P425/2
APPLIED MATHEMATICS
PAPER 2
JULY / AUGUST
3 HOURS

ST.JOSEPH OF NAZARETH HIGH SCHOOL

UGANDA ADVANCED CERTIFICATE OF EDUCATION
INTERNAL MOCK EXAMINATION 2017
APPLIED MATHEMATICS
PAPER 2
TIME: 3 HOURS

INSTRUCTIONS:

- Answer **all** the eight questions from section **A** and any **five** questions from section **B**.
- Begin each question on a fresh page.
- All working **must** be shown clearly.
- Silent non – programmable calculators and mathematical tables may be used.
- In numerical work, take $\boldsymbol{g = 9.8\ ms^{-2}}$

SECTION A (40marks)

1. Using $\boldsymbol{s = ut + \frac{1}{2}at^2}$ for a particle moving with initial velocity $\boldsymbol{u}$ and constant acceleration $\boldsymbol{a}$ after time $\boldsymbol{t}$, show that the $\boldsymbol{v^2 = u^2 + 2as}$ hence find the acceleration of the particle which travels $1.25km$ from a speed of $15km/h$ to $30km/h$ (05marks)

2. At Buganda Road Court any of the three verdicts "**guilty**", "**not guilty**" and "**not proven**" are tried. Of all the cases tried by the court **70%** of all these verdicts are guilty, **20%** are not guilty and **10%** are not proven. When the court's verdict is guilty the probability that the accused is really innocent is **0.05** while for not guilty and not proven, the probabilities of innocents are **0.95** and **0.25** respectively. Find the probability that an innocent person will be found guilty. (05marks)

3. Show that the equation $\boldsymbol{xe^x - x - 1 = 0}$ has a root between **0.5** and **1** hence using linear interpolation once estimate the root to **two** decimal places. (05marks)

4. A car dealer knows from past experience that on average he can make a sale to about 20% of his customers. What is the probability that in five randomly selected presentations, she makes a sale to;
   i) Exactly three customers
   ii) At least two customers (05marks)

5. One end of a light inextensible string of length 7.5m is fixed to a point on a vertical pole. A particle of mass $1.25kg$ is attached to the other end of the string. The particle is held $2.1m$ away from the pole by a horizontal force. Find the magnitude of this force and the tension in the string. (05marks)

6. Show that the maximum relative error for finding the volume of the cylinder of radius $\boldsymbol{r}$ and height $\boldsymbol{h}$ is $2\left|\frac{e_r}{r}\right| + \left|\frac{e_h}{h}\right|$ where $\boldsymbol{e}$ is the error in each of the dimensions. (05marks)

7. The mean and standard deviation of the four numbers $\boldsymbol{2, 3, 6}$ *and* $\boldsymbol{9}$ *are* $\boldsymbol{5}$ *and* $\boldsymbol{7.5}$ respectively. Two numbers $\boldsymbol{a}$ *and* $\boldsymbol{b}$ when added to this set of four numbers increases the mean by **1** and variance by **2.5**. find $\boldsymbol{a}$ and $\boldsymbol{b}$ (05marks)

8. An elastic string of natural length $1m$ is stretched $0.2m$ by a force of 30N. Find the modulus of elasticity and the extension when a force of 48N is applied. (05marks)

SECTION B (60 MARKS)

9. The table below shows the marks distribution of a group of students during an examination

Marks	Frequency density
- < 10	1
- < 20	2.5
- < 40	1.5
- < 60	2.2
- < 70	1.6
- < 95	0.6

a) Calculate

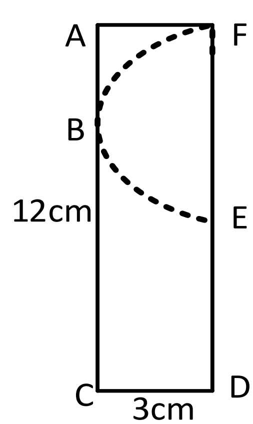
i) the mean (03marks)

ii) the standard deviation (04marks)

b) Draw a cumulative frequency curve and use it to estimate the median mark (05marks)

