MATH
PAPER 1
1986.
SECTION A.

1. The first term of a geometric progression is A and the sum of the first 3 terms is $\frac{7}{4}A$

(i) Show that there are two possible progressions.

(ii) Given that A = 4 , find the next two terms of each progression.

(b) Expand the expression

$$\frac{1}{(x+2)(3x+1)}$$

in ascending powers of x as far as the term in x^4.

2. (a) Solve the inequality .

$$\frac{x^2-2x+3}{x-1}<3.$$

(b) Given that the system of inequalities

$|x+2|\le 4$

$\frac{1}{2}x+y\le 4$

$y\ge \frac{1}{2}x+2$

Find the equation

$z = y + 2x.$

(c) Find by a graphical method or otherwise the set of integral values (x, y) that satisfy the system of inequalities. Hence determine the maximum value of Z.

3.(a) By row reducing the appropriate matrix to an echelon form solve the system of equations

$$x + 3y - z = 4$$
$$2x + 4y + z = 8$$
$$3x + 6y + 2z = 10.$$

(b) Find the values of p and q which make

$x^4 + 6x^3 + 13x^2 + px + q$

a perfect square.

Note: The above question was not part of this paper(b); the real question had some mistake!!

4.(a) Differentiate

(i) $x^{\sin x}$

(ii) $\log_{10}(1+\cos 2x)$

(b) A curve is represented parametrically by the equations

$x = 3t^2$, $y = 4t^3$.

Find the equation of the curve at any point.

5.(a) By dividing the interval [2,4] into five equal subintervals , use the trapezium rule to estimate the area under the curve.

$y = \frac{5}{x}$

between x = 2 , x = 4

(b) Show that the coordinates of the centre of mass of a solid formed by rotating the curve $y^2 = 4x$ between x = a and x = b about the x - axis are given by

$$\left[\frac{2}{3}\frac{(b^2+a^2+ab)}{a+b}, 0\right]$$

6.(a) Find $\int x^2\log(1-x)dx$

(b) By using the substitution t = tan x , evaluate

$$\int_0^{\pi/4}\frac{2\cos^2+\sin^2 x}{1+\cos^2 x}dx$$

7. Sketch the curve

$$\frac{x+1}{(x-1)(2x+1)}$$

showing clearly the nature of the turning points.

SECTION III :TRIGONOMETRY AND GEOMETRY.

8.(a) Prove that

$$\sin 4\theta = \frac{4\tan\theta(1-\tan^2\theta)}{(1+\tan^2\theta)^2}$$

(b) Show that in any triangle ABC

$\sin A + \sin B = 2\cos \frac{1}{2}C\sin(A + \frac{1}{2}C).$

(c) Find the general solution of the equation

$\cos 4\theta + \sin 2\theta = 0.$

9. Show that the angle two lines with gradients λ_1 and λ_2 is given by

$$\theta = \tan^{-1}\left(\frac{\lambda_1-\lambda_2}{1+\lambda_1\lambda_2}\right)$$

Hence find the angle between the lines.

$$y + 3x - 6 = 0$$
$$3y - x - 2 = 0$$

Show that the locus of point P which moves that the sum of the squares of the distance from these lines is 2 is a circle . Find the centre and radius of the circle.

10. Find the equation of the tangent to the ellipse. $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$

at the point (a cosθ , b sin θ) Hence show that the line y = mx + c is a tangent to the allipse if $c^2 = a^2m^2 + b^2$ and find the equation of the tangents from the point (-3,3) to the ellipse.

$$\frac{x^2}{16}+\frac{y^2}{9}=1$$

11. The tangent to the parabola $y^2 = 4ax$ with vertex O(0,0) at the point P(at^2, 2at) meets the matrix at Q . Show that SP and SQ are perpendicular where S is the

focus of the parabola. A perpendicular from the vertex meets the tangent at R . Find the locus of the midpoint of OR.

SECTION IV STATISTICS:

12.(a) The table shows the consumer price index and the average wages in shillings per hour of wages in a certain company for the period 1980-1984.

Year	1980	1981	1982	1983	1984
Price index	100	102	110	115	120
Wage per hour	120	130	144	160	180

Using 1980 as the base year calculate :

(i) the wage index

(ii) the real wages per hour

(iii) the purchasing power of the shilling for the given period .

(b) In a group of seven children there are three girls . Find the number of ways they can sit on a bench given that

(i) the girls sit together.

(ii) no two girls sit together.

(iii) Each girl has to sit in the middle of two boys.

13. (a) The table shows the distribution of marks obtained by a class of 30 students.

Marks	Frequency.
15-19	10
20-24	6
25-29	5
30-34	4
35-39	5

Calculate the mean , median and the mode for the above data.

(b) There are an equal number of boys and girls in a class of 2n students . In a certain tent the earn mark standard deviation of the boys are X_1 and δ_1 and of the girls X_2 and δ_2. respectively show that the variance of the marks of all the students is given by

$$\delta_1 = \tfrac{1}{2}\left(\delta_1^2 + \delta_2^2\right) + \tfrac{1}{4}\left(\delta_1 - \delta_2\right)^2$$

. **SECTION V. VECTORS.**

14.(a) The vertices of a triangle ABC are represented by the position vectors o ,.a,b respectively where 0 is the zero vector . show that the position vector of any point on BC is given by the position vector

p = k**a** +(1 - k)**b** for a suitable real number k.

(b) Find a vector r perpendicular to the vectors **s = 5i +3j + k** and **- i + 3j + 2k**. Hence the equation of a plane passing through the point (5,-1,-2) and parallel to s and t , find the angle between the plane and the line. x - 2 = $\frac{y-2}{2} = \frac{z-2}{3}$

15.(a) Given that

$$z = \frac{(1+2i)^3}{(1+i)(1-3i)}$$

Find (i) $|z|$

(ii)Arg(z)

(b) Show that 2 + 4i is a root of $z^4 - 4z^3 + 2lz^2 - 4z + 20 = 0$. Hence , find the other roots .

(c) Find the square root of $-1 + i\sqrt{3}$ giving your answer in the form x + iy.

MATH
PAPER 2
1986

SECTION A.

1. Given the equation $ax^2 + bx + c = 0$, show that the Newton Raphson method leads to t iterative formula.

$$X_{n+1} = \frac{aX_n^2 - c}{2aX_n + b}$$

Hence , construct a flow chart without subscripted variables to

(i) read the values of a, b,c and the first approximation A.

(ii)calculate the root.

(iii)test whether the difference between successive approximations to the root is less than the error limit ε_1.

(iv) print the equation , the root and number of iterations.

Use your flow chart to calculate the positive square root of 20 correct to 3 significant figures.

2.(a) The table shows the variables of a function f(x) at a set of points.

x	0.9	1.0	1.1	1.2
f(x)	0.266	0.242	0.218	0.192

Use linear interpolation to find

(i) the value of f(1.04)

(ii) the value of x corresponding to f(x) = 0.25.

(b) Given that Y_1 and Y_2 are approximations to X_1 and X_2 with error E_1 and E_2 respectively show that the maximum possible relative error in X_1/X_2 is

$$\left|\frac{E_1}{Y_1}\right| + \left|\frac{E_1}{Y_2}\right|$$

Given that the error in measuring an angle is up to 0.5^o , find the maximum possible percentage error in

$$\frac{\sin x}{\cos x}$$

VECTORS AND MECHANICS.

3.(a) A particle of mass 5kg at rest at a point (1,4,4) is acted upon by the three forces

F_1 = 3i + 3j ,F_2 = 2j + 4k , F_3 = 2i + 6k
Find
(i) the position and momentum of the particle after 4 seconds.
(ii) the work done by the forces in the seconds.
(b)) A particle of mass marks is projected with an initial speed u at angle θ to the horizontal. Given that the force due to air resistance is equal to mkv , show that the velocity at any time is given by

$$V = (u\cos\theta\mathbf{i} + u\sin\theta\mathbf{j})e^{-kt} - \frac{g}{k}\left(1 - e^{-kt}\right)\mathbf{j}$$

where k is constant and **i** and **j** are orthogonal unit vectors.

4. (a) A ship Y appears to an observer in ship Y at 10 o'clock to be travelling at a speed 20kmh^{-1} due North. After 30 minutes shipX which is travelling at a speed of 60kmh^{-1} N 60° collides with ship Y.
Find (i) the actual velocity of Y
(ii) the distance and bearing of ship Y at 10 o'clock.

5. (a) A car of mass 2 tonnes moves from rest down a road of inclination
$\sin^{-1}\left(\frac{1}{20}\right)$ to horizontal . Given that the engine develops a power of 64.8kw when it is travelling at a speed of kmh^{-1} and the resistance to motion is 500N . Find the acceleration of the car?
(b) A bullet of mass 40g is fired horizontally into a freely suspended block of wood of mass 1.96kg attached at the end of an inelastic string of length 1.8cm . Given that the bullet gets imbedded in the block and the string is deflected through an angle of 60° to the vertical , find
(i) the initial velocity of the block.
(ii) the maximum velocity of the block.

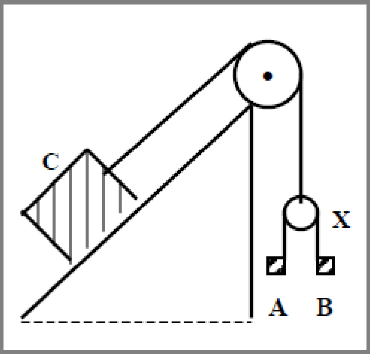
6.(a) A particle of mass m is placed on a rough plane inclined at an angle 30° to the horizontal. Given that the angle of friction
$\lambda > 30°$ show that the minimum force required to move the body to the plane is given by

$$\frac{1}{2}mg\left(\cos\lambda + \sqrt{3}\sin\lambda\right)$$

If this force is three times the least force that would cause the body to move down the plane show that

$$\lambda = \tan^{-1}\left(\frac{2}{\sqrt{3}}\right)$$

7. The diagram shows two masses A and B of 0.5kg and 1kg respectively connected by a light inextensible string passing over a smooth pulley X of mass 0.5kg . Pulley X is connected to a mass C of 2kg lying on a smooth plane inclined at an angle 45° to the horizontal by a light inextensible string passing over a fixed pulley.



Find
(i) the acceleration of the masses B and C.
(ii) the tension in the string when the system is released.

8. Find the centre of gravity of a semicircular lamina of radius r with the diameter as the base. A semicircle lamina of radius r and base OA is cut from a larger semicircle lamina of radius 2r and base AOB and the remainder is hung from A . Find the inclination of AOB to the vertical .

DIFFERENTIAL EQUATIONS.

9.(a) The gradient of the tangent at any point (x,y) of a curve is $x - \frac{2y}{x}$. Given that the curve passes through the point (2,4) , find the equation of the curve .
(b) Use the substitution y = ux to solve the differential equation.

$$x^2\frac{dy}{dx} = x^2 + y^2 + xy$$

given that y = 0 when $x = \frac{1}{2}\pi$

STATISTICS .

10.(a) Given that A and B are two events such that P(A) = 0.5 , P(B) = 0.7 and P(A∪B) = 0.8 find.
(i) $P(A\cap B)$
(ii)$P(A\cap \overline{B})$.
(b) A bag contains 3 black and 5 white balls . Two balls are drawn at random one at a time without replacement. Find .
(i) the probability that the second ball is white.
(ii) the probability that the first ball is white given the second is white.
(c) The probability that a student X can solve a certain problem is $\frac{2}{3}$ and that student Y can solve it is $\frac{1}{2}$. Find the probability that the problem will be solved if both X and Y try to solve it independently.

11. A discrete random variable X has a probability function

$$P(X = x) = \begin{cases} x/k & x = 1,2\ldots\ldots n \\ 0 & \text{otherwise} \end{cases}$$

Where k is a constant.
Given that the expectation of x is 3 , find
(i) the value of n and the constant k
(ii) the median and variance of X.
(iii) $P[X = 2 / x \geq 2]$

12.(a) A continuous variable X has a probability density function given by

$$f(x) = \begin{cases} \frac{1}{2} & 0<x<1 \\ \frac{1}{8} & 2<x<8 \\ 0 & \text{elsewhere} \end{cases}$$

Find
(i) the distribution function and expectation of X.
(ii) $P[\frac{1}{2} < x < 3]$.

(b) A normal population has mean 150 and variance 25. Find the probability that in a random sample size 5 taken from the population at least 1 will have a value less than 146.

13. (a) A pair of dice is tossed 144 times and the sum of the outcomes recorded . Find the probability that a sum of 7 occurs at least 26 times.

(b) Three people play a game in which each person tosses a coin . The game is success if one of the players gets an outcome different from the others.
Determine the probability that
(i) a success will occur at the first trial.
(ii) in two trials at least one success will occur.

14. (a)The table shows the distribution of weight of a random sample of 16 tins taken from large consignment.

Weight(gm)	97	98	99	100	101	102
frequency	2	1	2	3	6	2

Assuming the weights are normally distributed, determine a 95% confidence interval for the mean weight of all the tins.

(b) The life period of a certain machine approximately follows a normal distribution with 5 years and standard deviation 1 year. Given that the manufacturer of this machine replaces the machine that fall under guarantee, determine the length of the guarantee required so that not more an 2 % of the machines that fail are replaced. Determine the proportion of the machines that would be replaced if the guarantee period was years.

15. (a) Prove that if a,b,c are elements of a group (G.o) then
(i) $aob = aoc \Rightarrow b = c$
(ii) $(aob)^{-1} = b^{-1} o\, a^{-1}$

Given the set S =
$\{W_1 = 1, w_2 = \frac{1}{2} + \frac{1}{2}\sqrt{3}i\, w_3 = -\frac{1}{2} - \frac{1}{2}\sqrt{3}i\}$
determine whether (S,o) is a group , where o is the ordinary multiplication .

P425/1
MATHEMATICS
Paper 1
March 1987
3 hours

1.(a) Show that $\log_a{}^b = \dfrac{\log_c{}^b}{\log_c{}^a}$

Hence or otherwise solve the equation
$\log_2 0.013 - \log_3 30 = \log_{10} x^2$

(b) The polynomial $5x^3 + px^2 + qx + r$ has a factor x - 2 and a remainder of 3x+1 when divided by $x^2 - 1$. Find the values of p,q and r.

2(a) Prove by induction that

$$\sum_{k=1}^{n} k^2 = \frac{1}{6}n(n+1)(2n+1)$$

(b) The roots of the equation
$ax^2 + bx + c = 0$ are α and β.
(i) show that if
$\alpha - \beta = 1$ then $a^2 = 4(b^2 - ac)$

3.(a) The sum of the first ten terms of an arithmetic progression is 250 . Given that the difference between the tenth and the first is 36, find the common difference.

(b) Find the binomial expression of

$$\sqrt{\frac{(1+x)^3}{2+3x}}$$

in ascending powers of x up to the term x^3 where $|x| < 1$

4. Differentiate
(i) $\sec^2(\cot x)$
(ii) $a^{\cos^2 x^2}$
where a is a constant.

(b) A curve is defined by the parametric equations $x = at^2 \quad y = a(t - t^2)$

Find the stationary point on the curve and show whether it is a maximum or minimum .

5(a) The tangent to the curve
$x^2+xy+2y^2 = 7$ at a point p is parallel to the x-axis.
Find the coordinates of p.

(b) Two ships A and B start moving from the same point at the same time . Ship A moves $40kmh^{-1}$,N 30^0 E and ship B moves $48kmh^{-1}$ due east , find the rate at which they are separating from each other at the end of two hours.

6. Find

(i) $$\int \frac{3x^3 + 2x^2 - 3x - 1}{x(x^2 - 1)}$$

(ii) $\int e^{3x}\cos(2x+1)dx$

7.(a) Use the substitution $x = \frac{1}{u}$ to evaluate

$$\int_2^3 \frac{dx}{x(x^2+x)^{1/2}}$$

(b) Find

(i) the centre of gravity of the area bounded by the curve $y = x^2 + 2$ and the line $y = 3$.

(ii) the volume of solid generated about the line $y = 3$

SECTION III TRIGONOMETRY AND GEOMETRY

8. (a) Prove that

$$\sin x + \tan^2 x = \frac{1-\cos 2x + 2\sin x\cos^2 x}{1+\cos 2x}$$

(b) Given that a,b and c are the lengths of the sides of a triangle ABC , show that

$$\frac{a+b-c}{a+b+c} = \tan\frac{1}{2}A\tan\frac{1}{2}B$$

9. (a) Show that if $t = \tan\frac{\theta}{2}$ then

$$\sin\theta = \frac{2t}{1+t^2}$$

Hence , or otherwise solve the equation

$$3\cos\theta - 5\sin\theta + 1 = 0$$

(b) Find the general solution of the equation

$$\cos\theta + \sin\theta + \sec\theta + \operatorname{cosec}\theta = 0$$

10. The point P ($a\sec\theta, b\tan\theta$) lies on the hyperbola

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$$

show that

(i) the equation of the tangent to the hyperbola is

$bx - ay\sin\theta - ab\cos\theta = 0$

(ii) if the tangent at P cuts the asymptotes at Q and R then QR is bisected by P.

11. (a) The coordinates of three points A,B and C are (5,3) ,(-2,2) and (2,4) respectively. Find the equations of the perpendicular bisectors of AB and AC . Hence find the equation of the circle that passes through A,B and C.

(b) The tangents at a point Q on the circle $x^2 + y^2 = 4$ and a point R on the circle $x^2 + y^2 = 16$ meet at a apoint P , Given that $\overline{PQ}^2 + \overline{PR}^2 = 8$,find the locus of P.

SECTION IV.STATISTICS

12.(a) The table shows the retail price of three commodities together with the corresponding quantities consumed for the period 1980-82

	Prices			Quantities		
Year	1980	1981	1982	1980	1981	1982
A	39	38	41	96	98	102
B	61	62	60	11	12	14
C	50	55	48	70	85	80

Using 1980' as the base year , calculate

(I) the simple aggregate price index

(ii) the weighted aggregate price index

(b) The table shows the average monthly production of a certain commodity in thousands of tonnes.

Year	1980	1981	1982	1983	1984	1985	1986
Production	48	36	43	45	38	36	31

On the same coordinates axes represent the average monthly production and the four -year moving averages for the data.

(c) A student obtained 80% and 88% in mathematics and physics examination respectively.

The mean mark in Mathematics was 74% and standard deviation 10 marks and the corresponding values for physics are 80% and 16 marks respectively. In which subject was his relative performance better.

13. (a) Given that c(n,r) means the number of combinations of n objects taken r at a time , solve the equation

c(10,4)=c(x,3) + c(x,4)

(b) A three digit integer is to be formed using the digits 1,2,3,4 and 5.

if no digit is to be used more than once find

(i) the total number of different integers that can be formed

(ii) the probability that the integer formed is greater than 500

(iii) the probability that the integer formed is a multiple of 3

How many different integers can be formed if one of the digits may be repeated?

SECTION V VECTORS.

14.(a) Show that the points A,B C with position vectors 2**i**+3**j**, 4**i**+5**j**, 6**i**+9**j** respectively are the vertices of a triangle . Find the area of the triangle

(b) A line L_1 passes through the point (-4,7,5) and parallel to the vector 3**i**-**2j**+**4k** . Find

(i) the point of intersection of L_1 and the line

$$\frac{x}{2}=\frac{y+5}{1}=\frac{z+9}{8}$$

(ii) the equation of the plane containing L_1 and the origin.

SECTION VI COMPLEX NUMBERS

15.(a) Evaluate

(b) Find the modulus and argument of the complex number $\omega = 1 + \cos 2\theta - i\sin 2\theta$

(c) Solve the equation

$$z^2 + 2z^2 - z - \bar{z} + 9 = 0$$

P425/2
MATHEMATICS
Paper2
March 1987
3 hours.

SECTION 1 NUMERICAL METHODS

1. Show that an interative method for finding the square root of a number N is given by

$$\frac{1}{2}\left(X_n + \frac{N}{X_n}\right) n = 0,1 - - - - -$$

Draw a flow chart

(i) reads N and the initial approximation.

(ii) computes and prints the square root of N correct to 3 decimal places.

Perform dry run of the flow chart for $N = 28$ and $X_0 = 5$

2. (a) Given that X and Y are measured with possible errors ΔX and ΔY respectively, show that the relative error in the product XY is

$$\frac{|\Delta X|Y + |\Delta Y|X}{XY}$$

State clearly an assumptions made

Given that X =5.43 and Y =27.2 write down the maximum possible error in X and Y, Hence find the interval in which the product XY lies.

(b) The table shows the distance in centimetres travelled by a particle in five seconds of its motion

Time, t	0	1	2	3	4	5
Distance	0	15	37.5	68	104	135

Use linear interpolation to estimate

(i) the distance travelled at t = 2.2

(ii) the time when the distance travelled is 50cm.

3. (a) A particle moving with an acceleration given by **A** $= 3e^{-t}\mathbf{i} + 5\cos t\,\mathbf{j} - 4\sin t\,\mathbf{i}$ is located at (2,-3,4) and has velocity $v = 6\mathbf{i} - 2\mathbf{j} + 3\mathbf{k}$ at time t = 0.

Find

(i) the velocity,

(ii) the displacement at any time t.

(b) Forces of magnitude 3N, 4N, 4N, 3N and 5N act along the lines AB,BC CD, DA and AC respectively of a square ABCD of side a : the direction of the forces being given by the order of letters

Find

(i) the resultant force

(ii) the point where the line of action of the resultant force cuts AB.

4.(a) A sphere of mass m and radius r rests on a smooth plane inclined at an angle θ to the horizontal . it is supported by a string of length r fastened to the plane.

Find

(i) the tension in the string

(ii) the reaction at the point of contact of the sphere with the plane.

(b) A uniform rod of length 2l inclined at an angle θ to the horizontal rests in a vertical plane against a smooth horizontal bar at a height h above the ground and the rod is about to slip , show that the coefficient of friction between the rod and the ground is

$$\frac{\ell \sin^2\theta\cos\theta}{h - \ell\cos^2\theta\sin\theta}$$

5. The point P is 50km west of Q

Two aircraft A and B fly simultaneously from P and Q with velocities 400kmh^{-1} N 50^{0}E and 500 kmh^{-1} N 70^{0}W respectively.

Find

(i) the closest distance between the aircrafts.

(ii) the time of flight up to this point.

6. A particle is projected upwards with a velocity v from a point on a plane inclined at an angle θ to the horizontal . if the angle of projection is α to the horizontal($\theta < \alpha$).

(i) Find the range along the plane

(ii) show that the maximum range along the plane is

$$R_{max} = \frac{v^2}{g(1+\sin\theta)}$$

(iii) Find the time taken to cover R_{max} when $\theta = 30^0$ and v = 20ms^{-1}.

7(a) two particles A and B of mass m lie on a smooth table and are connected by an inextensible string . Particle A is given an impulse I in a direction making an angle θ with the line BA

Find

(i) the angle at which the particle A begins to move.

(ii) the impulse tension in the string,

(b) A bullet of mass 20g is fired with a velocity of $500ms^{-1}$ into a block of wood of mass 1kg resting on along smooth table.
find
(i) the common velocity of the bullet and the block when the bullet is embedded in the block.
(ii) the loss in kinetic energy.

8. (a) A mass of 10kg moving with simple harmonic motion in the horizontal direction is initially located at a distance 4m from the origin O and has a velocity of $20ms^{-1}$ and acceleration $100ms^{-2}$ directed towards O. Find the force on the mass when t = 2s

9(b) A sphere of mass 5kg attached at the end of a vertical spring of negligible mass stretches it 10 cm. Find the equation of motion and the amplitude if
(i) the sphere is pulled down 5cm and then released.
(ii) the sphere is pulled down 10cm and then given an initial velocity of vm/s downwards.

SECTION II DIFFERENTIAL EQUATIONS.

9. (a) Solve the equation

$$\frac{dy}{dx}+\frac{2xy}{x^2+1}-x=0$$

(b) A liquid cools in a room at constant temperature of 22^0C at a rate proportional to the excess temperature initially the temperature of the liquid was 100^0C and one minute later a was 92.2^0C ,Find the temperature of the liquid after 5 minutes.

SECTION III STATISTICS

10. (a) Given that A and B are mutually exclusive events and P(A) = 0.4 and P(B) = 0.5 , find
(i) $P(A\cup B)$
(ii) $P\left(A\cap \overline{B}\right)$
(iii) $P\left(\overline{A}\cap \overline{B}\right)$
(b) A box P contains 4 white and 6 red balls and a box Q contains 6 white and 2 red balls.
A box is chosen at random and a ball is drawn at random from it
(i) Find the probability that the ball drawn is red.
(ii) Given that the ball selected is white , find the probability that box P was selected.

11. (a) A game consists of drawing card at random without displacement from five cards consisting of three spades and two diamonds.
Given that the game is terminated when a diamond is drawn, find the expected number of draws
(b) A multiple choice test consists of ten questions. Each has five alternatives with only one correct answer. Five marks are awarded for each correct answer and one mark is subtracted for each incorrect answer or unattempted question.
if a candidate chooses the answer at random , find
(i) the expected number of correct answers
(ii) the expected overall marks
(iii) the probability that the candidate gets more than 8 marks.

12.A random variable x has the probability density function

$$f(x) = \begin{cases} kx & 0\langle x\langle 1 \\ (k/2)x & 1\le x\le 2 \\ 0 & \text{elsewhere} \end{cases}$$

Find
(i) the value of the constant k
(ii) E(x)
(iii) the median of x
(iv) $P(x<1.5 / 1\le x\le 2)$
(v) distribution function of x and sketch it.

13. (a) The error x made in determining a certain parameter in an experiment is a random variable having a uniform distribution over the interval(α,β) Given that the mean error is zero and the variance is 0.12, find the values of α and β
Hence , find the probability that the error will exceed 0.5

(b) A random sample of 16 tins of coffee selected from 95% confidence interval of the average weights in grammes
120 101 103 100 104 102 103 105
101 103 102 101 104 100 102 103
Given that the weights are normally distributed find a 95% confidence interval of the average weight of the tins.

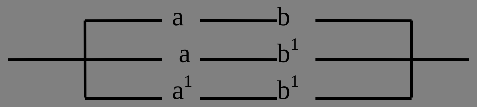
14. The weights of bars of soap produced in a certain factory are normally distributed.
Given that 10% of the bars weigh less than 140g and 20% weigh more than 165g, find
(i) the mean and variance of the distribution.
(ii) the percentage of bars that would be expected to weigh less than 145g.

If the variance of the distribution is reduced by 30%, find the production of bars that would be expected to weigh less than 148g.

SECTION IV LOGIC,ELECTRICAL CIRCUITS AND ALGEBRAIC STRUCTURES.

15. (a) use a truth table to show whether or not the statement $p \wedge (p \rightarrow \sim q) \rightarrow q$

(b) Given the circuit



(i) Write down a Boolean function for the circuit

(ii) Simplify your function and hence draw the simplest equivalent circuit.

(iii) Verify that the two circuits are equivalent.

(c) Given the truth table

p	q	S	T	U
T	T	F	F	F
T	F	F	F	F
F	T	F	T	T
F	F	T	F	T

where S ,T and U are function of p and q, find S(p,q), T(p,q) and U (p,q).

P425/2
MATHEMATICS
Paper 1
March 1988
3 Hours.

1. Solve the equations

$3x - y - 2z = 0$
$x + 3y - z = 5$
$2x - y + 4z = 26.$

(b) Given that $\dfrac{\log_{10} 3}{\log_{10} 2} = \dfrac{8}{5}$, solve for x and y in the simultaneous equations .

$3^x = 2^{3y+1}$
$4^{x-1} = 12^{2y+1}$

2(a) If $p = x + \dfrac{1}{x}$ express $x^2 + \dfrac{1}{x^2}, x^2 + \dfrac{1}{x^3}$ and $x^4 + \dfrac{1}{x^4}$ in terms of p.

(b) Prove that $(b - c)$ is a factor of $a^3(a - b) + b^3(c - a) + a^3(a - b)$ and write down two other factors of the expression.

3.(a) Write down the first four terms of the expansion of $(p + q)^n$ in descending powers of p . Hence other wise find the value of $(1.01)^{10}$ to 5 significant figures.

(b) Using the substitution $x^2 - 4x = y$, or otherwise find the real roots of the equation

$2x^4 - 16x^3 + 77x^2 - 180x + 63 = 0$

4(a). Given that $z_1 = 2 - 3i$
$z_2 = 3 + 5i$

Find (i) $\left|\dfrac{z_1}{z_2}\right|$

(ii) $z_1z_2 + (z_1 + z_2)$

(b) Solve $x^2 + 4x + 13 = 0$

5. (a) Show that $\sin 3\theta = 3\sin\theta - 4\sin^3\theta$. Hence solve the equation

$\sin 3\theta + \sin\theta = 0$ for $0^o \le \theta \le 360^o$

(b) Solve $3\sin\theta - \cos\theta = 3$ for $0^o \le \theta \le 360^o$.

6.(a) Prove that in any triangle ABC $a^2 = b^2 + c^2 - 2bc \cos A$.

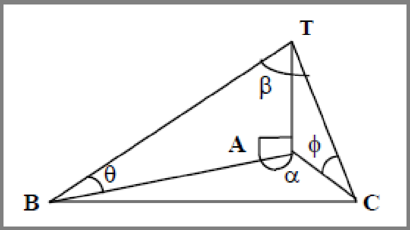
(b) Prove that if $t = \tan\frac{1}{2}\theta$, then

$\sin\theta = \dfrac{2t}{1+t^2}$, $\cos\theta = \dfrac{1-t^2}{1+t^2}$.

Hence prove that $\tan^2 22.5^o = 3 - 2\sqrt{2}$.

7. Find the equation of the normal at $P(ap^2. 2ap)$ to the parabola $y^2 = 4ax$.
Show that the normal to the curve at L (a,2a) passes through the point B(5a, -2a). Prove that there is just one other point M on the curve at which the normal passes through B and determine the coordinates of M.

8.



In the figure A,B,C are points on a horizontal ground . AT is a vertical flag post subtending angles θ at B and φ at C . Line BC subtends angles α at A and β at T . Write down the two expressions equal to BC^2. Hence , or other wise prove that

$$\frac{\cos\theta\cos\varphi\cos\alpha - \cos\beta}{\sin\theta\sin\varphi} = 1.$$

9. The position vector of points P and Q are **2i - 3j +4k** and **3i -7j+ 12k** respectively. Determine the length of PQ. PQ meets the plane $4x + 5y - 2z = 5$ at point S. Find

(i) the coordinates of S
(ii) the angle between PQ and the plane.

10. Find and distinguish between the nature of the two turning points of the curve $y = x^3 - x^2 - 5x + 6$ and sketch the curve .
Find the area enclosed between the curve and the lines $x = -2$, $x = 0$ and $y = 0$. Hence find the area enclosed between the curve and the line $y = x + 6$, where $-2 \le x \le 0$.

11. Evaluate $\int_a^{2a} \frac{x^3}{x^4 + a^4} dx$

(ii) Using the substitution $x = \cos 2\theta$, or other wise prove that

$$\int_0^1 \sqrt{\left(\frac{1-x}{1+x}\right)} dx = \frac{1}{2}\pi - 1$$

12. Given that $y = \tan^{-1}(1-x)$ show that

(i) $(2-x)\frac{dy}{dx} + \frac{1}{2}(1-x)^{-1/2} = 0$

(ii) $(2-x)\frac{d^2y}{dx^2} - \frac{dy}{dx} + \frac{1}{4}(1-x)^{-3/2} = 0$

Hence or other wise determine MacLaurin's series expansion of y up to the x^3 term. Use your expansion to evaluate

$\tan^{-1}\sqrt{\left(1 - \tfrac{1}{4}\pi\right)}$ to two decimal places.

13.(a) . Given that $y = e^{2x} \sin 3x$ prove that

$$\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 13y = 0 .$$

(b) A shop keeper found that his net profit P when selling a number n of a certain type of shirt per week is given by
$P = sh(750n - 0.1n^2 - 20,000)$.
He is selling 40 shirts per week ,show that if n increases from 40 to 41 profit will increase while an increase in n from 60 to 61 causes a decrease . Comment on your answer.

14. (a) . The quarterly cost , in shillings of water for a house hold over a period of 2 years is given in the table below.

	Quarters			
Year	1	2	3	4
1986	91	73	71	86
1987	99	80	64	95

Draw a graph to show these figures .
Calculate the four - quarterly moving averages and display these on the same axes.

(b) (i) Given n unlike objects , find the number of ways of dividing them into three unequal groups of sizes p, q and r where
$p + q + r = n$,
(ii) A committee of four is to be selected from six RC-1 and six RC -2 members. How many possible committees are there?
In how many ways will the members of RC -1 have a majority?

15. The table shows the number of people in millions in the different age groups in a country .

Age group	population in million
below 10	2
10 and under20	8
20 and under 30	10
30 and under 40	14
40 and under 50	10
50 and under 70	5
70 and under 90	1

Calculate
(i) the mean age
(ii) the mode
(iii) the standard deviation.
(iv) Draw a histogram to represent the above data.

P425/2
MATHEMATICS
Paper 2
March 1988
3 Hours.

1. (a) Using the substitution $y = xz$ or otherwise show that the solution of the equation

$2\frac{dy}{dx} = \frac{y}{x} + \frac{y^2}{x^2}$ is given by $\frac{(y-x)^2}{xy^2} = c$

where c is a constant
(b) Solve the equation

$$\frac{dy}{dt} = -0.5x(t)y$$

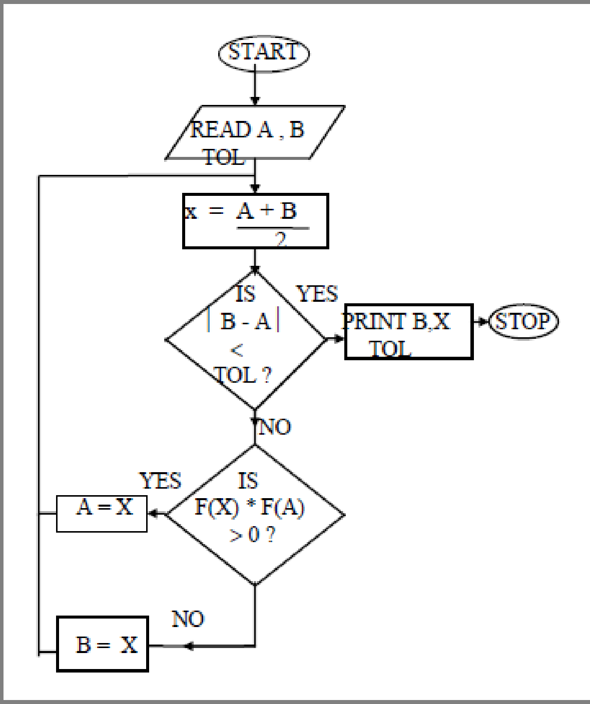
given that $x(t) = \frac{4}{(1+t)^2}$

and $y(0) = 10$

2. (a) Derive the simplest iterative formula based on Newton Raphson method for finding the root of the equation $e^{3x} - 3 = 0$

Use your formula with $x = \frac{1}{3}$ as the starting value to find the root correct to four significant figures. Hence find ln3 correct to 3 significant figures.

(b) An iterative method for approximating a root ot the equation f(x) = 0 is described in the flow chart below



Given that

A =1.6875, B =1.8750,TOL = 10^{-2} perform a dry run for the flow chart to determine $\sqrt[3]{5}$ tabulating the values of A,B and X at each stage.

3. (a) Define the term error and absolute error modulus. obtain the range of values within which the exact value of

$2.7654+3.8006-\dfrac{15.78}{0.9876}$ lies .

(b) The numbers A and B are approximated by the numbers X and Y respectively such that A =X -a, B = y-b where a,b are small numbers compared to A and B . Given that Y = f(x) and B = f(A) show that

$|b| = |a| f^1(A)$. If f(A) = A^p where p is a constant deduce that $|b| = |a| pA^{p-1}$ and find the expression for the relative error.

4.(a) A particle projected from point O with an initial velocity of **3i+4j** where **i** and **j** are vectors a long the x and y axis respectively. Find in vector form the velocity and position of the particle at any time.

(b) A particle P is projected from a point A with an initial velocity of 60ms^{-1} at an angle 30^{o} to the horizontal. At the same instant a particle Q is projected in opposite direction with initial speed of 50ms^{-1} from a point at the same level with A and 100m from A . Given that the particles collide find.

(i) the angle of projection of Q

(ii) the time when collision occurs.

5. (a) An object P passes through a point whose position vector is **3i - 2j** with constant velocity **i + j.** At the same instant an object Q moving with constant velocity **4i - 2j** passes through the point with position vector **i + 4j**.

Find :

(i) the displacement of P relative to Q after tseconds.

(ii)the time when P and Q are closest together and the closest distance at that time.

(b) To a cyclist riding due south at 20kmh^{-1} a steady wind appears to be blowing in the direction 240^{o}. When he reduces his speed to15kmh^{-1} the wind appears to blow in the direction 210^{0}. Find the true velocity of the wind .

6. (a) Four forces acting on a particle are represented by **2i + 3j**, **4i - 7j**, – **5i + 4j** and **i - j.** Find the resultant force. A fifth force represented by p**i** + q**j** is added to the system which is then in equilibrium . Find the values of the constants p and q.

(b) Two uniform rods AB and BC of equal length but of masses M and 3M respectively are freely joined together at B. The rods stand in a vertical plane with the ends A and C on a rough horizontal ground. The coefficient of friction μ at the points of contact with the ground is the same and the rods are inclined at 60^{0} to each other. Given that one of the rods is on point of slipping find μ . Find also the reaction at the hinge B when the rods are in this position.

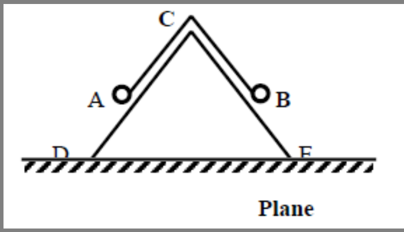
7. A particle moving with simple harmonic motion in a straight line passes through three points A,B,C in that order with velocities 0, 2ms^{-1} and -1 ms^{-1} respectively. Find the period and amplitude of the motion if AB = 2 metres and AC = 8 metres.

(b) Two springs AB and BC are joined together end to end to form a long spring. The natural length of the separate springs are1.6metres and 1.4 metres and their moduli of elasticity are 20N and 28N respectively. The end A is fixed and the combined spring is stretched by one metre Find the tension in the spring.

8. (a) Two spheres A and B equal size have masses m and 2m respectively. Sphere A is at rest on horizontal plane and sphere B which is moving on that plane with speed 2u along the line of their centres collides directly with A. Given that the coefficient of restitution e is 1, find the loss in kinetic energy after impact.

(b) A gun of mass M fires a shell of mass m and recoils horizontally. Given that the shell travels along the barrel

with speed v, find the speed with which the barrel begins to recoil if
(i) the barrel is horizontal
(ii) the barrel is inclined at an angle of 30^0 to the horizontal.



The diagram shows a wedge DCE of mass 10kg with the face DE in contact with asmooth horizontal plane. Two particles A and B of masses 3kg and 2kg respectively are connected by a light inextensible string passing over a smooth pulley fixed at the vertex C of the wedge . Given that the surface of the wedge is smooth and is moving freely, find
(i) the acceleration of the wedge
(ii) the acceleration of B.

10.(a) Define the independence of two events A and B Given that A and B are independent events in a sample space such that $P(A) = \frac{2}{5}$ and $P(A\cup B) = \frac{4}{5}$. Find
(i) P(B)
(ii) $P(\overline{A} \cup B)$.
(b) In a certain town the probability that a person owns a car is 0.25.Given that the probability that a person who owns a car is a University graduate is 0.2, find the probability that a person selected at random owns a car and is a University graduate.

11. (a) A random variable X has the following distribution
$P(X = 0) = P(X = 1) = 0.1$,
$P(X = 2) = 0.2$,
$P(X = 3) = P(X = 4) = 0.3$.
Find the mean and variance of X .
(b) A continuous random variable X has the distribution function

$$F(x) = \begin{cases} 3kx\left(1 - x^2/3\right) & 0 \le x \le 1 \\ 1 & x \ge 1 \end{cases}$$

Determine
(i) the value of k
(ii) the probability density of x
(iii) the mean of X
(iv) $P\left(X > 0.5 / 0.25 \le X \le 1\right)$

12.(a) In a certain clan the probability of a family having a boy is 0.6 . If there are 5 children in a family , determine
(i) the expected number of girls
(ii) the probability that there are at least three girls
(iii) the probability that they are all boys.

