

P425/2
APPLIED MATHEMATICS
Paper 2
July 2015
3 hours

MOCK EXAMINATIONS 2015

Uganda Advanced Certificate of Education

APPLIED MATHEMATICS

Paper 2

3 hours

INSTRUCTIONS:

Answer **all** the **eight** questions in Section A and **five** from Section B.

All workings must be shown clearly.

Where necessary for numerical work take $g = 9.8\text{ms}^{-2}$.

State the degree of accuracy at the end of each answer given.

SECTION A (40 MARKS)

1. The probability that John speaks the truth is $\frac{3}{5}$ and that Peter is $\frac{5}{8}$. Find the probability that they are likely to contradict each on an identical point.
2. The distribution function $F(x)$, of a discrete random variable x is given in the table below.

x	1	2	3	4
$F(x)$	0.14	0.47	0.79	1.0

- Find (a) $P(1 < x \leq 3)$
(b) the median value of x
3. A particle of mass 2kg initially moving with a constant velocity is acted upon by a retardation force. If after time, t its position vector is;

$$\mathbf{r} = \frac{t^2}{2}(\mathbf{i} + \mathbf{j}) + t(2\mathbf{i} + 5\mathbf{j}) + 6\mathbf{i} - 22\mathbf{k} \text{ metres. Find the time after which its momentum will reduce to } 30\text{kgms}^{-1} \text{ in magnitude}$$

4. Use the trapezium rule with 6 strips to find the approximate value of

$$\int_1^2 x \sin 2x \, dx, \text{ correct to four significant figures}$$

5. A coin is biased such that it is thrice as likely to show heads as tails. The coin is tossed five times. Calculate the probability that.

- (a) exactly three heads are obtained.
- (b) more than three heads are obtained.

6. Given that $X = 4.8654$ and $Y = 2.80$

- (a) State the maximum possible errors in X and Y .
- (b) Find the limits within which XY lies correct to 4 decimal places

7. A machine manufacturing nails makes approximately 15% that are outside the set tolerance limits. If a random sample of 200 nails is taken, find the probability that more than 21 nails will be outside the tolerance limits.
8. Two forces of magnitude P N and Q N, have a resultant of $2\sqrt{7}$ N. When the angle between their lines of action is 30° ; the resultant is of magnitude $2\sqrt{13}$ N. Calculate the values of P and Q .

SECTION B (60 MARKS)

9. By plotting a graph of X^3 and a suitable line locate each of the roots of the equation $X^3 - 12X - 6 = 0$. Hence use linear interpolation to find the greatest root, correct to three significant figures
10. (a) The table below shows marks obtained by some students in Mathematics and Physics.

Students	A	B	C	D	E	F	G	H	I	J
Maths	70	72	75	78	71	76	73	75	72	74
Physics	71	78	79	73	71	77	75	76	70	73

By using an appropriate method, determine the relationship between the students performance in Math's and Physics

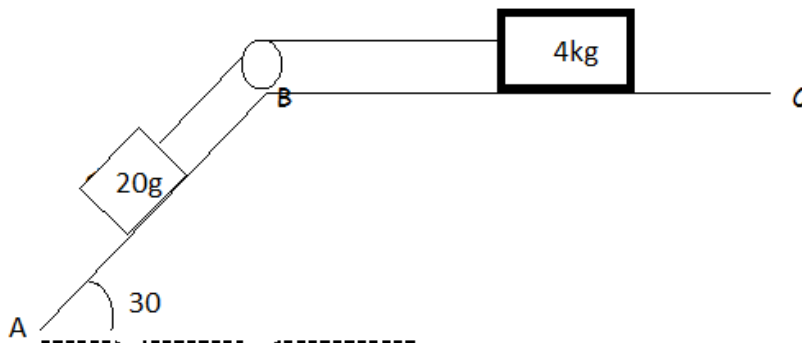
- (b) The times to nearest second, taken by 100 people to solve a problem are shown below

Time	No. of people
30 - 49	10
50 - 64	30
65 - 69	25
70 - 74	20
75 - 79	15

(i) Calculate the mean time

(ii) Draw a histogram for the data and use it to estimate the modal time.

10. (a)



Plane AC is made of two surfaces, a horizontal rough surface BC (coefficient of friction 0.215) and a smooth inclined surface AB . Boxes of masses 20kg and 4kg are placed on the plane as shown above. If the system is released from rest, determine the acceleration of the boxes.

(b) A particle of mass 2kg is projected with in a velocity of 10ms^{-1} up a rough plane inclined at 30° to the horizontal, from a point A 3metres from the bottom of the plane. If the particle comes to rest at B and angle of friction along the plane is

$$\tan^{-1}(1/4)$$

- (i) Find the potential energy of the particle at B and kinetic energy at A. Hence calculate the work done against friction.
- (ii) Show that the particle will not remain on the plane.

12. A random variable X has the probability density function;

$$f(x) = \begin{cases} \frac{1}{p-q} & ; p \leq x \leq q \\ 0 & \text{elsewhere.} \end{cases}$$

- a) Show that the variance of x is given by $\frac{(q-p)^2}{12}$
- b) The number exotic cows on a school farm take on a random variable x with a uniform distribution over the interval (p, q). The expected number of exotic cows is 9 with variance 12. Determine the;
 - (i) values of p and q
 - (ii) probability that at least 11 cows are exotic.

13. (a) Forces of magnitudes **6N**, **6N**, **4N** and **8N** act along **AB**, **BC**, **CD** and **AD** respectively, in the directions indicated by the order of the letters of a square **ABCD** of side 4m. Find the;

- (i) magnitude of their resultant
- (ii) equation of the line of action of their resultant, if it cuts **BA** produced.

(b) A block of mass 10kg suspended from the end A of a light inelastic string of length 40cm is kept in equilibrium when a force F inclined at 40° to the vertical acts on it. If the string is displaced through 20cm horizontally from the vertical through A, calculate the magnitude of F

14. (a) The exact numbers X and Y have been estimated using x and y respectively with corresponding errors Δx and Δy . Show that the maximum possible error in $\frac{X}{Y}$ is

$$\text{given by } \left| \frac{x}{y} \right| \left(\left| \frac{\Delta x}{x} \right| + \left| \frac{\Delta y}{y} \right| \right)$$

(b) The numbers $a=14.57$, $b=2.991$ and $c = 82.1143$ are each rounded off to the given number of decimal places. Find the;

(i) limits within which $c - \frac{a}{b}$ lies correct to 3 decimal places.

(ii) percentage error in (i) above correct to 2 significant figures

15 (a) The time taken by a Julian to complete a race is normally distributed with

mean 24 minutes and standard deviation of 4 minutes. Find the;

(i) probability that she takes less than 29 minutes

(ii) 95% central limits of the times the race takes

(b) Estimate the time taken in 7 races, for which prayers take at least 17 minutes

16. (a) Two bodies P and Q of mass 150g and 250g respectively are free to move on a straight horizontal track. Initially Q is at rest and P is moving towards Q with a velocity of 40ms^{-1} . Immediately after the impact Q has a velocity of 8ms^{-1} relative to P. Calculate the: -

(i) velocities of each body after impact

(ii) magnitude of the impulse imparted on Q by P

(b) A toy boat of mass 0.2kg starts on one side of a pond and is given an initial velocity of 0.5ms^{-1} towards the other side. The boat experiences a resisting force of $(0.0001 + 0.002V)$ N, where $V\text{ms}^{-1}$ is the speed of the boat. Given that the boat just reaches the other side, find the width of the pond.

END