10. a) Particles of masses $\mathbf{1}\boldsymbol{kg}, \mathbf{2}\boldsymbol{kg}, \mathbf{1}\boldsymbol{kg}$ $\boldsymbol{and}$ $\boldsymbol{mkg}$ are situated at $(6,4)$, $(-1,2)$, $(5,-1)$, and $(1,0)$ respectively. Given that the Centre of gravity of the particles is located at $(2, \bar{y}\ )$, determine m and $\bar{y}$. (04marks)

b) The figure ABCDEF below shows a lamina in form of a rectangle from which a whole in form of a semi-circle was made. The diameter of the semi-circle is $6cm$



i) Find the position of the Centre of gravity from AC and CD if the semi-circle EBF is removed.

Ii) If the remaining lamina is suspended at D, find the angle CD makes with the vertical (08marks)

11. a) Given the two iterative formulae $\boldsymbol{x_{n+1}} = \frac{3X_n - 1}{X_n^2}$ and $\boldsymbol{x_{n+1}} = \frac{2X_n^3 - 1}{3X_n^2 - 3}$, **each** for solving the equation of the function $f(x) = 0$

i) Deduce the function $f(x)$ (01mark)

ii) Use each of the above formulae **thrice** starting with $x_o = 1.5$ to solve the root of the function in a)i) above correct to **four** decimal places. (05marks)

b)i) Deduce with a reason which one of the two formulae is appropriate for determining the root of the function $f(x) = 0$ hence state the root to **three** decimal places (02marks)

ii) Draw a flow chart that reads the initial approximation x_o, computes and prints the root of the function $f(x) = 0$ using the formula in (b) i) above to three decimal places. (04marks

12. A continuous random variable X has a probability density function defined by

$$f(x) = \begin{cases} \alpha x & 0 \le x < 1 \\ \alpha & 2 \le x < 2 \\ \alpha(3 - x) & 2 \le x < 3 \end{cases}$$

(a) Sketch $f(x)$ hence find the value of $\propto$ (04marks)

(b) Calculate the expectation of X (03marks)

(c) Deduce the cumulative distribution function $F(x)$ hence find $P(\boldsymbol{1.5 < x < 2.5})$ (05marks)

13. (a)forces of magnitude $4N, \sqrt{5}N, 2N$ and $1N$ act along the sides AB, AC, CD and DA respectively of the rectangle ABCD in which $AB = 4cm$ and $BC = 3cm$.Given that the direction of the forces is indicated by the order of the letters , determine:

(i) the magnitude of the resultant force

(ii) length AY $where$ Y is the a point where the resultant cuts AB.

(06marks)

(b) Anon-uniform ladder PQ of weight $78.4N$ and length 5cm if freely suspended horizontally by two light inelastic strings PR and QS that makes angles 30^o and 40^o respectively with the vertical. Find the distance from P where the weight of the ladder acts.

(06marks)

14. (a) use the trapezium rule with five sub-intervals to find the $\int_0^{\frac{\pi}{3}} e^x sinx\ dx$. Give your answer correct to four significant figures.
(06marks)

(b) Determine the percentage error made in computing $\frac{12.1}{3.21-6.042}$, all numbers rounded to the given number of decimal places. Give your answer correct to two decimal places.
(06marks)

15. (a) a projectile is released with speed u at an angle of elevation θ to the horizontal, it just clears two obstacles , both of height hm, whose distances from the projection point are $bm\ and\ 3bm$ respectively. Show that the range of the projectile is $4bm$.
(06marks)

(b) the maximum range of a projectile, fired with speed u is R. A target is placed hm above the landing point. Show that the speed with which it must be projected if it is to hit the target without changing the angle of projection is $\frac{u^2}{\sqrt{u^2-gh}}$
(06marks)

16.(a)the random variable X is distributed as $X\sim B(200\ ,\ 0.7)$, find $P(136 \leq X < 148)$
(05Marks)

(b) the heights of students in a particular school are distributed with mean u and standard deviation $\delta\partial$. On the basis of the results obtained from a random sample of 100 students from the school, the 95% confidence interval for the μ was calculated and found to be $[177.22cm\ ,\ 179.18cm]$.
Calculate the value of the sample mean $\bar{x}$ and the value of the $\partial\delta$
(07marks)

END