(b) The volume of soft drinks bottled by a certain company is approximately normally distributed with mean 300ml and standard deviation2mls. Determine the probability that in a sample of 10 bottles at least two bottles contain less than 297.4mls.

13. (a) The mean and standard deviation of a random sample of size 100 is 900 and 600 respectively. Given that the population is normally distributed find a 95 % confidence interval of the population mean.

(b) A random sample of size 9 drawn from a normally distributed population has the following values 297.5, 298.7, 596.5, 300, 297.4, 596.6, 297.5, 300.5, 300 . Determine a 99% confidence interval for the population mean.

14.(a) The price of matoke is found to depend on the distance away from the nearest town. The table below gives the average price of matoke for markets around Kampala City.

Distance,d (km)	**40**	**8**	**17**	**20**	**24**	**30**	**10**	**28**	**16**	**36**
Price,p (sh)	**120**	**160**	**140**	**130**	**135**	**125**	**150**	**130**	**145**	**125**

(i) plot these data on a scatter diagram
(ii) Draw the line of best fit on your diagram.
(iii) Find the equation of your line in the form $p = \alpha + \beta d$ where α and β are constants.
Hence estimate the price of matoke when]
$d = 5$
(b) The following table gives the order in which six candidates were ranked in two tests X and Y.
X: 1 2 3 4 5 6
E C B F D A
Y: F A D E C C
1 0 3 4 6.5 5.5
Calculate the coefficient of rank of correlation and comment on your result.

15 (a) Simplify
(i) $p \vee (p \wedge) q$
(ii) $\sim(p \vee Q) \vee (\sim P \wedge Q)$
Hence deduce the relation between (I) and (ii)
(b) Given the compound statement

$\{p\Lambda Q\}v[(P^1\Lambda Q^1)vQ]vP$

(i) Draw an electric circuit corresponding to the statement.
(ii) construct a truth table for the statement and state what it tells you about the circuit

P425/2
MATHEMATICS
Paper1
March 1989
3hours

1.(a) Given that $\frac{a}{b}=\frac{c}{d}=k$,

show that $\frac{a+c}{b+d}$

Hence solve the equation

$\frac{x+4}{4}=\frac{y+2}{6}=\frac{3x+y}{5}$

4x + 2y + 5z = 30

(b) solve the equation

$e^{2x} - 4e^x+3 = 0$

2.(a) Prove that $\log_a b$ = loga + logb

Hence solve the equation

$\log_8(x-2) + \log_8(x + 2) = 3.$

(b) Mukasa deposits shs1.000 in a bank at the beginning of every year for 10 years. How much does he receive at the end of 10 years if he is paid a compound interest of 12.5 per annum.

3(a) Expand$(1-3x)^{1/4}$ in ascending powers of x as the term x^4 Hence evaluate $13^{1/4}$ correct to 3 significant figures.

(b) The roots of the quadratic equation $x^2 + bx + 2 = 0$ are a and b.

Given that $\alpha = \sqrt{5}+\sqrt{3}$

(i) show that $b = 2\sqrt{5}$

(ii) find the value of $\alpha^2\beta+\alpha\beta^2$

(iii) form the quadratic equation whose roots are $\alpha^2\beta^2$ and x

4. Determine

(i) $\log_{10}\cos3x$

(ii) $\sin^2(4x^2+5)$

5. Find the stationary points of the curve

$f(x) = 6x +3x^2 - 4x^3$

and distinguish between them.

Hence sketch the curve

(b) Use Maclaurin's theorem to expand

$\frac{\sin x}{(1-x)^2}$

as far as the term x^3

6.(a) Find $\int x\sec^2 x dx$

(b) Evaluate

$\int_2^3 \frac{3+3x}{x^3-1}dx$

7.(a) Use the substitution x = sinθ to evaluate

$\int_{1/2}^{\sqrt{1/2}} \frac{x^2dx}{\sqrt{(1-x^2)}}$

(b) Find the area enclosed by the curve $y = x^2 - 2$, the x axis and line x = 3

8.(a) ***Given that z_1 = 3. I, z_2 = 3 find the modulus and argument of***

(i) $z_1^2z_2^2$

(ii) $\frac{z_2}{z_1}$

(b) Show that $z_1 = 2 +3i$, and $z_2 = 2 - 3i$ are roots of the equation $z^4 + 5z^3 +18z^2 +7z + 13 =0$

Hence find the other roots.

9.(a) Given that $\cot^2\theta + 3\mathrm{cosec}^2\theta = 7$ show that $\tan\theta = \pm 1$

(b) (i) Express the function y = 4cosx 6sinx in the form Rcos(x+a) where R is a constant and x = 2π. Hence find the coordinates of the minimum point of y

(ii) sketch without use of tables the graph of y

(iii) state the values of x at which the curve cuts the y axis.

10. (a) A point p lies on the line AC of a triangle ABC such that BCP is an equilateral triangle show that

$AP^2 = a^2+c^2 - ac\cos B + \sqrt{3}ac\sin B.$

Deduce that $AP^2 = \frac{1}{2}(a^2+b^2+c^2)+2\sqrt{3\Delta}$ where Δ is the area of the triangle ABC.

(b) show that in any triangle PQR tan

$\frac{1}{2}(Q-R)=\frac{q-r}{q+r}\cot\frac{1}{2}P$ Hence solve the triangle in which

θ = 15.32, r = 28.6 and $P = 39^0 59'$

11. (a) Given the parametric equations

x = 1 + 4cosθ, y = 2 + 3sinθ

show that the curve represented by the equations is an ellipse

(ii)state the coordinates of the centre and the length of the semi-axes.

(iii) Find the equation of the tangent to the ellipse at the point (1+4cosθ, 2 + 3sinθ)

(b) The normal at the point P(4cos0,3sunθ) on the ellipse

$$\frac{x^2}{16}+\frac{y^2}{9}=1$$

meets the x and y axes at A and B respectively. The mid-points of AB is M , show that the locus of M is an ellipse with the same eccentricity as the ellipse.

12. (a) Find the equation of the line through the intersection of the lines 3x - 4y + 6 = 0 and 3x + y + 13 = 0 which
(i) passes through the point(2,4)
(ii) makes an angle of 60^0 with the x axis.

(b)The circle $ax^2+by^2+2ax+2fy+c = 0$ cuts the intersection of the x axis at the point $_{A1}$ and A_2
find in terms of a,c and g the distance between A_1 and A_2
. A circle touches the y axis at a distance +4from the origin and cuts off an intercept 6 from the x axis. find the equation of the circle.

13. (a) Given that r and s are inclined at 60: t is perpendicular to r +s and $|r| = 8|s| = 5|t| = 10$ find $|r+s+t| and |r-s|$

(b) The equation of a plane is $r . \begin{bmatrix}2\\6\\9\end{bmatrix} = 33$ where r is the position vector of a point on P . Find
(i) the perpendicular distance from the origin to the plane.
(ii) the equation of a lineL which passes through the point A(5,-1,2) and perpendicular
(iii) the coordinates of the points of intersection of Pand L
.

14. The frequency distribution table shows the weight of 100 children measured to the nearest kg

Weight	**Number of children**
10 14	5
15 19	9
20 24	12
25 29	18
30 34	25
40 44	10
45 49	6

Calculate the mean and standard deviation.
Draw a cumulative frequency curve for the data, Hence estimate
(a) median weight
(b) the number of children with weight above 37 kg.

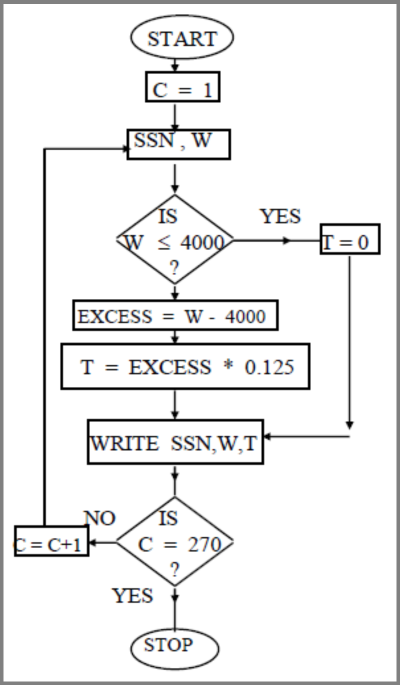
15.(a) The cost of making a cake is calculated from the cost of baking flour, sugar milk and eggs, The table below gives the cost of these items in 1985 and 1986

item	1985	1986	weight
flour per kg	60	78	12
sugar per kg	50	40	5
Milk per litre	25	30	2
Eggs per egg	10	15	1

Using 1985 as the base year
(i) calculate the price relatives for each item , hence find the simple price indices for the cost of making a cake
(ii) Find the weighted aggregate price index for the cost of a cake.
if the cost of making a cake in 1986 was sh30 find the cost 1985 using the two indices in (i) and (ii)
(b) The registration numbers of vehicles consists of three letters followed by three digits. Find the total number registration numbers if
(i) no letter nor digit is replaced
(ii)the first letter is u and no triple zero.

P42/2
MATHEMATICS
Paper 2
March 1989
3hours.

1. (a) Find the simplest iterative formula based on Newton-Raphson's method for approximating $\sqrt{2}$ .Taking x_0 = 1 as a first approximation , find the second approximation.
(b) Given the equation $e^x - 2x + 1 = 0$, show by plotting suitable graphs on the same coordinate axes or otherwise that the root of the equation lies between 1 and 1.5.
2. In the flow diagram C = counter ,
SSN = social security number,W = monthly wage of a factory employee in shillings.



Copy and complete the following table.

SSN	W	T
01-86-003	8400	----
03-86-095	8200	----
04-86-064	7500	----
02-86-035	8000	----
04-86-066	6400	----
01-87-098	4800	----
02-87-105	6300	----
03-87-135	5500	----
01-88-215	3800	----
01-88-217	3500	-----

For how many employees is this program designed?

Among these employees there are some senior staff whose monthly salary is more than sh10,000 each. These pay tax as follows.

$12\frac{1}{2}\%$ for salary above sh 4000 but not more than sh10000 then 25% for salary above sh1000

Modify the given flow diagram in order to incorporate the senior staff.

SECTION II:VECTORS AND MECHANICS.

3.(a) The frictional resistance to the motion of a car of mass 1000 kg is 30v N , where vms^{-1} is the speed of the car. Find the steady speed at which the car ascends a hill of inclination

$\sin^{-1}\left(\frac{1}{10}\right)$

if the power exerted by the engine is 12.8KW.

(b) A particle of mass 0.1kg is released from rest at a height 25m above the ground level and falls freely under gravity . Taking the ground level as the zero level potential energy find the sum of the kinetic energy of the particle when t = 2 seconds.

4.A particle of weight W is at rest on an inclined plane under the action of a force p acting parallel to a line of greatest slope of the slope of the plane in upward direction, the angle of friction between the particle and the plane is λ and the angle of inclination of the plane to the horizontal is 2λ, show that $P_{max} = W \tan\lambda(4\cos^2\lambda-1)$ and $P_{min} = \mu W$ respectively.

Show that the coefficient of friction between the particle and the plane is $\sqrt{\frac{3}{5}}$.

5. A ball rolls from rest down a rough plane inclined at 30^o to a smooth horizontal plane. it rolls for 3m before it reaches the horizontal plane. The coefficient of friction between the ball and the inclined plane is 0.25

Find

(i) the velocity of the ball at the instant of touching the horizontal plane.

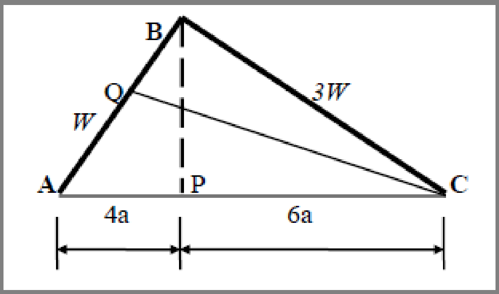
(ii) the time the ball takes to travel a horizontal distance of 2m.

6. Three particles A,B,C of masses m,2m,3m respectively lie on a smooth horizontal table in a straight line ABC perpendicular to the table. Particle C is just on the edge of the table and AB = BC =2a . Particle A and B are connected by a light inextensible string of length 3a and particles B and C are connected by an identical string .

Particle C is then gently displaced over the edge of the table so that it falls freely. Find the speed of B just after it is jerked into motion and show that the loss of energy in the jerk is -6mga .

Find also the speed and acceleration of A just after it is jerked into motion and the tension in the string AB.

7.



The diagram shows two uniform rods AB and BC , of weights W and 3W respectively.

which are smoothly hinged together at B . The point P is the point AC which is vertically below B and AP = 4a, PC = 6a . The rods rest in equilibrium in vertical plane with the ends A and C on a smooth horizontal plane. The end C is connected to a point Q in AB by a light inelastic string. show that the magnitude of the reaction of the plane at A is $\frac{17}{10}$W and find the magnitude of the reaction of the plane at AC.

If BC = 10a and Q is the mid-point of AB , find the tension in CQ.

8. (a) A uniform rod PRQ of mass Mkg and length 2l is free to oscillate about p .A particle of Mkg is attached to a point on the rod.

Find the maximum length of an equivalent simple pendulum from Q.

(b)A particle of unit mass oscillate about a point O with a period of 2π secs. It passes a point A with a velocity of $4ms^{-1}$ away from O. Given that OA = 4m , find

(i) the amplitude of motion

(ii) the speed at B where OB = 3m.

SECTION III:DIFFERENTIAL EQUATIONS.

9.(a) Solve the equation

$\frac{dy}{dx} = 2y + 3$

Given that y = 0 when x = 0 , expressing y as a function of x

(ii) A curve in the x-y plane has the property that the slope of the tangent to a curve in x-y plane at the point with coordinates(x,y) is equal to y + cosx.

Given that the curve passes through (0,1) find its equation.

SECTION IV :STATISTICS AND PROBABILITY.

10. The outputs of 9 machines in a factory are independent random variables each with probability density function given by

$$f(x) = \begin{cases} ax & 0 \le x \ge 10 \\ a(20 - x) & 10 \le x \le 20 \\ 0 & \text{otherwise} \end{cases}$$

Find

(i) the value of a

(ii) the expected value and variance of the output of each machine. Hence or otherwise find the expected value and variance of the total output from all machines.

11. (a) Given that A and B are mutually exclusive events such that

P(A) = 0.5 P(A∪B) = 0.9, find

(i) $P(\overline{A} \cup B)$

(ii) $P(\overline{A} \cap \overline{B})$

(b) if A and B are events and

$P(B) = \frac{1}{6}$ $P(A \text{ and } B) = \frac{1}{12}$, $P(B/A) = \frac{1}{3}$ Calculate

P(A),and P(A/B),P(A/B). where B is the event B does not occur.

(i)State the independent

(ii) mutually exclusive

12. In a certain country 60% of the cars are privately owned. of the privately owned cars 70% are small , whereas of the cars which are not privately owned 40% are small . independent of ownership 20% of the small cars and 30% of the large cars are less than two years old. if a car is chosen at random , Calculate the probability that

(i) the car is small

(ii) the car is privately owned given that it is large.

(iii) the car is privately owned large and more than two years old.

(iv) the car is large , given that it is privately owned and more than two years old.

13. The table below shows the diameters in centimetres of $30\frac{1}{2}$ liter cups taken at random from a large batch.

9.02	9.02	9.00	9.02	9.01	9.01
9.00	9.01	9.02	9.00	9.00	9.00
9.01	8.99	9.01	9.00	9.00	9.03
9.00	9.00	8.98	9.01	9.05	9.00
8.99	9.01	9.01	8.99	9.01	9.00

Calculate

(i) the mean diameter

(ii) the standard deviation

(iii) the standard error of the mean,

(iv) state two values between which the complete batch lies.

14. A certain firm sells maize flour in bags of mean weight 40 kg and standard deviation of 2 kg. Given that the weight is normally distributed find,

(i) the probability that the weight of any bag taken at random will lie between 41.0 and 42.5kg.

(ii) the percentage of bags whose weight exceeds 43kg.

(iii) the number of bags rejected out of a 500 bag purchased by a retailer whose consumers cannot accept a bag whose weight is below 38.5 kg

SECTION V:LOGIC,ELECTRICAL,CIRCUITS AND ALGEBRAIC STRUCTURES.

15. Given that p represents 'Tonny is strong' and q represents 'Peter is weak'

(a) write down the compound statements in English represented by each of the following

(i) $\sim p$

(ii) $p \vee q$

(iii) $q \rightarrow p$

(iv) $\sim p \wedge q$

(v) $\sim p \rightarrow q$

(b) The table shows a binary operation defined on set s (0,1)

Determine whether (s ,⊕)is a group. if it is a group what type of group?

MATH PAPER 1

1990

SECTION A

1. (a) Find $\log_9 27\sqrt{3}$ without using tables.

(ii) Simplify $(\log_a b^2) \times (\log_b a^2)$

(b) Express $\log_{25}(xy)$ in terms of $\log_5 x$ and $\log_5 y$. Hence solve the simultaneous equations.

$\log_{25} xy = 4\frac{1}{2}$

$\frac{\log_5 x}{\log_5 y} = -10$

2. (a) The polynominal

$x^4 + px^3 - x^2 + qx - 12$ has factors x +1 and x +2. Find the values of p and q ; hence factorise the polynominal completely.

(b) Show that if the expressions . x^2 + bx+c and x^2 +px +q have a common factor then $(c-q)^2 = (b -p) (cp -bq)$

3.(a) Given that the complex conjugate satisfy the equation

$z\bar{z} + 2iz = 12 + 6i$

Find the possible values of Z.

(b) Find the cartesian equation , in its simplest form , of the curve described by

$|w - 3 + 6i| \le 2|w|$

4. The frequency distribution shows the heights , to the nearest cm ,of 80 prisoners.

Height in cm	Number of prisoners
150- 154	3
155-159	7
160-164	10
165-169	15
170-174	25
175-179	12
180- 184	6
185-189	2

(a) Calculate

(i) the median height.

(ii) the standard deviation for the heights of the prisoners

(b) Plot the cummulative frequency curve corresponding to the data and use your curve to estimate the semi - interquartile range .

5. Determine the stationary points (including points of inflection) of the curve.

$$y = \frac{x}{x^2 + 1}$$

Sketch the curve.

6. Show that the tangents of gradient m to the ellipse

$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ are $y = mx \pm \sqrt{(a^2m^2 + b^2)}$

Find (i) the equations of the tangents to the ellipse

$\frac{x^2}{6} + \frac{y^2}{3} = 1$ from the point (-2,5)

(ii) the coordinates of the points of contact of these tangents .

7. (a) Find $\int \sin^{-1}x dx$

(b) Sketch the curve y = 1 + sinx from

$x = 0$ to $x = \frac{\pi}{2}$.

Find the coordinates of the cenrtoid of the area enclosed by the curve, the linex = $\frac{\pi}{2}$ and coordinate axes.

. (a) Determine the general solution of the equation tan 2x + 2sin x = 0

(b) Show that in a triangle ABC

tanA + tanB + tanC = tanA tanB tanC.

9. (a) From a point A , apilot flies in the direction N38°20'W to a point 125 km from A he then flies in the direction S51°40'E for 125km. He wishes to return to A from this point. How far and in what direction must he fly?

(b) Show that for all values of θ

$$\cos\theta + \cos\theta\left(\theta + \frac{2\pi}{3}\right) + \cos\left(\theta + \frac{4\pi}{3}\right) = 0$$

Hence or otherwise show that

$$\cos^2 + \cos^2\left(\theta + \frac{2\pi}{3}\right) + \cos^2\left(\theta + \frac{4\pi}{3}\right) = \frac{3}{2}.$$

10. (a) Let Δx and Δy be the increments in x and y respectively . Given that y = tan 2x write down an expression for Δy in terms of x and Δx. Hence estimate the values of $\tan\frac{9\pi}{20}$.

(b) Tabulate the values of the function

$f(x) = \sqrt{(1 + x^2)}$ to three decimal places, for the values of x from 0 to 1 at intervals of 0.1 .

Using the trapezium rule estimate

(i) Using all the coordinates you have tabulated .

(ii) Using only the coordinates at intervals of 0.2 comment on the accuracy of your results.

11. (a) Find the derivative of $y = \sin^2 x$ from first principles

(b) Show that $\int_0^1 \frac{x^2 + 6}{(x^2 + 4)(x^2 + 9)} dx = \frac{\pi}{20}$

12.(a) Find the polar equation of the curve

$(x^2 + y^2) = a^2 (^{x2} - y^2)$, where a is a constant.

(b) Solve the simultaneous equations

x +y = 7

$x^2 + y^2 \le 37$

are simultaneously true .

13. (a) The position vector of the points A,B and C are **2i-j +5 k; i - 2j** +k and **3i+k -2k** respectively . Given that L and M are the mid points of AC and CB respectively , show that LM is parallel to BA.

(b) Show that the points with position vectors **4i -8j -13j ; 5i -2j -3k** and **5i +4j +10k** are the vertices of a triangle .

14. (a) Part of the line x -3y +3 = 0 is a chord of the rectangular hyperbola

$x^2 - y^2 = 5$

(b) Find the equation of the tangent at the point P $\left(ct, \frac{c}{t}\right)$ on the rectangular hyperbola $xy = c^2$ and prove that the equation of the normal at P is $y = t^2x + \frac{c}{t} - ct^3$

A point N (X, Y) on the normal is such that $\overline{ON} = \overline{NP}$ where O is the origin

show that $3ct^4 - t^3x - c = 0$.

15. (a) Find how many words can be formed using all letters in the word 'MINIMUM.'

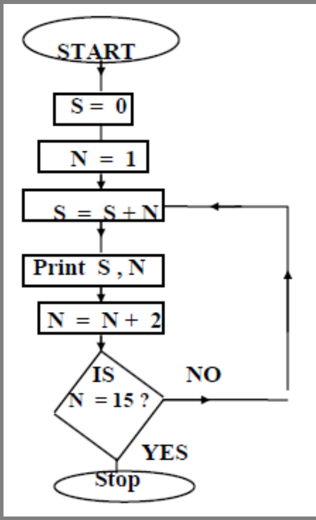
(b) Compute the sum of the four digit numbers formed with the four digits 2,5,3,8 if each digit is used only once in each arrangement.

(c)A Committee consisting of 2 men and 3 women is to be formed from a group of 5 men and 7 women . Find the number of different committees that can be formed . If two of the women refuse to serve on the same committee, how many committees can be formed?

MATH PAPER 2
1990.
SECTION A.

1.(a) The bus stages along Jinja - Kampala road are 10km apart. An express bus travels between the two towns only stop at these stages except in case of emergency when it is permitted to stop at a point in between two stages. The fares up to the first , second , third and fourth stages Jinja are shs 110, shs 150, shs 185 and shs 200 respectively. On a certain day a passenger paid to travel from Jinja in the bus up to the fourth stage but fell sick and had to be left at a health centre 3m away from Jinja . Given that he was refunded money for the part of the journey he had not travelled . Find the approximate amount he received . Another person who only had shs 165 was allowed to board the bus but would be left at a point worth his money. How faraway from Jinja was he to be left?

(b) Study the flow chart given below.



Perform a dry run of the flow chart.

Hence state the purpose of the flow chart.

(c) Draw a flow chart for computing the mean of the square roots of the first one hundred natural numbers.

2. Two positive numbers Y_1 and Y_2 are each rounded off to three decimal places to give x_1 and x_2 respectively. Find in terms of x_1 and x_2 the maximum relative error in using x_1x_2 as an approximation for $y_1\, y_2$.

The numbers 2.6754 , 4.8006 , 15.175 and 0.95 have been rounded off correct to the given number decimal places. Find the range of values within the exact value of

$2.6754\left(4.8006 - \frac{15.175}{0.92}\right)$ can be expected to lie.

2. (a) Find the general solution of the equation.

$\frac{dy}{dx} + y\cot = 3\sin x\cos x$.

(b) The rate of cooling of a body is proportional to the difference 0 between the temperature of the body and that of the surrounding air. Write down a differential equation involving o for this process.

If the surrounding air is kept at 20°C and the body elasticity λ and natural length a has one end P fixed . A mass m hanging in equilibrium at the other end Q , stretches

the string through a distance L . Show that when the mass is pulled down, a further small distance and released from rest the resulting motion is simple harmonic motion of

period. $T = 2_{\pi}\sqrt{\left(\frac{1}{g}\right)}$.

The mass m is detached and replaced by a mass m^1 which also similarly moves with simple harmonic motion of

period T . Show that $\frac{m}{m^1} = \left(\frac{T}{T^1}\right)^2$ and find the period in terms of T and T^1 if both masses hang together at the end of the string.

5. The horizontal and vertical components of the initial velocity of a particle projected from a point O on a horizontal plane are p and q respectively.
(a) express the vertical distances , y travelled in terms of the horizontal distance x . and the components p and q.
(b) Find the greatest height , H attained and the range R, on the horizontal plane through O . Hence show that

$$y = \frac{4Hx}{R^2}(R - x)$$

Given that the particle passes through point(20,80) and H = 100m find the velocity of projection.

6. A particle p leaves the origin and moves with constant velocity **2i + 6j** while a particle starts from the origin with initial velocity **4i - 8j** and moves with acceleration **i + j** find:
(i) the position of P and Q after 2 seconds.
(ii) the time at which the velocities of the two particles are perpendicular to each other.
(iii) the time at which the point R with the position vector **17i + 25j** lies on the line joining the positions of the particles P and Q.

7. A non - uniform ladder AB is in equilibrium with A in contact with a horizontal floor and B in contact with a vertical wall. The ladder is in a vertical plane perpendicular to the wall. The centre of gravity of the ladder is at G where $\overline{AG} = \frac{2}{3}\overline{AB}$. The coefficient of friction between the ladder and the wall is twice that between the ladder and the floor. If the ladder makes an angle θ with the wall and the angle of friction between the ladder and floor is λ ,prove that 4 tan θ = 3 tan 2λ.
How far can a man of mass m ascend the ladder without the ladder slipping given that $\theta = 45^0$ and the coefficient of friction between the ladder and the floor is $\frac{1}{2}$.

8.(a) The maximum power developed by the engine of a car of mass 200 kg is 44 kw . When the car is travelling at 20 kmh^{-1} up an incline of l in 8 it accelerates at a rate of 2 ms^{-2} . At which rate will it accelerate when travelling down an incline of l in 16 at 60 kmh^{-1} , if in both cases the engine is developing the maximum power and the resistance to motion are the same?

(b) A particle of mass 2 units moves under the action of a force which depends on the time t given by
$F = 24t^2$ **i** + (36t - 16)**j** . Given that at t = 0 the particle is located at **3i - j** and has a velocity **6i + 15j** , find
(i) the kinetic energy of the particleat t = 2.
(ii) the impulse in moving the particle from t = l to t = 2.

9.(a) A uniform tray is 75 cm long and 50 cm wide and weighs 600 g . Objects weighing 3000g and 600 g are placed on the tray 15 cm and 25 cm from one of the longer sides and from one of the shorter sides 30 cm and 40 cm respectively. Find the position of the centre of gravity.
(b) A particle of mass marks hangs at rest from the end of a string of length l . The particle is projected horizontally with speed a and so starts to move in a vertical circle. Assuming that the particle continues to move in a circle, show that the tension in the string when it makes an angle θ within its initial position is given by

$$T = \frac{m}{\ell}\left(u^2 - 2g\ell\cos\theta\right)$$

Deduce that the particle makes a complete revolution $u^2 > 5g\ell$.

10. The probability of a number on the top face when an unbalanced die is tossed is proportional to the number. Find the probability that an odd or a prime number will appear.
If the die is tossed twice, find the probability distribution function for the sum of the two numbers that appear on the top face.
What is the most likely sum?

11.(a) The number x of cars crossing the Owen falls Dam daily is uniformly distributed between 1026 to 3025 cars.

(i) Find the probability that at least 1625 cars cross the bridge.
(ii) What is the expected number of cars that will cross the bridge on any given day?
(b) The probability density function of a random variable X is

$$f(x) = \begin{cases} k\sin x \text{ for } 0 \le x \le \pi \\ 0 \text{ elsewhere.} \end{cases}$$

Determine
(i) the value of k
(ii) $p\left(X > \frac{\pi}{3}\right)$
(iii) the median value of X.

12. Ten pairs of observations have been made on two random variables X and Y . The ten (x, y) are (0,22) , (-7, 12) , (-10, 15) , (-12, 22) (-17, 5), (-30, -5) , (-32, -13), (10, 30) (-12, 8) .
(i) Plot the results on a scatter diagram.
(ii) Draw on a scatter diagram the lines of best fit for predicting Y from X and for predicting unifying the lines clearly.'
(iii) State the coordinates of the points of intersection of the two lines.

(iv) Estimate the expected value of Y corresponding to $X = -7$.

(v) Calculate the rank correlation coefficient for these data.

13. (a) A box contains 3 red , 2 green and 5 blue crayons. Two crayons are randomly selected in one box without replacement. Find the probability that

(i) the crayons are of the same colour.

(ii) at least one red crayon is selected.

(b) In an experiment a box contains 2 green and 5 blue balls. A second box contains 5 green and 3 blue balls. One ball is drawn at random from the second box and placed into the first box. What is the probability that a ball now drawn at random from the first box is green?

14. (a) A random sample of ten newly born babies in a certain hospital had a mean weight of 36 kg and a standard deviation of 0.96 kg.

(i) Construct a 99 per cent confidence interval for the mean weight of the babies in the hospital.

(ii) If x = 3.36 kg is used as an estimate of the mean weight of all the babies born in the hospital, with what confidence can you assert that the error of the estimate is at most 0.1 kg?

(b) Statistics records from the Uganda Police Traffic Department shows that on weekend nights one out of every ten drivers on the road is drunk. A random sample of four hundred drivers are checked on weekend. Find the probability that the number of drunk drivers is at least 35 but less than 47.

15.(a) Given that the statements

Mukasa reads New vision

Mukasa reads Star,

Mukasa reads Daily Nation.

Write each of the following statements in symbolic forms.

(i) Mukasa reads New vision or Star but not Daily Nation.

(ii) Mukasa reads New vision and Star or he reads neither New vision nor Daily Nation.

(iii) It is not true that Mukasa reads New vision but not Daily Nation.

(iv) It is not true that Mukasa reads Daily Nation but not New vision.

(b) Show that

(i) $p \to q \equiv p^1 v q$

$p \leftrightarrow q \equiv (p \to q)\Lambda(q \to p)$

State the rules of algebra of proportion elsewhere show that $p \to q \equiv (p\Lambda q)v(p^1\Lambda q^1)$

MATH

PAPER 1

1991.

1. (a) Write down the expansion of $\sqrt{1-x}$ in ascending powers of x as far as the term in x^4. Use your expansion to find $\sqrt{90}$ correct to four significant figures.

(b)Prove by induction that

$$p + pq + pq^2 + \ldots + pq^{n-1} = p\left(\frac{1-q^n}{1-q}\right)$$

2. (a) Express $2x^2 + 11x + 6$ in the form $p(x + q)^2 + r$ and hence deduce its minimum value , where p,q and r are constants.

(b) If α and β are the roots of

$ax^2 + bx + c = 0$,

express $(\alpha - 2\beta)(\beta - 2\alpha)$ in terms of a , b and c . Hence deduce the condition for one root to be twice the other.

(c) Solve the simultaneous equations .

$$\begin{aligned} 4p - q + 2r &= 7 \\ p + q + 6r &= 2 \\ 8p + 3q - 10r &= -3 \end{aligned}$$

3. (a) Evaluate $\int_0^{\pi/2} x\cos^2 x\,dx$

(b) Find the co-ordinates of the centre of gravity of the area enclosed by the curve.

$y = \cos x$ and the coordinate axes.

4. (a) Differentiate

(i) $(\sin x)^x$.

(ii) $e^{-2/x}\sin 3x$

(b) Find the turning points of the curve given by the parametric equations:-

$$y = t + \frac{1}{t}$$

$$x = t^2 .$$

Determine the nature of the turning points and sketch the curve.

5. The table below gives the data about the masses of FORM THREE girls at Tororo Girls School in February 1988.

Mass (kg)	40 - 44	45 - 49	50 - 54	55-59	60-64	65- 69	70-74
Frequency	3	30	29	33	13	1	1

(i) Calculate the mean mass

(ii)Determine the number of girls whose mass exceeded the mean mass.

(iii) Find the median mass

(iv)Draw a cumulative frequency curve and estimate the 10 - 90 percentile range of masses.

6. (a) The total impedance z in an electric with two branches z_1 and z_2 is given by

$$\frac{1}{z}=\frac{1}{z_1}+\frac{1}{z_2}$$

Given that $z_1 = 3 + 4i$

$z_2 = 5 + 5i$

Where $i = \sqrt{-1}$, calculate the total impedance z in the form a + bi.

(b) If n is a variable and

$z = 4n + 3i(1 - n)$

Show that the locus of z is a straight line.

Determine the minimum value of $|z|$

7. (a) Simplify $\dfrac{\sin 3x}{\sin\alpha}-\dfrac{\cos 3x}{\cos\alpha}$

(b) Express $5\sin\theta + 12\cos\theta$ in the form $r\sin(\theta+\alpha)$ where r and α are constants. Hence determine the minimum values of

$5\sin\theta + 12\cos\theta + 7$.

(c) Given that $\tan\beta = \dfrac{3}{4}$, where β is acute, find the values of $\tan 2\beta$ and $\tan\beta/2$

8. Prove that the equation of the tangent to the parabola $y^2 = 4ax$ at the point

$p(at^2, 2at)$ is $ty = x + at^2$.

The tangent at p meets the y - axis at Q. Given that F is a fixed point (h,0) and R is a point such that FQPR is a parallelogram, find

(i) the coordinates of R,

(ii) the equation of the locus of R

9. (a) Given that the roots of the equation

$ax^2 + bx + c = 0$

are in the ratio p : q, show that

$ac(p + q)^2 = b^2pq$.

(b) The expression $x^7 - ax^3 + b$ is divided by x - 1 and has a remainder 8 when divided by x - 2. Find

(i) a and b,

(ii) the remainder when the expression is divided by x + 2 using a synthetic approach.

10. (a) Show that

$$2\tan^{-1}\left(\frac{1}{3}\right)+\tan^{-1}\left(\frac{1}{7}\right)=\frac{\pi}{4}.$$

(b) Find x given that

$\tan^{-1}(1+x) + \tan^{-1}(1-x) = 32$.

(c) Given that

$\sin\theta + \sin\phi = p$ and

$\cos\theta + \cos\phi = q$

show that

$$\sin(\theta+\phi)=\frac{2pq}{p^2+q^2}.$$

11. (a) The position vector of a body of mass 12.5 kg is $8t^2\mathbf{i} + 6t\mathbf{j}$ meters at a given time, the.

Determine the (i) velocity after 4 seconds,

(ii) the force on the body.

(b) The vector OA is represented by the displacement vector a and OB by b. Point R divides AB into the ratio $\lambda : \mu$. Find the position vector of R in terms of vectors a and b and the scalars λ and μ.

If the points P,Q and R have position vectors p, q and r, respectively, and M the mid- point of QR, show that the position vector of n is a point on PM such that PN : NM = 2 : 1 is $\frac{1}{3}(p+q+r)$.

Hence determine the coordinates of N when P is (5,6), Q (3,4), and R (7,2).

12. (a) The displacement x of a particle at time t is given by $x = \sin t$. Find the mean value of its velocity over the interval

$0 < t < \dfrac{\pi}{2}$

(i) with respect to time t.

(ii) with respect to displacement x.

(b) By dividing the interval $[0, \pi]$ into seven sub intervals and using the trapezoidal rule evaluate

$$\int_0^{\pi} x\sin x\,dx.$$

13. (a) Find

(i) $\int x\sec^2 x\,dx$

(ii) $\displaystyle\int \frac{x^3}{\sqrt{(1-x^2)}}dx$

(b) Evaluate

$$\int_2^3 \frac{2x^2+1}{(x+2)(x-1)^2}dx$$

14. The table below shows the expenditure on examiners, in thousands of shillings, during the year 1987 ordinary level marking exercise.

10	11	10	12	14	16	20	25
21	22	13	17	18	24	30	32
27	35	40	44	39	50	54	53
44	37	36	39	52	51	57	15
16	19	34	43	26	38	53	40

(i) Form a frequency distribution table with class intervals of 5000 shillings ; the lowest class limit being 10,000.

(ii) Draw a histogram to represent the above data and superimpose a frequency polygon.
(iii) Calculate
(a) the mean expenditure
(b) the standard deviation .
15. (a) (i) Show that

$$\operatorname{cosec}\left(\frac{\pi}{2}+\theta\right)\sin\left(\frac{3\pi}{2}-\theta\right)=-1.$$

(ii) Solve the equation
$\tan^2\theta \tan 4\theta = 1$ for $0 \le \theta \le 90^0$.

(b) Prove that $\dfrac{\sin A+\sin B}{\cos A+\cos B}=\tan\dfrac{A+B}{2}$

Hence deduce that if A, B and C are the angles of a triangle , then $\dfrac{\sin A+\sin B}{\cos A+\cos B}=\cot\dfrac{C}{2}$.

MATH
PAPRE 2
1991
SECTION A.

1. (i) Show that the Newton - Raphson formular for approximating the reciprocal , a, of a number N is given by $x_{n+1} = x_n(2-Nx_n)$; = 0,1,2 --------
(ii) Draw a flow chart to illustrate the use of the algorithms for the computing and printing of a close approximation to a. .Take the initial approximation to be a and ensure that the computation ceases as soon as the absolute value of the difference between consecutive iterates is less than 5×10^{-3} or when twenty iterations have been performed.

(iii) Perform a dry run for your flow chart for N = 7.45; a = 0.2.
2. (a) Let x_1 and x_2 approximate the numbers x_1 and x_2 with errors of e_1 and e_2 , respectively . Show that the maximum possible error in the sum $x_1 + x_2$ is
$|e_1| + |e_2|$.
Hence or otherwise , evaluate 3.45 + 4.87 - 5.16 as accurately as possible given that the numbers are each correct to the given number of significant figures.
(b) The table below is an extract from table of

cosx	0'	10'	20'	30	40'	50'
$(\cos 80^o)$	0.1736	0.1708	0.1679	0.1650	0.1622	0.1593

Determine
(i) $\cos 80^o 36'$
(ii) $\cos^{-1} 0.1685$.
(a) The position vector r of a particle in motion is given by

$$\mathbf{r} = 5\mathbf{i} + t^3\mathbf{j} + t^2\mathbf{k}$$

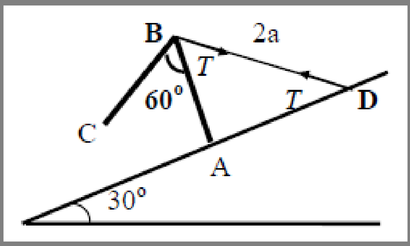
Where is the time seconds .
Determine :
(i) the velocity and acceleration of the particle at a time ,
(ii) the speed at time t = 4 seconds.
(b) Two points P and Q are x meters apart . A particle starts from rest at P and moves directly towards Q with an acceleration of a ms^{-2} until it acquires a speed of v ms^{-1}. It maintains this speed for T seconds and then brought to rest at Q under a retardation of a ms^{-2}
Prove that

$$T = \frac{x}{v} - \frac{v}{a}$$

4. (a) A particle performing a simple harmonic motion satisfies the equation $\dfrac{d^2x}{dt^2} + w^2x = 0$, where w is a constant and x is the distance from the centre of motion.
Show that x = A cos (wt +e) , where e is a constant and A is the amplitude.
(b) A particle moving with a simple harmonic motion of amplitude a meters travels from a point P_1 , x_1 meters from the centre of motion directly to a point Q , x_2 meters from the centre of motion in t seconds. Show that the period T of the motion satisfies .

$$a^2\cos\frac{2\pi t}{T} = x_1x_2 + \sqrt{(a^2 - x_1^2)(a^2 - x_2^2)}$$

5. The diagram **shows** a uniform rod AC of weight w bent at B , being kept in equilibrium on a plane of inclination 30^o by an elastic string BD of natural length 2a.
Given that AB = a BC = b and ABC = 60^o,



(i) Show that the tension in the string is given by

$$T = \frac{\sqrt{5}w(a+b)}{8a}$$

(ii) Find the modulus of the string.
(iii) Determine the reaction at A.
6. Four points A,B,C, and D in a river from half a regular hexagon . The diagonal AD is perpendicular to the direction of the current. The speed of the current is $5km^{-1}$. How long dose it take a motor boat whose maximum speed is $15km^{-1}$ to go along ABCD ?

