education
MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA

GERT SIBANDE DISTRICT

GRADE 12

MATHEMATICS

TERM 3 TEST

AUGUST 2022

MARKS: 60

TIME: 1 HOUR

This question paper consists of 7 pages and 1 information sheet

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions:

1. This question paper consists of 4 questions. Answer **ALL** the questions.
2. Clearly show **ALL** the calculations, reasoning, diagrams, graphs, etc, that you have used in determining your answers.
3. An approved calculator (non-programmable and non-graphical) may be used, unless stated otherwise.
4. If necessary, answers should be rounded off to **TWO** decimal places, unless stated otherwise.
5. Number the answers **EXACTLY** as the questions are numbered.
6. It is in your own interest to write legibly and to present the work neatly
7. Diagram are not drawn to scale

QUESTION 1

1.1 Xoli bought a new equipment at a cost of R12 146,72. The value of the equipment depreciated at a rate of r% per annum compounded monthly.
Calculate r if it took 3 years for the equipment to depreciate to R10 000, 00. (4)

1.2 A car with a technical problem, overheated, which resulted in its engine coolant temperature (ECT) reaching 150 °C.
Determine the time (in minutes) it took the engine to cool down to its normal ECT of 81 °C if the temperature of the coolant cools down or decreases at a rate of 8% per minute (3)

1.3 A school will need to replace some of its equipment in 6 years' time. The principal calculated that the new equipment will cost R44 500.
The school establishes a sinking fund to pay for the new equipment and makes an immediate deposit of R6 300 into the fund, which generates interest at 6,85% p.a. compounded monthly.

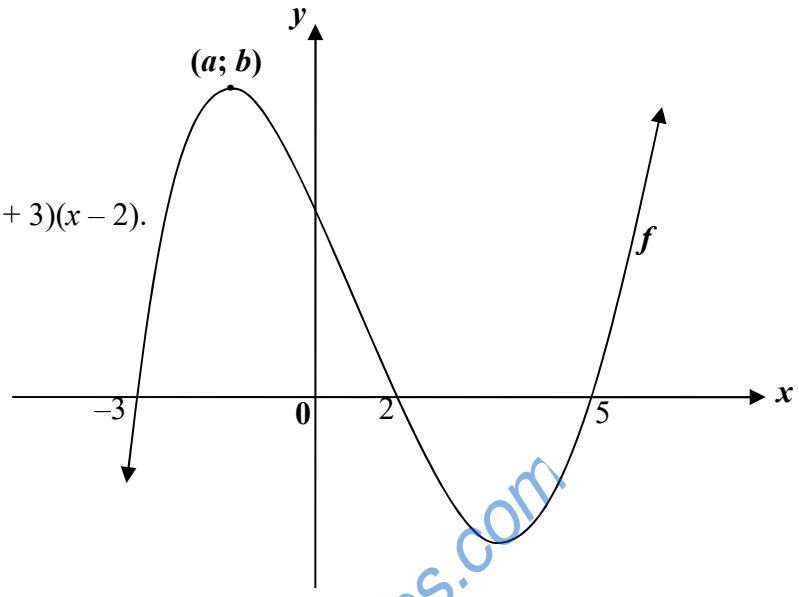
1.3.1 Show that the value of the sinking fund that the school must deposit into the fund will be R35 008,65 after depositing the R6 300. (3)

1.3.2 How much money should the school deposit each month so that the fund will have enough money to cover the cost of the new equipment? (3)

[13]

QUESTION 2

2.1 The graph, not drawn to scale, represents the cubic function f with equation
$f(x) = x^3 - 4x^2 - 11x + 30 = (x - 5)(x + 3)(x - 2)$.



Determine:

2.1.1 the values of a and b, where $(a; b)$ is a turning point of f. (4)

2.1.2 the values of x for which $f'(x) < 0$ where $f(x) \geq 0$ (2)

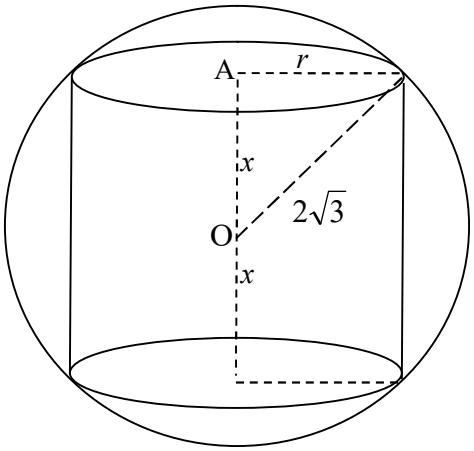
2.1.3 the values of x for which f is concave down (2)

