MINISTERE DES ENSEIGNMENTSSECONDAIRES
****
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MINISTRY OF SECONDARY EDUCATION
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GBHS NYALLA
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NAME OF STUDENT :.....	
N°	**Date :**.....
TEST N° :.....	**Classe : USS\USA**
PERIOD .....**DURATION : Three (3) Hours**	

EXPECTED OUTCOME :.....

APPRECIATION OF COMPETENCE (MARK A CROSS(X))

NOT ACAUIRED (NA)	BEING ACQUIRED (EA)	ACQUIRED (A)

EVALUATION MARK :	**Paper 1** ..... **Paper 2 :**.....	**FINAL MARK**
	Paper 3 :.....	

PARENT : Name:.....

Date :.....**Tel :**..... **Signature :**.....

OBSERVATIONS (PARENT) :	

NICKEINSTEIN...

MATHEMATICS

Time Allowed: 3 hours.

Instructions:

1. This paper is arranged in three sections; **A**, **B** and *C*. Candidates are required to answer **ONLY**, **SECTIONS A** and **B**, or **SECTIONS A** and **C**. Candidates should **ANSWER EACH SECTION ON SEPARATE SHEETS.**
2. *Sufficient working must be done to demonstrate the mathematical method employed. The number of marks is given in brackets at the end of each question or part-question. You are reminded of the necessity for good English and orderly presentations in your answers.*

SECTION A: (Pure Mathematics) **1 Hour 30 Minutes**

1. A function f is defined by $f(x) = 2x^3 - 3x^2 - 36x + 12$.

(i) Evaluate $f(3)$ and $f(-2)$.

(ii) Obtain $f'(x)$.

(iii) Use your expression for $f'(x)$ to find the coordinates of the two stationary points on the curve.

(iv) By drawing a sign table, distinguish between the stationary points.

(v) Obtain the point of inflexion.

(vi) Sketch the graph of $y = f(x)$. Deduce the range of values of k for which the equation $f(x) = k$ has three real roots.

[1+1+2+3+2+2=11 Marks]

2. (a) A function f is defined by $f(x) = |x^2 - 1| - |x^2 - 4|$, determine $f'(x)$.

(b) Given that $\sin y = 2 \sin x$, show that

(i) $\left(\frac{dy}{dx}\right)^2 = 1 + 3\sec^2 y$.

(ii) By differentiating (*i*) with respect to x, show that $\frac{d^2y}{dx^2} = 3\sec^2 y \tan y$ and hence that, $\cot y \frac{d^2y}{dx^2} - \left(\frac{dy}{dx}\right)^2 + 1 = 0$.

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[2+(2+3)=7 Marks]

3. (a) State, without prove, the following theorems;

(i) Rolle's Theorem

(ii) Mean Value Theorem

(b) (i) Given the function $f(x) = x^2 - 2x - 3$ defined on the interval $[-1, 3]$. Determine whether the hypothesis of Rolle's theorem holds for the function f defined on the given interval and if they do, verify the conclusion of the theorem.

(ii) Given that the function $f(x) = x^3$ is differentiable in the interval $(-2, 2)$, use the Mean Value theorem to find the value of x for which the tangent to the curve is parallel to the chord through the points $(-2, -8)$ and $(2, 8)$.

[(1+1)+(3+3)=8 Marks]

4. (a) Use the trapezium rule with five ordinates to estimate $\int_0^{0.8} e^{x^2} dx$.

(b) Solve the differential equation $x(1-y)\frac{dy}{dx} = -2y$ given that $y = 2$ when $x = e$, hence, show that $y = In\left(\frac{x^2y}{2}\right)$.

[3+3=6 Marks]

5. (a)

x	1.7	2.3	3.2	4.3	5.9
y	28.7	115.0	525.0	2100.0	8800.0

The table shows corresponding values of x and y obtained experimentally. It is given that x and y are connected by a relation of the form $y = ax^b$, where a and b are constants. By drawing a suitable linear graph, estimate the values of a and b to one decimal place.