7. (a) A jet fighter is flying at a height of 1km at a speed of 1080 km^{-1}. To bomb an anti - air craft battery on the ground the pilot releases a bomb at a point P which is vertically above Q on the ground. How far is Q from the battery.
(b) Water issues out of a nozzle of a pipe at a speed of 10ms^{-1} . The nozzle of the pipe is placed at 30^o to the horizontal and 1m below and outside the rim of the top of a tank. If the water just flows into the tank, calculate the maximum distance between the nozzle and the tank .

8. A train of mass 300 tonnes is pulled from rest down an incline by an engine of tractive force of 120 kN . The air resistance to motion is 90kN.
(i) If the train attains a speed of 63kmh^{-1} in 25 seconds determine the slope of incline.
(ii) At that time a tree which fell across the rails sighted a head and the driver immediately applies the brakes.
If the train stops after moving a further distance of 300m, determine force exerted by the brakes .
(iii) If the brakes fall and the tree is carried along the rails at a constant speed of 25kmh^{-1}, what is the resistance to motion of the train?

9.(a) Solve the equation

$x^2\frac{dy}{dx} + y = x^2e^{\frac{1}{x}}$ given that y = 2 when x = 0 .

(b) Edule walks to school at a rate which is proportional to the distance he still has to cover. His home is 500m from school. If he begins moving from home at a rate of 3 ms^{-1} , how many hours does he take to cover three -fifth of the distance ?

10. (a) Three balls are drawn at random one after the other without replacement from a bag containing 21 white , 9 blue , 40 red and 12 orange balls.
Determine the probability that the first ball is blue , the second red or blue and the third is white.
(b) Tom is to travel from Lira to Kampala for an interview. The probabilities that he will be in time for the interview when he travels by bus and taxi are 0.1 and 0.2 , respectively . The probabilities that he will travel by bus and taxi are 0.6 and 0.4 , respectively.
(i) Find the probability that he will be on time.
(ii) Given that he is not on time what is the probability that he travelled by a taxi ?

11. (a) A random variable X and the probability function :

$$f(x) = \begin{cases} k2^x;' = 0,1,2,---; 6. \\ 0, \quad \text{elsewhere} \end{cases}$$

Determine :
(i) the value of k
(ii) E (X)
(iii) P(x < 4/ x >1).
(b) A question paper contained 100 objective questions with four alternative answers but only one correct answer . A candidate who sat for the paper attempts eighty questions purely by guessing and left out the remaining twenty . Determine the probability that :
(i) he got 0%
(ii)he scored between 20% and 30%.
(iii) he passed if the pass mark was fixed at 30 %.

12. Three examiners X ,Y and Z each marked the scripts of ten candidates who sat a mathematics examination . The table below shows the examiners ‘ ranking of the candidates.

CANDIDATES.

Examiner	A	B	C	D	E	F	G	H	I	J
X	8	5	9	2	10	1	7	6	3	4
Y	5	3	6	1	4	7	2	10	8	9
Z	6	3	7	2	5	4	1	10	9	8

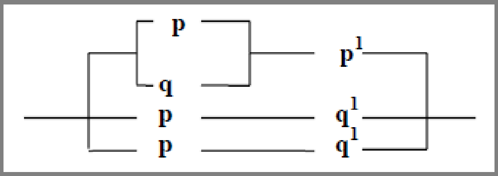
Calculate the coefficient of rank correlation of the rankings between :
(i) X and Y
(ii) Y and Z
State with reason whether there is significant difference between rankings of the three examiners.

13.An amateur rifleman’s probability of hitting a target is 0.

(i) Find the probability that he will hit the target at least once in 8 trials.
(ii) Find the minimum number of shots he must fire in order to be 95% confident that at least one shot has hit the target .
(iii) After some practice his probability of hitting the target increases to 0.64. Find the 95% confidence limits for the number of times he hits the target in 100 trials.

14.(a) A random sample of 10 items is taken from a population of items whose weights are normally distributed. The sample is found to have a mean of 50 g and a standard deviation of 8g. What are the 95% confidence limits for the mean of the population?
(b) The length of a type A rod is normally distributed with mean of 15 cm and a standard deviation of 0.1cm . The length of another type B rod is also normally distributed with a mean of 20cm and standard deviation 0.16cm . For a type A rod to be acceptable its length must be between 14.8cm and 15.2cm and for a type B rod the length must be between 19.8 cm and 20.2 cm.

(i) What proportion of each type of rod is of acceptable length?
(ii) One rod of type A and another type B are chosen at random . What is the probability that they are within these limits ?
(iii)What is the probability that only one of them is of acceptable length ?
15. (a) Find out whether the statement
$[P \wedge q] \rightarrow q^1] \leftrightarrow (p \vee q)$ is a contradiction by using a truth able .(b) Given that the circuit below



(i) Write down the boolean expression for the circuit.
(ii) Simplify the expression and draw an equivalent simple circuit.
(c) Show that the set of integers from a group with respect to addition.

P525
MATHEMATICS
Paper 1
March 1992
3 hours.

1(a)Given that $\log_b a = x$ show that $b = a^{1/x}$ and reduce that

$$\log_a b = \frac{1}{\log_b a}$$

(b) Find the values of x and y such that
(i) $\log_{10}^{x} + \log_{10}^{y} = 1.0$
$\log_{10}^{x} - \log_{10}^{y} = \log_{10}(2.5)$
(ii) $2^x.3^y = 432$.
(c) Simplify $\frac{1+\sqrt{2}+\sqrt{3}}{\sqrt{2}+\sqrt{3}}$

2.The first, fourth and eighth terms of an arithmetic progression (AP) form a geometric progression (G.P) If the first term is 9, find
(i)the common difference of A.P
(ii)the common ratio of the G.P.
(iii)the difference in sums of the first 6 terms of progressions.

3.Expand $\sqrt{\frac{1+2x}{1-2x}}$ up to and including the terms in x^3. Hence find the value of $\sqrt{\frac{1.02}{0.98}}$ to four significant figures.

Deduce the value of $\sqrt{51}$ to three significant figures.

4(a)For any two complex numbers $z_1$and z_2 represent the complex numbers
(z_1+z_2);$(z_2-z_1)$and z_1z_2 on the Argand diagram.
(b)Given that $z_1 = 3+4_1$ and $z_2-z_1 = -1+2i$,
(i)Express z_1z_2,(z_1+z_2) and z_2-z_1 in the form $(\cos\theta + \sin\theta)$
(ii)Determine the angle between $z_1 + z_2$ and $z_2 - z_1$.

5.Prove that

$$\tan(\tfrac{\pi}{4}+\theta) - \tan(\tfrac{\pi}{4}-\theta) = 2\tan 2\theta$$

(b)By expressing $2\sin\theta\sin(\theta + \alpha)$ as a difference of cosines of two angles or otherwise where α is a constant ,find it's least value.
(c)Solve for θ in the equation
$\cos\theta - \cos(\theta+60^o)= 0.4$
for $0^o \le \theta \le 360^o$

6.(a)Prove that in any triangle ABC

$$\frac{b^2-c^2}{a^2} = \frac{\sin(B-C)}{\sin(B+C)}$$

Show that for any isosceles triangle ABC with AB = c the base area of the triangle is given by
$\Delta = {}^1/_2\, c\sqrt{s(s-c)}$.
where s is half of the perimeter of the triangle.
Given that $\Delta = \sqrt{3}$ and s =4 determine the sides of the triangle.

7.A circle A passing through the point
(t + 2,3t) has it's center at (t,3t). Another circle B of radius 2 units has its center at (t + 2,3t).
(i)Determine the equations of the circles A and B in terms of t.
(ii)If t = 1 , find the points of intersection of the two circles.
(iii)Show that the common area of intersection of circles A and B is $8\left(\frac{\pi}{3}-\frac{\sqrt{3}}{4}\right)$ Sq. units.

8(i) Show that the locus of mid-point of the line joining the parabola $y^2 = 8x$ and the point (8,0)is parabola.
(ii)Determine the points at which lines from the new focus are perpendicular to the parabola $y^2 = 8x$
(iii) Find the y-coordinate of the point at which the tangent at one of the points meet the y-axis.

9(i)Determine a unit vector perpendicular to the plane containing the points
A(0,2-4),B(2,0,2)and C(-8,4,0)
(ii)find the equation of the plane.
(iii)show that the point (5,-4,3)lies on the plane.

(iv)write down the equation in the form
r = **a** + λ**b** of the perpendicular through the point P(3,4,2)to the plane.
(v)If the perpendicular meets the plane N, determine NP.

10.A curve is given by

$$\frac{x-1}{(2x-1)(x+1)}$$

(i) Show that for real values of x ,
y cannot take on values in the interval $\left(\frac{1}{9}, 1\right)$
(ii)Determine the turning points of the curve.
(iii)State with reasons, the asymptotes of the curve.
(iv)sketch the curve

11(a)Find the mean value of y = x(4 - x) in the interval where y ≥ 0.
(b)Given that

$$\frac{3x^3+2x^2-6x-2}{(x^2+x-2)(x^2-2)} = \frac{A}{x+2}+\frac{B}{x-1}+\frac{Cx+D}{x^2-2}$$

determine the values of A,B,C and D.
Hence evaluate

$$\int_2^4 \frac{3x^3+2x^2-6x-2}{(x^2+x-2)(x^2-2)}dx$$

12(a)A metal sheet of dimensions x and y cm is to be made by welding together the piece cut from the sheet such that the width and the height of the finished box are equal.

Assuming that all the metal sheet is used without wastage determine the height of the box in terms of x and y for which the volume of the box is maximum.
Hence find the maximum volume of the box.

(b)Differentiate the following with respect to x
(i) $\tan^{-1}\left(\frac{x}{1-x^2}\right)$
(ii)x^{2x}.

13(a)Show that

$$\int_0^{\pi/4} x\tan^2 x\,dx = \frac{1}{32}\left(8\pi-\pi^2-16\log_e 2\right)$$

(b)Find the y-coordinates of the center of gravity of the region bounded by the curve $y = 1 + \cos^2\theta$ and $0^o \le \theta \le {}^{\pi}/_{4}$.

14.The table below gives the weekly earnings of a random sample of workers in a soap factory in Kampala.

Weekly earnings(Ushs)	No of workers
Under 1500	1
1500and under 2000	4
2000and under 2500	28
2500and under 3000	42
3000and under 3500	33
3500and under 4000	18
4000and under 4500	13
4500and under 5000	9
5000and over	2

Calculate
(i)the percentage number of workers earning shs 3050 and above.
(ii)the mean weekly earning and the standard deviation of the distribution.
(iii)If the wages are increased by 10%,determine the new mean weekly wage and the new standard deviation.
15.(a)The table below shows the amount of milk (in thousand of litres) produced by a certain exotic farm in yearly quarters for the 1986-1989 period.

	QUARTERS			
Year	1^{st}	2^{nd}	3^{rd}	4^{th}
1986	19.5	30.0	32.5	25.0
1987	30.5	37.0	38.5	26.0
1988	36.5	44.5	46.5	35.0
1989	45.5	50.0	52.5	42.5

(i)Calculate the four –point moving averages for the data
(ii)On the same axes plot the four –point moving averages and the given data.
(iii)Comment on the trend of milk production over the period of 4 years.

(b)The wages and wage bills for a group of traders in a factory for two years are determine(i) the weight average wage for ----
(ii)the wage index in 1989, taking 1986as the base year.

P425/2
MATHEMATICS
Paper 2
Match 1992
2 hours.

NUMMERICAL METHODS AND CALCULATIONS.

1.Given the equation $ax^2 + bx + c = 0$
Show that the Newton Raphson methodleads to the interative formula.

$$X_{n+1} = \frac{aX_n^2 - C}{2aX_n + b}$$

Force construct a flow chart without specripted variables to
(i)Read the values of a,b,c and the first approximation A
(ii)Calculate the root

(iii)List whether the difference between successive approximations to the root is less than the error limit s.
(iv)List the equation, the root and number of iterations.
(v).Use your flow chart to calculate negative square root of 20 correct to 3 significant figures.

2(a)The table shows the values of a function f(x) at a set points.

f(x)	0.9	1.0	1.1	1.2
x	0.266	0.242	0.218	0.192

(i)Use near interpolation to find the value of f(1.04),

(ii)the value of x corresponding to
f(x) = 0.25.
Given that y_1 and y_2 are approximation to $X_1$and X_2 with error E_1 and E_2 respectively
Show that the maximum possible relative error in X_1/X_2 is

$$\left|\frac{E_1}{Y_1}\right| + \left|\frac{E_2}{Y_2}\right|$$

Given that the error is measuring an angle is up to 0.5^o .
Find the maximum possible percentage error in

$$\frac{\sin x}{\cos x}$$

VECTORS AND MECHANICS

3.(a)A particle of mass 5kg rest at a point (1, -4, 4) is acted upon by the three forces
$\mathbf{F}_1 = 3\mathbf{i} + 3j$, $\mathbf{F}_2 = 2\mathbf{j} + 4\mathbf{k}$, $\mathbf{F}_3 = 2\mathbf{j} + 6\mathbf{k}$
Find
(i)The position and momentum of the particle after 4 seconds.
(ii)the work done by the forces in the 4 seconds.

(b)A particle of mass 0.1 kg is released from rest at a height 25 metres above the ground level and falls freely under gravity. Taking the ground level as the zero level potential energy, find the sum of kinetic and potential energy of the particle when t = 2 seconds.

4.(a)Aparticle of unit mass oscillates about a point O with a period of 2π seconds. It passes a point A with a velocity of 4 ms^{-1} away from 0. Given that OA = 4m, Find
(i)the amplitude of motion
(ii)the speed of B where OB = 3 m

(b)A uniform rod PRQ of mass M kg and length 2l metres is free to oscillate about P.
A particle of mass $^5/_4$ M kg is attached to a point on the rod. Find the maximum length
of an equivalent simple pendulum from Q.

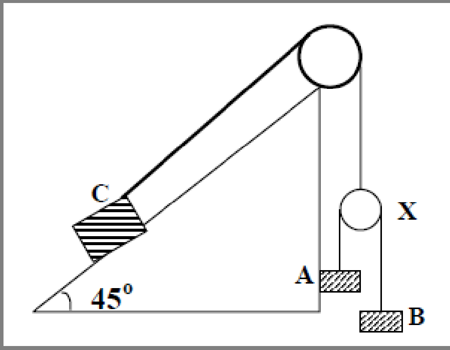
5(a)A car of mass 2 tonnes moves from rest down a road of inclination $\sin^{-1}(^1/_{20})$to horizontal. Given that the engine develops a power of 64.8 km when it is traveling at a speed of 54kmh^{-1} and the resistance to motion is 500N, find the acceleration of the car.

(b)A bullet of mass 40 g is fired horizontally into a freely suspended block of wood of mass 1.96 kg attached at the end of an inelastic string of length 1.8 cm. Given that the bullet gets embedded in the block and the string is deflected through an angle of 60o to the vertical, find
(i) the initial velocity of the block
(ii)the maximum velocity of the block

6(a)A particle of mass m is placed on a rough plane inclined at angle 10^o to the horizontal. Given that the angle of friction
$\lambda > 30^o$ show that the minimum force required to move the body up the plane is given by
½ mg($\cos\lambda + \sqrt{3}\sin\lambda$)
If this force is three times the least force that would cause the body to move down the plane show that

$$\lambda = \tan^{-1}\left(\frac{2}{\sqrt{3}}\right)$$

7. The diagram shows two masses A and B of 0.5 kg and 1 kg respectively connected by a light inextensible string passing over a smooth pulley X of mass 0.5Kg. Pulley X is connected to mass C of 2 kg lying on a smooth plane inclined at an angle 45^o to the horizontal by alight inextensible string passing over a fixed pulley.



Find .
(i) the acceleration of masses B and C.
(ii)the tension in the string when the system is released.

8. Find the center of gravity of a semicircular lamina of radius r with the diameter as the base. A semicircle lamina of radius r and base OA is cut from a larger semicircle lamina of radius 2r and base AOB and the remainder is hung from A. Find the inclination of AOB to the vertical.

DIFFERENTIAL EQUATIONS.

9.(a)The gradient of the tangent at any point (x,y) of a curve is $x - \frac{2y}{x}$ .Given that the curve passes through the point(2,4) , find the equation of the curve.

(b) use the substitution y = ux to solve the differential equation

$x^2 \frac{dy}{dx} = x^2 + y^2 + xy$ given that $y = 0$ when $x = \frac{1}{2}\pi$

STATISTICS

10(a)given that Aand B are two events such that P(A) = 0.5, P(B) = 0.7 and
$P(A \cup B) = 0.8$ Find. (i) $P(A \cap B)$

(ii) $P(A \cap \overline{B})$

(b)A bag contains 3 black and 5 white balls. Two balls are drawn at random one at a time without replacement.
Find. (i)the probability that the second ball is white.
(ii)the probability that the first ball is white given the second is white.

(c)The probability that a student X can solve a certain problem is $^2/_3$ and that student y can solve it is ½ . Find the probability that the problem will be solve if both X and Y try to solve it independently.

11.A discrete random variable X has a probability function
P(X = x) { x/ k :x = 1, 2 ----- n
0 otherwise
Where k is a constant.
Given that the expectation of X is 3, find
(i)the value of n and the constant k
(ii)the median and variance of X.
(iii)$P(x = 2/x \geq 2)$

12(a) A continuous variable X has a probability density function given by

$$f(x) = \begin{cases} \frac{1}{2}, & 0 \langle x \langle 1 \\ \frac{1}{8}, & 2 \langle x \langle 8 \\ 0, & \text{elsewhere} \end{cases}$$

Find
(i)the distribution function and expectation of x
(ii) of $(^1/_2 < x < 3)$
(b) A normal population has mean 150 and variance 25. Find the probability that in a random sample size 5 taken from the population at least 1 will have a value less other 146.

13(a) A pair of dice is tossed 144 times and the sum of the outcomes recorded. Find
the probability that a sum of 7 occurs at least 26 times.

(b)Three people play a game in which each person tosses a coin. The game is success if one of the players gets an outcome different from the others.
Determine the probability that
(i)a success will occur at the first trial.
(ii)in two trials at least one success will occur.

14(a)The table shows the distribution of weight of a random sample of 16 tins taken from large consignment.

Weight(gm)	97	98	99	100	101	102
Frequency	2	1	2	3	6	2

Assuming the weights are normally distributed, determine a 95% confidence interval for the mean weight of all the tins.

(b)The life period of a certain machine approximately follows a normal distribution with 5 years and standard deviation 1 year. Given that the manufacturer of this machine replaces, the machine that fall under guarantee, determine the length of the guarantee required so that not more an 2% of the machines that fail are replaced. Determine the proportion of the machines that would be replaced if the guarantee period 4 years.

P425/1
MATHEMATICS
Paper 1
March 1993
3 hours

1 (a) Solve $3^{2x+1} - 3^{x+1} - 3^x + 1 = 0$
(b) Solve the simultaneous equations

$$\begin{aligned} x + 2y - 3z &= 0 \\ 3x + 3y - z &= 5 \\ x - 2y + 2z &= 1. \end{aligned}$$

2 (a) When the quadratic expression $ap^2 + bp + c$ is divided by p - 1 , p - 2 , and p + 1, the remainders are 1,1 and 25 respectively . Determine the factors of the expression.

(b) Express $2x^3 + 5x^2 - 4x - 3$ in the form $(x^2 + x - 2) Q(x) + Ax + B$: where Q (x) is a polynominal in x and A and B are constants. Determine the values of A and B and the expression Q (x)

3(a) (i)Show that in 2^r, r =1,2,3----- is an arithmetic progression .
(ii) Find the sum of the first 10 terms of the progression.
(iii) Determine the least value of m for which the sum of the first 2m terms exceeds 883.7.

(b) Given that the equations $y^2 + py + q = 0$ and $y^2 + my + k = 0$ have a common root, show that $(q-k)^2 = (m-p)(pk - mq)$.

4 Solve the simultaneous equations

$z_1 + z_2 = 8$

$4z_1 - 3iz_2 = 26 + 8i$

Using the values of z_1 and z_2 find the modulus and argument of

$z_1 + z_2 - z_1 z_2$

5. Use the Maclaurin's theorem to show that the expansion $e^{-x}\sin x$ up to the term in x^3 is

$$\frac{x}{3}\left(x^2 - 3x + 3\right).$$

Hence evaluate $e^{\frac{-\pi}{3}} \sin \pi/3$ to 4 decimal places.

6 (a) Differentiate with respect to x :

(i) $\tan^{-1}\left(\frac{6x}{1-2x^2}\right)$.

(ii) $(\cos x)^{2x}$

(b) Write down the expressions for the volume v, and surface area s of cylinder of radius r and height h.

If the surface area is kept constant, show that the volume of the cylinder will be maximum when h = 2r .

7. Find (i) $\int \ln\left(x^2 - 4\right)dx$.

(ii) $\int \frac{dx}{3 - 2\cos x}$

(iii) Use the substitution of $x = \frac{1}{u}$ to evaluate

$$\int_1^2 \frac{dx}{x\sqrt{x^2 - 1}}$$

8. A curve is given by the parametric equations $x = 4\cos 2t$, $y = 2\sin t$.

(i) Find the equation of the normal to the curve at $t = \frac{5}{6}\pi$

(ii) Sketch the curve for $-\frac{\pi}{2} \langle\ t\ \langle \frac{\pi}{2}$

(iii) Find the area enclosed by the curve and the y axis .

9.(a) Show that $\cos 3\theta = 4\cos^3\theta - 3\cos\theta$.

Hence solve the equation $4x^3 - 3x - \frac{\sqrt{3}}{3} = 0$

(b) Find all the solution $5\cos x - 4\sin x = 6$ in the range $-180^0 \le x \le 180^0$

10. Given that $\tan^{-1}(\alpha) = x$ and $\tan^{-1}(\beta) = y$ by expressing α and β as tangent ratios of x and y and manipulating the ratios show that $x + y = \tan^{-1}\left(\frac{\alpha+\beta}{1-\alpha\beta}\right)$.

Hence or otherwise:

(i) Solve for x in

$$\tan^{-1}\left(\frac{1}{x-1}\right) + \tan^{-1}(x+1) = \tan^{-1}(-2).$$

(ii) without using tables or calculators, determine the value of

$$\tan^{-1}\left({}^{1}/_{2}\right) + \tan^{-1}\left({}^{1}/_{5}\right) + \tan^{-1}\left({}^{1}/_{8}\right)$$

11. (a) A tangent from the point T $(t^2, 2t)$ touches the curve $y^2 = 4x$

find (i) the equation of the tangent

(ii) the equation of the line L parallel to normal at $(t^2, 2t)$ and passing through (1,0).

(iii) the point of intersection X of line L and the tangent.

(b) A point p(x, y) is equidistant from X and T. Show that the locus of p is $t^4 - 3t - 2(x + y) = 0$.

12. The equation of a circle , centre O is given by $x^2 + y^2 + Ax + By + C = 0$,

where A, B and C are constants. Given that $4A = 3B, 3A = 2C$, and $C = 9$

(a) Determine

(i) the coordinates of the circle,

(ii) the radius of the circle.

(b) A tangent is drawn from the point Q (3,2) to the circle. Find (i) the coordinates of P , the point where the tangent meets the circle

(ii) the area of triangle QPO.

13.(a) A and B are points whose position vectors are **a = 2i + k** and **b = i - j + 3k** respectively.

Determine the position vector of the point P that divides AB in the ratio - 4 **:** 1.

(b) Given that **a = i - 3k + 3k** and **b = -i - 3j + 2k** determine

(i) the equation of the place containing **a** and **b**.

(ii) the angle the line $\frac{x-2}{4} = \frac{y}{3} = \frac{z-1}{2}$ makes with the plane in(i) above.

14. The table below shows the marks scored in General Paper by some students in mock examination from a certain school:

Marks	Number of students
31-40	12
41-50	18

51-60	14
61-70	8
71-80	6
81-90	2

(a) (i) Draw a histogram to represent the scores
(ii) from your histogram , estimate the mode
(b)Calculate the mean ,median and standard deviation.

15. Musa reckons that in 1988, his farm produced 60% of his income, and that farm production in the year 1988,1990,1992 were in the ratio 60:55:50. His other income. salary, in million shillings was :-

1988	1990	1992
8	20	32

However , in real terms this salary must be related to the cost of living index which was

1988	1990	1992
100	160	240

(i) Find his salary in real terms for each of the years given and express it as an index with 1988 as 100.
(ii) Still keeping 1988 as the base year, find an index of the total real income for 1990 and 1992.
(iii) A mend (ii) if the farm production for 1988 formed 75% of his income (the ratio 60:55:50 remaining valid)

P425/2
MATHEMATICS
Paper2
March 1993
3 hours

1. Show that the equation $3x^3 + x - 5 = 0$ has real root between x =1 and x = 2
(i) Using linear interpolation find the first approximation for this root.
(ii) Using the Newton Raphson formular , find the value of this root correct to 2 decimal places.

2. (a) When
$x = 0.8, e^x = 2.2255$ and $e^{-x} = 0.4493$ correct to 4 decimal places.
(i) Round off the values of e^x and e^{-x} to 2 decimal places.
(ii) Truncate the values of e^x and e^{-x} to 2 decimal places.
(iii) If the maximum possible error in the value of e^x and e^{-x} is ± 0.00005. What are the corresponding maximum and minimum values of the quotient e^x / e^{-x} ? (Giving your answer correct to 3 decimal places)

(b) Show that the iterative formular for solving the equation $x^3 = x + 1$ is

$X_{n+1} = \sqrt{1 + \frac{1}{x_n}}$. Starting with $x_0 = 1$, find the solution of the equation to four significant figures. Draw a flow diagram that computes and prints the root of the equation.

3. (a) Forces **2i - 3j, 7i + 9j, - 6i-4j, -3i - 2j** act on a lamina at points
(1,-1) ,(1,1) , (-1,-1) ,(-1,!), respectively. Determine
(i) the resultant of the forces.
(ii) the sum of their moments about (0,0) . What effect do the forces have on the body?

(b) Two beads A and B starts together from point O and slide down in a vertical plane a long smooth straight wires inclined at angles 30^o and 60^o respectively.
The wires are on the same side of the vertical. Taking **i** and **j** as unit vectors in the horizontal and vertical directions respectively: show that the acceleration of the bead B relative to bead A is $\frac{g}{2}\mathbf{j}$ where g is the acceleration due to gravity.

4. ABDC is a square lamina of side a from which a triangle ADE is removed , E being a point CD of distance t from C
(i) show that the centre of mass of the remaining lamina is at a distant $\frac{a^2 + at + t^2}{3(a+t)}$ from BC.
(ii) Hence , show that if this lamina is placed in a vertical plane with CE resting on a horizontal table , equilibrium will not be possible if t is less than $\frac{a(\sqrt{3}-1)}{2}$

5. (a) A particle moving with simple harmonic motion has speed of $6ms^{-1}$ and $8ms^{-1}$ at distances 16m and 12m respectively from it's equilibrium position. Find the amplitude and period of the motion.

(b) A particle of mass 3kg is moving on the curve described by **r** = sin 3**t** i+ 8 c**os 3tj**. where **r** is the position vector of the particle at time t.
(i)Determine the position and velocity of the particle at the time t = 0
(ii) show that the force acting on the particle is -27**r**.

6. A body of mass 10kg rests on a smooth horizontal plane. Horizontal forces of magnitudes $2\sqrt{3}$,16,5 and F Newtons act on the body in the directions 030^0, 120^0,0^0 and 270^o respectively. Given that the acceleration of the

body is 3ms$^{-2.}$. Find the value of F and give the direction of the acceleration.

(b) A car of mass 1500kg is pulling a trailer of mass 600kg up a road inclined at an angle $\alpha = \sin^{-1}(0.1)$. The resistance to motion for both the car and the trailer is 0.15N per kg. If they are retarding at 0.5ms^{-2}. Find
(i) the tractive force exerted by the engine.
(ii) the tension in the coupling between the car and trailer.

7. A particle of mass m is placed on a smooth face wedge which stands on a smooth horizontal plane. The face of the wedge is inclined at an angle α to the horizontal and the mass of the wedge is 4m. if the system is released from rest , show that the speed of the particle relative to the wedge after one second is

$$\frac{5g\sin\alpha}{4+\sin^2\alpha}$$

8(a) A particle is projected with speed v at an angle θ above the horizontal . If the particle passes through the point P(x, y)
(i) write down the expressions of x and y in terms of θ and time t.
(ii) Hence or otherwise show that

$$y = x\tan\theta - \frac{gx^2\sec^2\theta}{2v^2}$$

where g is the acceleration due to gravity.
(iii) show that the range on the horizontal through the point of projection is

$$R = \frac{v^2\sin 2\theta}{g}.$$

(b) A mortar fires shells at different angles of projection from point O. If the speed of projection is $\sqrt{50g}$ where g is the acceleration due to gravity, and the shell is projected so as to pass through the point B (10,20).
(i) find the possible angles of projection.
(ii) deduce that the difference between the corresponding times taken to travel from O to B is $\frac{(10-2\sqrt{5})}{\sqrt{g}}$.

9.(a) The rate of change of atmospheric pressure ,P with respect to altitude, h in kilometres is proportional to the pressure. If the pressure at 6000 metres is half of the pressure P_o at the sea level, find the formula for the pressure at any height.

(b) Solve the differential equation

$$\left(x^2+1\right)\frac{dy}{dx} + y^2 + 1 = 0, \quad x = 0, \ y = 1.$$

10.(a) A random variable X has the probability density function

$$f(x) = \begin{cases} k\left(1-x^2\right); & 0 \le x \le 1, \\ 0 & :\text{otherwise} \end{cases}$$

where k is the constant, find
(i) the value of the constant k
(ii) the mean of X
(iii) the variance of X.

(b) The number of times a machine breaks down every month is a discrete random variable X with the probability distribution

$$P(X = x) = \begin{cases} k\left(\frac{1}{4}\right)^x & : x = 0,1,2,3-- \\ 0 & :\text{otherwise} \end{cases}$$

where k is the constant.
Determine the probability that the machine will break down not more than two times a month.

11.(a) Five different screws in a box are needed in a certain order for assembling a certain product. What is the probability of picking them out in the correct order of assembling ?

(b) A bottle manufacturer has three inspection points. One for size : the second for colour and the third for flaws such as cracks and bubbles in the bottle. The probability that each inspection point will incorrectly accept or reject a bottle is 0.02 What is the probability that

(i) a bottle faulty in colour and with a crack will be passed?
(ii) a bottle with at least 2 faults will be passed?
(iii) a perfect bottle will be rejected?

12.The life time of a bulb is normally distributed with a mean of 800 hours and standard deviation of 80 hours. The manufacturer guarantees to replace bulbs which blow after less than 660 hours.
(i) What percentage of the bulbs will he have to replace under the guarantee?
(ii) The manufacturer is only willing to replace a maximum of 1% of the bulbs. What should be the guaranteed lifetime of the bulbs?
(iii) Instead of reducing the guaranteed lifetime as in (ii) the mean lifetime was increased by superior technology. What should be the new mean so that only 1% are replaced if the guaranteed lifetime remains at 660 hours but the standard deviation is reduced to 70 hours?
13. Nkeza makes 5 practice runs in the 100m sprint. A run is successful if he runs it in less than 11 seconds. There are 8 chances out of 10 that he is successful.

Find the probability that

(i) he records no success at all.

(ii) he records at least 2 successes.

(b) If he is successful in the 5 practice runs he makes two additional runs . The probability of success in either of the additional runs is 0.7. Determine the probability that Nkeza will make 7 successful runs in total.

14. Ten shops in Kampala which attract a similar number and type of customers are ranked in terms of quality of service, size of verandah and price of items. Rank 1 indicates best service, largest verandah and lowest price of commodities. The results, including monthly average sales are given below:

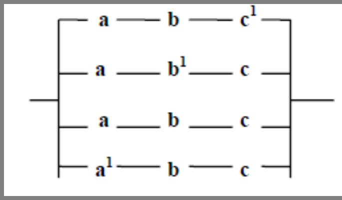
Shop	*Quality of service*	Size of verandah	*Price of commodities*	Sales (in tens ofkg)
A	3	3	6	20
B	7	5	10	10
C	4	10	7	31
D	6	7	2	47
E	8	2	4	37
F	2	1	5	38
G	5	8	3	38
H	9	6	8	15
I	10	4	10	21
J	1	9	1	42

(a) By calculation determine whether the price of commodities or the size of the verandah is the more important factor affecting sales.

(b) Is there any evidence that the size of the verandah influences the quality of service?

(c) Is there evidence that a shop with lower priced commodities offers poor quality service (e.g. by employing fewer sales people)?

15.



(a) Write down the boolean equation for the above circuit. Simplify and draw the equivalent simple circuit.

(b)(i) show that the boolean polynomal $(p \wedge q) \wedge (p \vee q)'$ is a contradiction.

(ii) Write down the analogous polynominal.

(iii) Comment on the flow of current through this net work.

P425/1
MATHEMATICS
Paper 1
March 1994
3hours

1. (a) Solve

$$\sqrt[2]{(x-1)} - \sqrt{(x+4)} = 1$$

(b) Solve the simultaneous equations:

$x + y + z = 2$

$$\frac{x+2y}{-3} = \frac{y+2z}{4} = \frac{2x+z}{5}$$

2. (a) If $\log_2^x + \log_4^x + \log_{16}^x = \frac{21}{16}$

(b) In an arithmetic progression $u_2 + u_2 + u_3 + ..., u_4 = 15$ and $u_{16} = -3$. Find the greatest integer N such that $u_N \geq 0$ determine the sum of the first N terms of the progression.

3. (a) Given that α and β are the roots of the equation $x^2 + px + q = 0$.

Express $(\alpha - \beta^2)(\beta - a^2)$ in terms of p and q . Deduce that for one root to be the square of another , $p^3 - 3pq + q^2 + q = 0$ must hold.

(b) Determine the expansion of $\frac{(x+4)}{(x^2-1)}$ in ascending powers of x up to the term containing x^y for $|x| < 1$.

4.(a) Given that $z = 3 + 4i$, find the value of the expression $z + \frac{25}{z}$.

(b) Given that $\left|\frac{z-1}{z+1}\right| = 2$, show that the locus of the complex number is $x^2 + y^2 + \frac{10x}{3} + 1 = 0$. Sketch the locus.

5.(a) Express $\sqrt{\left(\frac{\sin 2\theta - \cos 2\theta - 1}{2 - 2\sin 2\theta}\right)}$ in terms of tan θ.

(b) Find the general solution of the equation

$\sqrt{3}\sin\theta - \cos\theta + 1 = 0$.

(c) Factorise

$\cos\theta - \cos 3\theta - \cos 7\theta + \cos 9\theta$ in the form $A\cos k\theta \sin l\theta \sin m\theta$. Where A, k, l and m are constants.

6(a) Given that $\sin x + \sin y = \lambda_1$ and

$\cos x + \cos y = \lambda_2$

show that

(i) $\tan\frac{(x+y)}{2} = \frac{\lambda_1}{\lambda_2}$

(ii) $\cos(x+y) = \frac{\lambda_2^2 - \lambda_1^2}{\lambda_2^2 + \lambda_1^2}$

(b) Solve the simultaneous equations.

$\cos x + 4\sin y = 1$

$4\sec x - 3\operatorname{cosec} y = 5$

for values of x and y between 0^o and 360^o.

7. Prove that the tangents to the parabola $y^2 = 4ax$ at the points P $(ap^2, 2ap)$ and Q $(aq^2, 2aq)$ meet at the point T $(apq, a(p+q))$

(i) If M is the mid point of PQ, prove that TM is bisected by the parabola.

(ii) If P and Q vary on the parabola in such a manner that PQ is always parallel to fixed line $y = mx$, show that T always lies on the fixed line parallel to the x - axis.

8. The co-ordinates of a point P (x,y) on the curve are given parametrically by the equations $x = a\cos\theta$, $y = b\sin\theta$ where a and b are constants and θ is the parameter. Find :

(i) the Cartesian equation of the curve and identify the curve .

(ii) the equation of the tangent to the curve at the point at which the parameter θ - .φ.

(iii) the relation between φ_1 and φ_2 if the tangents at the points $(a\cos\varphi_1, b\sin\varphi_1)$.$(a\cos\varphi_2 . b\sin\varphi_2)$ are at right angles to one another.

9. (a) Differentiate

(i) $e^{ax}\sin bx$

(ii) $\dfrac{(x+1)^2(x+2)}{(x+3)^3}$

giving your answer in the simplest form .

(b) Given that $y = {}_e\tan^{-1}x$ show that

$$(1+x^2)\frac{d^2y}{dx^2}+(2x-1)\frac{dy}{dx}=0.$$

Hence or otherwise determine the first four non- zero terms of the maclaurin's expansion of y.

10.(a) Evaluate

$$\int_1^{\sqrt{3}}(x+\tan x)dx$$

(b) Use the trapezium rule with sub - intervals to estimate

$$\int_0^{\pi}\sin {}^{x}\!/_{3}\,dx$$

correct to 3 decimal places. Find error in your estimation and suggest how the accuracy of your result can be improved.

11. (a) Determine the equation of the normal to the curve $y = \dfrac{1}{x}$ at the point $x = 2$.

Find the co -ordinates of the other point where the normal meets the curve again.

(b) Find the area of the region bounded by the curve $y = \dfrac{1}{x(2x+1)}$, the x - axis and the lines $x = 1$ $x = 2$

12. Show that the curve $y = \dfrac{x+1}{x^2+2x}$, has no turning points . Sketch the curve.

Give the equations of the asymptotes.

13. A vector XY of magnitude a units makes an angle of α with the horizontal . Another vector YZ beginning from end point Y , inclined at angle β to the same horizontal axis is of magnitude b units . If θ is the angle between the positive directions of the two vectors , where $\theta = \beta - a$ is acute , show that the resultant vector XZ has a magnitude XZ equal to $\sqrt{(a^2+b^2+2ab\cos\theta)}$ units and is inclined at an angle

$\alpha + \sin^{-1}\left(\dfrac{b\sin\theta}{xz}\right)$ to the horizontal . Hence or otherwise calculate the magnitude and direction of the resultant vector of the vectors XY and YZ , inclined at 30^o and 75^o to the horizontal and of magnitudes 9 and 6 units respectively.

14. The table below shows the weights of some freshers in 1991/1992 academic year who underwent medical examination at the university hospital.

Weight (in kg)	Number of students
40 - 44	3
45 - 49	10
50 - 54	15
55 - 59	10
60 - 64	4
65 - 69	5
70 - 74	4
75 - 79	6
80 - 84	1

(a) Calculate the

(i) mode

(ii) median and mean weight of the students.

(b) Draw a cumulative frequency graph. .Hence deduce the interquartile range of the weights.

15.(a) Four and five digit numbers greater than 6000 obtained by arranging the digits 3,4,5,6,7 . How many of these are

(i) odd numbers

(ii) even numbers

(b) Nine out of twelve members of the school's Geography Club are to be taken out on a study tour. Given that there are seven boys and five girls and that at least 3 girls have to go for the tour :

(i) Find the number of ways in which the selection of students can be done?

(ii) If there are two sisters in the club , who are definately selected to go , in how many ways can the remaining students be selected.

P425/2
MATHEMATICS
Paper 2
March 1994
3hours

1. (a) Given the following table of values

x	0	5	10	15	20
t	0	12	25	39	54

use linear interpolation to find

(i) t when x = 12,

(ii) x when t = 45.

(b) Show graphically that there is only one positive real root of the equation :

$xe^{-x} - 2x + 5 = 0$

Using the Newton Raphson method , find this root correct to 1 decimal place.

2 (a) Given x = 3, y = 12 , z = 6 all to the nearest integer , find the maximum value of

(i) $\frac{x+z}{y}$, (ii) $\frac{xy}{z}$, (iii) $\frac{x}{y} - \frac{y}{z}$.

(b) A trader in tea and coffee makes an annual profit in tea of sh .1080 million with margin of error of $\pm$10% and an annual loss in coffee of shs 560 million with a margin error of $\pm$5% .

(i) Find the range of values representing his gross income.

(ii) Given that his annual income tax is shs .75 million , express this as a percentage of his gross income giving your answer as a range of values.