2.2 The graph of a cubic function has the following properties:

- $f(1) = f(6) = f(-2) = 0$
- $f'(4) = f'(-0{,}7) = 0$
- $f'(x) > 0, x \in (-0{,}7; 4)$

Use this information to draw a sketch graph of f.
Clearly indicate the x-coordinates of the turning points and ALL the x-intercepts. (3)

2.3 The diagram shows a cylindrical can that fits into a sphere with centre O.
The radius is $2\sqrt{3}$ units. OA = x units



$V = \frac{4}{3}\pi r^3 \qquad V = \frac{1}{3}\pi r^2 h \qquad V = \pi r^2 h$

2.3.1 Show that the radius of the cylinder is given by $r = \sqrt{12 - x^2}$ (2)

2.3.2 Calculate the value of x for which the volume of the cylinder is a maximum (4)

[17]

QUESTION 3

3.1 It is given that $P(A) = \frac{1}{4}$ and $P(A \text{ or } B) = \frac{1}{3}$

Determine P(B), as a simplified fraction, if A and B are independent events. (3)

3.2 A car park has 14 VOLKSWAGEN cars and 18 BMW's. There are no other cars. During the afternoon two cars are stolen – one early afternoon, the other later.

Determine, using a tree diagram, the probability that:

3.2.1 Both cars were BMW's. (3)

3.2.2 The first one stolen was a BMW and the second one a Volkswagen. (2)

3.3 Four - digit codes (not beginning with 0), are to be constructed from the set of digits {1 ; 3 ; 4 ; 6 ; 7 ; 8 ; 0 }.

3.3.1 How many four - digit codes can be constructed, if repetition of digits is not allowed? (1)

3.3.2 Calculate the probability of randomly constructing a four - digit code which is divisible by 5 if repetition of digits is allowed. (3)

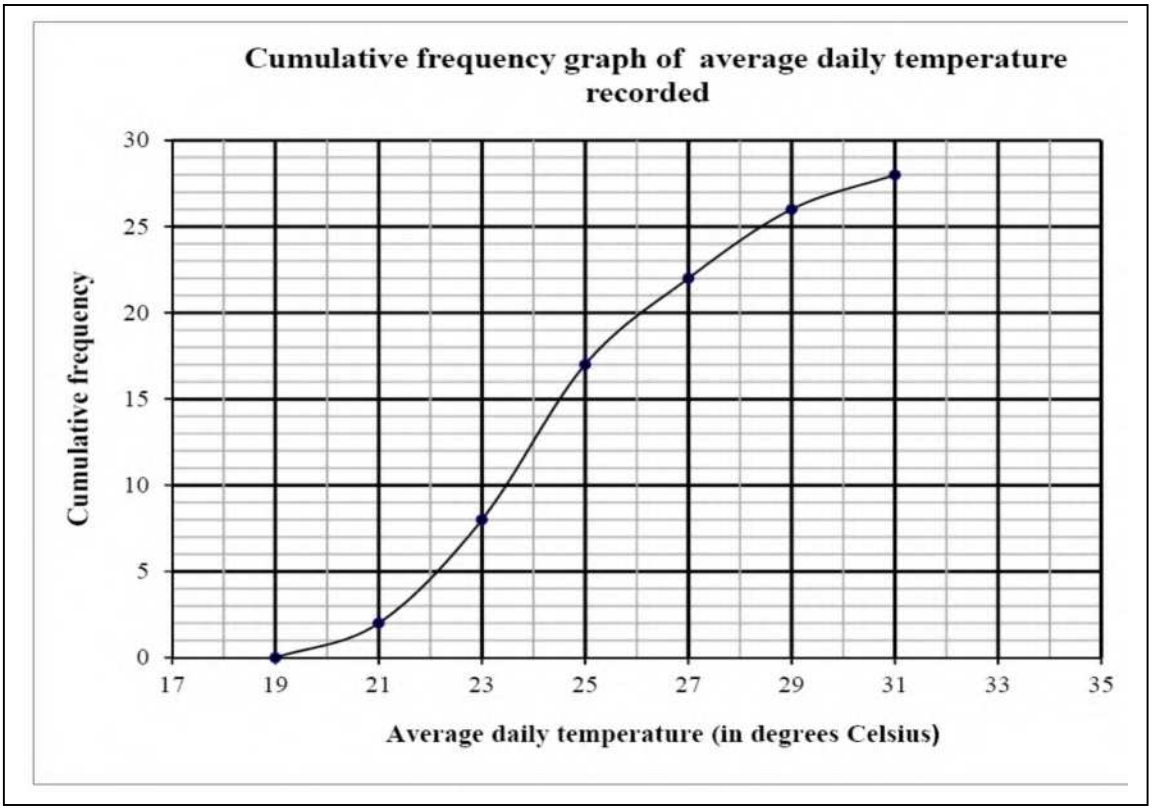
3.4 Consider the word: EINSTEIN.

