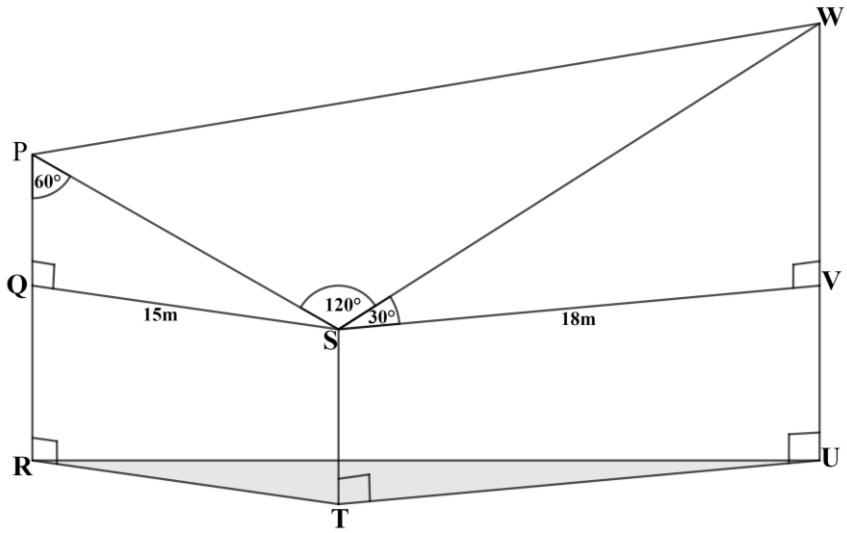
2.4 The figure below is an event centre where the rectangular walls STRQ and STUV are vertical to the horizontal plane RTU. Metallic poles are erected along RQ and UV and extended to points P and W respectively. ΔPSW is the roof of the event centre. Also, $\text{Q}\widehat{\text{P}}\text{C} = 60°, \text{P}\widehat{\text{S}}\text{W} = 120°, \text{W}\widehat{\text{S}}\text{V} = 30°, \text{QS} = 15\text{m}$ and $\text{SV} = 18\text{m}$. Calculate the following and leave your answers correct to 1 decimal place:



2.4.1 The length of PS

2.4.2 The length of SW

2.4.3 The length of PW

(3 × 2) (6)

[25]

QUESTION 3

A biologist is conducting research on whether birds of prey exposed to pollutants lay eggs with thinner shells. He collects a random sample of egg shells from 6 different nests and tests them for pollutant levels (x), and also measures the thinning of the shells (y). The results are shown in the table below:

Pollutant levels (x)	3	8	30	25	15	12
Thinning (y)	1	3	9	10	5	6

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

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

3.3 Draw the regression equation calculated in QUESTION 3.2 on the scatter plot in Addendum A (attached). (2)

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3.4 The biologist reviews similar research and determines that pollutant levels above 16 are likely to result in the death of a chick soon after hatching. Using the regression equation calculated in QUESTION 3.2; estimate the minimum thinning of shells that is likely to result in the death of a chick. (2)

3.5 Calculate the standard deviation of the pollutant levels. (3)
[15]



QUESTION 4

4.1 Define the following terminologies as used in probabilities. In each case, write down a formula that matches the definition.

4.1.1 Mutually inclusive events

4.1.2 Independent events

(2 × 2) (4)

4.2 A test was given to 91 students and the table below shows the grades received by the students. The students received an A, B or a C in the test

	A	**B**	**C**	**Total**
Male (M)	16	20	9	45
Female (F)	15	Y	23	X
Total	31	28	32	91

4.2.1 Determine the values of X and Y. (2)



4.2.2 If a student is selected at random, what is the probability of selecting a student

(a) that obtained grade A in the test. (1)

(b) that obtained grade C in the test, given that the selection is made from the female students only. (1)

(c) that is a female or obtained grade B in the test. (2)



(d) that did not obtained grade B in the test (2)

4.2.3 Are the events "Male" and Grade "A" independent? Do a calculation correct to 1 decimal place to justify your answer. (3)
[15]

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QUESTION 5

5.1 Simple interest and compound interest are two methods of appreciation. Under which method will investments appreciate faster? (1)

5.2 A woman invested a certain amount of money into an account that yields a 5,5% simple interest per annum. Given that she had R22 464 at the end of 8 years, calculate how much she initially invested into the account. (3)

5.3 Salome opened a tax-free investment account with Standard Bank and deposited R17 500 into the account. She intends to use the money in 12 years' time when her son will be going to university. Given that the account earns interest at 7,5% per annum compounded quarterly, calculate the following:

5.3.1 The amount of her investment after 12 years. (2)

5.3.2 The interest her investment would earn after 12 years. (1)

5.4 Musi bought a car for R350 000. The value of the car depreciates at 20% p.a. on the reducing balance method. In 7 years' time the car must be replaced by another of the same model and type. However, the value of the new car appreciates at 5% p.a. simple interest. What will Musi pay in 7 years' time if the old car is used as a trade-in for the new car? (5)

5.5 Define the following terminology as used in taxation:

5.5.1 Taxable income

5.5.2 Tax rebate

(2 × 1) (2)

5.6 Mary, a 70 year old netball coach with no dependents, has the following financial details:

Gross monthly salary	R150 000
13th cheque	R100 000
Annual performance bonus	R75 000
Tax paid to SARS during the year	R650 000

The individual tax rate table obtained from the South African Revenue Services (SARS) for the financial year 2024 is provided on the next page.