3 To a motorist travelling due North at 40km^{-1} the wind appears to come from the direction N 60^0 E at 50 kmh^{-1}.

(i) Find the n true velocity of the wind.

(ii) If the wind velocity remains constant , but the speed when the wind appears to be blowing from the direction N 45^0E.

4 Strings AC and BC are both of natural length 5l . AC is inelastic and BC has a modulus of elasticity λ, A and B are attached to points in a horizontal line , distance 5l apart. A mass M is attached to C and the system is in equilibrium in vertical plane with BC of length 6l. Find the λ and the tension in CA and CB .

5 (a) A bullet travelling at 150ms^{-1} will penetrate 8cm into a fixed block wood before coming to rest. Find the velocity of the bullet when it has penetrated 4cm of the block.

(b) A particle of mass 2kg , initially at rest at (0,0,0) is acted upon by the force

$$\begin{pmatrix} 2t \\ t \\ 3t \end{pmatrix} \text{N}$$

Find (i) it's acceleration at time t.

(ii) it's velocity after 3 seconds.

(iii) the distance the particle has travelled after 3seconds.

6(a) A,B,C and D are the points (0,0) , (10,0) , (7,4) and (3,4) respectively . if AB ,BC,CD and DA are made of thin wire of uniform mass , find the coordinates of the centre of gravity.

(b)If instead ABCD is a uniform lamina , find it's centre of gravity ,G .

(ii) If the lamina is hung from B , find the angle AB makes with the vertical.

7. A particle p of mass m lies on a smooth horizontal table and is attached to two light elastic strings fixed to the table at points A and B . The natural lengths of the strings are AP = 4l , PB = 5l and their moduli of elasticity are mg and $\frac{5mg}{2}$ respectively .

AB = 12l .

Show that when P is in equilibrium ,

AP = 6l .

P is now held at C in the line AB with AC = 5l and then released. Show that the resulting motion is simple Harmonic with period $4\pi\frac{\sqrt{\ell}}{3g}$.

Find the maximum speed.

8 A non -uniform beam AB , 4.5 m long is balanced horizontally on two supports p and Q such that AP = 0.4 and QB = 0.6m . When a mass of 20 kg is placed at either ends , the beam is on the point of toppling.

Find (i) the distance from A at which the weight of the beam acts,

(ii) the weight of the beam,

(iii) the distance from A at which the 20kg mass must be placed for the reaction of the supports to be equal.

9 (a) Solve the differential equation

$\frac{dt}{d\theta}$ +t cot θ , given that t = 3 when $\theta = \frac{\pi}{2}$.

(b) The mass of a man together with his parachute is 70kg. When the parachute is fully open the system experience an upward force proportional to the velocity of the system . If the constant of proportionality is $^1/_{10}$

and the system is decreasing at the speed of $10ms^{-1}$ when the parachute opens out, determine the speed of the parachutist three minutes later.

10 The packets of omo sold are of four categories namely , small, medium , large and giant . On a particular day, the stock is such that the ratio of small : medium: large:giant is equal to 4:2:1:1. The costs of the packets are in the ratio small:dedium:large :giant = 350:500:800:1400 respectively.

(a) 30 packets are sold randomly on that particular day , the total cost of the sales being s'shillings

Calculate (i) the expected value of s,

(ii) the standard deviation of s.

(b) Ten packets are picked at random . Determine the probability that six are medium size packets.

11. A continuous random variable X has a probability density function :

$f(x) = kx(3-x)$ for $0 \le x \le 2$,

$f(x) = k(4-x)$ for $2 \le x \le 4$,

$f(x) = 0$ else where .

Find (i) the value of k,

(ii) the mean,

(iii) f(x) , the cummulative distribution function,

(iv) $p(1 \le x \le 3)$.

12. (a) Two biased tetrahedrons have each their faces numbered 1 to 4. The chances of the getting any one face showing uppermost is inversely proportional to the number on it. If the two tetrahedrons are thrown and the number on the uppermost face noted , determine the probability that the faces show the same number.

(b) If it is ,the probability that Alex goes to play football is $\frac{9}{10}$ and the probability that Bob goes is $\frac{3}{4}$. If it is not fine , Alex's probability is $\frac{1}{2}$ and Bob's is $\frac{1}{4}$. Their decisions are independent . In general it is known that it is twice as likely to be fine as not fine.

(i) Determine the probability that both go to play .

(ii) If they both go to play , What is the probability that it is a fine day ?

13. (a) Among the spectators watching a football match , 80% where the home team's supporters while 20% were the visiting team's supporters . If 2500 of the spectators are selected randomly , what is the probability that there are more than 540 visitors in this sample ?

(b) A factory manager states that the average time taken to make one unit of a product is 48 minutes . A sample of 49 trials was taken and the average time was 49minutes with a standard deviation of 20 minutes.

(i) Test the managers'claim at 99% level of confidence.

(ii) Determine the 80% confidence limits of the mean production time per unit.

14. In many Government institutions Officers complain about typing errors . A test was designed to investigate the relationship between typing speed and errors made. Twelve typists A,B,C,D---L were picked at random to type the same text.

The table below shows the rankings of the typists according to speed and errors made. (N.B . lowest ranking in errors implies least errors made)

TYPIST :	A	B	C	D	E	F	G	H	I	J	K	L
SPEED :	3	4	2	1	8	11	10	6	7	12	5	9
ERRORS:	2	6	5	1	10	9	8	3	4	12	7	11

Calculate the rank correlation coefficient: Test the assertion made by the officers and comment on your result.

(0 = 0.71 and τ = 0.58 are Spearman's and Kendalls' correlation coefficients respectively , at 1% level of significance based on 12 observations.)

(b) The cost of travelling a certain distance away from the city centre is found to depend on the route and the distance a given place is away from the centre. The table below gives the average rates of travel charged for distances to be travelled away from the city centre :

Distance ,s(km)	9	12	14	21	24	30	33	45	46	50
Rates chargesd, r (shs)	750	1000	1150	1200	1350	1250	1400	1750	1600	2000

(i) Plot the above data on a scatter diagram and draw line of best fit through the points of the scatter diagram.

(ii) Determine the equation of the line above in the form $r = \beta s + a$, where a and β are constants . Use your results to estimate to the nearest shilling the cost of travelling a distance of 40km.

15 (a) p,q and r represent the statements : "He is a candidate ", "He is preparing for examinations" and " He will pass" respectively. Give appropriate sentences which describe each of the following statements.

(i)$p \wedge q$. (ii) $-(p \vee r)$

(iii)$(p \wedge -q) \rightarrow -r$ (iv) $r \leftrightarrow q$

(v)$-(q \wedge -r)$.

(b) Using the rules of algebra of propositions or otherwise , show that

$(p \wedge q) \rightarrow \{(p \vee r) \wedge (q \vee -r)\} \vee r\}$ is tautology.

MATHEMATICS
Paper 1
March 1995
3 hours

SECTION A (40 marks)

1. Solve the simultaneous equation.
$2^x + 4^y = 12$
$3(2)^x - 2(a)^{2y} = 16$
Hence show that $(4)^x + 4(3)^{2y} = 100$

(b) Given that a and b are roots of the quadratic equation $ax^2 + bx + c = 0$
determine an equation whose roots are $\alpha + \beta$ and $\alpha^3 + \beta^3$.
Hence or otherwise solve the equations .
$\alpha + \beta = 2$
$\alpha^3 + \beta^3 = 26$

2. (a) The first term of an arithmetic progression (A,P) is 73 and the ninth 25 . Determine
(i) the common difference of the A.P
(ii) the number of terms that must be added to give a sum of 96.

(b) A geometric progression (G.P) and an arithmetic progression (A.P) have the same first term. The sums of their first , second and third terms are 6,10.5 and 18 respectively. Calculate the sum of their fifth terms.

3.(a) Determine the possible values of x in the equation $\log_2 x + \log_x 64 = 5$.

(b) Jack operates an account with a certain bank which pays a compound interest rate of 13.5% per annum. He opened the account at the beginning of the year with shs. 500,000 and deposits the same amount of money at the beginning of every year. Calculate how much he will receive at the end of 9 years . After how long will the money have accumulated to shs 3.32 million?

4.(a) (i) Express each of the complex numbers .
$z_1 = (1 - i)(1 + 2)$, $z_2 = \dfrac{2+6i}{3-i}$ and $z_3 = \dfrac{-4i}{1-i}$
a + bi where a and b are real numbers.
(ii) Find the modulus and argument of z_1, z_2, z_3 given in (a) (i) above .
(b) Find the square roots of 12i - 5.

5.(a) Express $\sin\theta + \sin 3\theta$ in the form
$m\cos\theta\sin\theta$ where m and n are constants.

(b) Find the general solution of
$\cos 7\theta + \cos 5\theta = 2\cos\theta$.

(c) Prove that $\dfrac{\sin A + \sin 4A + \sin 7A}{\cos A + \cos 4A + \cos 7A} = \tan 4A$

6. Show that $f(x) = \dfrac{x(x-5)}{(x-3)(x+2)}$ has no turning points.

Sketch the curve y = f(x) .If $g(x) = \dfrac{1}{f(x)}$
sketch the graph of y = g(x) on the same axes . Show the asymptotes and where f(x) and g(x) intersect.

7. The tangent at any point $P(ct, \frac{c}{t})$ on the hyperbola $xy = c^2$ meets x and y axes at A and B respectively. O is the origin.
(a) Prove that
(i) AP = PB
(ii) the area of triangle AOB is constant.
(b) If the hyperbola is rotated through an angle 45^o about O , find the new equation of the curve.

8.(a) Prove that
$\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C} = 2R$ where triangle ABC has all the angles acute and R is the radius of the circumcircle.
(b) From the top of a vertical cliff 10m high , the angle of depression of ship A is 10^0 and of ship B is 15^o. The bearings of A and B from the cliff are 162o and $202\frac{1}{2}^0$ respectively. Find the bearing of B from A.

9.(a) (i) Show that $\dfrac{d}{dx}(d^x) = a^x \text{Ina}$

(ii) Find $\int 3^{\sqrt{2x-2}}dx$

(b)A shell is formed by rotating the portion of the parabola $y^2 = 4x$ for which $0 \le x \le 1$ through two right angles about its axis.
Find (i) the volume of the solid formed.
(ii) the area of the base of the solid formed.

10.(a) (i) Express $\dfrac{x^3-3}{(x-2)(x^2+1)}$ as partial fractions.

Hence otherwise find $\displaystyle\int \frac{x^3-3}{(x-2)(x^2+1)}$

(b) Use the trapezium rule to estimate the integral
$\displaystyle\int_2^3 \left(\frac{x}{x^2+1}\right)dx$ using five sub- intervals. Give your answer correct to 4 decimal places. Find the error in your estimation.

11. (a) (i) If $x^2\sec x - xy + 2y^2 = 15$,
Find $\dfrac{dy}{dx}$.

(ii) Given that $y = \theta - \cos\theta$; $x = \sin\theta$, show that

$$\frac{d^2y}{dx^2} = \frac{1+\sin\theta}{\cos^3\theta}$$

(b) Determine the maximum and minimum values of x^2e^{-x}

12. (a) Obtain the first two non- zero terms of the Maclaurin's series for sec x.

(b) Show by Taylor's expansion that the first four terms of $\cos(x + h) = \cos x - h\sin x - \frac{h^2}{2}\cos x + \frac{h^3}{6}\sin x$ where x and h are in radians , and rather small .Use the expansion to evaluate $\cos 3.9^0$ correct to 4 decimal places using x = 0.

13. The position vectors of the points A and B with respect to the origin 0 are $\begin{pmatrix} 3 \\ 1 \\ -2 \end{pmatrix}$ and $\begin{pmatrix} 4 \\ -1 \\ 2 \end{pmatrix}$ respectively.

Determine the equation of the line AB.

(b) Find the equation of the plane OPQ where 0 is the origin and p and Q are the points whose position vectors are $\begin{pmatrix} 0 \\ 3 \\ 0 \end{pmatrix}$ and $\begin{pmatrix} 1 \\ 0 \\ 3 \end{pmatrix}$ respectively.

(c) (i) Given that R is the point at which line AB meets the plane OPQ , find the coordinates of R.

(ii) Show that the points S (1, -2) lies on $\overline{OR}$.

14. The data below shows the amounts of cotton (in 100's of bales) produced by Growers Union over a certain period of time.

70	41	34	55	45	66	73	77	80	30
50	45	72	50	27	70	55	70	85	70
30	50	60	53	40	45	35	55	20	81
25	51	35	62	60	30	45	35	50	89
53	23	28	65	68	50	65	34	35	76

(i) Beginning with the 20-29 class interval of equal width construct a frequency table for the data.

(ii)draw a cumulative frequency curve for data and hence estimate the median production.

(iii)calculate the mean and standard deviation of the production.

15. 9a) The table below shows the quarterly cost (in '000'\$ Ugandan shillings) of electricity for a household over a period of three years 1992- 1994.

Year	Quarters			
	1	2	3	4
1992	68	60	59	65
1993	82	80	80	92
1994	94	78	90	105

(i) Calculate the four -point moving averages.

(ii) On the same axes , plot both the raw data and the moving averages.

(iii) Comment on the cost of electricity over the period of three years.

(b) (i) Evaluate $80P_5$ and $80C_6$

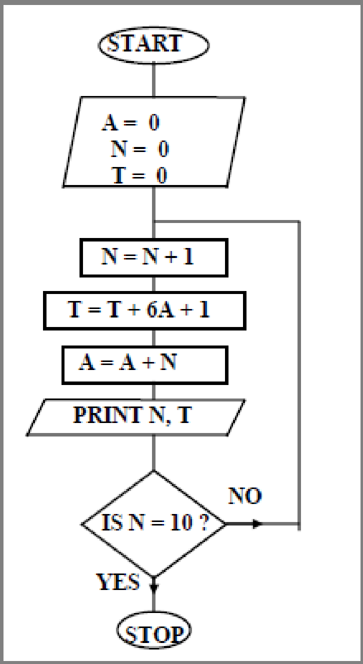
(ii) Solve for n in $nC_4 = nC_2$

(iii) A committee of five students to comprise the school council is to be selected from eight male students and five female students . Find how many possible commitees can be obtained.

MATHEMATICS
Paper 2
March 1995
3 hours

SECTION A

1(a)



Perform a dry run of the chart shown a above . What is the outcome in words After the dry run state the relationship between N and T .

(b) By sketching the graphs of 2x and tan x show that the equation 2x = tanx has one root between x = 1.2 Use linear interpolation to find the value of the root correct to 2 decimal places.

2 (a) Show that the Newton - Raphson formula for finding the root of the equation

$2x^3 + 5x - 8 = 0$ is

$$\frac{4x^3 + 8}{6x^2n + 5}.$$

(b) Taking that the first approximation to the root of the above equation as 1.2 . draw a flow diagram which reads and prints the number of iterations and root . Carry out a dry run of the flow chart and obtain the root with an error of less than 0.001.

3 In the Gulf waters , a battleship steaming northwards at 16km h^{-1} is 5km southwards of a submarine.
(i) Find two possible courses which the submarine could take in order to intercept the battleship if it's maximum speed is 12km h^{-1}.

4 A particle p starts from a point with a position vector 2**j** +2**k** with a velocity **j**+**k** . A second particle Q starts at the same time from the point whose position vector is -11**i**-2**j**-7**k** with a velocity of 2**i**+**j**+2**k** . Find
(i) the time when the particles are closest together ,
(ii) the shortest distance between the particles ,
(iii) how far each particle has traveled by this time.
A particle of mass 2m rests on a rough plane inclined to the horizontal at an angle of $\tan^{-1}(3\mu)$, where μ is the coefficient of friction between the particle and plane . The particle is acted upon by a force p . Newtons.

5 (a) Given that the force acts along the line of greatest slope and that the particle is on the point of sliding up , Show that the maximum force possible to maintain the particle in equilibrium is

$$P_{max} = \frac{8\mu mg}{\sqrt{1+9\mu^2}}.$$

(b) Given that the force acts horizontally in a vertical plane through a line of greatest slope and that the particle is on the point of sliding down the plane . Show that the maximum force required to maintain the particle in equilibrium is

$$P_{min} = \frac{4\mu mg}{1+3\mu^2}.$$

6. Two uniform rod AB, AC each of weight w and length 10cm are smoothly hinged at A . The ends B and C rest on a smooth horizontal plane . An inextensible string joins B and C and the system is kept in equilibrium in a vertical plane with the string taut. An object of weight 2W climbs the rod AC to a point E such that AE = 8cm. Given that angle BAC is $2\theta^0$. determine in terms of w and θ :
(i) the reaction at the ends B and C .
(ii) the tension in the string.
Hence , show that the reaction at A is given by
$$\frac{W}{10}\sqrt{(9\tan^2\theta+4)}$$

7 .A particle of mass $\frac{4}{3}$m is attached to one end of a string of length ,1 .the other end being attached to a fixed point A . The particle falls from rest at B at the same horizontal level as A . if AB $= \frac{\sqrt{3}}{2}\iota$.
(i) show that the impulse on the string when it tightens is $\frac{2}{3}m\sqrt{gl}$.
(ii) Find the inclination of the string to the vertical when the kinetic energy of the particle is $\frac{3}{2}$of that at the point when the string first tightens .

8 (a) A bullet , traveling at 150ms^{-1} will penetrate 8cm into a fixed block of wood before coming to rest . Find the velocity of the bullet when it has penetrated 4cm of the block.
(b) A particle of mass 2kg, initially at rest at (0,0,0) is acted upon by the force
$$\begin{pmatrix} 2t \\ t \\ 3t \end{pmatrix} N$$
Find (i) the acceleration at the time t .
(ii) the velocity after 3 seconds.
(iii) the distance travelled after 3 seconds.
9 A vessel in the shape of an inverted right circular cone contains a liquid. The rate of evaporation of the liquid is proportional to the surface exposed to the atmosphere . The radius of the base of the cone is 9cm and the height of the cone is 15 cm . If it takes 1 min for the radius of the surface of the liquid to decrease from 9cm to 4.5cm . how long will it take for the liquid to evaporate completely ?
10. A note contains one 200sh note , three 100sh notes and n 50sh notes. A note is selected at random from the bag . it's value noted and then replaced . The process is repeated many times. If the average of the values of the notes after many trials is 110sh, determine
(i) the value of n.
(ii) the expected value of the sum of the two notes selected at random without replacement.

MATHEMATICS
Paper 1
April 1996
3 hours

1. Solve $3(3^{2x}) + 2(3^x) - 1 = 0$
2. Express as equivalent fraction with a rational denominator

$$\frac{\sqrt{2}}{\sqrt{2}+\sqrt{3}-\sqrt{5}}$$

3.Solve the inequality

$$\frac{x-1}{x-2} > \frac{x-2}{x+3}$$

4. Find how many terms of the series

$$1+\frac{1}{5}+\frac{1}{5^2}+\frac{1}{5^3}+---$$

must be taken so that the sum will differ from the sum to infinity by less than 10-6

5. Solve the simultaneous equations

2x - 5y + 2z = 14

9x +3y - 4z = 13

7x +3y - 2z = 3

6. Find the orthocentre (the point of intersection of the altitudes)of the triangle with vertices at A(-2,1), B(3,4) and C(-6,-1)

7. Differentiate with respect to x, expressing your results as simply as possible.

$$\sin^{-1}\left[\frac{3+5\cos x}{5+3\cos x}\right]$$

Evaluate

$$\int_0^{\frac{1}{2}\pi} \sin 2x \cos x\, dx$$

SECTION B

9.(a) Find x if $\log_x{}^8$-$\log_x{}^2 16$ =1

(b) The sum of p terms of an arithmetic progression is q , and the sum of q terms is p , find the sum of p + q terms.

10. (a) Given that z = $\sqrt{3}+i$ find the modulus and argument of

(i) z^2

(ii) $\frac{1}{z}$

(iii) Show in an Argand diagram the points representing complex numbers z, z^2 and $\frac{1}{z}$

(b) In an Argand diagram ,p represents a complex number z such that

$$2|z-2| = |z-6i|$$

show that plies on a circle, find

(i) the radius of this circle

(ii) the complex number represented by it's centre.

11.(a) Find the equation of the circle circumscribing the triangle whose vertices are A(1,3),B(4,-5) and C(9,-1). find also it's centre and radius.

(b) If the tangent ,to this circle at A(1,3) meets the X -axis at P(h,o) and the Y-axis at Q(o,k) , find the values of h and k.

12.(a) Given that 7 tanθ + cot θ = sec θ, derive a quadratic equation for sinθ

Hence , or otherwise, find all values of q in the interval $0^0 \le \theta \le 180^0$ which satisfy the given equation , giving your answer to the nearest 0.1^0, where necessary.

(b) The acute angles A and B are such that

cosA = $\frac{1}{2}$, sinB =$\frac{1}{3}$.

Show , without the use of tables or a calculator, that

$$\tan(A+B) = \frac{9\sqrt{3}+8\sqrt{3}}{5}$$

13. (a) Prove that

(sin2θ –sinθ) (1+2cosθ) = sin3θ.

(b) A vertical pole BAO stands with its base O on a horizontal plane , where BA = c and AO = b , A point p is situated on the horizontal plane at distance x from O and the angle APB = θ.

(i) Prove that

$$\tan\theta = \frac{cx}{x^2+b^2+bc}$$

(ii) As p takes different positions on the horizontal plane , find the value of x for which θ is greatest.

14. A curve is given by

$$y= \frac{(x-1)(x-9)}{(x+1)(x+9)}$$

(i) Determine the turning points of the curve.

(ii) Determine the equations of the asymptotes of the curve.

(iii) Sketch the curve

15. Find the general solution of the equation

$$x\frac{dy}{dx}-2y=(x-2)e^x.$$

(b) The rate of cooling of a body is given by the equation

$$\frac{dT}{dt}=-k(T-10)$$

where T is the temperature in degrees centigrade, k is a constant , and t is the time in minutes.

when t = 0, T = 90 and when t = 5, T = 60.

Find T when t = 10.

16. (a) In the triangle ABC p is the point on Bc such that Bp:pc = λ:μ.

show that

(λ+μ) AP = λAC + μAB.

(b) The non -collinear points A,B and C have position vectors a,b and c respectively with respect to an origin o .

The point M on AC is such that AM:MC =2:1 and the point N on AB is such that AN:NB =2:1

(i) show that $BM = \frac{1}{3}a - b + \frac{2}{3}c$

and find a similar expression for CN.

(ii) The lines BM and CN intersect at L .

Given that BL = rBM and CL = sCN, where r and s are scalars, express BL and CL in terms of r,s,a,b and c.

(iii) Hence , by using triangle BLC, or otherwise, find r and s.

P425/2
MATHEMATICS
Paper 2
April 1996
3Hours

SECTION A.

1. One end of a light inextensible string of length 75cm is fixed to a point on a vertical pole. A particle of weight 12N is attached to the other end of the string. The particle is held 21cm away from the pole by horizontal force . Find the magnitude of this force and the tension in the string.

2. A particle with position vector 40**i**+10**j**+20**k** moves with constant speed $5ms^{-1}$ in the direction of the vector 4**i**+7**j**+4**k**. find it's distance from the origin after 9 seconds.

3. A cyclist travel 1.25km as he accelerates uniformly at a rate of Q ms^{-1} from a speed of $15km^{-1}$. Find the value of Q .

4. In an experiment the following observations were recorded

T :	0	12	20	30
θ :	6.6	2.9	-0.1	-2.9

use linear interpolation to find

(i) θ when T =16

(ii) T when θ = -1

5. A balanced coin is tossed three times and the number of times X a 'Head' appear is recorded. Complete the following table.

n	0	1	2	3
Event	(TTT)		HHT,HTT,THH	
P(X=n)	1/8			

Determine the average of the expected number of heads to appear.

6. In a certain year in the mid-1980s the production of tea in the common wealth ,as per the following countries was as shown below.

Country	production of tea in millions of kg
Bangladesh	41
India	635
Indonesia	108
Kenya	140
Malawi	40
Sri Lanka	212
Tanzania	17
Uganda	7

Give a pie chart representation of the data.

7. A bicycle dealer imports 40% and 60% of spare parts from countries A and B respectively. The percentages of parts produced defective in the countries are 0.3% and 0.5% respectively. A spare part is drawn at random from a sample of parts imported from A and B . Find the probabilities that

(i) it is defective and is from country B

(ii) it is defective.

8. A population consists of 15 numbers,
2,4,7,3,5,6,3,6,10,7,8,9,3,4,3
find

(i) the mode

(ii) the median

(iii) the mean and standard deviation of the population.

SECTION B.

9.(a) Find the position of the centre of gravity of three particles of masses 1kg,5kg and 2kg which lie on the y-axis at points (0,2), (0,4) and (0,5) respectively.

(b) The area enclosed by the curve $y = x^2$ and the lines y = 0, x = 2 and x = 4 lying in the first quadrant is rotated about the
x-axis through one revolution . Find the coordinates of the centre of gravity of the uniform solid so formed.

10. Initially two ships A and B are 65km apart with B due east of A .A is moving due east $10km^{-1}$ and B due south at $24km^{-1}$.
The two ships continue moving with these velocities. find the least distance between the ships in the subsequent motion and the time taken to the nearest minute for such a situation to occur.

11. (a) A conical pendulum consists of a light inextensible string AB of length 50cm fixed at A and carrying a bomb of mass 2kg at B . The bomb describes a horizontal circle about the vertical through A with a constant angular speed of A $radm^{-1}$. Find the tension in the string.

(b) A smooth surface is inclined at 30^o to the horizontal .A body A of mass 2kg is held at rest on the surface by a light elastic string which has one end attached to A and the other to a point on the surface 1.5cm away from A up a line of greatest slope. if the mondulus of the string is 2gN , find it's natural length.

12. A block of mass 6.5kg is projected with a velocity of $4ms^{-1}$ up a line of greatest slope of a rough plane. Calculate the initial kinetic energy of the block. The coefficient of friction between the block and the plane is $\frac{2}{3}$ and the plane makes an angle θ with the horizontal where sin θ = 5/13. The block travels a distance d m up the plane before coming instaneously to rest. Express in terms of d.

(i) the potential energy gained by the block in coming to rest.
(ii) the work done against friction by the block in coming to rest.
Hence calculate the value of d
(Take gravity = $10ms^{-2}$)

13. (i) Show that the iterative formula for solving the equation
$2x^2 - 6x - 3 = 0$

$$X_{n+-1} = \frac{2x_n^2 + 3}{4x_n + 6}$$

(ii) Show that the positive root for $2x^2 - 6x - 3 = 0$ lies between 3 and 4. find the root correct to 2 decimal places.

14. In a survey of newspaper reading habits of members of staff of a university it is found that
80% read NEWVISION (N),
50% read MONITOR(M) and
30% read the EAST AFRICAN (E) .
Further 20% read both M and N
15% read both N and E and
10% read both M and E
(a) if a member of staff is chosen at random from the university community find the probabilities

(i) that the member reads none of the three papers.
(ii) the member is one of those who read at least one of the three papers.

(b) Estimate the number of staff who read at least two papers if the total number is 500.
(c) What is the probability that, given that a member of staff reads at least two newspapers, he reads all the three.

15. A certain factory produces ball bearings. A sample of the bearing from the factory produced the following results.

Diameter of bearing in mm	frequency
91-93	4
94-96	6
97-99	34
100-102	40
103-105	13
106-108	3

(i) Determine the mean and variance of the diameter of the sample bearings.
(ii) Estimate the mean surface area of the bearings produced by the factory.

16. The following Table gives the marks obtained in Calculus, physics and Statistics by seven (7) students

Calculus	72	50	60	55	35	48	82
physics	61	55	70	50	30	50	73
Statistics	50	40	62	70	40	40	60

Draw scatter diagrams and determine rank correlation coefficients between the performances of the students in
(i) Calculus and physics
(ii) Calculus and Statistics
Give interpretations to your results.

P425/2
MATHEMATICS
Paper1
March1997
3hours

SECTION A

1. Solve the equation
$4\cos x - 2\cos 2x = 3$,
for $0^o \leq x \leq \pi$.
(05marks)

2. Find the value of k for which the equation $\frac{x^2 - x + 1}{x - 1} = k$ has repeated roots . What are the repeated roots ? ***(05marks)***

3. By reducing to echelon form solve the simultaneous equations
$x + y + z = 0$
$x + 2y + 2z = 2$
$2x + y + 3z = 4$.
(05marks)

4. Given that $x = \theta - \sin\theta$,
$y = 1 - \cos\theta$,

show that $\frac{dy}{dx} = \cot\frac{\theta}{2}$. ***(05marks)***

5. ABCD is a square inscribed in a circle
$x^2 + y^2 - 4x - 3y = 36$.
Find the length of diagonals and the area of the square . ***(05marks)***

6. Find (i) $\int \sin^2 x dx$,

(ii) $\int \tan^3 x dx$.

7. Find the distance of the point (-2, 0, 6) from the plane
$2x - y + 3z = 21$ ***(05marks)***

8. Determine the volume of the solid generated when the region bounded by the curve $y = \cos x$ and the x - axis for values of x between 0 and $\pi/4$, is rotated about the x-axis . ***(05marks)***

SECTION B

9 (a) If $\log_b a = x$ show that $b = a^{1/x}$

and deduce that $\log_a b = \frac{1}{\log_b a}$

(b) Solve (i) $\log_n 4 + \log_4 n^2 = 3$,

(ii) $2^{2x-1} + \frac{3}{2} = 2^{x+1}$.

10 (a) Given the complex numbers
$z_1 = 1 - i$; $z_2 = 7 + i$ represent $z_1 z_2$ and $z_1 - z_2$ on the argand diagram.

Determine the modulus and argument of $\frac{z_1 - z_2}{z_1 z_2}$.

(b) If z is a complex number in the form (a + bi), solve

$$\left(\frac{z-1}{z+1}\right)^2 = i.$$

11 (a) Prove that
$\sin 3\theta = 3\sin\theta - 4\sin^3\theta$.

(b) Find all solutions to $2\sin 3\theta = 1$ for θ between 0^o and 360^o. Hence find the solutions of $8x^3 - 6x + 1 = 0$

12. The points A, B and C have position vectors (-2**i** + 3**j**) , (**i** - 2**j**) and (8**i** - 5**j**) respectively .
(i) Find the vector equation of line AC .
(ii) Determine the coordinates of D if ABCD is a parallelogram .
(iii) Write down the vector equation of the line through point B perpendicular to AC and find where it meets AC .

13. Express $f(x) = \frac{2x^2 - x + 14}{(4x^2 - 1)(x+3)}$ in partial fractions .

Hence evaluate $\int_1^3 f(x)dx$.

14. Find the equation of the chord joining the points $(ct_1, \frac{c}{t_1})$ to $(ct_2, \frac{c}{t_2})$ on a hyperbola . Hence deduce the equation of the tangent at $(ct, \frac{c}{t})$.

Find the equations of the tangents to the hyperbola
$x = 4t$
$y = 4/t$ which pass through point (4 , 3) .

15. Show that the tangents at (-1 , 3) and (1 , 5) on the curve $y = 2x^2 + x + 2$ pass through the origin . Find the area enclosed between the curve and these two tangents .

16 (a) Use Maclaurin's theorem to expand
$\ln(1 + \sin x)$ as far as the term in x^3

(b) Expand $(1-x)^{1/3}$ as far as the term in x^3. Use your expansion to deduce
$3\sqrt{24}$ correct to three significant figures .

MATH
PAPER 2
1997.

SECTION A.

1.A bag contains 5 white , 3 red and 2 green counters, 3 counters are drawn without replacement.
What is the probability that there
(i) is no green counter.
(ii) are 2 white counters and a green counter ?
(5 marks)

2. Given below is a table of corresponding values of X and Y.

X:	0	8	12	20
Y:	9.2	6.0	4.4	1.5

Use linear interpolation to find
(i) Y when X = 15,
(ii) X when Y = 5.0. ***(4marks)***

3. A particle with a position vector
10i + 3j + 5k moves with constant speed of $6ms^{-1}$ in the direction **i + 2j + 2k.**
Find its distance from the origin after 5 seconds .
(5 marks)

4. Particle of mass 4.5 and 6 kg are placed at (0,0) , (4,3) and (5,2) respectively in the line x -y plane. Find the co-ordinates of their centre of mass . ***(5 marks)***

5. The yields of 13 plots in 100's of kg were 16, 7, 10, 3, 11, 5, 8, 14, 18, 4, 11, 14 and 9.
Find the
(i) mean
(ii) standard deviation of this data. ***(6 marks)***

6. A box of mass 2kg is at rest on a plane inclined at 25o to the horizontal. The coefficient of friction between the box and the plane is 0.4 . What maximum force applied parallel to the plane would move the box up the plane?
(5 marks)

7. The probability of winning is $\frac{4}{5}$. Ten games are played.
What is the
(i) mean number of success.
(ii)variance .
(iii)probability of at least 8 successes in the games?
(5 marks)

8. A mass of 3kg is at rest on a smooth horizontal table. It is attached by a light inextensible string passing over a smooth fixed pulley a the edge of the table to another mass of 2 kg. Which is hanging freely. The system is released from rest . Determine the resulting acceleration and the tension in the string. ***(5 marks).***

SECTION B.

9.(a) The table below shows the likehood of where A and B spend Saturday evening:

	A	**B**
Goes to dance	$\frac{1}{2}$	$\frac{2}{3}$
Visits Neighbour	$\frac{1}{3}$	$\frac{1}{6}$
Stay at home	$\frac{1}{6}$	$\frac{1}{6}$

(i) Find the probability that both go out.
(ii) If we know that they both go out , what is the probability that both went to the dance?
(b) Four competitors throw a die in turn . What is the probability that
(i) they all score more than a 4.
(ii) two get less than a 3.
(iii)the total score is 23?

10. The probability density function of a random variable X is given by

$$f(x) = \begin{cases} k(x+2); -1 < x \le 0 \\ 2k(1-x); 0 < x \le 1 \\ 0 \text{ ;elsewhere} \end{cases}$$

(i) Sketch the function .
(ii) Find the probability
$P(0 < x < \frac{1}{2} / x > 0)$.

11. The heights of students in S1 were according to the following frequency table.

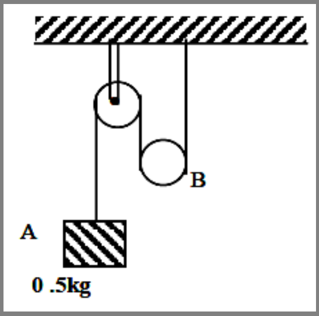
Heights(cm)	Frequency(f)
151- 153	2
154- 156	14
157- 159	13
160- 162	13
163- 165	2
166- 168	1.

(i) Estimate the mean and standard deviation of the height of students .
(ii) Determine and plot the cumulative frequency distribution for the student's heights. Hence estimate the median , lower and upper quartiles for the heights of the students.

12. Using the iterative formular show that the fourth root of the number N is $\frac{3}{4}x_n + \frac{N}{4x_n^3}$ hence show that

$(45.7)^{\frac{1}{4}} \approx 2.600$ (correct to three decimal places).

13.(a) Two particles are moving towards each other , along a straight line. The first particle has a mass of 0.2kg and moving with a velocity of $4ms^{-1}$, and the second has a mass of 0.4kg moving with a velocity of $3ms^{-1}$. On collision, the first particle reverses its direction and moves with a velocity of $2.5ms^{-1}$.
Find the
(i) velocity of the second particle after collision.
(ii) percentage loss in kinetic energy.
(b) The diagram shows particle A of mass 0.5kg attached to one end of a light inextensible string passing over a fixed light pulley and under a movable light pulley B. The other end of the string is fixed as shown below.

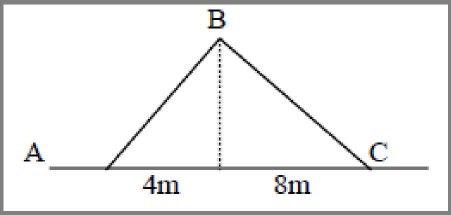


(i) What mass should be attached at B for the system to be in equilibrium ?

(ii) If B is 0.8kg . What are the accelerations of particle A and pulley B?

14. A particle of mass $\frac{1}{2}$ kg is released from rest and slides down a rough plane inclined 30^o to the horizontal. It takes 6 seconds to go 3 metre.
(i) Find the coefficient of friction between the particle and the plane (correct to 2 dec. places)
(ii) What minimum horizontal force is needed to prevent the particle from moving?

15. Two uniform rods AB , BC of masses 4kg and 6kg respectively are hinged at B and rest in a vertical position on a smooth floor as shown. A and C are connected by a rope.



(i) Find the reactions between the rods and the floor at A and C when the rope is taut.
(ii) If now a body is attached a quarter of the way up CB , and the reactions are equal , find the mass of the body.

16. At noon, a boat A is 30km from boat B and its direction fromB is 286^o . Boat A is moving in the North East direction at $16kmh^{-1}$ and boat B is moving in the Northern direction at $10kmh^{-1}$. By scale drawing or other wise determine when they are closest to each other. What is the distance between them then?

MATHEMATICS
Paper 1 1998.
SECTION A.(40 marks)

1. Solve simultaneously

$$\frac{1}{x}-\frac{1}{y}=\frac{1}{6}$$

$x(5-x) = 2y$ ***(05marks)***

2. Prove that

$$\log{}_6{}^x=\frac{\log_3{}^x}{1+\log_3 2}$$

Hence given that $\log_3{}^2 = 0.631$, find without using tables or calculators $\log_6 4$ correct to 3 significant figures.
(06marks)

3. Show that $\cos\theta = \frac{\tan^4\theta-6\tan^2\theta+1}{\tan^4\theta+2\tan^2\theta+1}$
(05marks)

4. The distance s m of a particle from a fixed point is given by $s = t^2(t^2+6) -4t(t-1)(t+1)$, where the is the time . Find the velocoty and acceleration of the particle when the = 1s.
(05marks)

5. Using the substitution $2x +1 = p$, find $\int_0^1 \frac{d\ dx}{(2x+1)^3}$

(05marks)

6. ABCD is a quadrilateral with A (2,-2) , B(5,-1) , C(6,2) and D(3,1) . Show that the quadrilateral is a rhombus.
(04marks)

7. The points P (4,-6, 1) Q(2,8,4) and R (3,7,14) lie in the same plane . Find the angle formed between PQ and QR.
(05marks)

8. Use Maclaurin's expression to express in $(1+x)^2$ in ascending power of x up to the term in x^4.
(05marks)

SECTION B.(60 marks)

9. (a) When $f(x) = x^3 - ax + b$ is divided by $x + 1$, the remainder is 2 and $x + 2$ is a factor of f (x) . Find a and b .
(b) If the roots of the equation $x^2 + 2x + 3 = 0$., are α and β , form the equation whose roots are $\alpha^2 -\beta$ and $\beta^2-\alpha$.

10(a) Show the region represented by $|z-2+i| < 1$ on an Argand diagram
(b) Express the complex number $z = 1-\sqrt{3i}$ in modulus -argument form and hence find z^2 and $\frac{1}{z}$ in the form a + bi

11. (a) Differentiate with respect to x
(i) $2x^2$,
(ii) $\sin^3 2x$.
(b) Find the equations of the tangent and normal to the curve
$y = 4x^3 - 6x^2 + 3x$ at the point (1,1)

12. (a) Find the solution of
$3 \cot\theta +\csc\theta = 2$
for $0 \le \theta \le 360^o$
(b) Solve $2 \sin x = \sin (x - 60^o)$
for -180o $\le x \le 180^o$13.
P $(ap^2 , 2ap)$ and Q $(aq^2 , 2aq)$ are two points on the parabola $y^2 = 4ax$. PQ is a focal chord .
Prove that pq = -1 , and hence that if the tangents at P and Q intersect at T the locus of T is given by $x + a = 0$
PM and QN are perpendiculars onto $x + a = 0$, s = (a , 0)
Prove that MSN = 90^o = PTQ.

14(a) Integrate $\frac{4x^2}{\sqrt{(1-x^6)}}$ with respect to x.

(b) Evaluate $\int_1^3 \frac{x^2+1}{x^3+4x^2+3x}dx$

15. Solve

(a) $y\frac{dy}{dx} = 2x - y$ by using the substitution

$y = vx$.

(b) $\frac{dy}{dx} - y \tan x = \cos^2 x$

16. (a) Given that OP = $\begin{pmatrix} 4 \\ -3 \\ 5 \end{pmatrix}$ and OQ= $\begin{pmatrix} 1 \\ 0 \\ 2 \end{pmatrix}$ find the co-ordinates of the point R such that $\overline{PR} : \overline{PQ} = 1:2$ and R are collinear.