It is given that there are 5040 possible different letter arrangements if all the letters of the word EINSTEIN are used.

What is the probability that identical letters will be grouped together? (2)
[14]

QUESTION 4

The 2012 Summer Olympic Games was held in London. The average daily temperature, in degrees Celsius, was recorded for the duration of the Games. A cumulative frequency graph (ogive) of this data is shown below.



4.1.1 Over how many days was the 2012 Summer Olympic Games held? (1)

4.1.2 Estimate the percentage of days that the average daily temperature was less than 24 °C. (2)

4.1.3 Write down the modal class of the data. (1)

4.2 The table shows the number of athletes and total number of medals that some countries obtained during the 2012 Summer Olympics.

(Information according to: http://www.wow.com/wiki/2012_London_Olympics)

Country	Number of athletes	Number of medals
USA	530	103
China	396	88
Great Britain	541	65
Russia	436	79
South Korea	245	28
Germany	392	44
France	330	34
Australia	410	35
South Africa	133	6
Canada	277	18
The Netherlands	175	20
New Zealand	184	13

4.2.1 Calculate the standard deviation of the medals received (2)

4.2.2 How many countries have their number of medals falling within one standard deviation from the mean (3)

4.2.3 Use the table to determine the equation of the least squares regression line for the data (3)

4.2.4 Calculate the correlation coefficient for the data (1)

4.2.5 Predict how many medals (to the nearest integer) a country with 150 athletes should obtain? (2)

4.2.6 Suppose the county in Question 4.2.5. represented by 150 athletes, obtained 60 medals. Name one possible reasons for this unexpected achievement (1)

[16]

TOTAL: 60

INFORMATION SHEET: MATHEMATICS

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$A = P(1+ni) \qquad A = P(1-ni) \qquad A = P(1-i)^n \qquad A = P(1+i)^n$$

$$\mathbf{T_n = a + (n-1)d} \qquad \mathbf{S_n} = \frac{n}{2}[2a + (n-1)d]$$

$$\mathbf{T_n} = ar^{n-1} \qquad S_n = \frac{a(r^n - 1)}{r-1}; \quad r \neq 1 \qquad \mathbf{S_\infty} = \frac{a}{1-r}; \quad -1 < r < 1$$

$$F = \frac{x[(1+i)^n - 1]}{i} \qquad P = \frac{x[1-(1+i)^{-n}]}{i}$$

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \qquad \mathbf{M}\left(\frac{x_1 + x_2}{2}; \frac{y_1 + y_2}{2}\right)$$

$$y = mx + c \qquad y - y_1 = m(x - x_1) \qquad m = \frac{y_2 - y_1}{x_2 - x_1} \qquad m = \tan\theta$$

$$(x-a)^2 + (y-b)^2 = r^2 \qquad \textbf{\textit{In } } \Delta ABC: \qquad \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc.\cos A \qquad area\ \Delta ABC = \frac{1}{2}ab.\sin C$$

$$\sin(\alpha + \beta) = \sin\alpha.\cos\beta + \cos\alpha.\sin\beta \qquad \sin(\alpha - \beta) = \sin\alpha.\cos\beta - \cos\alpha.\sin\beta$$

$$\cos(\alpha + \beta) = \cos\alpha.\cos\beta - \sin\alpha.\sin\beta \qquad \cos(\alpha - \beta) = \cos\alpha.\cos\beta + \sin\alpha.\sin\beta$$

$$\cos 2\alpha = \begin{cases} \cos^2\alpha - \sin^2\alpha \\ 1 - 2\sin^2\alpha \\ 2\cos^2\alpha - 1 \end{cases}$$

$$\sin 2\alpha = 2\sin\alpha.\cos\alpha$$

$$\bar{x} = \frac{\sum fx}{n} \qquad \sigma^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n}$$

$$P(A) = \frac{n(A)}{n(S)} \qquad P(A\ or\ B) = P(A) + P(B) - P(A\ and\ B)$$

$$\hat{y} = a + bx \qquad b = \frac{\sum(x - \bar{x})(y - \bar{y})}{\sum(x - \bar{x})^2}$$