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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/*]

5.6.1 Calculate the amount of tax that Mary must pay or receive after a SARS assessment. (5)

5.6.2 Mary seems to be paying too much tax to SARS. Advise her on how to legally reduce the amount of tax paid to SARS. (1)

[20]

TOTAL: 100

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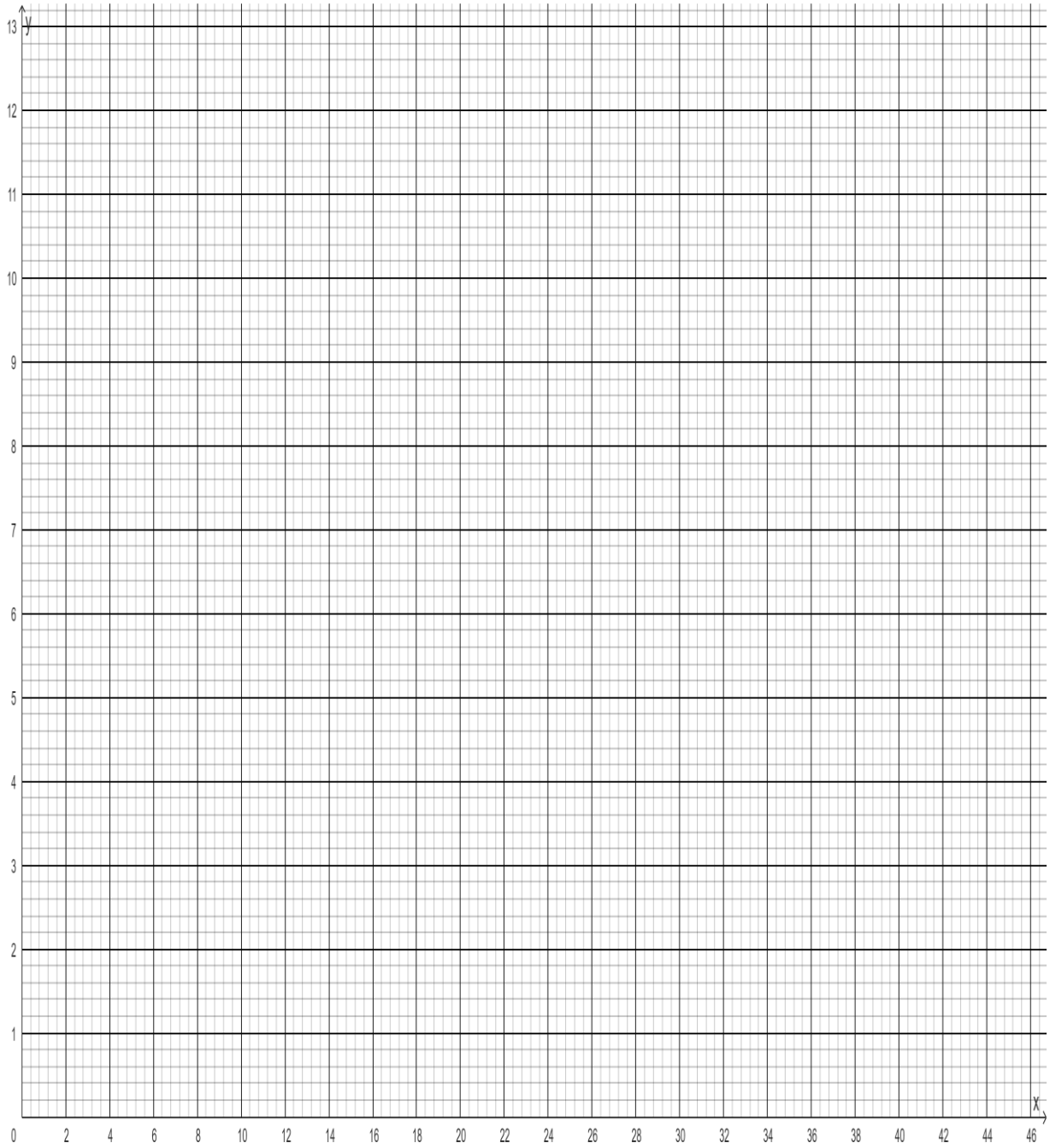
ADDENDUM A

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

CENTRE NUMBER: | | | | | | | | | | | |

3.1
3.3



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ADDENDUM B

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

CENTRE NUMBER: | | | | | | | | | | | |

3.2

NOTE: Choose between **OPTION 1** and **OPTION 2**

OPTION 1

Pollutant (x)	**Thinning** (y)	xy	x^2
3	1		
8	3		
30	9		
25	10		
15	5		
12	6		
$\sum x =$	$\sum y =$	$\sum xy =$	$\sum x^2 =$
$\bar{x} =$	$\bar{y} =$		

OPTION 2

Pollutant (x)	**Thinning** (y)	$(x-\bar{x})(y-\bar{y})$	$(x-\bar{x})^2$
3	1		
8	3		
30	9		
25	10		
15	5		
12	6		
$\sum x =$	$\sum y =$	$\sum (x-\bar{x})(y-\bar{y}) =$	$\sum (x-\bar{x})^2 =$
$\bar{x} =$	$\bar{y} =$		

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FORMULA SHEET

NOTE: Some of the formulae on this formula sheet may not be generally true, but may apply under certain conditions. Candidates are required to select the appropriate formula 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. $\text{Distance} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
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. $\text{Variance} = s^2 = \dfrac{\sum (x_i - \bar{x})^2}{n}$

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20. Standard deviation $= \sqrt{\dfrac{\sum (x_i - \bar{x})^2}{n}}$

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

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

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

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

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

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

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

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

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

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