(b) Show that the vector 5i -2j +k is perpendicular to the line

r = **i** - 4**j**+ (2**i** + 3**j** - 4**k**) .

(c) Find the equation of the plane through the point wih position vector 5**i** - 2**j** +3**k** perpendicular to the vector 3**i** +4**j** -**k**.

P 425/2
MATHEMATICS
Paper 2
March 1998
3 hours.

SECTION A

1. A descrete random variable , X has the following probability distribution

x	1	2	3	4
P(X)	$\frac{3}{16}$	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{16}$

Find the mean and variance of X ?

(05marks)

2. A carton of mass 0.4kg is thrown a cross a table with a velocity of 25 ms^{-1} , The resistance of the table to its motion is 50 N . How far will it travel before coming to rest?

What will be the resistance if it travels only 2 metres ?

(05marks)

3 A motor cyclist decelerated uniformly from 20km h^{-1} to 8km h^{-1} in travelling 896m , find rate of deceleration in ms^{-2}. ***(05marks)***

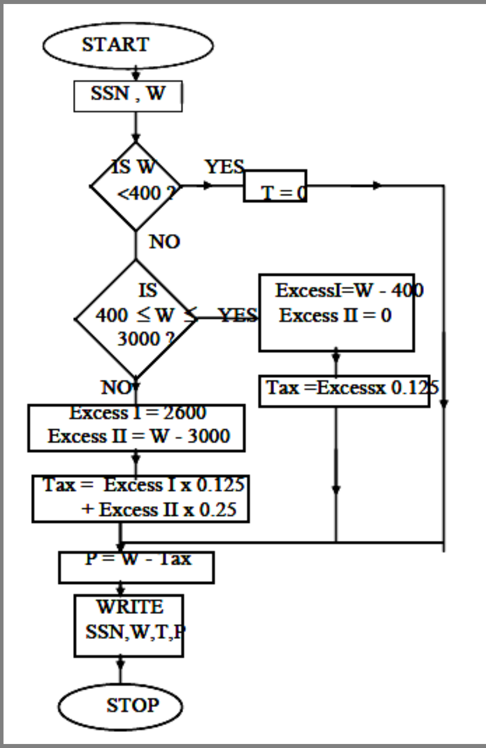
4. A particle of weight 8N is attached to point B of a light inextensible swing AB . It hangs in equilibrium with point A fixed and AB at angle of 30^0 to the downwrd vertical,A force F at B acting at right angles to AB , keeps the particle in equilibrium find the magnitude of F and the tension in the string ? ***(05marks)***

5.There are 3 black and 2 white balls in each of the two bags , A ball is taken from the first bag and put in the second , then a ball is taken from the second into the first , what is the probability that there are now same number of black ball and white balls in in each bag as there were to begin with ?

(05marks)

6 .Using the same graph show that the curve x^3 and the line 2x + 5 have a common real root . Using the Newton Raphson formula twice , find the posistive root of the equation $x^3 - 2x - 5 = 0$,
giving your answer to two decimal places. ***(05marks)***

7 In the flow chart below shows the social security number (SSN) and the monthly wage (W shillings) of an employee. P represents the net pay.



Copy and complete the following

SSN	W	T	P
280-04	380	-	-
180-34	840	-	-
179-93	4,500	-	-
380-06	5,580	-	-
385-03	8,000	-	-

(05marks)

8. 64% of the students at "A" level take science subjects and 36 % do Arts subjects . The probability of them being successful is $\frac{3}{4}$ for science students and $\frac{5}{6}$ for arts students , find the probability that a student chosen at random will fail. *(05marks)*

SECTION B

9(a)Given that the values x = 4 y = 6 and z = 8 each , have been approximated to the nearest integer , find the maximum and minimum values of

(i)$\frac{x}{y}$ (ii)$\frac{z-x}{y}$ (iii)(x+y)(z)

(b) A company had a capital of sh 500 million. the profit in a certain year was sh 25.8 million in section A of the company and sh 14.56 million in and an 8% error in B. Find the maximum and minimum values of the total profit of the sections as a percentage of the capital ?

10.(a) Show that the Newton Raphson's formular for finding the smallest positive root of the equation 3tan +x = 0 is

$$\frac{6x_n - 3\sin 2x_n}{6 + 2\cos^2 x_n}$$

(b) By sketching the graphs of y = tan x , y = $\frac{-x}{3}$ or otherwise , find the first approximation to the required root and use it to find the actual root correct to 3 decimal places.(H int work in radians)

11. The diameter of a sample of oranges to the nearest cm were

Diameter(cm)	8	9	10	11	12	13	14
Frequency:	9	15	21	32	19	13	11

(i) calculate the mean and standard deviation.
(ii) Assuming the distribution is normal , find the minimum diameter if the smallest 10% of the oranges are rejected for being too small.

12(a) A pupil has ten-multiple choice questions to answer, there are four alternative answers to choose from . if a pupil answers the questions randomly , find the probability.
(i) that at least four answer are correct.
(ii) of the most likely number of correct answers.
(b) Otim's chances of passing physics are 0.60 of chemistry 0.75 and of mathematics 0.80.
(i) Determine the chance that he passes one subject only.
(ii) if it is known that he passed at least two subjects , what is the probability that he failed chemistry ?

13.A random variable X has a distribution probability function given

$$f(x) = \begin{cases} kx : 0 \le x \le 1, \\ k(4-x^2), 1, \le x \le 2 \\ 0, \text{elsewhere.} \end{cases}$$

(i) find the constant k
(ii) determine E(X) and var (X)
(iii) sketch the cumulative distribution function F (x) and sketch it.

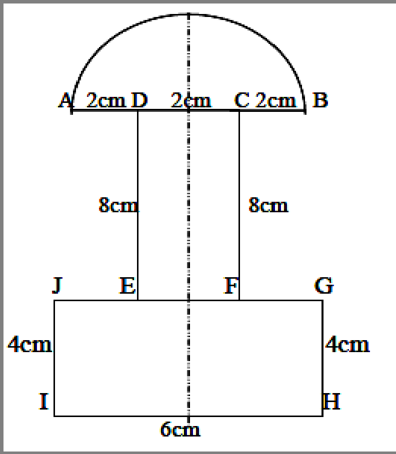
14.At thepoints A (0,-4) B(2,1) C(1,3) and D(-4,-2). there are forces

$$\begin{pmatrix}-1\\-5\end{pmatrix}, \begin{pmatrix}-2\\-3\end{pmatrix}, \begin{pmatrix}1\\4\end{pmatrix} \text{and} \begin{pmatrix}2\\4\end{pmatrix}$$

N respectively.
(I) prove that the resultant is a couple , and find its moment.
(ii) if the force at D is halved , find the magnitude of the resultant force . find also the equation of theline of action of the resultant.

15. (a) A particle is projected vertically upwarsd from a point O with speed after it has travelled a distance x above O , on its upwards motion , a second particle is projected vertically upwards from the same point and with the same initial speed , given that the particles collide at a height x above O ,x and v being constant , show that
(i)at maximum heigth H , $8v^2 = 9gH$
(ii) when the particles collide 9x = 20H.
(b)A stone thrown upwards at an angle a to the horizontal with speed u ms^{-1} just clears a vertical wall 4m high and 10m from the point of projection when travelling horizontally, find the angle of projection.

16.



The figure ABCDEFGHIJ shows a symetrical composite lamina made up of a semi- circle , radius 3cm a rectangle CDEF 20 cm x 8cm and another rectangle GHIJ 6cm x 4cm.

find the distance of the center of gravity on this lamina from IH . if the lamina is suspended from H , by means of a peg through a hole , calculate the angle of inclination of HG to the vertical.

P 425/1
MATHEMATICS
Paper 1
Nov-Dec 1998
3hours.

SECTION A.(40 marks)

1. Solve cosθ+ $\sqrt{3}\sin\theta = 2 \text{for} 0^0 \le \theta \le 180^0$

(5 marks)

2 . The gradient of a certain curve is given by kx. if the curve passes through the point (2,3) and the tangent that this point makes is an angle of $\tan^{-1} 6$ with the positive direction of the x-axis , find the equation of the curve. *(5 marks)*

3. Given that the roots of the equation $x^2 - 2x + 10 = 0$ a and b determine the equation whose roots are $\frac{1}{(2+\alpha)^2}$ and $\frac{1}{(2+\beta)^2}$ *(5 marks)*

4. By row reducing the appropriate matrix to echelon form , solve the system of the equation.

$x + 2y - 2z = 1$
$2x + y - 4z = -1$
$4x - 3y + z = 11$ *(5 marks)*

5. Find the simplest form, the deviative of $\cos^{-1}\left[\frac{1-x^2}{1+x^2}\right]$

(5 marks)

6.Show that $\int \tan^n x dx = \frac{\tan^{n-1}}{n-1} - \int \tan^{n-2} x dx$

Hence or otherwise find $\int \tan^4 x dx$ *(5 marks)*

7.Calculate the area of a triangle with vertices (1,-2) (5,2) and (4,-1) *(5 marks)*

8. PQRS is a quadrilateral withvertices P (1,-2) Q(4,-1) R (5,2) and S(5,2)
show that the quandrilateral is a rhombus. *(5 marks)*

SECTION B.

9(a) Given that $z_1 = -1 + i$, $z_2 = 2 + i$ and $z_3 = 1 + 5i$, represent z_2z_3 , $z_2 - z_1$ and $\frac{1}{z_1}$, on the Argand diagram . Also show the representation of $\frac{z_2z_3}{z_2 - z_1} + \frac{1}{z_1}$

(b) prove that for positive integer n.

$(\cos\theta + i\sin\theta)^n = \cos n\theta + i\sin\theta$

10(a) Solve $4^x - 2^{x+1} - 15 = 0$

(b) Five million shillings invested each year, at a rate of 15% interest, in how many years will it accumulate to more than sh.50million?

11.(a) If $y = \tan\left(\frac{x+1}{2}\right)$ showthat $\frac{d^2y}{dx^2} = y\frac{dy}{dx}$

(b) Find the equation of the tangent to the curve $x^2 + y^2 - 2xy = 4x$ at (1,-1).

12.The vector equation of the tangent of the line P and Q are given as

$\mathbf{r_p} = t(4\mathbf{i} + 3\mathbf{j})$ and $\mathbf{r_q} = 2\mathbf{i} + 12\mathbf{j} + 5(\mathbf{i} - \mathbf{j})$

(a) Use the dot product to find the angle between lines P and Q.

(b) if the lines P and Q meet at M , find the coordinates of M . find also the equation of the line through perpendicular to the line Q.

13. Sketch the curve

$y = x - \frac{8}{x^2}$ for $x > 0$, showing any asymptotes.

Find the area enclosed by the x-axis , the line x = 4 and the curve $y = x - \frac{8}{x^2}$.

if this area is now rotated about the x-axis through360^0, determine the volume of the solid generated, correct to three significant figures.

14. From the top a tower 12.6m high, the angles of depression of ship A and B are 12^0 and 18^0 respectively. the bearing of a shipA and ship B from the tower are 148^0 and $209\tfrac{1}{2}^0$ respectively.

Calculate

(i) how far apart the ship are from each other.

(ii) the bearing of ship A from B

15. Prove that

$\sin 2x = \frac{2\tan x}{1+\tan^2 x}$

(b) Solve for x in

(i) tanx +3cotx = 4

(ii) 4cos -3sinx = 2

$0 \le x \le 360^0$

16. A rumour spreads through atown at a rate which is proportional to the produc of the number of people who have heard it and that of those whi have not heard it .Given

that x is a fraction of the population of the town who have heard the rumour after time t

(i) form a differential equation connecting x , t and a constant k.

(ii) if initially a fraction C of the population heard the rumour deduce that

$$x = \frac{C}{C+(1-C)^{e-kt}}$$

(iii) Given that 15% had heard the rumour at 9.00a.m and another 15% by noon., find what further fraction of the population would have heard the rumour by 3.00 p.m

P425/2
MATHEMATICS
Paper 2
Nov/Dec. 1998
3 hours

SECTION A

1. The probability that two independent events occur together is $\frac{2}{15}$.

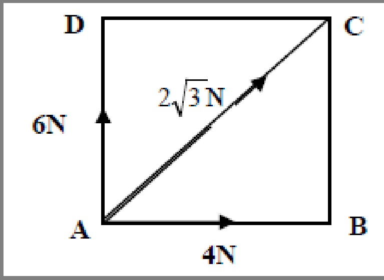
The probability that either or both events occur is $\frac{3}{5}$.

Find the individual probabilities of the two events.

(06marks)

2. Find an expression for the power exerted by s force **r** = $4t^2$ **i** + 4t**j** + $7t^2$**k** acting on a particle to give it a velocity v = t**i** -$3t^2$**j** +2t**k**. Find also the acceleration of the particle.

3.



Three forces of magnitude 6N,4N and $2\sqrt{3}$N act along AD,AB and AC respectively as shown above. ABCD is a square. Determine the resultant of the three forces and the angle which it makes with AB. *(05marks)*

4. Given X = 2.2255 ,Y = 0.449. correct to the given number of decimal places. State the maximum possible errors in the values of X and Y.

Hence determine the

(i) absolute error

(ii) limits within which the value of the quotient $\frac{X}{Y}$ lies giving your answer to 2 decimal places.

(05marks)

5. The probability that Bob wins a tennis game is $\frac{2}{3}$ He plays 8 games,what is the probability that he wins

(i) at least 7 games,

(ii) exactly 5 games? *(05marks)*

6. An elastic string of natural length 1.2m and modulus of elasticity 8N is stretched until the extending force is 6N , find the extension and the work done. *(05marks)*

7.By using Newton Raphson formula and

$$x_0 = \frac{\pi}{2}$$

as the initial approximation to the root of the equation 10cosx - x = 0 show that the approximation is $\frac{5\pi}{11}$.

(04marks)

8. The table below shows the distribution of marks gained by a group of students in a mathematics test marked out of 50.

Marks	Frequency
1 - 10	15
11 - 20	20
21 - 30	32
31 - 40	26
41 - 50	7

Plot an ogive for the data and use it to estimate the median mark and semi-interquartile. *(04marks)*

(06marks)

SECTION B

9.Show that the iterative formula for finding the fourth root of a number , N is given by

$$\frac{3}{4}\left(x_n + \frac{N}{3x_n^3}\right); n = 0,1,2,3--$$

Draw a flow chart that (i) reads the number N and the initial approximation x_0.

(ii) computes and prints N and its fourth root after iterations and gives the root correct to 3 decimal places.

(c) Perform a dry run for N = 39.0 and x_0 = 2.0

10.A particle is projected with a speed of $10\sqrt{2g}ms^{-1}$ from the top of acliff, 50m high. The partucle hits the sea at a distance of 100m from the vertical through the point of projection. show that there are two possible directions of projection which are perpendicular. Determine the time taken from the point of projection in each case.

11. A probability density function is given as

$$f(x)=\begin{cases} kx(4-x^2):0\le x\le 2 \\ 0 \quad :\text{Elsewhere}\end{cases}$$

find the (i) value of k,

(ii) median,

(iii) mean,

(iv)standard deviation.

12. Show that the root of the equation $f(x) = e^x + x^3 - 4x = 0$ lies between 1 and 2 .By using the Newton Raphson method , find the root to2 decimal places.

13. To one end of a light inelastic string is attached to a mass of 1kg which rests on a smooth wedge of inclination 30^0. The string passes over a smooth fixed pulley at the edge of the wedge , under a seond smooth movable pulley of mass 2kg and over a third smooth fixed pulley, and has a mass of 2kg attached to the other end,fin the acceleration of the masses and the movable pulley and the tension in the string. (assume the portions of the string lie in the vertical plane)

14.Boxes made in a factory have weights which are normally distributed with a mean of 4.5kg and a standard deviation of 2.0kg, find the probability of there being a box with a weight of more than5.4kg when a box is choosen at random. if a sample of 16 boxes is drawn, find the probability that the mean is between

(i) 4.6 and 4.7kg

(ii) 4.3 and 4.7kg

15.The ages of people in town were as follows

(a) Draw a histogram for this data

(b) State the modal age interval.

(c) Estimate the

(i) average age of the town ,

(ii) number of people under 18 years.

(iii) median age.

16(a) Ship A is sailing with a speed u kmh^{-1} in a direction $N30^0E$. A second ship B is sailing with a speed of v kmh^{-1} ina direction N θ 0E. The velocity of ship A relative to B is due North East. show that $u = v(\sqrt{3}+1)(\cos\theta - \sin\theta)$

(b) Ship A changes its course t $N\ 60^0E$, while it continues with the same speed.

ShipB continues with the same velocity. The velocity of ship A relative to B is now due East, find tanθ. (leave yuor andwer in surd form.)

MATHEMATICS

Paper I

Nov / Dec 1999

3 hours

SECTION A. (40 marks)

1 . Given that the equation $2x^2 +5x - 8 = 0$, has roots α and β , find the equation whose roots are

$$\frac{1}{(\alpha+2)^2} \text{ and } \frac{1}{(\beta+2)^2}$$ ***(04 marks)***

2. The vector equations of two lines are

$$r_1 = \begin{pmatrix}5\\-6\end{pmatrix} + \lambda\begin{pmatrix}3\\1\end{pmatrix} \text{ and}$$

$$r_1 = \begin{pmatrix}4\\1\end{pmatrix} + \gamma\begin{pmatrix}-2\\3\end{pmatrix}.$$ Determine the point where $\mathbf{r_1}$ meets $\mathbf{r_2}$. ***(5 marks)***

3. Solve $\cos(\theta + 35^0) = \sin(\theta + 25^o)$

for $0\le\theta\le 360^0$ ***(5 marks)***

4. The population of a country increases by 2.75 % per annum . How long will it take for the population to tripple ?***(5 marks)***

5. Differentiate with respect to x :

(i) 3x In x^2 ,

(ii) cot 2x ***(5 marks)***

6. Evaluate $\int_0^1 \frac{\tan^{-1}(x)}{1-x^2}dx.$ ***(5 marks)***

7. A curve is defined by the parametric equations

$x = t^2 - t$,

$y = 3t + 4$.

Find the equation of the tangent to the curve at (2 , 10). ***(5 marks)***

8. A cliff which is 100m high , runs in S.E - N.W direction along the coast . From the top of the cliff the angle of depression of a ship moving at a steady speed of $24kmh^{-1}$ towards the coast is 08^0.

Calculate the distance of the ship from the coast at that instant . What is the angle of elevation of the cliff from the ship one minute later ? ***(5 marks)***

SECTION B.(60 marks)

9. The locus of p is such that the distance OP is half the distance PR . where O is the origin and R is the point (-3 , 6) .

(i) Show that the locus of P describes a circle in the x- y plane.

(ii) Determine the radius and centre of the circle.

(iii) Where does P cut the line x = 3 ?

10. (a) Solve the equation
$2(3^{2x}) - 5(3^x) + 2 = 0$

(b) The equation of three planes P_1, P_2 and P_3 are
$2x - y + 3z = 3$,
$3x + y + 2z = 7$ and
$x + 7y - 5z = 13$ respectively.
Determine where the three planes intersect.

11. If z is a complex number, describe and illustrate on the Argand diagram the locus given by each of the following :

(i) $\left|\frac{z+i}{z-2}\right| = 3$, (ii) $\text{Arg}(z+3) = \frac{\pi}{6}$

12. (a) Solve $\sin 3x + 1/2 = \cos^2 x$ for $0 \le x \le 360^0$.

(b) Given that in any triangle ABC

$\tan\left(\frac{B-C}{2}\right) = \frac{b-c}{b+c}\cot\left(\frac{A}{2}\right)$,

Solve the triangle with two sides 5 and 7 and the included angle 45^0.

13. A research to investigate the effect of a certain chemicals on a virus infection crops revealed that the rate at which the virus population is destroyed is directly proportional to the population at that time . Initially the population was P_o at months later it was found to be P.

(a) Form a differential equation connecting P and t

(b) Given that the virus population reduced to one third of the initial population in 14 months , solve the equation in (a) above.

(c) Find
(i) how long it will take for only 5 % of the original population to remain .
(ii) What percentage of the original virus population will be left after 2½ months.

14. (i) Find $\int \frac{x^2}{(x^4 - 1)} dx$.

(ii) Evaluate $\int_0^1 \frac{x}{\sqrt{1+x}} dx$

15. A hemispherical bowl of radius a cm is initially full of water . The water runs out through a small hole at the bottom of the bowl at constant rate such that it empties the in 24 s. Given the depth of water is x cm and the volume of the water is $\frac{1}{3}\pi x^2(3a - x)\text{cm}^3$, show that the depth of water at that instant is decreasing at a rate

$a^2\lfloor 36x(2a - x)\rfloor^{-1}\text{cms}^{-1}$

Find how long it will take for the depth of the water to be at $\frac{1}{3}$a cm and the rate at which the depth is decreasing at that instant.

16. (a) Find , in cartesian form the equation of the line that passes through the points A (1,2,5) B((1,0,4) and C (5,2,1)

(b) Find the angle between the line $\frac{x+4}{8} = \frac{y-2}{2} = \frac{z+1}{-4}$ and the plane

$4x + 3y - 3z + 1 = 0$

P425/2
MATHEMATICS
Paper 2.
Nov / Dec .1999
3 hours.

SECTION A. (40 marks)

1. Given that A and B are mutually exclusive events and $P(A) = \frac{2}{5}$ and $P(B) = \frac{1}{2}$, find:

(i) $P(A \cup B)$
(ii) $P(A \cap \overline{B})$
(iii) $P(\overline{A} \cap \overline{B})$ *(5 marks)*

2. Four forces $a\mathbf{i} + (a-1)\mathbf{j}$, $3\mathbf{i} + 2a\mathbf{j}$, $5\mathbf{i} - 6\mathbf{j}$ and $-\mathbf{i} - 2\mathbf{j}$ act on a particle .
The resultant of the forces makes an angle of 45^o with the horizontal .
Find the value of a .
Hence determine the magnitude of the resultant force.
(5 marks)

3. Show by means of a graph that the equation $x + \log_e x = 0.5$ has only one real root that lies between $\frac{1}{2}$ and 1.*(5 marks)*

4. An overloaded taxi travelling at a constant speed of 90kmh^{-1} overtakes a stationary traffic police car . Two seconds later the police car sets off in pursuit of the taxi before , accelerating at a rate of 6ms^{-2} . How far does the traffic travel before catching up with the taxi?
(5 marks)

5. The table below shows the variation of temperature with time in a certain experiment.

Time (s)	0	120	240	360	480	600
Temp. (^{0}C)	100	80	75	65	56	48

Use linear interpolation to find the
(i) value in ^{0}C corresponding to 400s,
(ii) time at which the temperature is 77^0C. ***(5 marks)***

6. A box of 4.9kg rests on a rough horizontal plane inclined at an angle of 600 to the horizontal. If the coefficient of friction between the box and the plane is 0.35 , determine the force acting parallel to the plane which will move the box up the plane.
(5 marks)

7.At a bus park, 60% of the buses are Isuzu make , 25% are Styre type and the rest are of Tata make.
Of the Isuzu type , 50 % have radios , while for the Styer and Tata types only 5 % and 1% have radios, respectively . If a bus is selected at random from the park , determine the probability that :
(i) it has a radio
(ii) a styer is selected given that it has a radio. ***(5 marks)***

8. Given the variables x and y below,

x	80	75	86	60	75
y	62	58	60	45	68

92	86	50	64	75
68	81	48	50	70

Obtain a rank correlation coefficient between the variable x and y. Comment on your result. ***(5 marks)***

SECTION B.

9. (a) The area A of a parallelogramme formed by vectors a and b is given by $A|a||b|\sin\theta$, where θ is the angle between the vectors . Find the percentage error made in the area if $|a|$ and $|b|$ are measured with errors of $\pm 0.5^0$,and the angle with an error of $\pm 0.5^0$, given that.| **a** | = 2.5 cm,
| **b** | = 3.4 cm and θ = 30^o.
(b) Use the trapezium rule with sub - intervals to estimate $\int_0^{\pi} x\sin x\,dx$ correct to 3 decimal places.
Determine the error in your estimation and suggest how this error may be reduced.

10. (a) A man buys 10 tickets from a total of 200 tickets in a lottery . There is only one prize ticket of shs 10,000.
(i) Find the probability that one of the tickets is a prize ticket.
(ii) If the price of each ticket is Shs 100 and assuming that all tickets were sold , find the expected loss.

(b) A man lives at a point which is 20 minutes walk from the taxi stage. Taxis arrive at the stage punctually. If the probability distribution function for getting a taxi is given by

$$f(x) = \begin{cases} \frac{1}{20}, 0 \le x \le 20 \\ 0, \text{Elsewhere} \end{cases}$$

Determine the :
(i) expected time it takes to wait for a taxi ,
(ii)variance of the time it takes to wait for the taxi.

11.A particle is describing a simple harmonic motion in a straight line direction towards a fixed point O. When its distance from O is 3m its velocity is 25ms^{-1} and its acceleration 75ms^{-2} . Determine the

(i) period and amplitude of oscillation,
(ii) time taken by the particle to reach O.
(iii) velocity of the particle as it passes through O.

12. (i) Show that the iterative formula for approximating the root of f(x) = 0
by the Newton - Raphson process for the equation x_e^x +5x -10 = 0 is

$$x_{n+1} = \frac{x_n^2 e^{x_n} + 10}{e^{xn}(x_n + 1) + 5} .$$

(ii) Show that the root of the equation in (i) above lies between 1 and 2. Hence find the root of the equation. Correct your answer to 2 decimal places.

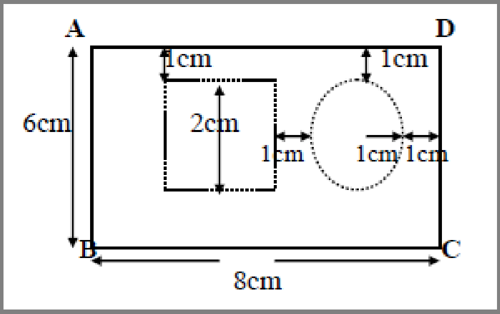
13. A factory produces two types of bars of soap ,A and B. Their lengths are normally distributed with type A having average length of 115cm and standard deviation 3cm . Type B have an average length 190 cm and standard deviation 5 cm.

(a) Determine the percentage of type
(i) A bars of that have a length of more than 120 cm,
(ii) B bars of soap that have a length of more than 180cm.
(b) Find the 95% confidence limits for the mean of length of type A bars of soap.

14.A rod AB of length 0.6 m long and mass 10kg is hinged at A . Its centre of mass is 0.5m from A . Alight inextensible string attached at B passes over a fixed smooth pulley o.8m above A and supports a mass M hanging freely. If a mass of 5kg is attached at B so as to keep the rod in a horizontal position, find the
(i) value of M
(ii) reaction at the hinge.

15. When a biased tetrahedron is tossed the probability that any of its face shows up is proportional to the square of the number on the face that shows up.
(i) Find the probability with which each of the numbers 1,2,3 and 4 on the faces of the tetrahedron appear.
(ii) If there independent tosses of the tetrahedron are made , what is the probability that the sum of the numbers on the faces that show up is a 3 or a 5.

16.



ABCD is a uniform rectangular sheet of cardboard of length 8cm and width 6cm. A square and circular hole are cut off from the cardboard as shown above.
Calculate the position of the centre of gravity of the remaining sheet.

MATHEMATICS
PAPER I
2000

SECTION A

1. Solve the simultaneous equation
$x - 2y + 3z = 6,$
$3x + 4y - z = 3$
$4x + 6y - 5z = 0$ ***(5 marks)***

2. Solve $\cos\theta + \sqrt{3}\sin\theta = 2$ ***(5 marks)***

3. Differentiate $x\,10^{\sin x}$ with respect to x ***(5 marks)***

4. Show that $\log_8 x = \frac{2}{3}\log_4 x$. hence, without using tables or calculators evaluate $\log_8 6$, correct to 3 decimal places, if
$\log_4 3 = 0.7925$ ***(5 marks)***

5. Evaluate $\int_0^{\pi/2} \frac{\cos x}{1+\sin^2 x}dx$ ***(5 marks)***

6. Show that the line $x - 2y + 10 = 0$ is a tangent to the ellipse $\frac{x^2}{64}+\frac{y^2}{9}=1$

7. In a culture of bacteria the rate of growth is proportional to the population present at time, t. the population doubles every day. given that the initial population, p_0, is one million, determine the day when the population will be 100 million. ***(5 marks)***

8. Show that the equation of the line through the points (1, 2, 1) and (4, -2, 2).
is given as $\frac{x-1}{3}=\frac{y-2}{-4}= z-1$ ***(5 marks)***

SECTION B

9(a) The nth term of a series is $U_n = a3^n + bn + c$. Given that $U^1 = 4$, $U_2 = 13$ and $U_3 = 46$ find the values of a, b and c. ***(6 marks)***
(b) If α and β are the roots of the equation $x^2 - px + q = 0$, find the equation whose roots are $\frac{\alpha^3-1}{\alpha}$ and $\frac{\beta^3-1}{\beta}$
(6 marks)

10 (a) Prove by induction that $2^n + 3^{2n-3}$ is always divisible by 7 for $n \le 2$ ***(6 marks)***
(b) Expand $(1 - {}^{x}/_{3})^{1/2}$ as far as the term in x^2. Hence evaluate $\sqrt{8}$, correct to three decimal places.***(6 marks)***

11. (a) A point P is twice as far from the line
$x + y = 5$ as from the point (3,0). Find the locus of P
(6 marks)
(b) A point Q is given parametrically by $x = 2t$, $y = \frac{2}{t}+1$.
Determine the Cartesian equation of Q and sketch it. ***(6 marks)***

12. (a) Show that the equation of the plane through points A with the position vector
-2**i** +4**k** perpendicular to the vector
i +3**j** - 2**k** is $x + 3y - 2z + 10 = 0$ ***(4 marks)***
(b) (i) Show that the vector 2i – 5j + 3.5 k is perpendicular to the line
r = 2**i** – **j** + λ(4**i** + 3**j** +2**k**). ***(3 marks)***
(ii) Calculate the angle between the vector
3**i** – 2**j** + **k** and the line in (b(i) above.
(5 marks)

13. (a) Solve $\cot^2\theta = 5(\operatorname{cosec}\theta + 1)$ for $0^0 \le \theta \le 360^0$ ***(5 marks)***
(b) Use $\tan {}^{\theta}/_{2} = t$, to solve $5\cos\theta - 2\sin\theta = 2;\ 0 \le \theta \le 360^0$

14. Express f(x) $\frac{6x}{(x-2)\,(x+4)^2}$ into partial fractions.
(7 marks)
Hence evaluate $\int f(x)\,dx$. ***(5marks)***

15. Show that the tangent to the curve

$4 - 2x - 2x^2$ at points (-1, 4) and $\left(\frac{1}{2}, 2\frac{1}{2}\right)$ respectively, pass through the point $\left(\frac{1}{4}, 5\frac{1}{2}\right)$. Calculate the area of the curve enclosed between the curve and the x-axis. ***(12 marks)***

16.(a) An inverted cone with a vertical angle of 60^0 is collecting water leaking from a tap at a rate of $0.2\text{cm}^3\ \text{s}^{-1}$. If the height of water collected in the cone is 10cm, find the rate at which the surface area of water is increasing. ***(6 marks)***

(b) Given that $y = e^{\tan x}$ show that

$$\frac{d^2y}{dx^2} - (2\tan x + \sec^2 x)\frac{dy}{dx} = 0$$

(6 mark)

P425/2
MATHEMATICS
2000

SECTION A

1. A family plans to have three children

(i) Write down the possible sample space and construct its probability distribution table (3 mark)

(ii) Given that X is the number of boys, find the expected number of boys. (2 marks)

2. By the method of linear interpolation use the table below to find the value of

(i) ln (1.66) (correct to 3 decimal places)

(ii) x corresponding to ln (x) = 0.4000.

X	1.4	1.5	1.6	1.7
lnx	0.3365	0.4055	0.4700	0.5306

(5 marks)

3. Two balls are randomly drawn without replacement from a bag containing 10 white and 6 red balls. Find the probability that the second ball drawn is

(i) red given that the first one was white,

(ii) white ***(5 marks)***

4. A boat traveling at 5 m s^{-1} in the direction 030^0 in still water is blown by wind moving at 8 ms^{-1} from the bearing of 150^0. Calculate the true speed and course the boat will be steered. ***(5 marks)***

5. Estimate the value of $\int_0^1 \frac{dx}{1+x^2}$ by the trapezium rule using five sub-intervals. (Give answer correct to 3 decimal places). ***(5 marks)***

6. On a certain farm 20% of the cows are infected by a tick disease. If a random sample of 50 cows is selected from the farm, find the probability that not more than 10% of the cows are infected ***(5 marks)***

7. A force acting on a particle of mass 15kg moves it along a straight line with a velocity of 10 ms^{-1}. The rate at which work is done by the force is done by the force is 50 watts. If the particle starts from rest, determine the time it takes to move a distance of 100m. ***(5 marks)***

8. A particle executing simple harmonic motion about appoint O, has speeds of $3\sqrt{3}$ m s^{-1} and 3 ms^{-1} when at distances of 1 m and 0.268 m respectively, from the end point. Find the amplitude of the motion ***(5 marks)***

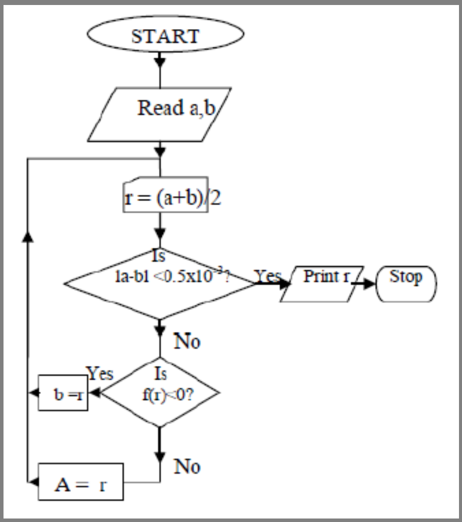
SECTION B

9. (a) Given that x = 2.5, y = 14.2 and z = 8.1 all the values correct to one decimal place, find the maximum value of

(i) $\frac{x+y}{z^2}$, (ii) $\frac{x-y}{x}$ (iii) $\frac{1}{x}+\frac{1}{y}-\frac{1}{z}$, correct to 3 decimal places. ***(6marks)***

(b) If the error in each of the value of e^x and e^{-x} is = 0.0005, find the maximum and minimum values of the quotient e^x/e^{-x}, when x = 0.04, giving your answer correct to 3 decimal places. ***(6 marks)***

10. An interval bisection algorithm that computes and prints the approximate value of the root, r of the equation f(x) = 0, in the interval [a , b], correct to 3 decimal places is given in the flow chart below



By determining f(x) and locating the appropriate interval [a, b], perform a dry run for the flow chart to determine $\frac{1}{\sqrt[3]{3}}$, correct to 3 decimal places. Tabulate values of a, b and r at each stage. ***(12 mark)***

11. A particle moving with an acceleration given by a = $4e^{-3t}$ **i** + 12sin t **j** – 7cos t **k**, is located at the point (5, -6, 2) and has velocity , v = 11**i** – 8**j** + 3**k** at time t = 0. Find the

(i) magnitude of the reacceleration

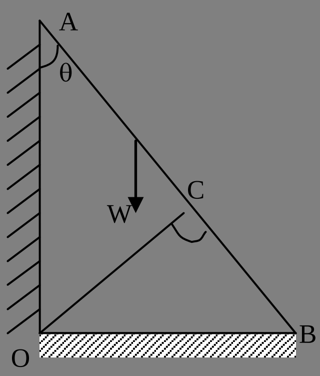
when t = 0
(ii) velocity at any time , t
(iii) displacement at any time, t.
(12 marks)

12. At 7.30a.m daily a bus leaves Kampala for Masaka. The times (min) taken to cover the journey were recorded over a certain period of time and were grouped as below in the table below:

Time(min)	Frequency(f)
80-84	10
85-89	15
90-94	35
95-99	40
100-104	28
105-109	15
110-114	4
115-119	2
120-124	1

(a) Calculate the mean time of travel from Kamapala to Masaka by the bus. ***(4 marks)***
(b) Draw a cumulative frequency curve for the data. Use your curve to estimate the
(i) median time for the journey
(ii) number of times the bus arrived in Masaka between 9.00 – 9.25 am
(iii) semi-interquartile range of time of travel from Kampala to Masaka. ***(8marks)***

13. The diagram below shows a uniform rod AB of weight W and length l resting at an angle θ against a smooth vertical wall at A. the other end B rests on a smooth horizontal table. The rod is prevented from slipping by an inelastic string OC, C being appoint on AB such that OC is perpendicular to AB and O on the point of intersection of the wall and the table. Angle AOB is 90^0

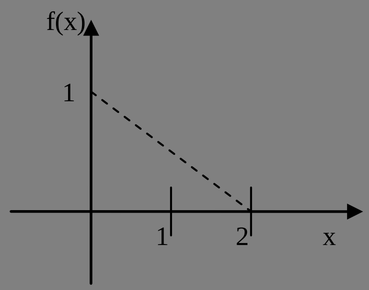


Find the (i) tension in the string
(ii) reactions at A and B in terms of θ and W.
(12 marks)

14(a) A random variable x takes on the valkues of the interval $0 < x < 2$ and has a probability density function given by

$$f(x) = \begin{cases} a & ; \; 0 \langle x \le 1\frac{1}{2}, \\ \frac{a}{2}(2-x) & ; \; 1\frac{1}{2} \langle x \le 2, \\ 0 & ; \; \text{Elsewhere.} \end{cases}$$

Find (i) the value if a,
(ii) P(x <1.6) ***(5 marks)***
(b) The probability density function f(x) of the random variable X takes on the form shown in the diagram below



Determine the expression for f(x) . hence obtain the
(i) expression for the cumulative probability density function of X
(ii) mean and the variance of X ***(7 marks)***

15. A sugar factory sells in bags of mean weight50kg and standard deviation 2.5kg. given that the weight of the bags are normally distributed, find the:
(i) probability that the weight of any bag of sugar randomly selected lies between 51.5 and 53kg
(4 marks)
(ii) percentage of bags whose weights exceed 54kgs,
(4 marks)
(iii) number of bags that will be rejected out of 1000 bags purchased for weighing below 45.0kg.
(4 marks)

16. Six forces, 9N, 5N, 7N, 3N,1N, and 4Nactalong the sides PQ,QR,RS, ST,TU, and UP of a regular hexagon of side 2 m, their directions being indicated by the order of the letters. taking PQ as the reference axis, express each of the forces in vector form. hence find the
(i) magnitude and direction of the resultant of the forces
(6 marks)
(ii) distance from p, where the line of action of the resultant cuts PQ ***(6 marks)***

P425/1
PURE MATHEMATICS
2001

SECTION A (40 Marks)

Attempt all questions in this sections

1. Solve the simultaneous equation:
$x^2 - 10x + y^2 = 25,$

$y - x = 1$ *(5 marks)*

2. if $y = \sqrt{x}$, show that

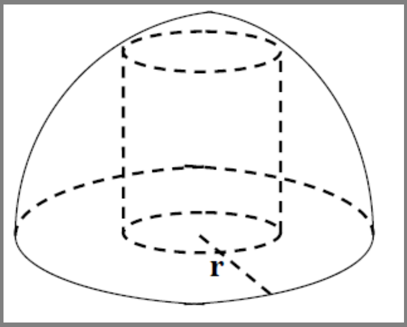
$$\frac{\delta y}{\delta x} = \frac{1}{\sqrt{(x+\delta x)} + \sqrt{x}}$$

Hence deduce $\frac{dy}{dx}$. *(5 marks)*

3. Given that sin2θ = cos3θ, find the value of sin θ, $0 \leq \theta < \pi$ *(5 marks)*

4. Find the point of intersection of the line $\frac{x}{5} = \frac{y+2}{2} = \frac{z-1}{4}$ with the plane $3x + 4y + 2z - 25 = 0$ *(5 marks)*

5. A cylinder is inscribed in a semi –hemisphere of radius r as shown in figure below.



Find the maximum volume of the cinder in terms of r *(5 marks)*

6. Expand $(1+x)^2$ in descending powers of x including the terms x^{-4} . If x = 9,
Find the % error in using the first two terms of the expansion *(5 marks)*

7 Find the locus of the point which is equidistant from the line x = 2 and the circle $x^2 + y^2 = 1$, illustrate this with a sketch *(5 marks)*

8. Solve the differential equation

$\frac{dy}{dx} = \frac{y}{2x+1}$, given x = 4 when y = 6.