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QUESTION 1

1.1

$A = P(1-i)^n$

$10\,000 = 12146{,}72(1-i)^{36}$

$\frac{10\,000}{12146{,}72} = (1-i)^{36}$

$\sqrt[36]{12146{,}72} = 1-i$

$i = 1-\sqrt[36]{12146{,}72}$

$\frac{r}{12} = 1-\sqrt[36]{\frac{10\,000}{12146{,}72}}$

$r = 0{,}06464$

$= 6{,}46\%$

✓substitution

✓simplification

✓ $\frac{r}{12}$

✓answer (4)

1.2

$A = P(1-i)^n$

$81 = 150\left(1-\frac{8}{100}\right)^n$

$0{,}54 = 092^n$

$n = \log_{0,92} 0{,}54$

$n = 7{,}39$

It will take 7,39 min.

✓substitution

✓ $0{,}54 = 092^n$

✓ answer (3)

1.3.1

R6 300 is deposited into the fund which earns interest until the end of the 6 years.

$A = P(1+i)^n$

$= 6300\left(1+\frac{0{,}0685}{12}\right)^{(6\times12)}$

$= R9491{,}35$

Outstanding amount:

R44 500 – R9 491,35 = R35 008, 65

✓ Subst. in formula

✓ R9491,35

✓ Subtraction (3)

1.3.2

$F = \frac{x\left[(1+i)^n - 1\right]}{i}$

$35008{,}65 = \frac{x\left[\left(1+\frac{0.0685}{12}\right)^{(6\times12)} - 1\right]}{\frac{0{,}0685}{12}}$

$\therefore x = \frac{35008{,}65 \times \frac{0{,}0685}{12}}{\left[\left(1+\frac{0{,}0685}{12}\right)^{(6\times12)} - 1\right]}$

$x = R394{,}50$

✓values of i and n

✓substitution

✓answer (3)

QUESTION 2

2.1.1

$3x^2 - 8x - 11 = 0$

$(3x-11)(x+1)=0$

$x = \frac{11}{3}$ *or* $x = -1$

$a = -1$

$b = f(-1)$

$= (-1-5)(-1+3)(-1-2)$

$= 36$

✓ derivative = 0

✓ factors

✓ value of a

✓ Value of b

(4)

2.1.2

$x \in (-1;2]$ *or*

$-1 < x \leq 2$

✓ Critical values

✓ notation

(2)

2.1.3

Point of inflection

$f''(x) = 6x - 8$

$\therefore x = \frac{4}{3}$

$x < \frac{4}{3}$

$or \left(-1 + \frac{11}{3}\right) \div 2$

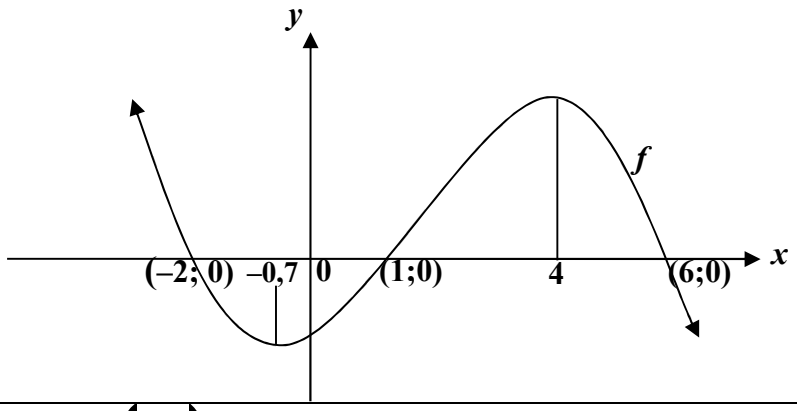
$\therefore x < \frac{4}{3}$

✓ $\frac{4}{3}$

✓ notation

(2)

2.2



✓ shape

✓ x-intercepts.

