# UGANDA ADVANCED CERTIFICATE OF EDUCATION <br> PRE - REGISTRATION EXAMINATIONS 2016 <br> APPLIED MATHEMATICS <br> PAPER 2 <br> TIME: 3HOURS 

## Instructions

Attempt all the questions from Section A and any FIVE from Section B. For numerical work, take $\mathrm{g}=9.8 \mathrm{~ms}^{-2}$

## SECTION A: (40MARKS)

1. A fair die is tossed thrice. Find the median and the most likely number of heads obtained.
2. A particle moves in a straight line and when its distance from a fixed point O is $x$ metres, its retardation is $\left(5+\frac{1}{2} x\right) \mathrm{ms}^{-2}$. Given that its velocity is $20 \mathrm{~ms}^{-1}$ when $x=0$. Find the value of $x$ when the particle first comes to rest.
3. The resultant force acting on a vehicle was recorded after every 5 seconds as $740 \mathrm{~N}, 590 \mathrm{~N}, 460 \mathrm{~N}$ and 360 N . Given that initially the force acting was 800 N , estimate;
i) The force acting after 12 s
ii) The time when the force is 300 N .
4. The resultant of two forces XN and 3 N is 7 N . If the 3 N force is reversed, the resultant is $\sqrt{19} \mathrm{~N}$. Find the value of X and the angle between the two forces.
5. In a certain school, students are allocated houses namely Kizito (K), Kibuka (Kb), Mugaga (Mu), Mbaga (Mb) and Charles(C) in the ratio 30\%, $15 \%, 10 \%, 10 \%$ and $35 \%$ respectively on admission. Each house has an estimated ratio of girls of $5 \%, 2 \%, 3 \%, 4 \%$ and $1 \%$ respectively. If the sports master randomly picks a student at random from the school;
a) What is the probability that the student is a girl?
b) Given that the student is a girl, what is the probability that she belongs to Kibuka House?
6. A continuous random variable X has the distribution function

$$
f(x)=\left\{\begin{array}{cc}
3 k x\left(1-\frac{x^{2}}{3}\right) & , 0 \leq x \leq 1, \\
1 & x>1
\end{array} \quad\right. \text { Determine }
$$

i) The value of $k$
ii) Probability density function of $x$.
7. The table below shows the order in which ten candidates were ranked in an aptitude test.

| Position | $1^{\text {st }}$ | $2^{\text {nd }}$ | $3^{\text {rd }}$ | $4^{\text {th }}$ | $5^{\text {th }}$ | $6^{\text {th }}$ | $7^{\text {th }}$ | $8^{\text {th }}$ | $9^{\text {th }}$ | $10^{\text {th }}$ |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| Test 1 | A | F | D | C | H | J | K | B | E | L |
| Test 2 | D | F | C | A | J | K | H | B | L | E |

Calculate the rank correlation coefficient between tests 1 and 2. Hence comment on your result at a $5 \%$ level.
8. A box of mass 6 kg is placed on a rough plane inclined at $45^{\circ}$ to the horizontal. The coefficient of friction between the box and the plane is 0.5 . Find the magnitude of the horizontal force that must be applied to the box so that it moves up the plane with an acceleration of $2 \sqrt{2} \mathrm{~ms}^{-2}$.

## SECTION B (60MARKS)

9. A car of mass 800 kg is towing a trailer of mass 150 kg on a level road frictional resistance to each vehicle amounts to 7 N per kg of mass.
a) Calculate the tension in the tow bar when the vehicles are travelling at a constant speed.
b) The car and the trailer now climb a straight slope of inclination 1 in 20. If the frictional resistance are the same as before and the power of the engine is 50 KW , calculate
i) The maximum speed up the slope
ii) The acceleration when the speed is $54 \mathrm{kmh}^{-1}$
10. The probability distribution of a discrete random variable X is given by

$$
P(X=x)=\left\{\begin{array}{c}
k(n-x): x=1,2,3, \ldots n \\
0: \text { otherwise }
\end{array}\right.
$$

a) Find k in terms of n
b) Show that the expectation of X and the variance of X are given by $\frac{1}{3}(n+1)$ and $\frac{1}{18}(n+1)(n-2)$ respectively.
c) If $n=5$, construct the probability distribution of $X$. Hence sketch $P(X=x)$.
11. The heights of 250 students were recorded in a survey as below.

| Height (cm) | $170-$ | $175-$ | $180-$ | $185-$ | $190-$ | $195-<200$ |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| No of <br> students | 19 | 36 | 70 | 64 | 39 | 22 |

a) Calculate the mean and the modal height.
b) Plot a cumulative frequency curve to represent the data and use it to estimate;
i) The median height
ii) The standard deviation
iii) $70^{\text {th }}$ percentile
12. A car A is travelling at a constant velocity of $20 \mathrm{kmh}^{-1}$ due East and a cyclist B is travelling with a velocity of $16 \mathrm{kmh}^{-1}$ in the direction of the vector $(-4 i+3 j)$. At noon A is 1.2 km due North of $B$.
a) Obtain an expression for the position vector of A and B at time $t$ hours past noon.
b) Find the position vector of $A$ relative to $B$.
c) Deduce that, if dkm is the distance between A and B, then $25 d^{2}=36\left(100 t^{2}-16 t+1\right)$. Hence show that the minimum separation between $A$ and $B$ is 720 m and find the time at which this occurs.
13. Forces of magnitude $5 \mathrm{~N}, 4 \mathrm{~N}, 7 \mathrm{~N}, 2 \mathrm{~N}$ and 8 N act along the directions $\mathrm{PQ}, \mathrm{QR}, \mathrm{SR}, \mathrm{SP}$ and PR respectively of a rectangle PQRS whose length is 6 b and width 3 b . The direction of the force being indirected by the order of the letters.
a) Find the magnitude and direction of the resultant of the forces.
b) Show that the line of action of the resultant force cuts PQ at a distance $\frac{1}{2} b$ from P .
14. The marks of 500 candidates in an examination are normally distributed with mean 45 marks and standard deviation 20marks.
i) Given that the pass mark is 41 , estimate the number of candidates who passed the examination.
ii) If $5 \%$ of the candidates obtain a distribution by scoring x marks or more, estimate the value of $x$.
iii) Estimate the interquartile range of the distribution.
**END **