Hence determine the value of x when y = 10. *(5 marks)*

SECTION B (60 MARKS)

9. (a) Use De Moivre's theorem or otherwise to simplify

$$\frac{(\cos\theta + i\sin\theta)(\cos 2\theta + i\sin 2\theta)}{\cos\theta/2 + i\sin\theta/2}$$ *(3 marks)*

(b) express $\frac{i}{4+6i}$ in modulus –argument form *(4 marks)*

(c) solve $(z + 2z^*))z = 5 + 2z$, where ∗ is the complex conjugate of z *(5 marks)*

10. (a) It can be proved by induction that, for all positive n,

$1^3 + 2^3 + 3^3 + \ldots + n^3 + \frac{1}{4}n^2(n+1)^2$.

From this result, deduce that

$(n+1)^3 + (n+2)^3 + (2n)^3 = \frac{1}{4}n^2(3n+1)(5n+3)$ *(6 marks)*

(b) A man deposits sh.800,000 into his saving account on which interest is 15% per annum. If he makes no withdraws, after how many years will his balance exceed sh 8 millions? *(6 marks)*

11. (a) Using calculus of small increments, or otherwise find $\sqrt{98}$ correct to one decimal place *(4 marks)*

(b) Use Maclaurins' theorem to expand $\ln(1+ax)$, where a is constant. Hence or otherwise expand $\ln\left(\frac{(1+x)}{\sqrt{(1-2x)}}\right)$ up to the term in x^2

For what values of x is the expansion valid? *(8 marks)*

12. (a) (i) Find the equation of the chord through the points $(at_1, 2at_1)$ and (at_2^2, 2 at_2 of the parabola $y^2 = 4ax$

(ii) Show that the chord cuts the directrix when

(b) Find the equation of the normal to the parabola $y^2 = 4ax$ at $(at^2, 2at)$ and determine its point of intersection with the directrix *(6 marks)*

13. (a) show that

$\tan\left(\frac{x+y}{2}\right) - \tan\left(\frac{x-y}{2}\right) = \frac{2\sin y}{\cos x + \cos y}$ *(6 marks)*

(b) Find the radians, the solution of the equation $\cos x + \sin 2x = \cos 3x$,for $0 \leq x \leq 2\pi$ *(6 marks)*

14. (a) Find the Cartesian equation of the plane through A(0,3, -4),B(2, -1,2)and C(7,4,-1). Show that Q(10,13, -10) lies in the same plane

(b) Express the equation of the plane in (a) in the scalar product form

(c) Find the area of triangle ABC in (a) *(12 marks)*

15. (i) Find the cartesian equation of the curve given parametrically by :

$$x = \frac{1+t}{1-t} , \; y = \frac{2t^2}{1-t}$$

(ii) Sketch the curve

(iii) Find the area enclosed between the curve and line y = 1 *(12 marks)*

16 (a) Integrate $\frac{2x}{\sqrt{x^2+4}}$ with respect to x *(2marks)*

(b) Evaluate $\int_0^{\pi/6} \sin x \sin 3x \, dx$ *(4 marks)*

(c) (using the substitution x = 3 sin θ, evaluate

$\int_o^3 \sqrt{\left(\frac{3+x}{3-x}\right)}dx$ *(6marks)*

P425/2
APPLIED MATHEMATICS
2001

1.Two events A and B a neither nor mutually exclusive. Given that P(B) = 1/3,

$P(A \cap \overline{B}) = 1/3$ find

(i) $P(\overline{A} \cup \overline{B})$ *(2 marks)*

(ii) $P(\overline{A} / \overline{B})$ *(3marks)*

2.In an experiment to measure the rate of cooling of an object, the following temperatures, (θ^0C) against time , T were recorded.

Temperature θ^0C	80	70.2	65.8	61.9	54.2
Time, T(s)	0	10	15	20	30

Use the linear interpolation to find

(i) the value of θ when T = 18 s, *(3 marks)*

(ii) when $\theta = 60^0$ *(2 marks)*

3. If X = 4.5, Y = 2.54 and Z = 26.4, all measured to the nearest number of decimal places of X,Y and Z, respectively, find the range within the exact value of the expression

$X - \frac{Y}{XZ}$ lies *(5 marks)*

4. A coin is biased so that a head is twice as likely to occur as a tail. if the coin is tossed 15 times , determine the,

(i) expected number of heads, *(2 marks)*

(ii) probability of getting at most 2 tails .*(3 marks)*

5. A particle of mass 5 kg is placed on a smooth plane inclined at $\tan^{-1}\left[\frac{1}{\sqrt{3}}\right]$ to the horizontal. Find the magnitude of the force acting horizontally, required to keep the particle equilibrium and the normal reaction to the plane. *(5 marks)*

6. A physics student measured the times taken in seconds for a trolley to run down slopes of varying gradients and obtained the following results: 35.2, 34.5, 29.3, 30.9, 31.8. Calculate the mean and standard deviation.

(5 marks)

7. A,B and C are points on a straight road such that AB =- BC = 20m. A cyclist moving with uniform acceleration passes A and then notices that it takes him 10s and 15s to travel between A and B and A and C respectively. Find

(i) his acceleration

(ii) the velocity with which he passes A *(5 marks)*

8. An inextensible string to two scale pans A and B, each of weight 20 gm, passes over a smooth fixed pulley. Particles of weight 3.8Nand 5.8N are placed in pans A and B respectively. Find the reaction of the scale pan holding the 3.8N weight, if the system is released from rest. [Take g = 10 m s^{-2}] *(5 marks)*

SECTION B

9. (a)(i) Round off 6.00213,

(ii) Truncate 5415000, to 3 significant figures

(2 marks)

(b) Use the trapezium rule with eight sub-intervals to estimate $\int_2^4 \frac{10}{2x+1}dx$ correct to 4 decimal places.

Calculate the percentage error in your estimation. How may this error be reduced?

(10 marks)

10 (a) A bag A contains 2 green and 2 blue balls, while bag B contains 2 green and 3 blue balls. A bag is selected at random and two balls from it without replacement. Find the probability that the balls drawn are of different colours *(6marks)*

(b) Affair die is rolled 6 times. Calculate the probability that

(i) a 2 or 4 appears a on the first throw,

(ii) four 5 s will appear in the six throws.

(6marks)

11. (a) Given two iterative formulae I and II (shown below) for calculating the positive root of the quadratic equation f(x) = 0 as:

I	II
$x_{n+1} = \frac{1}{2}(x_n^2 - 1)$	$x_{n+1} = \frac{1}{2}\left(\frac{x_n^2+1}{x_n - 1}\right)$ for n = 1,2,3,……

Taking $x_0 =$ 2.5, use each formula thrice to two decimal places to decide which is the suitable formula. Give a reason for your answer. *(5 marks)*

(b) If α id an approximate root of the equation $x^2 = n$, show that the iterative formula for finding root reduces to

$\frac{\frac{n}{2}+\alpha}{2}$ hence , taking α = 4 estimate $\sqrt{17}$ correct to 3 decimal places *(7 marks)*

12 . The table below shows the weights to the nearest kg of 150 patients who visited a certain health unit during a certain week :

Weight (kg)	No of patients (f)
0-19	30
20-29	16

30-39	24
40-49	32
50-59	28
60-69	12
70-79	8

(a) Calculate the approximate mean and model weight of the patients (5 marks)

(b) plot an ogive for the data. Use the ogive to estimate the

(i) median and semi-interquartile range for the weights of patients,

(ii) probability that patients weighting between 13 kg and 52.5 kg visited the health unit.

13. An object of mass 5 kg is initially rest at a point whose position vector is -2**i** + **j**. If it is acted upon by a force, F = 2**i** + 3**j** – 4 **k**, find

(i) the acceleration ***(2marks)***

(ii) its velocity after 3 s, ***(4 marks)***

(iii) its distance from the origin after 3 s. ***(6 marks)***

14. (a) A mass oscillate with S.H.M. of period on second . The amplitude of the oscillation is 5cm. given that the particle begins from the centre of the motion, state the relationship between the displacement x of the mass at any time, t

Hence find the first times when the mass is 3cm from its end position ***(6 marks)***

(b) A particle of mass M is attached by means of lights stings AP and BP of the same length a m and moduli of elasticity mg and 2 mg N respectively, to the points A and B on a smooth horizontal table. The particle is released from the mid- point of AB, where AB = 3 a m

show that the motion of the particle is S.H.M. with period

$$T = \left[\frac{4\pi^2 a}{3g}\right]^{2/2}$$ ***(6 marks)***

15. A continuous random variable X is define by the p.d.f

$$f(x) = \begin{cases} k\left(x - \frac{1}{a}\right), & 0 < x < 3 \\ 0 \quad , & \text{Elsewhere} \end{cases}$$

Given that P(x > 1) = 0.8, find the

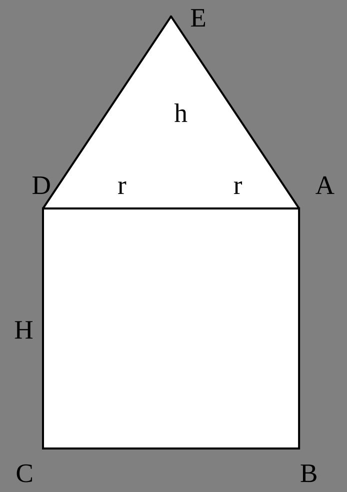
(i) values of α and k, ***(6 marks)***

(ii) probability that X lies between 0.5 and 2.5 ***(3 marks)***

(iii) mean of X

16(a) Prove that the centre of mass of a solid cone ¼ of the vertical height from the base
(5 marks)

(b) The figure below show a solid cone of radius r, height h, joined to a solid cylinder of the same material with the same radius and height H.



If the centre of mass of the whole solid lies in the plane of the base of the cone where the two solids are joined , find H. if instead H = h and r = ½ h, find the angle AB makes with the horizontal , if the body is hang from A.
(7 marks)

P425/1
PURE MATHEMATICS
2002

SECTION A (40 *marks)*

*Attempt **all** questions in this section.*

1. Solve the equation 2cosθ - cosecθ = 0;
$0^o < \theta < 270^o$ ***(05 marks)***

2. The vertices of a triangle are P (2,-1,5), Q (7, 1,-3) and R (13,-2, 0). Show that $\angle PQR = 90^0$.

Find the coordinates of S if PQRS is a rectangle
(05 marks)

3. Show that 2 + i is a root of the equation $2z^3 - 9z^2 + 14z - 5 = 0$.

hence find the other roots ***(06 marks)***

4. The points R(2,0) and P(3,0) lie on the x-axis and Q (0,y) lies on the y-axis.

The perpendicular from the origin to RQ meets PQ at point S(X, - Y)

Determine the locus of S in terms of X and Y
(05 marks)

5. If $y = \sqrt{(5x^2 + 3)}$,

show that $y\frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^2 = 5$. ***(04 marks)***

6. Given that $\log_3 x = p$ and $\log_{18} x = q$, show that $\log_6 3 = \dfrac{q}{p-q}$

(05 marks)

7. Given that $y = \ln\left(1 - \frac{1}{u}\right)^{1/2}$,

$2u = \left(x + \frac{1}{x}\right)$, show that

$$\frac{dy}{dx} = \frac{(x+1)}{(x-1)(x^2+1)}$$

8. Evaluate $\displaystyle\int_0^1 \frac{x^3}{x^2+1}\,dx$

SECTION B (60 marks)

9. (a) The tenth value of an arithmetic progression (AP) is 29 and the fifteenth term is 44.

(i) Find the value of the common difference and the first term.

(ii)Hence find the first 60 terms *(07 marks)*

(b)A cab le 10m long is divided into ten pieces whose lengths are in a geometrical progression. The length of the longest piece is 8 times the length of the shortest piece. Calculate to the nearest centimeter the length of the third piece. *(5 marks)*

10. P is a variable point given by the parametric equations

$x = \frac{a}{2}(t + 1/t)$; $y = \frac{b}{2}(t - 1/t)$.

Show that the locus of P is $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$

State the asymptotes. Determine the coordinates of the points where the tangent from p meets the asymptotes.

11.(a) Find the equation of the perpendicular line from point

$\mathbf{A} = \begin{pmatrix} 2 \\ -1 \\ 4 \end{pmatrix}$ onto the line $\mathbf{r} = \begin{pmatrix} 1 \\ 0 \\ 2 \end{pmatrix} + \lambda \begin{pmatrix} 2 \\ 1 \\ 2 \end{pmatrix}$.

What is the distance from **A** to **r**?*(08 marks)*

(b) Find the angle contained between line OR and the x- y plane, where

$OR = \begin{pmatrix} 2 \\ 1 \\ 2 \end{pmatrix}$ *(04 marks)*

12.(a) Show that

$$\frac{\sin 3\theta \sin 6\theta + \sin\theta \sin 2\theta}{\sin 3\theta \cos 6\theta + \sin\theta \cos 2\theta} = \tan 5\theta$$

(b) Express $4\cos\theta - 5\sin\theta$ in the form $R\cos(\theta + \beta)$, where R is a constant and β an acute angle.

(i) Determine the maximum value of the expression and the value of θ for which it occurs

(ii) Solve the equation

$4\cos\theta - 5\sin\theta = 2.2$, for $0^0 < \theta < 360^0$

(07marks)

13…(a) Find the equation whose roots are $-1 \pm i$, where, $i = \sqrt{-1}$.

(b) Find the sum of the first 10 terms of the series 1+ 2i- 4 -8i + 16+ …, in the form a + bi , where a and b are constants and *(05 marks)*

$I = \sqrt{-1}$

(c) Prove by induction that

$(\cos\theta + i\sin\theta)^n = \cos n\theta + i\sin n\theta$

(05 marks)

14.(a) use $t = \tan\frac{\theta}{2}$ to evaluate

$\displaystyle\int_0^{\pi/2} \frac{d\theta}{3 - \cos\theta}$. ***(05 marks)***

(b) Integrate the following with respect to x:

(i) In x (ii) $x^2\sin 2x$

(07 marks)

15. Given the curve $y = \dfrac{x(x-3)}{(x-1)(x-4)}$,

(i) show that the curve does not have turning points.

(ii) Find the equations of the asymptotes. Hence sketch the curve.*(12 marks)*

16. (i) The volume of a water reservoir is gene rated by rotating the curve $y = kx^2$ about the y- axis. Show that when the central depth of the water in the reservoir is h meters, the surface area a is proportional to *h* and the volume *v* is proportional to h^2

(06 marks)

(ii) If the rate of loss of water from the reservoir due to evaporation is $\lambda\mathbf{A}$ m^2 per day, obtain a differential equation for h after t days.

Hence deduce that the depth of water decreases at a constant rate.

(ii) Given that $\lambda = ½$, determine how it will take for the depth of water to decrease from 20m to 2 m

P425/2
MATHEMATICS
2002

SECTION A

1. On a certain day ,fresh fish from lakes : Kyoga, Victoria, Albert and George were supplied to one central markets of Kampala in the ratio 30% , 40% 20% and 10% respectively. Each lake had an estimated ratio of poisoned fish of 2% , 3%, and 1%, respectively. If health inspector picked a fish at random,

(a) What is the probability that the fish was poisoned?

(b) Given that the fish poisoned, what is the probability that it was from lake Albert? *(5 marks)*

2. The table below shows how y varies with x in an experiment at different points

X	y
-1.0	-1.0
-0.5	-2.2
-1.4	-3.7

Use linear interpolation or extrapolation to find

(a) y when x = 0.5,

(b) x when y = -4.5 *(5 marks)*

3. A driver of a car traveling at 72 km h^{-1} notices a tree which has fallen across the road , 800m ahead suddenly reduces the speed to 36 km h^{-1} by applying the brakes. For how long did the driver apply the brake? *(5 marks)*

4. The chance that a person picked from kampala street is employed is 30 in every 48. The probability that that person is a university graduate given that he is employed is 0.6 find the:

(a) probability that a person picked at random from the street is a university graduate and is employed,

(b) number of people that are not university graduates and are employed from a group of 120 people *(5 marks)*

5. Use a suitable table of values that the function , x $x^3 - {}^8/_x$ has two real roots in the interval (-3, 3) . Hence use interpolation to determine the approximate value of the negative real root of the function , giving your answer correct to 1 decimal place *(5 marks)*

6. The resistance to the motion of a lorry of mass m kg is $^1/_{200}$ of its weight. When traveling at 108 km h^{-1} on a level road and ascends a hill its engine fails to work. Find how far up the hill (in km) the lorry moves before it comes to rest .

Give your answer correct to one decimal place.

5 marks)

7. The table below shows the cumulative distribution of the age (in years) of 400 students of a girl's secondary school

Age (in years	Cumulative frequency
<12	0
<13	27
<14	85
<15	215
<16	320
<17	370
<18	395
<19	400

Plot an ogive for the data and use it to estimate the

(a) median age,

(b) 20^{th} to 80^{th} percentile age range.

(5marks)

8. A particle moves in the x-y plane such that its position vector at any time , t is given by

$\mathbf{r} = (3t^2 - 1)\mathbf{i} + (4t^3 + t - 1)\mathbf{j}.$

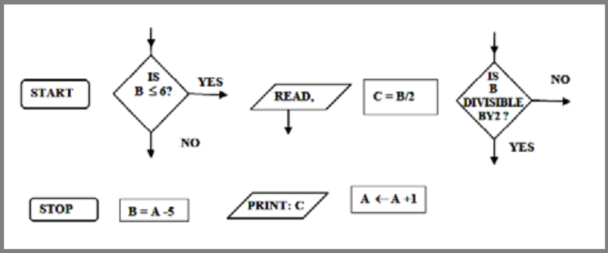
Find

(a) its speed

(b) the magnitude of acceleration after t = 2 *(5 marks)*

SECTION B

9. Given below are parts of a flow chart not arranged in order.



(a) Rearrange them and draw a complete logical flow chart. *(4marks)*

(b) State the purpose of the flow chart. *(2 marks)*

(c) Perform a dry run of your rearranged flow chart by copying and completing the table below:

A	B	C
46	--	--
77	--	--
120	--	--
177	--	--

(6 marks)

10. A pair of a dice is tossed 180 times, determine the probability that a sum of 7 appears

(a) exactly 40 times

(b) between 25 and 35 inclusive times

(12 marks)

11. (a) A random variable x has the probability density function

$$f(x) = \begin{cases} \frac{1}{b-a}, & a \le x \le b; \\ 0, & \text{else where} \end{cases}$$

Show that the variance of x is $\frac{(b-a)^2}{12}$.

(6 marks)

(b) During rush hours , it was observed that the number of vehicles departing for Entebbe from kampala taxi park take on a random variable x with a uniform distribution over the interval $[x_1,x_2]$

If in one hour , the expected number of vehicles leaving the stage is 12, with variance of 3, calculate the :

(i) values of x_1 and x_2

(ii) probability that at least 11 vehicle leave the stage

6 marks)

12. (a) aparticle of mass 3 kg is attached to the lower end B of an inextensible string. The upper end A of the string is fixed to a point on the ceiling of a roof. A horizontal force of 22 N and an upward vertical force of 4.9 N act upon the particle making it to be in equilibrium, with the string making an angle α with the vertical.

Find the value of α and the tension in the string

(6 marks)

(b) A non-uniform rod of mass 9kg rests horizontally in equilibrium supported by two light inextensible strings tied to the ends of the rod. The string makes angles of 500 and 600 with the rod. Calculate the tensions in the strings.

(6 marks)

13. Show graphically that there is only one real root of the equation

$x^3 + 2x - 2 = 0$.

Using the Newton Raphson formula thrice, estimate the root of the equation . Give your answer correct to 2 decimal places ***(12 marks)***

14. The times taken by a group of students to solve a mathematical problem are given below:

Time (min)	5-9	10-14	15-19	20-24	25-29	30-34
No of students	5	14	30	17	11	3

(a) Draw a histogram for the data. Use it to estimate the modal time for solving a problem. ***(5 marks)***

(b) Calculate a mean time and standard deviation of solving a problem

(7 marks)

15. (a) The velocities of two ships P and Q are **i+ 6j** and **– i +3j** km h^{-1} respectively. At a certain instant the displacement between the two ships is **7 i + 4j** km

Find the :

(i) relative velocity of ship P to Q

(ii) magnitude of displacement between ships P and Q after 2 hours

(5 marks

(b) The position vectors of two particles are $\mathbf{r}_1 = (\mathbf{4i}- \mathbf{2j})\,t + (\mathbf{3i} + \mathbf{j})t^2$ and $\mathbf{r}_2 = \mathbf{10i} + \mathbf{4j} + (\mathbf{5i} - \mathbf{2j})t$ respectively

Show that the two particles will collide. Find their speed at the time of collision. ***(7 marks)***

16 A particle is projected from level ground towards a vertical pole, 4 m high and 30m away from the point of projection. It just passes the pole in one second.

(a) its initial speed and angle of projection

(b) the distance beyond the pole where the particle will fall. ***(12 marks)***

P425/1
PURE MATHEMATICS
2003

SECTION A

1. Show that z = 1 is a root of the equation

$z^3 - 5z^2 + 9z - 5 = 0$.

Hence solve the equation for the other roots. ***(5 marks)***

2. Given the position vectors OA = (3, -2, 5) and OB = (9,1,-1) find the position vector of point C , such that C divides AB internally in the ratio 5:-3. ***(5 marks)***

3. Solve the equation $\cos 2\theta + \cos\theta = 0 : 0^0 \le 180^0$ ***(5 marks)***

4. Find $\int x \ln x dx$ x ***(5 marks)***

5. Solve for x in the equation

$\log_4 (6-x) = \log_2 x$ ***(5 marks)***

6. If $y = e^{-t}\cos(t + \beta)$,show that $\frac{d^2y}{dt^2} + \frac{2dy}{dt} + 2y = 0$

(5 marks)

7. The points A (2,1), P(α, β) and points B(1, 2) lie in the same plane. PA meets the a-axis at the point (h,o and PB meets the y-axis at the point (o, k). Find h and k in terms of α and β ***(5 marks)***

8. Determine $\frac{d}{dx}\left[\ln \frac{x}{\sqrt{(1+x^2)}}\right]$ when $x = 2$

(5 marks)

SECTION B

9(a) Show that cot A + tan2A = cot A sec 2A. ***(4 marks)***

(b) Show that $\tan\theta = 3t - t^3/ 1-3t^2$, where

$t = \tan\theta$. Hence or otherwise show that $\tan\frac{\pi}{12} = 2 - \sqrt{3}$

(8 marks)

10 (a) Given the inequalities y > x - 5 and

$0 < {}^{6}/_{x,}$ illustrate graphically by shading out the unwanted regions. ***(6 marks)***

(b) Solve the simultaneous equation the equation of the tangents at the point (-3, 3) to the ellipse $\frac{x^2}{16}+\frac{y^2}{9}=1$ ***(7 marks)***

15.(a) Find $\int x^3 e^{x^4}$ ***(3 marks)***

(b) Use the substitution t = tan x to find $\int \frac{1}{1+\sin^2 x}dx$ ***(9marks)***

16. (a) Solve the differential equation $\frac{dR}{dt}=e^{2t}+t$, , given that R (0) = 3.

(b) The acceleration of a particle after time t seconds is given by $a = 5 + \cos {}^1/_2\, t$. if initially the particle is moving at l ms^{-1} , find its velocity after 2π seconds and the distance it would have covered by then.

P425/ 2
MATHEMATICS
2003

SECTION A

1. Events A and B are such that P(a) = ½ , P(B) = ${}^3/_8$ and P(A/B) = ${}^7/_{12}$
find the (i) P(A∩B
(ii) $P\left(B/\overline{A}\right)$

2. Two decimal numbers x and y are rounded off to give X and Y with errors E_1 and E_2 respectively. Show that the maximum relative error made in approximating X^2Y by X^2Y is given by $2\left|\frac{E_1}{X}\right|+\left|\frac{E_2}{Y}\right|$ ***(5 marks)***

3. ABCD is a square of side a. Forces of magnitude 2N, 1N, $\sqrt{2}$ N and 4N act along AB, BC, AC and DA respectively., the direction being in the order of the letters. Find the magnitude and direction of the resultant force. ***(5 marks)***

4. In an examination scaling is done such that candidate A who had originally scored 35% gets 50% and candidate B with 40% gets 65%. Determine the original mark for candidate C whose new mark is 80% ***(5 marks)***

5. Find the approximate value of $\int_0^1 \frac{1}{x^2+1}dx$ using five sub-intervals ***(5 marks)***

6. A spring AB of natural length 1.5m and modulus λN. A particle of weight 15Nis then attached to end C of second spring. When the system is hanging freely in equilibrium, the distance AC is 4m, find the value of λ. ***(5 marks)***

7. the table below shows the marks scored in a mathematics examination by students in a certain school.

Marks	Number of student
30-39	12
40-49	16
50-59	14
60-69	10
70-79	8
80-89	4

(4 marks)

(i) Draw a histogram and use it to estimate the mode
(ii) Calculate the mean score.

(8 marks)

8. A train starts from station A with a uniform acceleration of 0.2 ms^{-2} for 2 minutes and attain a maximum speed and moves uniformly for 15 minutes. It is then brought to rest at a constant retardation of 4/5 ms^{-2} at station B. find the distance between station A and B.

SECTION B: (60 MARKS)

attempt any **Five** questions from this section. All questions carry equal marks.

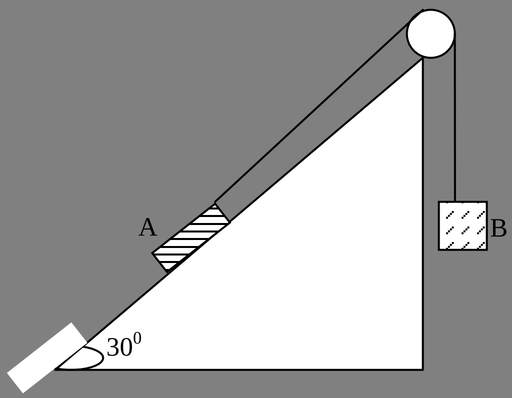
9. (i) Show that the equation x = In (8-x) has a root between 1 and 2
(ii) Use Newton's Raphson method to find the approximate root of
x = ln (8 –x) correct to 3 decimal places.

10. Given the cumulative distribution function.

$$F(x) = \begin{cases} \frac{x^2-1-x}{2} ; & 1 \le x \angle 2 \\ 3x - \frac{x^2}{2} ; & 2 \le x \angle 3 \\ 1 ; & x \ge 3 \end{cases}$$

(a) Find (i) the p.d.f
(ii) P(1.2 < x < 2.4)
(iii) the mean of x.
(b) Sketch f(x).

11. Block A and b of masses 2 and 3kg respectively are connected by a light inextensible string passing over a smooth pulley as shown below



Block A is resting on a rough inclined at 300 to the horizontal while block B hangs freely. When the system is released from rest, block B travels a distance of 0.75m before it attains a speed of 2.25 ms^{-1} .

Calculate the

(i) acceleration of the blocks

(ii) coefficient of friction between the plane and block A

(iii) reaction of the pulley on the string.

(12 marks)

12.(i)Determine the iterative formulae for finding the fourth root of a given number N

(ii) Draw a flow chart that reads N and the initial approximation, X_o computes and prints the forth root of N correct to 3 decimal places and N.

(iii) Perform a dry run for N = 150.10 and X_0 = 3.200

13. In a school of 800 students their average weight is 54.5kg and standard deviation 6.8kg. If the weight of all the students in the school assume a normal distribution, find the

(i) probability that a student picked at random weighs 52.8 or less kg,

(ii) number of students who weigh over 75kg,

(iii) weigh range of the middle 56% of the student of the school *(12 marks)*

14. A particle of weight 24N is suspended by a light inextensible string from a light ring. the ring can slide along a rough horizontal rod. the coefficient of friction between the rod and ring is $^1/_3$. A force of P Newton's acting upwards on the particle at 45^0 to the horizontal, keeps the system in equilibrium with the ring at a point of sliding . Find the.

(i) value of P

(ii) tension in the string *(12 marks)*

15. the table below shows the percentage of sand y, in the soil at different depths x. (in cm)

Soil depth (x) (cm)	35	65	55	25	45	75	20	90	51	60
%age of sand , (y)	86	70	84	92	79	68	96	58	86	77

(a) (i) Plot a scatter diagram for the data . Comment on the relationship between the depth of the soil and the percentage of sand in the soil.

(ii) Draw a line of best fit through the points of the scatter diagram . use your result to estimate the percentage of the sand in the soil at a depth of 31cm.

and depth of soil with 54% sand.

(b) Calculate a rank correction coefficient between the percentage of sand in soil and the depth of the soil.

(12 marks)

16. Two particles P and Q initially at positions 3**i** +2**j** and 13**i** +2**j** respectively begin moving Particle P moves with a constant velocity of 2**i** + 6**j** while particle Q moves with a constant velocity of 5j, the units being in meters and meters per second respectively.

(a) find the

(i) time the particles are nearest to each other

(ii) bearing of particle P from Q when they are nearest to each other.

(b) given that after half the time the two particles are moving closest to each other, particle P reduces its speed to half its original speed , in the direction to approach particle Q, and the velocity of Q remains unchanged , find the direction of particle P *(12 marks)*

P425/2
APPLIED MATHEMATICS
. 2004

SECTION A: (40 MARKS)

Attempt all the questions in this section

1 A particle is performing S.H.M. with center *Am*plitude 6m and period 2 π. Points *B* and *C* lie between *O* and A with *OB* = 1m, *OC* = 3m and *OA* = 6m. Find the least time taken while traveling from.

a) A to *B*

b) A to C.

2 . The probability of two independent events *P and Q* occurring together is $^1/_8$. The probability that either or both events occur is $^5/_8$. Find:

a) Prob *(P)*

b) Prob (*Q)*

3. In the table below is an extract of part of log x to base 10, $\log_{10}$ x:

x	80.00	80.20	80.50	80.80
$\log_{10} x$	1.9031	1.9042	1.9058	1.9074

Use linear interpolation to estimate :

a) $\log_{10} 80.759$,

b) the number whose logarithm is 1.90388.

(05 marks)

4. A particle is projected at an angle 60^0 to the horizontal with a velocity of 20 ms^{-1}. Calculate the greatest height the particle attains. [Use g = 10ms^{-2}] ***(05 marks)***

5. Twenty percent of the eggs supplied by a poultry farm have cracks on them. Determine the probability that a sample of 900 eggs supplied by the farm will have more than 200 eggs with cracks. ***(05 marks)***

6 . Two forces of magnitude 12N and 9N act on a particle producing an acceleration of 3.65 ms^{-1}. The forces act an angle of 60^0 to each other. Find the mass of the particle.

(05 marks)

7 . Eight applicants for a certain job obtained the following marks in aptitude and written tests:

Applicant	A	B	C	D	E	F	G	H
Aptitude test	33	45	15	42	45	35	40	48
Written test	57	60	40	75	58	48	54	68

Calculate a rank correlation coefficient of the applicant's performance in the **two** tests. Comment on your result.

(05 marks)

8 . Given the numbers; X = 2.678 and Y = 0.8765, measured to the nearest number of decimal places indicated,

a) State the maximum possible errors in X and Y

Determine the absolute error in XY

b) Find the limits within which the product XY lies, correct to **4** decimal places ***(05 marks)***

SECTION B: (60 MARKS)

Attempt any **five** questions from this section. All questions carry equal marks

9 . (a) Abel, Bob and Charles applied for the same job in a certain company. The probability that Abel will take the job is $^3/_4$. the probability that Bob will take it is $^1/_2$, while the probability that Charles won't take the job is $^1/_3$,

What is the probability that:

(i)none of them will take the job?

(ii)One of them will take the job?

(b)Two events A and *B* are independent. Given that $P(A \cap B') = ¼$ and $P(^{A'}/_B) = {}^1/_6$, use a Venn diagram to find the probabilities

(i) $P(A)$

(ii) $P(B)$

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

(iv) $P(A \cup B)'$

10. (a) Use the trapezium rule to estimate the area of $y = 5^{2x}$ between the x – axis, x = 0 and x = 1, using **five** sub – intervals. Give your answer correct to **3** decimals places.

(b)Find the exact value of:

$$\int_0^2 5^{2x}\,dx$$

(c)Determine the percentage error in the two calculations in (a) and (b) above. ***(12 marks).***

11. The probability density function of a random variable X is given by

$$f(x) = \begin{cases} k(x+2); & -1 < x < 0, \\ 2k \quad ; & 0 \le x \le 1 \\ \frac{k}{2}(5-x); & 1 < x \le 3 \\ 0 \quad ; & \text{Elsewhere} \end{cases}$$

(a) Sketch the function $f(x)$.

(b) Find the:

i) value of k

ii) mean of X

iii) $P(0 < x < {}^1/_x > 0)$.

12. (a) Use a graphical method to find a first approximation to the real root of

$x^3 - 3x + 4 = 0$.

(b)use the Newton – Raphson method to find the root of the equation correct to **2** decimal places. ***(12 marks).***

13 . A car of mass *M* kg has an engine which works at a constant rate of

2 H kW. The car has a constant speed of

V ms^{-1} along a horizontal road.

(a) Find in terms of *M, H, V, g and Θ,* the acceleration of the car when traveling:

(i)up a road of inclination *Θ*

with a speed of ¾ V ms^{-1},

(ii)down the same road with a speed of $^3/_5$ V ms^{-1}, the resistance to the motion of the car apart from gravitational force, being constant.

(b) If the acceleration in(a) (ii) above is 3 times that of (a) (i) above, find the angle of inclination θ, of the road.

(c) If the car continues directly up the road, in case (a) (i) above, show that its maximum speed is $^{12}/_{13}$ Vms^{-1}.***(12 marks)***

14. The heights (in cm) of senior six candidates in a certain school were recorded as in the frequency table below:

Heights (cm)	Frequency (f)
149 – 152	5
153 – 156	17
157 – 160	20
161 – 164	25
165 – 168	15
169 – 172	6
173 – 176	2

a) Estimate the mean height and standard deviation of the candidates

b) Plot a cumulative frequency curve (ogive)

c) Use your ogive in (b) above to estimate the: l

i) median height

ii) range of the height of middle 60% the candidates

(12 marks)

15. (a) A non-uniform ladder A*B*, 10m long and mass 8kg, lies in limiting equilibrium with its lower end A resting on a rough horizontal ground and the upper end *B* resting against a smooth vertical wall.

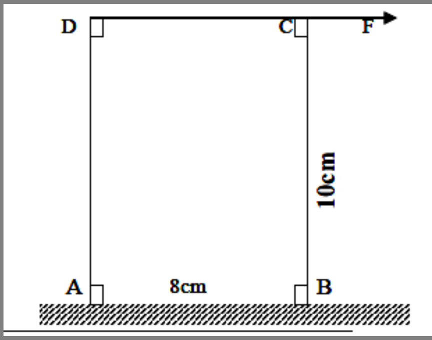
If the centre of gravity of the ladder is 3 m from the foot of the ladder and the ladder makes an angle of 30^0 with the horizontal, find the:

(i) Coefficient of friction between the ladder and the ground

(ii) Reaction at the wall.

(06 marks)

(b) The diagram below show a cross – section *ABCD* of a uniform rectangular block of base, 8 cm and height, 10 cm resting on a rough horizontal table.



An increasing force, *F*, parallel to the table is applied on the upper edge. If the coefficient of friction between the block and the table is 0.7, show that the block will tilt before sliding. ***(06 marks)***

14 Two planes A and B are both flying above the Pacific Ocean. Plane A is flying on a course of 010^0 at a speed of 3000kmh^{-1}. Plane *B* is flying on a course of 340^0 at 200 km^{-1}. At a certain time, plane *B* is 40 km from plane A. Plane A is then on bearing 060^0. After what time will they come closet together, and what will be their minimum distance apart?

(Give your answers correct to **1** decimal place).

(12 marks).

P425/1
PURE MATHEMATICS
2005

SECTION A (40 Marks)

Attempt all questions in this section

1. Given the complex number

$z = \dfrac{(3i+1)(i-2)^2}{i-3}$ determine

(i) z in the form a +ib, where a and b are constant

(ii) arg (z) ***(5 marks)***

2. Find $\displaystyle\int_0^{\sqrt{\frac{\pi}{2}}} 2x\cos(x^2)dx$ ***(5marks)***

3. Solve the inequality $(0.6)^{-2x} < 3.6$, correct to **2** decimal places ***(5 marks)***

4. Given that the vectors a**i** – 2**j** + **k** and a**j** – 4**k** are perpendicular, find the values of a ***(5 marks)***

5. A spherical balloon is inflated such that the rate at which its radius is increasing is 0.5cm s^{-1}.Find the rate at which

(i) the volume is increasing at the instant r = 5.0 cm

(ii) its surface area is increasing when r = 8.5 cm

(5 marks)

6. Solve the equation 2sin2θ + 3 cosθ = 0,

$0^0 \le \theta \le 360^0$ ***(5 marks)***

7. Sketch the parabola $y^2 = 12(x-4)$.

State the focus and equation of the directrix.

(5 marks)

8. Determine $\dfrac{d}{dx}\left\{\ln\left(\dfrac{x}{\sqrt{1+x^2}}\right)\right\}$,

when x = 2 ***(5 marks)***

SECTION B (60 MARKS)

Attempt five questions from this section. All questions carry equal marks

9 (a) Given that X,Y and Z are angles of a triangle XYZ. Prove that

$\tan(Z-Y) = \dfrac{x-y}{x+y}\cot\dfrac{Z}{2}$

Hence solve the triangle if x = 9cm, y = 5.7cm and Z = 57^0 ***(7 marks)***

(b) Use the substitution $t = \tan\dfrac{\theta}{2}$ to solve the equation

3cosθ - 5sinθ = -1 for $0^0 < \theta < 360^0$ ***(5 marks)***

10(i) Determine the coordinates of the point of intersection of the line

$\frac{x+1}{2} = \frac{y-3}{5} = \frac{z+2}{-1}$ and

the plane x + y =12

(ii)Find the angle between the line

$\frac{x+1}{2} = \frac{y-3}{5} = \frac{z+1}{-1}$ and the plane

x + y + z = 12 ***(12 marks)***

11(a)Determine the Binomial expansion of $\left(1+\frac{x}{2}\right)^4$.

Hence evaluate $(2.1)^4$ correct to **2** decimal places ***(6marks)***

(b). A geometric progression (GP) has a common ratio r <1, u_1 = 15 and $S\infty$ =22.5,where $S\infty$ is its sum to infinity and u_1, the first term. Find the

(i) value of **r**

(ii) ratio of $\mathbf{u_2:u_3}$ ***(6marks)***

12 (a) Find the equation of a circle which passes through the points (5,7), (1,3)and (2,).

(6 marks)

(b) (i) If x = 0 and y = 0 are tangents to the circle $x^2 + y^2 + 2gx + 2fy + c = 0$,

show that $c = g^2 = f^2$

(ii)Given that the line 3x - 4y +6 = 0 is also a tangent to the circle in (b) (i) above , Determine the equation of the circle lying in the first quadrant ***(6 marks)***

13. Given the curve y = sin 3x find the

(a) (i)value of $\frac{dy}{dx}$ at the point $\left(\frac{\pi}{3},0\right)$

(ii)equation of the tangent to the curve at this point

(b) (i) sketch the curve y = sin 3x

(ii) calculate the area bounded by the tangent in (a) (i) above the curve and the y-axis

(12 marks)

14 (a) Solve the equation

$\frac{4x-3y}{4} = \frac{2y-x}{3} = \frac{z+4y}{2}$ and

6x + 6y + 2z = 6 ***(12 marks)***

(b) Given the polynomial

f(x) = Q(x)g(x) + R(x), where Q(x) is the quotient , g(x) = (x-α)(x-β) and R(x) the remainder , show that

$R(x) = \frac{(x-\beta)f(\alpha)+(\alpha-x)f(\beta)}{\alpha-\beta}$

when f(x) is divided by g(x)

Hence find the remainder when f(x) is divided by $x^2 - 9$, given that f(x) divided by x-3 is 2 and when divided by x +3 is -3 ***(7 marks)***

15. Express $\frac{3x^2+x+1}{(x-2)(x+1)^3}$ into partial fraction

Hence evaluate $\int_3^4 \frac{3x^2+x=1}{(x-2(x+1)^3}dx$ give your answer correct to **3** decimal places ***(12marks)***

16 (a) Solve the differential equation

$\frac{1}{x}\frac{dy}{dx} = \sin x \sec^2 3y$ ***(4 marks)***

(b) A hot body at a temperature of 100^0C is placed in a room of temperature 20^0C. Ten minutes later; its temperature is 60^0C.