✓ x-coordinates of the turning

(3)

2.3.1

$x^2 + r^2 = \left(2\sqrt{3}\right)^2$ (Pythagoras theorem)

$r^2 = 12 - x^2$

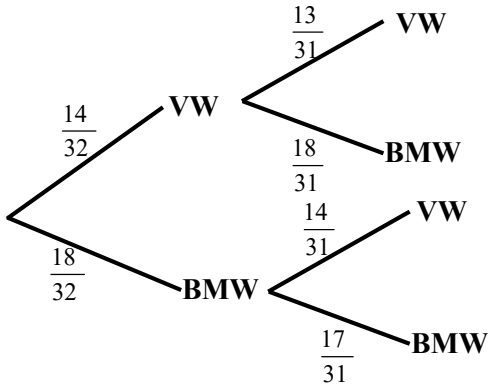
$r = \sqrt{12 - x^2}$

✓ $x^2 + r^2 = \left(2\sqrt{3}\right)^2$

✓ $r^2 = 12 - x^2$

(2)

2.3.2	$h = 2x$ $V = \pi r^2 h$ $= 2\pi x\left(12 - x^2\right),$ $= 24\pi x - 2\pi x^3$ $\therefore \frac{dV}{dx} = \frac{d\left(24\pi x - 2\pi x^3\right)}{dx} = 0$ $6\pi x^2 = 24\pi$ $x^2 = 4,\ x = \pm 2$ $\therefore x = 2$	✓substitution in V formula ✓ $24\pi x - 2\pi x^3$ ✓ $\frac{dV}{dx} = 0$ ✓answer (4)

QUESTION 3		
3.1	P(A or B) = P(A) + P(B) – P (A and B) P(A or B) = P(A) + P(B) – P(A)×P(B) $\therefore \frac{1}{3} = \frac{1}{4} + P(B) - \frac{1}{4} \times P(B)$ $\therefore \frac{1}{3} - \frac{1}{4} = \frac{3}{4}P(B)$ $\frac{1}{12} = \frac{3}{4}P(B)$ $\therefore P(B) = \frac{1}{12} \times \frac{4}{3}$ $= \frac{1}{9}$	✓ P(A and B)=P(A) ×P(B) ✓ substitution into correct formula ✓ answer (3)
3.2.1	 $P(\text{both } BMW) = \frac{18}{32} \times \frac{17}{31}$ $= \frac{153}{496} \approx 0{,}31$	✓ tree diagram ✓ $\frac{18}{32} \times \frac{17}{31}$ ✓ answer (3)

3.2.2	$P(\text{BMW and VW}) = \frac{18}{32} \times \frac{14}{31}$ $= \frac{63}{248} \approx 0,25$	✓ $\frac{18}{32} \times \frac{14}{31}$ ✓ answer (2)
3.3.1	$6 \times 6 \times 5 \times 4 = 720$	✓ answer (1)
3.3.2	$6 \times 7 \times 7 \times 1 = 294$ $P(\text{code div by } 5) = \frac{294}{2058}$ $= 0,1224$ $= 12,24\%$	✓252 ✓2058 ✓ answer (3)
3.4	$n(E) = 5! = 120$ $P(E) = \frac{5!}{5040}$ $= \frac{120}{5040}$ $= \frac{1}{42}$	✓5! Or 120 ✓answer (2)

QUESTION 4		
4.1.1	28 days	✓modal class (1)
4.1.2	Accept between 12 days and 13days 12 days $\frac{12}{28} \times 100 = 42{,}86\%$ Or 12,5 days: 44,64% 13 days: 46,43%	✓number of days ✓correct % (2)
4.1.3	23 °C to 25 °C 23 °C < t < 25 °C	✓modal class (1)
4.2.1	$\delta = 30{,}52$	✓✓answer (2)
4.2.2	For one standard deviation: (44,42 – 30,52 ; 44,42 + 30,52) (13,9 ; 74,94) 8 countries	✓ minimum ✓ maximum ✓ answer (3)
4.2.3	a = –22,70544202 b = 0,1989294404 y = –22,71 + 0,20x	✓value of a ✓value of b ✓equation (3)
4.2.4	r = 0,8496991 = 0,85	✓answer (1)
4.2.5	y = –22, 71 + 0,20(150) = 7,29 About 7 medals	✓substitution ✓answer (2)
4.2.6	Athletes may be using drugs or high performance stimulants Or they may be using high tech equipment to train Or they may be allowed to participate in more than one field and excelling whenever they are participating	✓any valid reason (1)