(b) Show that the equation $f(x) = 0$, where $f(x) \equiv x^3+x^2-2x-1$, has a root in the interval $1 < x < 2$. Use the Newton-Raphson procedure, with initial value 1, to give two further approximations to the positive root of $f(x) = 0$. giving your answer to 2 decimal places.

[5+3=8Marks]

SECTION B:(Mathematics with Mechanics)

1 Hour 30 Minutes

1. The position vector of a particle of mass $5kg$ at time t seconds is r where

$$r = \left[\left(2+t^2\right)i + tj + \left(3 - \frac{t^3}{3}\right)k\right]m.$$

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(a) Find the momentum and kinetic energy of the particle at time $t = 2$.

(b) Find the work done by the particle between $t = 0$ and $t = 2$.

(c) Show that the Cartesian equation of the path of the particle is $y(x-2) + 3z = 9$.

[6+3+4=13 Marks]

2. A small smooth sphere P of mass $4kg$, moving with speed $5ms^{-1}$ on a smooth horizontal plane strikes a second smooth sphere Q of equal radius but of mass $3kg$, moving in the same direction with speed $2ms^{-1}$. Given that the coefficient of restitution between the spheres is $\frac{1}{3}$,

(a) calculate the loss in kinetic energy after impact,
Given also that the spheres collide just at the end of the plane which is $6m$ above a horizontal floor, and that the subsequent motion is under gravity,

(b) find the time taken by each sphere to strike the floor after impact.

[7+3=10 Marks]

3. (i) A car of mass 5 tonnes is moving along a horizontal straight road at a steady speed of $10ms^{-1}$. The magnitude of the force resisting the motion of the car is proportional to the speed of the car.

(a) Given that the engine of the car is working at $40kW$, find the magnitude of the force resisting the motion of the car.

(b) The car ascends a hill whose inclination to the horizontal is θ, where $20\sin\theta = 1$ at a steady speed of $5ms^{-1}$. Calculate the rate at which the engine of the car is working at this instance.

(ii) A uniform ladder ST of length $2a$ and weight W rest with its end S on a smooth horizontal floor and the end T against a smooth vertical wall. It is maintained in equilibrium at an angle $arctan2$ by a horizontal force P applied at S. Find the magnitude of P.

[(3+4)+6=13 Marks]

4. The two forces $\mathbf{F}_1 = (-3i + 2j + k)N$ and $\mathbf{F}_2 = (j - k)N$ act at points $\mathbf{r}_1 = (2i - 3j + k)m$ and $\mathbf{r}_2 = (-i + k)m$ respectively.

(a) Find the moment of $\mathbf{F}_1$ about the origin.

(b) Show that the lines of action of $\mathbf{F}_1$ and $\mathbf{F}_2$ intersect.

A third force, $\mathbf{F}_3$, is added to the system. Given that the system is in equilibrium,

(c) find the magnitude of $\mathbf{F}_3$ and a vector equation of it line of action.

[2+5+5=12 Marks]

5. (i) The events A and B are such $P(A/B) = \frac{7}{10}$, $P(B/A) = \frac{7}{15}$ and $P(A \cup B) = \frac{3}{5}$. Find,

(a) $P(A \cap B)$

(b) $P(A/B')$

(ii) When a car owner needs her car serviced, she phones one of three garages, X or Y or Z. Of her calls to them, 30%, are to garage X, 10% to Y and 60% to Z. The percentages for the occasions when the garage phoned can take the car in on the day of phoning are 20% for X, 6% for Y and 9% for Z.

(a) Find the probability that the garage phoned will not be able to take the car in on the day of phoning.

(b) Given that the car owner phones a garage and the garage will take her car in on that day, find the probability that she phones garage Y.

[(3+3)+(3+3)=12 Marks]

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EVERY NEXT LEVEL OF YOUR LIFE WILL DEMAND A DIFFERENT YOU.