(i) Write down a differential equation to represent the rate of change of temperature, θ of the body with time t

(ii) Determine the temperature of the body after a further ten minutes. ***(8marks)***

MATHEMATICS
PAPER 2
2005

SECTION A: (40 MARKS)

Attempt all the questions in this section

1 A particle moves in a straight line with S.H.M. of period 5 seconds. The greatest speed is 4m s^{-1}. Find the

(i)amplitude

(ii)speed when it is $\frac{6}{\pi}$ m from the centre.

(05 marks)

2. In the table below, is part of an extract of sec x^0.

$x = 60^0$	o'	12'	24'	36'	48'
sec X^0	2.0000	2.0122	2.0245	2.0371	2.0498

Use linear interpolation to estimate the

(i) Value of sec 60^0 15'

(ii) Angle whose secant is 2.0436.

(05Marks)

3. A good football striker is nursing an injury in his leg. The probability that his team will win the next match when he is playing is $^4/_5$, otherwise it is $^2/_3$. The probability that he will have recovered by the time of the match is ¼. Find the probability that his team will win the match

(05 marks)

4. On the average 15% of all boiled eggs sold in a restaurant have cracks. Find the probability that a sample of 300 boiled eggs will have more than 50 cracked eggs.

(05 marks)

5. A particle is projected with velocity of 40 m s^{-1} at an angle of 60^0 to the horizontal from the foot to a plane inclined at an angle of 30^0 to the horizontal. Find the time at which the particle hits the plane.

[Use $g = 10\text{ m s}^{-2}$]
(05 marks)

6. The table below shows the marks scored by ten students in Mathematics and Fine Art tests.

	A	B	C	D	E	F	G	H	I	J
Math	40	48	79	26	55	35	37	70	60	40
Fine Art	59	62	68	47	46	39	63	29	55	67

Calculate the rank correlation coefficient for the students' performance in the two subjects. Comment on your results.
(05 marks)

7. The forces 3N, 4N, 5N and 6N act along the sides *AB, BC, CD and DA* of a rectangle. Their directions are in the order of the letters. *BC* is the horizontal. Find the resultant force and the couple at the centre of the rectangle of sides 2 m by 4 m. *(05 marks)*

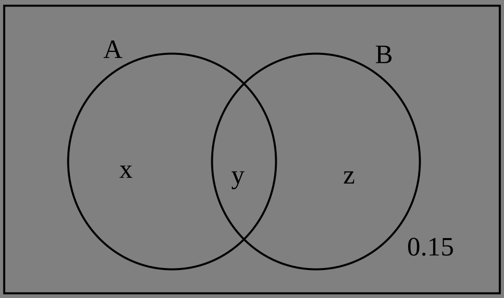
8. Given the numbers $a = 23.037$ and $b = 8.4658$, measured to their nearest number of decimal places indicated.

(i) State the maximum possible errors in *a* and *b*.
(ii) Determine the absolute error in a/b.
(iii) Find the limits within which a/b lies, correct to 4 decimal places. *(05 marks)*

SECTION B: (60 MARKS)

Attempt any **five** questions from this section. All questions carry equal marks.

9.(a) A and B are intersecting sets as shown in the Venn diagram below.



Given that $P(A) = 0.6$, $P(A'/B) = 5/7$, and
$P(A \cup B) = 0.85$, find

(i) The values of x, y and z
(ii) $P(A/B')$.
(06 marks)

b) A bag contains 4 white balls and 1 black ball. A second bag contains 1 white ball and 4 black balls. A ball is drawn at random from the first bag and put into the second bag.
Then a ball is taken from the second bag and put into the first bag. Find the probability that a white ball will be picked when a ball is selected from the first bag. *(06 marks)*

10.(i) Use the trapezium rule to estimate the area of $y = 3^x$ between the x – axis, x = 1 and x = 2, using five sub – intervals. Give your answer correct to 4 significant figures.

(ii)Find the exact value of $\int_0^1 5^{2x}\,dx$

(iii)Find the percentage error in calculations (i) and (ii) above. *(12 marks)*

11. The probability density function of a random variable X is given by

$$f(x) = \begin{cases} 2kx & ; 0 \leq x \angle 1 \\ k(3-x); & 1 \leq x \leq 2, \\ 0 & ; \text{ elsewhere.} \end{cases}$$

(a) Sketch the functions $f(x)$.
(b) Find the
(i) Value of *k*,
(ii) Mean of x,
(iii) $P(1 < x < {}^{2}/_{x} > 0)$. *(12 marks)*

12. Use a graphical method to show that the equation $e^x + x - 4 = 0$ has only one real root. Use the Newton-Raphson method to find the root the equation correct to 3 significant figures. *(12 marks)*

13. (a) A pump 2 m^3 of water through a vertical distance of 10 metres in one and a half minutes, discharging it at a speed of 2.5 ms^{-1}.
Show that the power it develops is approximately 2.25 kW (to 3 significant figures). *(04 marks)*
(b)A car of mass 1000kg. has a maximum speed of 150 kmh^{-1} on a level rough road and the engine is working at 60 kW.
i) Calculate the coefficient of friction between the car and the road if all the resistance is due to friction.
ii) Given that the tractive force remains unaltered and the non-gravitational resistance in both cases varies as the square of the speed, find the greatest slope on which a speed of 120 km^{-1} could be maintained. *(08 marks)*

14. A particle P moving with a constant velocity **2i + 3j +8k**, passes through a point with position vector **6i – 11j + 4k**. at the same instant, a particle *Q* passes through a point with position vector **i - 2j +5k**, moving with constant velocity **i - 2j +5k**, find the

a) position and velocity of *Q* relative to *P* at that instant.
(b)shortest distance between *P* and *Q*
(c) time that elapses before the particles are nearest to one another. *(12 marks)*

15 The weights of a senior five science class in a certain school were recorded as in frequency table below.

Weight (kg)	Frequency
50 – 53	3
54 – 578	
58 – 61	12
62 – 65	18
66 – 69	11
70 – 73	5
74 – 77	2
78 – 81	1

b) Estimate the mean and standard deviation of the student's weight.

c) Plot an ogive

d) Use your ogive to estimate the:

(i) Median weight

(ii) Number of students who weigh between 58.9 kg and 66.7kg. ***(12 marks)***

16. A uniform ladder of length 2 and weight W rests in a vertical plane with one end against a rough vertical wall and the other against a rough horizontal surface, the angles of friction at each end being $\tan^{-1}\frac{1}{3}$ and $\tan^{-1}\frac{1}{2}$ respectively.

a) If the ladder is in limiting equilibrium at either end, find θ, the angle of inclination of the ladder to the horizontal.

b) A man of weight 10 times that of the ladder begins to ascend it, how far will he climb before the ladder slips? ***(12marks).***

P425/1
MATHEMATICS
PAPER 1
NOV./DEC. 2006
3 hours

SECTION A

1. Prove $\tan\left(\frac{\pi}{4}+\theta\right) - \tan\left(\frac{\pi}{4}-\theta\right) = 2\tan 2\theta$

2. Differentiate

$\dfrac{3x+4}{\sqrt{2x^2+3x-2}}$ with respect to x

3. Show that when the quadratic expressions $x^2 + bx + c = 0$ and $x^2 + px + q = 0$ have a common root, then, $(c - q)^2 = (b - p)(cp - bq)$

4. Prove that $y = -3x + 6$ is a tangent to the rectangular hyperbola whose parametric co-ordinates are of the form $\left(3t, \frac{\sqrt{3}}{t}\right)$

5. Find the point of intersection of the plane $11x - 3y + 7z = 8$ and the line

$r = \begin{pmatrix} -3 \\ 1 \\ 5 \end{pmatrix} + \lambda\begin{pmatrix} 1 \\ 2 \\ -2 \end{pmatrix}$, where λ is a scalar.

6. A group of nine has to be selected from ten boys and four girls or four boys and five girls. How many different groups can be chosen?

7. Solve the differential equation

$\frac{dy}{dx} + 3y + 7z = e^{2x}$ given that when $x = 0, y = 1$.

(05marks)

8. Evaluate $\int_0^2 \frac{8x}{x^2 - 4x - 12}\,dx$ correct to 2 decimal places.

SECTION B

9. (a) Express the complex numbers $z_1 = 4i$ and $z_2 = 2 - 2i$ in the trigonometric form

$r(\cos\theta + i\sin\theta)$.

Hence or otherwise evaluate $\frac{z_1}{z_2^2}$

(b) Find the values of x and y in

$$\frac{x}{2+3i} - \frac{y}{3-2i} = \frac{6+2i}{1+8i}$$

10. (a) Differentiate from first principles

$y = \frac{x}{x^2+1}$ with respect to x. (05 marks)

(b)(i) Determine the turning points of the curve $y = x^2(x - 4)$.

(ii) Sketch the curve in (i) above for $-2 \le x \le 5$.

(iii) Find the area enclosed by the curve above the x – axis. ***(07 marks)***

11. (a) Given the vectors $a = 3i - 2j + k$ and $b = i - 2j + 2k$,

(i) the acute angle between the vectors.

(ii) vector **c** such it is perpendicular to both vectors **a** and **b.**

(b) Given that OA = a and OB = b, point R is on $\overline{OB}$ such that $\overline{OR} : \overline{RB} = 4:1$.point P is on $\overline{BP} : \overline{PA} = 2:3$ and when $\overline{RP}$ and $\overline{OA}$ are both produced they meet at point Q

Find:

(i) **OR** and **OP** in terms of **a** and **b.**
(ii) **OQ** in terms of **a.**
12. (a) Solve the equation 3 cosx + 4 sinx = 2 for $0 \le x \le 360^0$. *(06 marks)*
(b) If A, B, C are angles of a triangle, show that
Cos2A + Cos2B + Cos2C = -1 – 4 Cos A CosB CosC. *(06 marks)*
13. (a) Form the equation of a circle that passes through the points
A (-1, 4), B (2, 5) and C (0, 1). *(07 marks)*
(b) The line x + y = c is a tangent to the circle $x^2 + y^2 - 4y + 2 = 0$. Find the coordinates of the points of contact of the tangent for each value of c.
14.(a) Find the first three terms of the expansion of $\frac{1}{1+x}$, using Maclaurin's theorem.
15. (a) Expand $(a + b)^4$. Hence find $(1.996)^4$, correct to 3 decimal places.
(b) A credit society gives out a compound interest of 4.5% per annum. Muggaga deposits shs 300,000 at the beginning of each year.
How much money will he have at the end 4 years, if there are no withdrawals during this period?

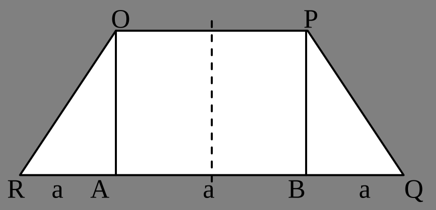
16. Find:
(a) $\int \ln x^2 \, dx$.
(b) $\int \frac{dx}{e^x - 1}$

MATHEMATICS
Paper 2
2006

1. A and B two independent events with A twice as likely to occur as B.

If P (A) $= \frac{1}{2}$, find
(i) $P(A \cup B)$,
(ii) $P[(A \cap B)/A)]$,
2. A cylindrical pipe has a radius of 2.5cm measured to the nearest unit. if the relative absolute error made in calculating its volume is 0.125, find the absolute relative error made in measuring its height.
3. Joan played 12 chess games. The probability that she wins a game is $\frac{3}{4}$.
Find the probability that she will win:
(i) exactly 8 games,
(ii) more than 10 games

4. The resultant of the forces
$F_1 = 3\mathbf{i} + (a\text{-}c)\,\mathbf{j}$, $F_2 = (2a+3c)\,\mathbf{i} + 5\mathbf{j}$,
$F_3 = 4\mathbf{i} + 6\mathbf{j}$ acting on a particle is $10\mathbf{i} + 12\mathbf{j}$.
Find the:
(i) values of a and c.
(ii) magnitude of force F_2.
5. The figure below shows a uniform lamina OPQR in the shape of a trapezium.OP = a m, RQ =3a m. The vertical height oP from RQ = a m. Calculate the centre of OPQR.



6.A vehicle of mass 2.5 metric tones is drawn up on a slope of 1 in 10 from rest with an acceleration of 1.2 ms^{-2}, against a constant frictional of resistance of $\frac{1}{100}$ of the weight of the vehicle, using a cable. Find the tension in the cable.
7. The probability distribution for the number of heads that show up when a coin is tossed 3 times is given by

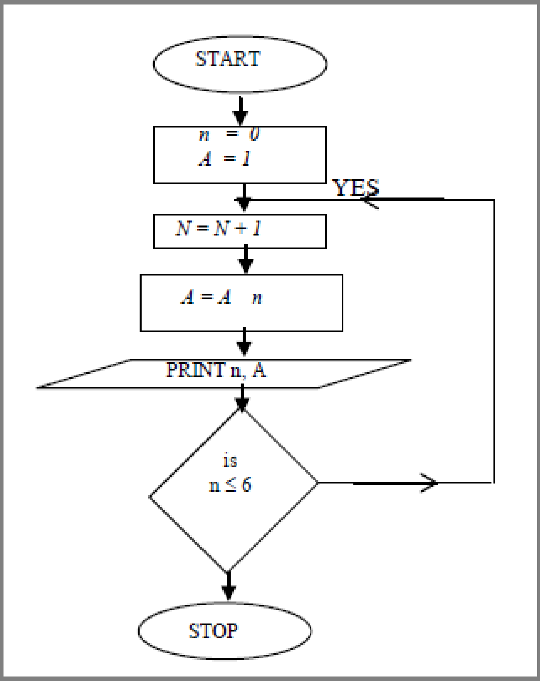
$P(X = x) = \left\{ \frac{1}{k}\binom{3}{x} \right.$, x = 0, 1,2, 3,.

Find:
(i) The value of k,
(ii) E(X).
8. Use the trapezium rule with 7 ordinates to estimate $\int_0^3 \frac{1}{1+x} dx$, correct to 3 decimal places.

SECTION B (60 MARKS)
9.(a). Among the spectators watching a football match, 80% were the home tam supporters while the rest were the visitor team's supporters. If 2500 of the spectators are selected at random, what is the probability that there were more than 540 visitors in this sample?

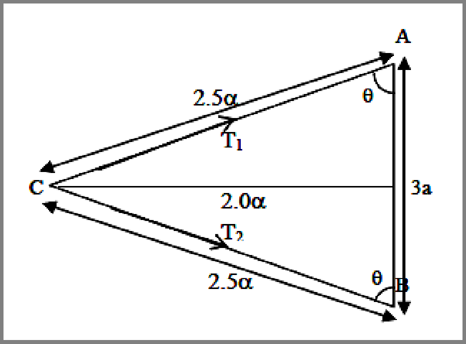
(b) . The times a factory takes to make units of a product are approximately normally distributed. A sample of 49 units of the product was taken and found to take an average of 50 minutes with a standard deviation of 2 minutes.
Calculate the 99% confidence limits of the mean time of making all the units of the product.

10. (a) study the flow chart below and answer the questions that follow:



(i) Perform a dry run for the flow chart,
(ii) State the purpose of the flow chart,
(iii)Write down the relationship between n and A.
(b) Draw a flowchart that reads and prints the mean of the first twenty counting numbers and perform a dry run of your chart.

11. (a) A light inextensible string of length 5a metres has one end attached to point A and the other end to point B which is vertically below A and 3a metres from it. A particle P of mass m kg, is fastened to the mid-point of AB.



Show that the tensions in the upper and lower strings are: $(15mu^2 + 40\ mga)/48a$ respectively.
Hence deduce that the motion is possible if $15u^2 \geq 40\ ga$. (07 marks).
(b) A particle is placed on the lowest point of the inside of a smooth spherical shell of internal radius 3a m and is given a horizontal velocity of $\sqrt{13ag}$ m/s. how high above the point of projection does the particle rise?

12. The table below is the distribution of weights of a group of animals.

Mass (Kg)	Frequency
21 – 25	10
26 – 30	20
31 – 35	15
36 – 40	10
41 – 45	30
51 – 65	45
66 - 74	5

Draw a cumulative frequency curve to estimate the semi-interquartile range.
(b) Find the :
(i) Mode
(ii) Standard deviation of the weights.

13. a light elastic string of natural length l has one end fastened to a fixed point O. the other end o the string is attached to a particle of mass m. When the particle hangs in equilibrium, the length o the string is $\frac{7\ell}{4}$ .the particle is displaced from equilibrium so that it moves vertically with simple harmonic motion when the string is taut.

(a) Show that its period is $\pi\sqrt{\left(\frac{3\ell}{g}\right)}$

(b)At t=0, the particle is released from rest at a point A, at a distance $\frac{3\ell}{2}$ vertically below O. Find the:
(i) depth below O of the lowest point L,
(ii) time taken to move from A to L,
(iii)depth below O of the particle at time

$t = \frac{1}{3}\pi\sqrt{\left(\frac{3\ell}{g}\right)}$

14(a)(i) Show that the Newton – Raphson formula for approximating the Kth root of a number N is given by:

$$x_n + 1 = \frac{1}{K}\left[(K-1)x_n + \frac{N}{x_n^{k-1}}\right]$$

(a) Use your formula to find the positive square root of 67 correct to **four** significant figures.
(b) Show that one of the roots of the equation $x^2 = 3x-1$ lies between 2 and 3. By use of linear interpolation, find the root to **two** decimal places.

15.A continuous random variable X has a probability density function given by:

$$f(x) = \begin{cases} \beta, & 2 < x < 3 \\ \beta(x-2), & 3 < x < 4 \\ 0, & \text{otherwise} \end{cases}$$

(i) Sketch f(x).
(ii) Find the value of β, hence f(x).
(iii) Median, m.
(iv) P(2.5 < x < 3.5) ***(12marks)***

16. (a) A particle is project at an angle of elevation of 30^0 with a speed of 21m/s. If the point of projection is 5m above the horizontal ground, find the horizontal distance that the particle travels before striking the ground.
(Take g = $10ms^{-2}$) ***(06 marks)***

(b) A boy throws a ball at an initial sped of 40m/s at an angle of elevation, a. Show, taking g to be 10m/s, that the times of flight corresponding to a horizontal range of 80m are positive roots of the equation $T^4 - 64T^2 + 256 = 0$.
(06marks)

2007 PAPER ONE
SECTION A

1 The 5^{th} term of an article progression (A.P.) is 12 and the sum of the first 5 terms is 80. Determine the first term and the common difference ***(05 marks)***

2 Given that $\int_o^a (x^2 + 2x - 6)dx = 0$, find the value of a. ***(05 marks)***

3. Solve the equation $\log_2 x - \log_x 8 = 2$

4. Show that

$$\frac{\sin\theta - 2\sin 2\theta + \sin 3\theta}{\sin\theta + 2\sin 2\theta + \sin 3\theta} = \tan^2\frac{\theta}{2}$$ ***(05 marks)***

5 A point P has coordinates (1, -2, 3) and a certain plane has the equation x + 2y + 2z = 8. The line through P parallel to the line

$\frac{x}{3} = \frac{y+1}{-1} = z + 1$ meets the plane at a point Q.

Find the co-ordinates of Q. ***(05 marks)***

6 . A hemispherical bowl of internal radius, r is fixed with its rim horizontal and contains a liquid to a depth, h. Show by integration that the volume of the liquid in the bowl is

$\left(\frac{1}{3}\right)\pi h^2(3r - h)$

7. Find the locus of the point p(x, y) which moves such that its distance from the point S (-3, 0) is equal to its distance from a fixed line x = 3. ***(05 marks)***

8 Differentiate: $\log_e\left(\frac{1+x}{1-x}\right)^{\frac{1}{2}}$ .Simplify your answer. ***(05 marks)***

SECTION B

9 (a) The function $f(x) = x^3 + px^2 - 5x + q$ has a factor (x – 2) and has a value of 5 when x = -3. Find p and q. (04 marks)

(b) The roots of the equation $ax^2 + bx + c = 0$ are α and β. Form the equation whose roots are $\frac{\alpha}{\beta}$ and $\frac{\beta}{\alpha}$

(c) Simplify: $\frac{\sqrt{3}-2}{(\sqrt[2]{3}+3)}$ in form of $p + q\sqrt{3}$ where p, q are rational numbers. (03 marks)

10. Sketch the curve: $y = \frac{4(x-3)}{x(x+2)}$

11(i) Show that the equation of the tangent to the hyperbola (a secθ b tanθ) is bx – ay sinθ – ab cosθ = 0.
(ii) Find the equations of the tangents to $\frac{x^2}{4} - \frac{y^2}{9} = 0$, at the points where θ = 45^o and where θ = 135^o.
(iii) Find the asymptotes.

12 (a) Solve 2 sin 2x = 3 cos x, for $-180 \le x \le 180^0$.
(b) Solve sinx – sin 4x = sin2x – sin3x for $-\pi \le x \le \pi$

14 (a) What is the smallest number of terms of Geometric Progression (G.P) 5, 10, 20, … that can give a sum greater than 500,000? (04 marks)

(b) Prove by induction $\sum_{r=1}^{n}\frac{1}{r(r+1)} = \frac{n}{n+1}$

(c) Solve simultaneously $a^3 + b^3 = 26$ and a + b = 2 ***(04 marks)***

(b) $\sum_{r=1}^{n}\frac{1}{r(r+1)} = \frac{n}{n+1}$ when n = 1

15 Given that the position vectors of A, B and C are OA = $\begin{pmatrix}1\\-2\\2\end{pmatrix}$, OB = $\begin{pmatrix}3\\2\\-1\end{pmatrix}$ and OC = $\begin{pmatrix}7\\-2\\2\end{pmatrix}$,
(i) Prove that A, B and C are collinear.
(ii) Find the acute angle between OA and OB.
(iii) If OABD is a parallelogram, find the position vectors of E and F such that E divides DA in the ratio 1:2 and E it externally in the ratio 1:2

16 (a) Given x = r cos θ and y = r sin θ,
show that $\frac{d^2y}{dx^2} = -\frac{1}{r}\text{cosec}^3\theta$.

(b) Solve: $\frac{dy}{dx} + 2y\tan x = \cos^2 x$ given that y = 2, when x = 0

2007 PAPER TWO

1. A die is tossed 40 times and the probability of getting a six on any one toss is 0.122. Estimate the probability of getting between 6 to 10 sixes.

2. Find the position vector of the centre of gravity of a uniform lamina in the form of a triangle whose vertices are; (2, 2), (4, 6) and (0, 3).

3 Use the Trapezium rule with 7 ordinates to find the value of $\int_0^{\pi}(1+\sin x)^{\frac{1}{2}}dx$, correct to two decimal places.

4. A particle of mass 2 kg moving with peed 10 ms1 collides with a stationary particle of mass 7 kg. Immediately after impact the particles move with the same speed but in opposite directions.
Find the loss in kinetic energy during collision.

(i) Find the probability that they both go out.
(ii) If we know they both go out, what is the probability that they both went to dance?

6. Show that the equation f(x) = $x^3 + 3x - 9$ has a root between x = 1 and x = 2. Using the Newton Raphson formula once, estimate the root of the equation, rounded off to two significant figures.

7. The heights, in centimeters, of children in a senior – One class were:

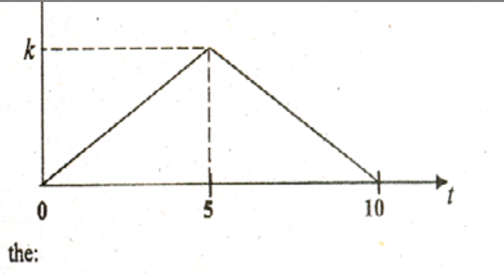
Heights(cm)	151-153	154 - 156	157 - 159	160 - 162	163- 165	166 - 168
Frequency Y	2	14	13	13	2	1

Calculate the:
(i) mean height
(ii) standard deviation.

8 The initial velocity of a particle moving with constant acceleration is (3i – 5j) ms^{-1}. After 2 seconds the velocity of the particle is of magnitude 6 ms 1 and parallel to (i + j). Find the acceleration of the particle.

SECTION B

9. The departure time T of pupils from a certain day primary school can be modeled as in the diagram below, where t is the time in minutes after the final bell at 5.00 pm.



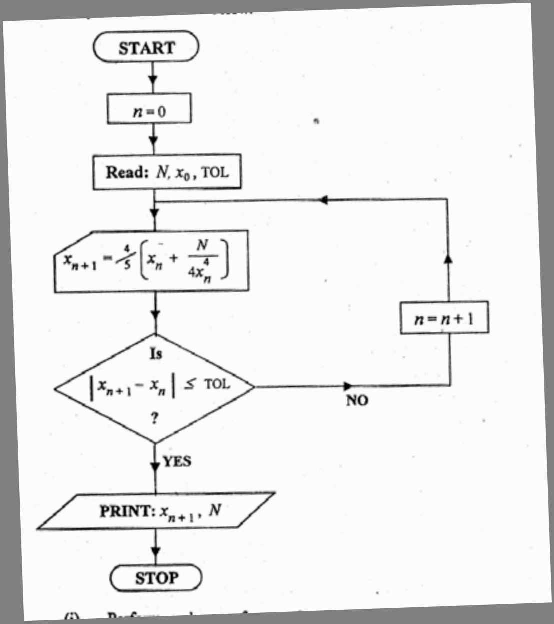
Determine the:
(a) value of k,
(b) equations of the p.d.f.
(c) E(T)
(d) probability that a pupil leaves between 4 and 7 minutes after the bell.

10. A car started from rest, accelerated uniformly for 2 minutes and then maintained a speed of 50 kmh^{-1}. Another car started 2 minutes later from the same spot, and this car too accelerated uniformly for 2 minutes and it then maintained a speed of 75 kmh^{-1}.
(i) Draw a velocity – graph and find when and where the second car overtook the first.
(ii) The first car maintained the speed of 50 kmh^{-1}for 10 minutes. It then decelerated uniformly for a further $2\frac{1}{2}$ minutes before coming to rest. How far has the car traveled from the start?

11. (a) The table below gives the values of x and their corresponding values of f(x)

X	2	3	4	5
f(x)	3.88	5.11	8.14	11.94

Use linear interpolation to determine the value of:
(i) f(x) when x = 2.15
(ii)x when f(x) = 10.72
(b) Study the flow chart below:



(i) Perform a dry run for x_o = 2 and N = 65, TOL = 0.0005.
(ii) State the purpose of the flow chart.

12. Below are marks scored by 8 students A, B, C, D, E, F, G and H in mathematics, Economics and Geography in the end of term examinations.

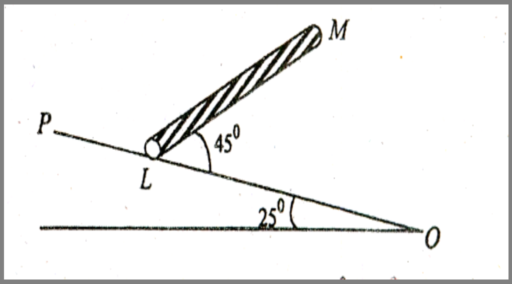
	A	B	C	D	E	F	G	H
Maths	52	75	41	60	81	31	65	52

Econ	50	60	35	65	66	45	69	48
Geog	35	40	60	54	63	40	55	72

Calculate the Rank Correlation Coefficients between the performance of the students in:
(i) Mathematics and Economics
(ii) Geography and Mathematics.

Comment on the significance of Mathematics in the performance of Economics and Geography. [Spearman, $\rho = 0.86$, Kendalls, $\tau = 0.79$ based on 8 observations at 1% level of significance.]

13. (a) A rod AB, 1 m long has a weight of 20 N and it's centre of gravity is 60 cm from A. It rests horizontally with A against a rough vertical wall. A string BC is fastened to the wall at C, 75 cm vertically above A. g
Find the:
(i) normal and frictional forces at A. if friction is limiting, find he coefficient of friction.
(ii) tension in the string.
(b) A uniform rod LM of weight W rests with L on a smooth plane PO of inclination 25^0 as shown in the diagram below.



The angle between LM and the plane is 45^0. What force parallel to PO applied at M will keep the rod in equilibrium?
(Give your answer in terms of W)
14. The numbers A and B are rounded off to a and b with errors e_1 and e_2, respectively.
(i) Show that the maximum relative error made in the approximation of $\frac{A}{b}$ by $\frac{a}{b}$ is

$$\left|\frac{e_1}{a}\right| + \left|\frac{e_2}{b}\right|$$

(ii) If also the number C is rounded off to c with error e_3, deduce the expression for the maximum relative error in taking the approximation of $\frac{A}{B+C}$ as $\frac{e}{b+c}$ in terms of e_1 e_2, e_3, a, b and c
(iii) Given that a = 42.326, b = 27.26 and C = -12.93 are rounded off to the given decimal places, find the range within which the exact value of the expression, B lies.

15. (a) A box contains 7 red balls and 6 blue balls. Three balls are selected at random without replacement. Find the probability that:
(i) they are of the same colour.
(ii) at most two are blue.
(b) Two boxes P and Q contain white and brown cards. P contains 6 white cards and 4 brown cards. Q contains 2 white cards and three brown cards. A box is selected at random and a card is selected.
Find the probability that:
(i) a brown card is selected.
(ii) box Q is selected given that the card is white.

16. A particle of mass, m kg is projected with a velocity of 10 ms^{-1} up a rough plane of inclination 30^0 to the horizontal. If the coefficient of friction between the particle and the plane is ¼ calculate how far up the plane the particle travels.
(b) A car is working at 5 kW and is traveling at a constant speed of $72kmh^{-1}$. Find the distance to the motion.

PAPER ONE 2008

SECTION A

1.Find the fourth roof of 4 + 3i
2.Without using tables or calculators,
show that $\tan 15^0 = 2 - \sqrt{3}$

3.Evaluate $\int_0^{\frac{\pi}{2}} \sin 2\theta c \cos d\theta$

4.Given the vectors a = **i** − 3**j** +3**k** and
b = **i** − 3**j** + 2**k**, find the:
(i)a cute angle between vectors a and b
(ii)equation of the plane containing and b.

5.Given the points O (0,0) and P(4,2), A is the locus of the points such that OA:AP = 1:2.
Q is the mid point of AP. Find the locus of Q in its simplest form.
6.Given that a and b are the roots of the equation $\alpha^2 + px + q = 0$, express $(\alpha^2 - \beta^2)$ and $(\alpha^3 - \beta^3)$ in terms of p and q.

7.Differentiate $\tan^{-1}\left[\frac{x^2}{2} + 2x^3\right]$ with respect $+_o$x.

8. Find the volume of the solid of revolution formed by rotating the area enclosed by the curve y = x(1+x), the x-axis, the lines x = 2 and x = 3 through four right angles about the x-axis.

SECTION B:

9.A circle cuts the y-axis at two points A and B. It touches the x-axis at a distance 4 units from the origin and distance AB is 6 units.
A is the point (0,1)

(a) equation of the circle
(b) equation of the tangents to the circle at A and B.

10. (a) Solve the equation cos x + cos 2x = 1 for values of x from 0^o to 360^o inclusive.

(b) (i) Prove that

$$\frac{\cos A + \cos B}{\sin A + \sin B} = \cos\frac{A+B}{2}$$

(ii) Deduce that $\frac{\cos A + \cos B}{\sin A + \sin B} = \tan\left(\frac{c}{2}\right)$

Where A, B and C are angles of a triangle.

11. (a) Give that $y = \frac{1+\sin^2 x}{\cos^2 x + 1}$, show that

$$\frac{dy}{dx} = \frac{3\sin 2x}{\left(\cos^2 x + 1\right)^2}$$

Hence, find $\frac{dy}{dx}$ when $x = \frac{2\pi}{3}$

(b)A curve is represented by the parametric equations x = 3t and $y = \frac{4}{t^2+1}$. Find the general equation of the length to the curve in terms of x, y and t. hence determine the equation of the tangent at the point (3, 2).

12.The position vectors of points A and B are OA = 2i – 4j – k and OB = 5i – 2j + 3k respectively. The line AB is produced to meet the plane 2x + 6y – 3z = -5 at a point c Find the;
(a)coordinate of c
(b)angle between AB and the plane

13.(a)Use partial fractions to evaluate $\int_4^6 \frac{dx}{x^2 - 2x - 3}$

(b)Evaluate $\int_0^{\frac{\pi}{2}} x \sin 2^2 x dx$

14.On the same axes sketch the curves $f(x) = x^2(x + 2)$ and

$g(x) = \frac{1}{f(x)}$

Show the asymptotes and tuning points.

15 (a) Find the binominal expansion of $\left(1 - \frac{x}{x}\right)^2$.

Use your expansion to estimate (0.875)5 to four decimal places.

(b)A financial credit society gives a 2% compound interest for annum to its members. If Ochola deposits shs 100, 000 at the beginning of every year starting with 2004, how much would he collect at the end of 2008 if there are no withdraws within thus period?

16.(a) Solve the differential equation:

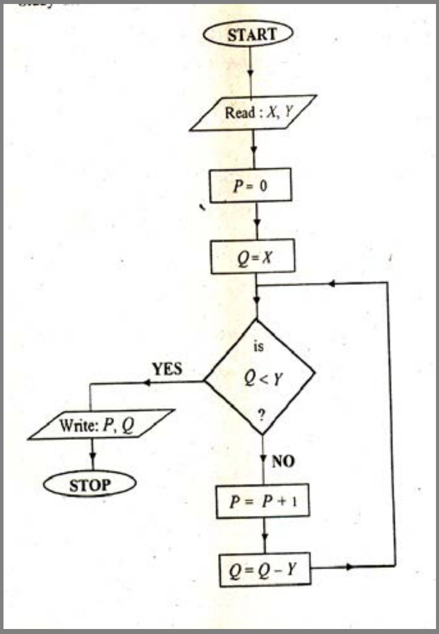
$$x\frac{dy}{dx} - y = x^3e^{x2}$$

(b)The number of car accidents x in a year on a high way was found to approximate the differential equation $\frac{dy}{dx} = kx$, where t is the time in years and k a constant. At the beginning of 2000 the number of recorded accidents was 50.
If the number of accidents increased to 60 at the beginning of 2003, estimate the number that was expected at the beginning of 2005.

2008 PAPER TWO
SECTION A

1.The probability that Anne reads, the New Visitors is 0.75 and the probability that she reads the New visitors and not the Daily Monitor is 0.65. The probality that she reads neither of the papers is 0.15. Find the probability that she reads the Daily monitor.

2. Study the flow chart below



P	Q
O	22
……………………	……………………
……………………	……………………
…………………....	……………………

This record: P = ………………….
Q = ………………….

What is the purpose of the flow chart?

3.The force A of magnitude 5N acts in the direction with unit vector $\frac{1}{5}$j (3i + 4j) and force B of magnitude 13N acts in direction with unit vector $\frac{1}{5}i + \frac{12}{13}j$. find the resultant of forces A and B.

4. Sugar packed in 500g packets is absorbed to be approximately normally distributed with a standard deviation of 4g.

If only 2% of the packets contained less than 500g of sugar, calculate the mean weight of the sugar in the packets.

5.Use the trapezium rule with 6 ordinates to evaluate

$\int_0^1 \frac{1}{e^{x^2}}dx$ correct to 2 decimal places.

6.The engine of a train exerts a force of 35,000N on a train of mass 240 tonnes and draws if up a slope of 1 in 120 against resistance totaling to 60N/ tonne. Find the acceleration of the train.

7.A discrete random variable x has the following probability distribution.

X	0	1	2	3	4
P(x=x)	0.09	0.15	0.40	0.25	0.11

Find the mean and standard deviation of the distribution.

8. Find coordinates of the centre of mass of the lamina shown below.

Take A as the origin and 'AD, AB as $\overline{x}$ and $\overline{y}$ axes respectively.

SECTION B:

9.The table below shows the amount of money (in thousands of shillings) that was paid out as allowance to participants during a certain workshop

Amount (sh.000s)	No of participants
110 – 114	13
115 – 119	20
120 – 129	32
130 – 134	17
135 – 144	16
145 – 159	12

(a)Draw a histogram and use it to estimate the modal allowance.

(b) Calculate:

(i) median allowances.

(ii)mean allowances.

10.(a)The numbers x and y were estimated with maximum possible errors of ΔX and ΔY respectively. Show that the percentage relative error in XY is $\left[\frac{\Delta X}{X} + \frac{\Delta Y}{Y}\right]$ x 100.

(b)Obtain the range of values within which the exact value of 3.55x2.71635 lies.

(c)Locate each of the three roots of the equation

$x^3 - 5x^2 + 5 = 0.$

11.(a) Derive the equation of the path of a projectile projected from origin O at angle x to the horizontal with initial speed 4 ms$^{-!}$

(b) A particle projected from a point on a horizontal ground moves freely under gravity and hits the ground again at A.

Taking O. as the origin, the equation of the path of the particle is $60y = 20\sqrt{3x - x^2}$, where x and y are measured in metres. $\left|\frac{\Delta X}{X}\right|$

Determine the:

(i) initial direction and speed of projection

(ii) distance OA (take gas 10m5-2).

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

$$f(x) = \begin{cases} \lambda(1-\cos x); & 0 \le x \le \frac{\pi}{2}, \\ \lambda \sin x; & \frac{\pi}{2} < x \le \pi \\ 0 & \text{elsewhere.} \end{cases}$$

Find :

(i) the value of λ

(ii) $P\left[\frac{\pi}{3} < x < \frac{3\pi}{4}\right]$

b)Show that the mean, N, of the distributions

$1 + \frac{\pi}{4}$

13.A particle of mass 1.5 kg lier on a smooth horizontal table table and is attached to too light elastic strings fixed at points P and Q 12m a part. The stings are of natural length 4m and 5m and their moduli λ and 2.5 λ respectively.

(a) Show that the particle stays in equilibrium at a point R midway between P and Q.

(b)If the particle is held at some point 5m the line particle is PS + 4.3m and then released, show that the particle performs simple harmonic motion and find the:

(i)`Period of oscillation

(ii) Velocity when the particle is 5.5m from P (b)This part of the questions is not in the syllabus. i.e. simple harmonic motion of the particles attached between two points of the string (s). so in this case, all the marks are awarded to part (a) of the question.

14(a)Show graphical that there is only one positive real root of the equations.
$e^x - 2x - 1 = 0$, between 1 and 2.
(b)Use the Newton Raphson method to calculate the roof of the equation in (a) correct to 2 decimal places.
Hence the root is 1.26 (2 dp)

15.(a)Sixty students sat for a mathematics contest whose pass work was 40 marks.
Their scores in the contest were approximately normally distributed. 9 students scored less than20 marks while 3 scored more than 70 marks.
Find the:
(i)Mean score and standard deviation of the contest.
(ii)Probability that a student chosen at random passed the contest.

(b)The times a machine takes to print each of the 10 documents were recorded in minutes as given below:
16.5, 18.3, 18.5, 16.6, 19.4, 16.8, 18.6, 16.0, 20.1, 18.2.
If the times of printing the documents are approximately normally distributed with variance of 2.56 minutes, find the 80% confidence interval for the mean time of printing the documents.

16.A uniform bean AC of mass 8 kg and length 8m is hinged at the end A and maintained in equilibrium by two strings attached to it at points C and D as shown below.
The tension in BC is twice that in BD;

$$\overline{AB} = 4\text{m}, \quad \overline{AD} = \frac{3}{4}\overline{AC}$$

Find the:
(i)tension in string BC,
(ii)magnitude and direction of the resultant force at the hinge.

P425/1
PURE MATHEMATICS
2009

SECTION A

1.. Solve the simultaneous equations;

$$p + 2q - r = -1$$
$$3p - q + 2r = 16$$
$$2p + 3q + r = 3.$$

2.Give that $\sin(\theta - 45^0) = \cos(\theta + 45^0)$

Show that $\tan\theta = 1$.
Hence find θ if $0^0 \le \theta = 560^0$.

3. Differentiate $e^{a x 2}$

4. If $y = \dfrac{3-2x}{4+x^2}$,find the range of possible values of y for real x

5.The points P(2, 3), Q. (-11, 8) and R. (-4, -5) we vertices of a parallelogram PQRS which has PR as a diagonal. Find the co-ordinates of vertex S.

6.Find $\displaystyle\int \frac{dx}{1-\cos x}$

7. Find the equation of a line through the point (1,3,2-2) and perpendicular to the plane whose equation is
$4x + 3y - 2z - 16 + 0$

8. Solve the differential equation

$$x(1-y)\frac{dy}{dx} + y = 0$$

Or SECTION B

9.(a) By using the binorminal theorem expand $(8 - 24x)^{2/3}$ as far the 4^{th} term.
Hence evaluate $4^{2/3}$ to one decimal place.
(b) Find the coefficient of x in the expansion of

$$\left(x + \frac{2}{x^2}\right)^{10}$$

10.(a) Defferentiate In $(1- 2x^2)^{-1/2}$
With respect to x.

(b) Integrate $\dfrac{4x - x^3 + x^2 + 1}{x^3 + x}$ with respect to x, we have; x.

11. (a) use the factor formula to show that

$$\frac{\sin(A+2B) + \sin A}{\cos(A+2B)\cos A} = \tan(A+B)$$

(b) Express y = 8cos x + 6 sin x in the formula R cos (x – x) where R is positive and x is acute.
Hence find the maximum and minimum values of

$$\frac{1}{8\cos x + 6\sin x + 15}$$

12(a) Given that

$$\frac{ix}{1+iy} = \frac{3x + i4}{x + 3y,}$$ find the values of x and y,

(07 marks)

b) if z = x + iy, find the equation of the locus

$$\left|\frac{z + 3}{z - 1}\right| = 4.$$ ***(05 marks)***

13.(a)Find the angle between the planes $x - 2y + z = 0$ and $x - y = 1$ ***(04 marks)***

(b) Two lines are given by the parametric equations:
- i + 2j + k + t (i – 2j + 3k) and
-3i + pj + 7k + 5 (i – j + 2 k).
If the lines intersect, find the
(i)values of t, s and p
(ii) the co-ordinates of the points of intersection.
(08) marks)

14.(a)Use Maclaurin's theorem m to expand $\frac{1}{\sqrt{(1+x)}}$ up to the term in x^3.
(b) Given that $e^x = \tan 2y$ show that

$$\frac{d^2y}{dx^2} = \frac{e^x - e^{3x}}{2(1+e^2x)}$$

15(a) Find the equation of the tangent and normal to the ellipse $\frac{x^2}{4} + \frac{y^2}{1} = 1$ at the point P (2 cosθ, sinθ).
(b) If the tangent in (9) cuts the y – axis at point A and the x –axis at point C, find the co-ordinates of the points A, B and C.
16.In a certain process he rate of production of yeast is Rx grammar per minute, where x grammar is the amount produced and R = 0.003.
(a) show that the amount of yeast is doubled in about 230 minutes.
b) If in addition yeast is removed at a contact rate of m grammas per minute, find the
(i) amount of yeast at time t minutes, given that when t = 0, x = p grammas
ii) Value of m if p= 20, 000 grammas and the supply of yeast is exhausted in 100 minutes.

APPLIED MATHEMATICS
2009
Paper 2
SECTION A: (40 MARKS)
Answer* all *questions in this section.

1.If *A* and *B* are independent events:
(i)show that the events *A* and *B'* are also independent.
(ii)find *P*(*B*) given that *P*(*A*) = 0.4 and $P(A \cup B) = 0.8$.
(05 marks)

2.A car moves from Kampala to Jinja and back. It's average speed on the return journey is 4 kmh^{-1} greater than that on the outward journey and it takes 12 minutes less. Given that Kampala and Jinja are 80 km apart, find the average speed on the outward journey. ***(05 marks)***

3.The table below shows the distance in kilometers (km) a truck can move with a given amount of fuel in litres (*l*).

Distance (km)	20	28	33	42
Fuel (*l*)	10	13	21	24

Estimate

(a)how far the truck can move on 27.5 *l* of fuel,

(b)the amount of fuel required to cover 29.8 km.
(05 marks)

4. The random variable *X* has a probability function

$$F(x) = \begin{cases} k2^x & ; \quad x = 0,1,2,3. \\ 0 & ; \quad \text{elsewhere.} \end{cases}$$

Find:
(a) the value of the constant *k*.
(b) *E*(*X*). ***(05 marks).***
5.A body of mass 8 kg rests on a rough plane inclined at θ to the horizontal.
If the coefficient of friction is μ, find the least horizontal force in terms of μ , θ and *g* which will hold the body in equilibrium. ***(05 marks)***
6.Use the trapezium rule with six ordinates to estimate

$$\int_1^2 \frac{\ell n\ x}{x}\,dx \quad .$$

Give your answer correct to **three** decimal places. ***(05 marks)***
7.The following information relates to three products sold by a company in the year 2001 and 2004

Product	2001		2004	
	Quantity in thousands	Selling price Per unit (£)	Quantity in thousands	Selling price Per unit (£)
A	76	0.60	72	0.18
B	52	0.75	60	1.00
C	28	1.10	40	1.32

Calculate the
(a)percentage increase in sales over the period.
(b) corresponding percentage increase in income over the period. ***(05 marks)***
8.The velocity of a particle at any time *t* is given by an equation;
$v(t) = {}^{-}a\omega \sin \omega t + b\omega \cos \omega t.$
(a)Find the expression for the displacement *x* at any time giventhat *x* = 0 when time *t* = 0.
(b)show that the motion of the particle is Simple Harmonic. ***(05 marks)***
SECTION B: (60 MARKS)
Answer any* five *questions from this section. All questions carry equal marks.

(a) The dimensions of a rectangle are 6.2cm and 5.36cm.
(i)State the maximum possible error in each dimension.

(ii)Find the range within which the area of the rectangle lies.
(05 marks)

(b)The numbers a = 26.23, b = 13.18 and c = 5.1 are calculated with percentage errors of 4, 3 and 2 respectively.

Find the limits to **two** decimal places within which the exact value of the expression $ab - \frac{b}{c}$ lies. ***(07 marks)***

A pile driver of mass 1200 kg falls freely from a height of 3.6 m and strikes without rebounding, a pile of mass 800 kg. The blow drives the pile a distance of 36 cm into the ground.

Find the

(a)resistance of the ground.***(08 marks)***

(b)time for which the pile is in motion. ***(04 marks)***

[*Assume the resistance of the ground to be uniform*]

The table below shows the income of 40 factory workers in millions of shillings per annum.

1.0	1.1	1.0	1.2	5.4	1.6	2.0	2.5
2.1	2.2	1.3	1.7	1.8	2.4	3.0	2.2
2.7	3.5	4.0	4.4	3.9	5.0	5.4	5.3
4.4	3.7	3.6	3.9	5.2	5.1	5.7	1.5
1.6	1.9	3.4	4.3	2.6	3.8	5.3	4.0

(a) Forum a frequency distribution table with class intervals of 0.5 million shillings starting with the lowest limit of I million shillings. ***(02 marks)***

(b)Calculate the

(i)mean income.

(ii)standard deviation. ***(06 marks)***

(c)Draw a histogram to represent the above data. Use it to estimate the model income. ***(04 marks)***

12.Forces of magnitude 3N, 4N, 4N, 3N and 5N act along the lines AB, BC, CD, DA and AC respectively of the square $ABCD$ whose side has a length of a units. The direction of the forces are indicated by the order of the letters.

(a)Find the magnitude and direction of the resultant force ***(09 marks)***

(b)If the line of action of the resultant force cuts AB produced at E, find the length AE.***(03 marks)***

13.(a)A box contains two types of balls, red and black. When a ball is picked from the box,
the probability that it is red is $^7/_{12}$. Two balls are selected at random from the box without replacement.

Find the probability that

(i) the second ball is black.

The first ball is red, given that the second one is black.

(b) An interview involves written, oral and practical tests. The probability that an interviewee passes the written test is 0.8, the oral test is 0.6 and the practical test is 0.7. What is the probability that the interviewee will pass

(i)the entire interview?

(ii)Exactly two of the interview tests?

14. (a) Show that the root of the equation $2x - 3\cos(^x/_2) = 0$ lies between 1 and 2. ***(03 marks)***

Use Newton Raphson's method to find the root of the equation in (a) above. Give your answer correct to **two** decimal places.

15.(a)The masses of soap powder in certain packets is normally distributed with mean 842 grams and variance 225 (grams).

Find the probability that a random sample of 120 packets has sample mean with mass

(i) between 844 grams and 846 grams.

(ii) Less than 843 grams.

(b)A random sample of size 76 electrical components produced by a certain manufacturer have resistances $r_1, r_2, \ldots r_{76}$ ohms

Where $\sum r_i = 740$ and $\sum r_i^2 = 8{,}216$

Calculate the

(i)unbiased estimate for the population variance.

(iii) 91.86% confidence interval for the mean resistance of the electrical components produced.

[*Give answers correct to* **3** *decimal places.*] ***(06 marks)***

16.Two particles P and Q move with constant velocities of $(4i + j - 2k)$ ms^{-1} and $(6i + 3k)$ ms^{-1} respectively. Initially P is at the point with position vector $(-i + 20j + 21k)$m and Q is at the point with position vector $(i + 3k)$m.

Find the

(a)time for which the distance between P and Q is least. ***(08 marks)***

(b)distance of P from the origin at the time when the distance between P and Q is least. ***(02 marks)***

(c)least distance between P and Q. ***(02 marks)***

END.

PURE MATHEMATICS
NOV. / DEC. 2010
Paper 1
SECTION A: (40 MARKS)
Answer* all *questions in this section.

1.Solve the inequality $\frac{3x - 1}{x + 2} \geq 2$. ***(05 marks)***

2. The points *A* and *B* lie on the positive sides of the x – axis and y- axis respectively. If the length of *AB* is 5 units and angle *OAB* is θ, where *O* is the origin, find the equation of the line *AB*. *(Leave θ in your answer)* ***(05 marks)***

3.Solve the simultaneous equations:

$2x - y + 3z = 10,$

$x + 2y - 5z = -9,$

$5y + y + 4z = 11.$ ***(05 marks)***

4.Show from first principles that

$$\frac{d}{dx}(\tan x) = \sec^2 x.$$ ***(05 marks)***

5.Given the points *A*(-3, 3, 4), *B*(5, 7, 2) and *C*(1, 1, 4), find the vector equation of a line which joins the mid-points of *AB* and *BC*. ***(05 marks)***

6.Evaluate $\int_1^{\sqrt{2}} \frac{x^2}{\sqrt{x^4 - x^2}}dx$ ***(05 marks***

7.Express sin x + cos x in the form Rcos (x – a). Hence, find the greatest value of sin x + cos x – 1. ***(05 marks)***

8.Solve the differential equation:

$$x + \frac{dy}{dx} = e^x$$ ***(05 marks)***

SECTION B: (60 MARKS)

Answer any* five *questions from this section. All questions carry equal marks.

9.(a)Expand $\sqrt{\left(\frac{1+x}{1-x}\right)}$ in ascending powers of x to a term in x^2.***(04 marks)***

(b)(i)Using the expansion of $(1 + x)^{½}$ up to the term in x^3, Find the value of $\sqrt{1.08}$ to 4 decimal places.***(04 marks)***

(ii)Express $\sqrt{1.08}$ in the form $\frac{a}{b}\sqrt{c}$.

Hence evaluate $\sqrt{3}$

Correct to 3 significant figures. ***(04 marks)***

10.(a)Use the substitution $x^2 = \theta$ to find $\int \frac{x}{1+\cos x^2}$ *dx*. ***(06 marks)***

(b)Given that $y = 3\sqrt{\frac{x-1}{(x^2-1)^2}}$, show that

$$\frac{dy}{dx} = \frac{1-3x}{3(x+1)^{5/3}(x-1)^{4/3}}$$ ***(06 marks)***

11.(a) The equation of the Plane *R* is $\mathbf{r}.\begin{pmatrix}4\\3\\-2\end{pmatrix} = 16$, where **r** is the position vector of *R*. Find the perpendicular distance of the plane from the origin. ***(04 marks)***

(b)Find the Cartesian equation of the plane through the points P(1,0, -2) and Q(3, -1, 1) parallel to the line with a vector equation

$\mathbf{r} = 3i + (2a - 1)j + (5 - a)k$. ***(08 marks)***

12.(a)Find the gradient of the curve $y = x^2 - 25\log_{10}x$. at the point when $x = 10$.
(Give your answer correct to 3 significant figures.) ***(05 marks)***

(b)Use Maclaurin's theorem to express In (sin *x* + cos *x*) as a power series up to the term in x^2. ***(07 marks)***

13.(a) (i)Find the co-ordinates of the points where the ellipse $\frac{x^2}{4}+\frac{y^2}{9}=1$ cuts the axes. ***(04 marks)***

(ii)Express the given equation in a(i) above, in it's polar form. ***(03 marks)***

(b) If the line $y = mx + c$ is a tangent to the ellipse

$\frac{x^2}{4}+\frac{y^2}{9}=1$,

Show that $c^2 = 4m^2 + 9$. ***(05 marks)***

14.(a)Given that the complex number *Z* and it's conjugate $\bar{Z}$, satisfy the equation

$Z\bar{Z} + 3\bar{Z} = 34 - 12i$, find the values of *Z*. ***(07 marks)***

(b)Find the Cartesian equation of the locus of a point P represented by the equation

$$\left|\frac{Z+3}{Z+2-4i}\right| = 1$$ ***(05 marks)***

15.(a)Solve cos*x* + cos3*x* = cos2*x* for all values of *x* between 0^0 and 360^0. ***(05 marks)***

(b)Show that $\tan\left(\frac{\pi}{4}+\frac{A}{2}\right) = \frac{1+\sin A}{\cos A}$ ***(07 marks)***

16.Bacteria in a culture increase at a rate proportional to the number of bacteria present. If the number increases from 1000 to 2000 in one hour,

(a)how many bacteria will be present after 1½ hours? ***(09 marks)***

(b)how long will it take for the number of bacteria in the culture ***(03 marks)***

END.

APPLIED MATHEMATICS
2010
Paper 2

SECTION A: (40 MARKS)

Answer* all *questions in this section.

1.Two events M and N are such that $P(M) = 0.7$, $P(M$ **Error! Bookmark not defined.** $\cap N) = 0.45$ and $P(M' \cap N') = 0.18$. Find:

(a)$P(N')$, ***(03marks)***

(b)P(M or N but **not both** M and N). ***(02 marks)***

2.P, Q and R are points on a straight road such that $PQ = 20m$ and $QR = 55m$. A cyclist moving with uniform acceleration passes P and then notices that it takes him 10 s and 15 s to travel between (P and Q) and (Q and R) respectively.

Find his uniform acceleration.***(05 marks)***

3.Find the approximate value, to **one** decimal place of

$$\int_0^1 \frac{dx}{1+x},$$

using the trapezium rule with five strips. ***(05 marks)***

4.The probability mass function of a discrete random variable X is given by

$$f(x) = \begin{cases} \frac{16}{15}x^2 & ;\ x = 1, 2, 3, 4 \\ 0 & ;\ \text{Otherwise} \end{cases}$$

Find the:

(a)mean of X, ***(02 marks)***

(b)variance of X. ***(03 marks)***

5.A carton of mass 3 kg rests on a rough plane incline at an angle of 30^0 to the horizontal. The coefficient of friction between the carton and the plane is $^1/_3$. Find a horizontal force that should be applied to make the carton just about to move up the plane. ***(05 marks)***

6.The table below shows the values of a continuous function f with respect to t

t	0	0.3	0.6	1.2	1.8
$f(t)$	2.72	3.00	3.32	4.06	4.95

Using linear interpolation find:

(a)$f(i)$ when $t = 0.9$, ***(03 marks)***

(b) t when $f(t) = 4.48$. ***(02 marks)***

7.The table shows the expenditure (in Ug. Shs.) of a student during the first and Second terms.

ITEM	EXPENDITURE		WEIGHT
	First term	Second term	
Clothings	46,500	49,350	5
Pocket money	55,200	57,500	3
Books	80,000	97,500	8

Using first term expenditure as the base, calculate the average weighted price index to **one** decimal place. ***(05 marks)***

8.A particle moving with Simple Harmonic Motion (SHM) travels from a point x m from the centre , to a point on the opposite side of and xm from in 3 s. The particle takes a further 2 s to reach the extreme point of the motion. Find the period of the motion. ***(05 marks)***

SECTION B: (60 MARKS)

Answer any* five *questions from this section. All questions carry equal marks.

9. (a)If a is the first approximation to the root of the equation $x^5 - b = 0$,

Show that the second approximation is given

by $\dfrac{4a + {}^{b}/_{a^4}}{5}$ ***(04 marks)***

(b)Show that the positive real root of the equation $x - 17 = 0$ lies between 1.5 and 1.8 use the formula in (a) above to determine the root to **three** decimal places. ***(08 marks)***

10. The table below shows the marks obtained by students in a physics test.

Marks (%)	Frequency
25 – 29	9
30 – 34	12
35 – 39	10
40 – 44	17
45 – 49	13
50 – 54	25
55 – 59	18
60 – 64	14
65 – 69	8
70 – 74	8

(a)Draw a histogram and use it to estimate the modal mark. ***(04 marks)***

(b)Find the:

(i)mean mark, ***(05 marks)***

(ii) standard deviation. ***(03 marks)***

11.Two equal particles of mass, m are attached to the ends of an elastic string of length a and are placed close together on a horizontal plane. If one of the particles is projected vertically upwards with a velocity $\sqrt{2gh}$ where $h > a$,

(a)show that the other particle will rise a distance

$\frac{1}{4}$ $(h-a)$ before coming to rest. ***(05 marks)***

(b)determine the loss in kinetic energy when the string becomes taut if
$a = 20m$, $h = 54m$ and $m = 4.8$ kg. ***(07 marks)***

12.(a)The probabilities that three players *A*, *B* and *C* score in a netball game are $\frac{1}{5}$, $\frac{1}{4}$ and $\frac{1}{3}$ respectively. If they play together in a game, what is the probability that:

(i) only *C* scores, ***(02 marks)***
(ii) at least one player scores, ***(02 marks)***
(iii) two and only two players score.***(02 marks)***

(b)There are 100 students taking principal mathematics in a certain school. 56 of the students are boys and the remainder are girls. The probability that a student takes principal mathematics given that the student is a boy is $^1/_5$. The probability that a student takes principal mathematics given that the student is a girl is $^1/_{11}$.

(i)is a boy given that the student takes principal mathematics, ***(04 marks)***
(ii)does **not** take principle mathematics. ***(02 marks)***

13.The centre of a regular hexagon *ABCDEF* of side $2a$ metres is .
Forces of magnitude 4N, *s*N, *t*N, 1N, 7N and 3N act along the sides *AB*, *BC*, *CD*, *DE*, *EF* and *FA* respectively. Their directions are in the order of the letters.
(a)Given that the resultant of these six forces is of magnitude $2\sqrt{3}$N acting in a direction perpendicular to *BC*, determine the values of s and t. ***(06 marks)***
(b)(i)show that the sum of the moments of the forces about is $27a\sqrt{3}$ Nm
ii)If the mid-point of *BC* is *M*, find the equation of the line of action of the resultant, refer to *OM* as *x*-axis and *OD* as *y*-axis ***(03 marks)***

14.(a) Two positive real numbers N_1 and N_2 are rounded off to give n_1 and n_2 respectively.
Determine the maximum relative error in using n_1n_2 for $N1\ N2$. State any assumptions made. ***(05 marks)***

(b) If $N_1 = 2.765$, $N_2 = 0.72$, determine the range within which the exact values of
(i) $N_1 N_2 (N_1 - N_2)$,
(ii) $\frac{N_2 - N_1}{N_1 \quad N_2}$, are expected to lie. Give your answers to **three** decimal places.
(07 marks)

15. Two aircrafts *P* and *Q* are flying at the same height. *P* is flying due north at 500 kmh^{-1} while *Q* is flying due west at 600 kmh^{-1}. When the aircrafts are 100 km apart, the pilots realize that they are about to collide. The pilot of *P* then changes course to 345^0 and maintains the speed of 500 kmh^{-1}. The pilot of *Q* maintains his course but increases the speed.
Determine the;
(a)distance each aircraft would have traveled if the pilots had not realized that they were about to collide, ***(09 marks)***
(b)new speed beyond which the aircraft *Q* must fly in order to avoid collision. ***(03 marks)***

16.(a)The chance that a cow recovers from a certain mouth disease when treated is 0.72. If 100 cows are treated by the same vaccine, find the 95% confidence limits for the mean number of cows that recover. ***(05 marks)***
(b)The ages of the taxis on a route are normally distributed with a standard deviation of 1.5 years. A sample of 100 taxis inspected on a particular day gave a mean age of 5.6 years.
Determine:
(i)a 99% confidence interval for the mean age of all taxis that operate on the route, ***(03 marks)***
(ii)the probability that the taxis of ages between 5.4 and 5.8 years.***(04marks)***

END.

P425/1 PAPER 1
PURE MATHEMATICS
Nov.Dec.2011. 3 hours.
SECTION A

1. Solve the equation $\log^{25} 4x^2 = \log^5 (3 - x^2)$
(05 marks)

2. Find the equation of a line through the point (2,3) and perpendicular to the line $x + 2y + 5 = 0$.
(05 marks)

3. Evaluate $\int_1^3 \left(\frac{3x^2+4x+1}{x^3+2x^2+x}\right) dx$. ***(05 marks)***

4. A committee of 4 men and 3 women is to be formed from 10 men and 8 women. In how many ways can the committee be formed? ***(05 marks)***

5. Show that: $\tan^{-1}\left(\frac{1}{2}\right) + \tan^{-1}\left(\frac{1}{5}\right) = \tan^{-1}\left(\frac{7}{9}\right)$
(05 marks)

6. Given that $R = q\sqrt{(1000 - q^2)}$, find
(a) $\frac{dR}{dq}$, ***(05 marks)***
(b) the value of *q* when *R* is maximum. ***(05 marks)***

7. Show the points A ,B and C with position vectors $3\mathbf{i} + 3\mathbf{j} + \mathbf{k}$, $8\mathbf{i} + 7\mathbf{j} + 4\mathbf{k}$ *and* $11\mathbf{i} + 4\mathbf{j} + 5\mathbf{k}$ respectively, are vertices of a triangle. ***(05 marks)***

8. (a) Form a differential equation by eliminating the constants a and b from $x = a\cos t + b\sin t$.

(04 marks)

(b) State the order of the differential equation formed in (a) above. *(01 mark)*

SECTION B: (60 MARKS)

9. (a) The first term of an Arithmetic progression (A.P) is ½. The sixth term of the A.P is Fourth term. Find the common difference of the A.P.

(b) The roots of a quadratic equation $x^2+px+q=0$ are α and β.

Show the quadratic equation whose roots are $\alpha^2 - q\alpha$ and $\beta^2 - q\beta$ is given by $x^2 - (P^2 + pq - 2q)x + q^2(q + p\ 1) = 0$. *(07 marks)*

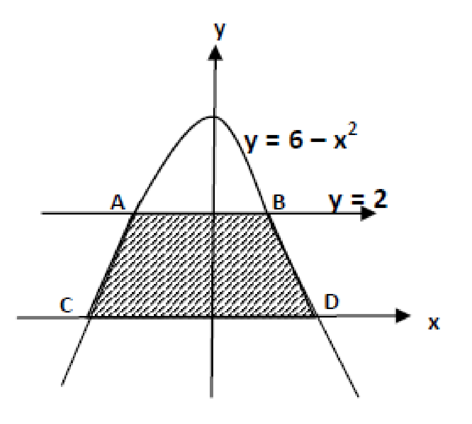
10. (a) Form a quadratic equation having $-3 + 4i$ as one of it's roots. *(05 marks)*

(b) Given that $Z_1 = -1 + i\sqrt{3}$ and $Z_2 = -1\ i\sqrt{3}$,

(i) express $\dfrac{Z_1}{Z_2}$ on an Argand diagram.

(ii) find $\dfrac{Z_1}{Z_2}$ *(07 marks)*

11. In the diagram below; the curve $y = 6 - x^2$ meets the line $y = 2$ at A and B, and the x- axis at C and D.



Find the

(a) coordinates of A,B,C and D. *(04 marks)*

(b) area of the shaded region, correct to **one** decimal place. *(08 marks)*

12. (a) Find the angle between the lines

$x = \dfrac{y-1}{2} = \dfrac{z-2}{3}$ and $\dfrac{x}{2} = \dfrac{y+1}{3} = \dfrac{z+2}{4}$ *(06 marks)*

(b) Find in vector form the equation of the line of intersection of the two planes,

$2x + 3y - z = 4$ and $x - y + 2z = 5$ *(06 marks)*

13. (a) Find the equation of the tangent to the parabola $y^2 = \dfrac{x}{16}$ at the point $\left(t^2, \dfrac{t}{4}\right)$. *(05 marks)*

(b) if the tangents to the parabola in (a) above at the points $P\left(P^2, \dfrac{P}{4}\right)$ and $Q\left(Q^2, \dfrac{Q}{4}\right)$ meet on the line $y = 2$.

(07 marks)

14. (a) Solve $3\sin x + 4\cos x = 2$ for $-180^0 \le x \le 180^0$.

(04 marks)

(b) Show that in any triangle ABC, $\dfrac{a^2 - b^2}{c^2} = \dfrac{\sin(A-B)}{\sin(A+B)}$. *(04 marks)*

15. (a) Differentiate the following with respect to x:

(i) $(x+1)^{½}(x+2)^2$

(ii) $\dfrac{2x^2 + 3x}{(x-4)^2}$ *(06 marks)*

(b) The base radius of a right circular cone increases and the volume changes by 2%. If the height of the cone remains constant, find the percentage increase in the circumference of the base.

(06 marks)

16. (a) Solve the differential equation.

$\dfrac{dy}{dx} = \dfrac{\sin^2 x}{y^2}$, given that $y = 1$ when $x = 0$.

(05 marks)

(b) It is observed that the rate at which a body cools is proportional to the amount by which it's temperature exceeds that of it's surroundings. A body at 78^0 C is placed in a room at 20^0C and after 5 minutes the body has cooled to 65^0C. What will be It's temperature after a further 5 minutes?

(07 marks)

P425/2 , PAPER 2
PURE MATHEMATICS
Nov.Dec.2011. 3 hours.
SECTION A

1. The data below represents the lengths of leaves in centimeters. 4.4, 6.2, 9.4, 12.6, 10.0, 8.8, 3.8, and 13.6.

Find the

(a) Mean length, *(02 marks)*

(b) Variance *(07 marks)*

2. A particle of mass 2kg moves under the action of three forces, $\mathbf{F}_1, \mathbf{F}_2$, and $\mathbf{F}_3$. At a time, t,

$\mathbf{F}_1 = (\frac{1}{4}t - 1)\mathbf{i} + (t-3)\,\mathbf{j}$ N,

$\mathbf{F}_2 = (\frac{1}{2}t + 2)\mathbf{i} + (\frac{1}{2}t + 4)\mathbf{j}$ N and

$\mathbf{F}_3 = (\frac{1}{4}t - 4)\mathbf{i} + (\frac{3}{2}t + 1)\mathbf{j}$ N.

Find the acceleration of the particle when t = 2 seconds. *(05 marks)*

3. The table below shows delivery charges by a courier company.

Mass (gm)	200	400	600
Charges (Shs)	700	1200	3000

Using Linear interpolation or extrapolation, find the,

(a) Delivery charge of a parcel weighing 352 gm. ***(03 marks)***

(b) Mass of a parcel whose delivery charge is Shs 3,300. ***(02 marks)***

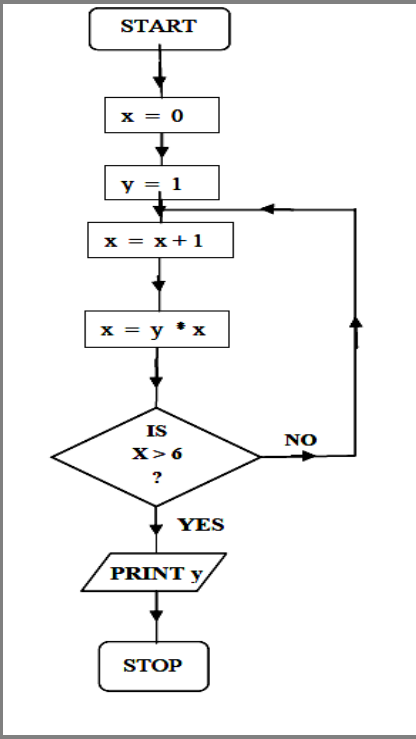
4 .Two events *A* and *B* are such that $P(A'\cap B)=3x$, $P(A\cap B')=2x$, $P(A'\cap B')=x$, and $P(B)=\frac{4}{7}$. Using a venn diagram, Find the values of

(a) x, ***(03 marks)***

(b) $P(A\cap B)$. ***(02 marks)***

5. A man can row a boat in still water at 6kmh^{-1}. He wishes to cross a river to a point directly opposite his starting point. The river flows at 4kmh^{-1} and has a width of 250 m. Find the time the man would take to cross the river. ***(02 marks)***

6. Study the flow chart given below



(a) Perform a dry run. ***(04 marks)***

(b) What is the purpose of the flow chart? ***(01 mark)***

7. Given that $X \sim N(2, 2.89)$, find $P(X \angle 0)$. ***(05 marks)***

8. Particles of weight 12N, 8 N and 4 N act at points (1-3), (0, 2) and (1,0) respectively. Find the centre of gravity of the particles. ***(05 marks)***

SECTION B: (60 MARKS)

9. The continous random variable X has the probability destiny function (p.d.f) given by

$$f(x) = \begin{cases} k_1 x, & 1 \le x \le 3, \\ k_2 (4-x) & 3 \angle x \le 4, \\ 0, & \text{otherwise,} \end{cases}$$

Where k_1 and k_2 are constants.

(a) Show that $k_2 = 3k_1$ ***(02 marks)***

(b) Find:

(i) the values of k_1 and k_2, ***(06 marks)***

(ii) E(X) , the expectation of X. ***(04 marks)***

10. An elastic string of length a metres is fixed at one end P and carries a particle of mass 3 kg at it's other end Q. The particle is describing a horizontal circle of radius 80 cm with an angular speed of 5 rads^{-1} .

Determine the:

(a) (i) angle the string makes with the horizontal ,

(ii) tension in the string. ***(08 marks)***

(b) value of a. ***(02 marks)***

(c)linear speed of the particle. ***(02 marks)***

11. (a) Use the trapezium rule with five sub-intervals to estimate .

$\int_0^{\frac{\pi}{3}}$ tan x dx, correct to three decimal places. ***(07 marks)***

(b) Find the value of $\int_0^{\frac{\pi}{3}}$ tan x dx, correct to three decimal places.

(ii) Calculate the percentage error in your estimation in (a) above.

(iii) Suggest how the percentage error may be reduced. ***(05 marks)***

12. The heights and masses of ten students are given in the table below.

Height(cm)	**156**	**151**	**152**	**146**	**160**	**157**	**149**	**142**	**158**	**141**
Mass(kg)	**62**	**58**	**63**	**58**	**70**	**60**	**55**	**57**	**68**	**56**

(a) (i) Plot the data on a scatter diagram.

(ii) Draw the line of best fit.

Hence estimate the mass corresponding to a height of 155cm. ***(06 marks)***

(b) (i)Calculate the rank correlation coefficient for the data.

(ii) Comment on the significance of the heights on mass of the students.

[Spearman's ℓ = 0.79 and Kendall's τ =0.64 at 1% level of significance based on 10 observations.]

(06 marks)

13. A football player projects a ball at aspeed of 8 ms^{-1} at an angle of 30^0 with the ground. The ball strikes the ground at apoint which is level with the point of projection. After impact with the ground, the ball bounces and the horizontal component is reserved in direction and halved in magnitude. The player running after the ball kicks it again at a point which is at a horizontal distance of 1.0m from the point where it bounced, so that the ball continues in the same direction.

Find the:

(a) horizontal distance between the point of projection and at the point at which the ball first strikes the ground. ***(05 marks)***

[Take g = 10ms^{-2}]

(b) (i) the time interval between the ball striking the ground and the player kicking it again.

(ii) the height of the ball above the ground when it is kicked again.

[Take g = 10ms^{-2}] ***(07 marks)***

14. (a) (i) On the same axes, draw graphs of $y = x^2$ and y= cos x for 0 $\le x \le \frac{\pi}{2}$ at intervals of $\frac{\pi}{8}$.

(ii) From your graphs, obtain to one decimal place, an approximate root of the equation x^2 –cos x =0. ***(06 marks)***

(b) Using newton –Raphson method, find the root of the equation x^2-cos x =0, taking the approximate root in (a) as an initial approximation. Give your answer correct to three decimal places. ***(06 marks)***

15. Box A contains 4 red sweets and 3 green sweets. Box A is twice as likely to be picked as box B. If a box is chosen at random and two sweets are removed from it, one at a time without replacement;

(a) find the probability that the two sweets removed are of the same colour. ***(06 marks)***

(b) (i) construct a probability distribution table for the number of red sweets removed.

(ii) find the mean number of red sweets removed. ***(06 marks)***

16. The diagram below shows a uniform wooden plank *AB* of mass 70kg and length 5cm.The end A rests on a rough horizontal ground. The plank is in contact with the top of a rough pillar at C. The height of the pillar at C. The height of the pillar is 2.2m and *AC* =3.5m.

C r-*`

Given that the coefficient of friction at the ground is 0.6 and the plank is just about to slip, find the :

(a) angle the plank makes with the ground at A.

0751108679 ***(03 marks)***

(b) normal reaction at

(i) A,

(ii) C. ***(06 marks)***

(c) Coefficient of friction at C. ***(03 marks)***

P425/1 , PAPER 1
PURE MATHEMATICS
Nov.Dec.2012. 3 hours.
SECTION A

1. Solve the simultaneous equations.

3x – y + z = 3,

x – 2y + 4z = 3,

2x + 3y – z =4. ***(05 marks)***

2. (a) prove that $\frac{2\tan}{1+\tan^2} = \sin 2$.

(b) solve sin 2 = cos for $0^0 \le \theta \le 90^0$ ***(05 marks)***

3. Differentiate $\frac{3x-1}{\sqrt{(x^2+1)}}$ with respect to x. ***(05 marks)***

4. A line passes through the points A(4,6,3 and B(1,3,3.

(a) Find the vector equation of the line.

(b) Show that the point C(2,4,3) lies on the line in (a0 above. ***(05 marks)***

5. The sum of the first n terms of the geometric progression (G.P.) is $\frac{4}{3}\left(4^n-1\right)$. Find n^{th} term as an intergral power of 2. ***(05 marks).***

6. The line y=mx + c is a tangent to the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ when c = = $\sqrt{(a^2m^2+b^2)}$. Find the equation of the tangents to the ellipse $\frac{x^2}{4}+\frac{y^2}{1}=1$ from the point (0, $\sqrt{5}$) ***(05 marks).***

7. Using a suitable substitution, find $\int\frac{\sin^{-1}2x}{\sqrt{(1-4x^2)}}dx$ ***(05 marks)***

8. Find the equation of the normal to the curve $x^2y + 3y^2$ - 4x- 12 = 0 at the point (0,2). ***(05 marks)***

SECTION B: (60 MARKS)

9. If $z=\frac{(2-i)(5+12i)}{(1+2i)^2}$;

(a) find the:

(i) modulus of z,

(ii)argument of z. ***(08 marks)***

(b) represent z on a complex plane. ***(02 marks)***

(c) write z in the polar form. ***(02 marks)***

10. (a) Solve the equation 8 $\cos^4$x -10 $\cos^2$ x +3 =0 for x, in the range $0^0 \le x \le 180^0$ x. ***(07 marks)***

(b) prove that cos 4*A*- COS *AB*-cos 4*C* =4 sin 2B sin 2*C* cos 2*A* – 1 given that *A*, *B* and *C* are angles of a triangle. ***(05 marks)***

11.(a) Find the derivatives with respect to x of the following functions:

(i) $\frac{\cos 2x}{1+\sin 2x}$,

(ii)*In* (sec x + tan x). ***(06 marks)***

(b) $\int_0^{\frac{\pi}{2}} x^2 \sin x \, dx$.

12. Triangle *OAB* has ***OA*** = **a** and ***OB*** =**b**. C is a point on OA such that $OC = \frac{2a}{3}$. D is the midpoint of AB. When ***CD*** is produced it meets *OB* produced at E, such that ***DE*** = n***CD*** and ***BE*** = *kb*.

Express ***DE*** in terms of

(a) n, ***a*** and **b,** ***(06 marks)***

(b)k, ***a*** and **b,**

Hence find the values of *n* and *k*. ***(06 marks)***

13. (a)Find the equation of the locus of the point whish moves such that it's distance from D(4,5) is thrice the distance from it's origin. ***(05 marks)***

(b) The line y = mx intersects the curve $y=2x^2 - x$ at the points A and B. Find the equation of the locus of the point *P* which divides *AB* in the ratio 2:5.***(07 marks)***

14. (a)On the same axes sketch the curves y=x(x + 2) and y =x(4-x). ***(06 marks)***

(b) Find the area enclosed by two curves in (a). ***(03 marks)***

(c)Determine the volume of the solid generated when the area enclosed by the two curves in (a) is rotated about the x-axis. ***(03 marks)***

15. solve for x in the following equations:

(a) $9^x - 3^{(x+1)} = 10$; ***(06 marks)***

(b) $\log_4 x^2 - 6\log_x 4 - 1 = 0$. ***(06 marks)***

16. A 3.00pm, the temperature of a hot metal was 80^{0}C and that of the surroundings 20^{0}C. At 3.03pm the temperature of the metal had dropped to 42^{0}C. The rate of cooling of the metal was directly proportional to the difference between it's temperature and that of the surroundings.

(a) (i) Write a differential equation to represent the rate of cooling of the metal.

(ii) Solve the differential equation using the given conditions. ***(09 marks)***

(b) Find the temperature of the metal at 3:05 pm. ***(03 marks)***

P425/2 , PAPER 2
PURE MATHEMATICS

Nov.Dec.2012. 3 hours.
SECTION A

1. The forces $\begin{pmatrix}0\\2\end{pmatrix}, \begin{pmatrix}0\\4\end{pmatrix}, \begin{pmatrix}0\\3\end{pmatrix}$ and $\begin{pmatrix}0\\a\end{pmatrix}$N act at points (p,1,), (2,3), (4,5) and (6,1) respectively. The resultant is $\begin{pmatrix}0\\3\end{pmatrix}$N acting at (1, 1).

Find the values of *a* and *p*. ***(05 marks)***

2. Two events *A* and *B* are such that $P(A)= \frac{1}{5}$ and $P(B) = \frac{1}{2}$. Find $P(A \cup B)$ when *A* and *B* are:

(a) independent events,

(b) mutually exclusive events.

3. Use the trapezium rule with four sub-intervals to estimate:

$$\int_0^{\frac{\pi}{2}} \frac{1}{1+\sin x} dx.$$

Give your answer correct to **three** decimal places. ***(05 marks)***

4. (a) Show that the final velocity v of a body which starts with an initial velocity u and moves with uniform acceleration a consequently covering a distance x, is given by $V = [u^2 + 2ax]^{½}$

(b) Find the value of x in (a) if v = (30 m/s , u =10m/s and a= m/s^2. ***(05 marks)***

5. A teacher gave two tests in chemistry. Five students were graded as follows.

	GRADE				
TEST **1**	A	B	C	D	E
TEST **2**	B	A	C	D	E

Determine the rank correlation between the two test. Comment on your result. ***(05 marks)***

6. A light inextensible string passes over a smooth pulley fixed at the top of a smooth plane inclined at 30^0 to the horizontal. A mass of 4 kg is attached to one end of the string and hangs freely. A mass, ***m*** is attached to the other end of the string and rests on the inclined plane. If the system is in equilibrium, find ***m***. ***(05 marks)***

7. The table below shows the cost *y* shillings for hiring a motor cycle for a distance *x* kilometers.

Distance (x km)	10	20	30	40
Cost (Shs. *y*)	2800	3600	4400	5200

Use linear interpolation or extrapolation to calculate the:

(a) cost of hiring the motorcycle for a distance of 45 km,

(b) distance mukasa travelled if he paid Shs 4000. ***(05 marks)***

8. A random variable X has the following probability distribution:

$P(X = 0) = \frac{1}{8}$, $P(X=1) = P(X=2) = \frac{3}{8}$ and $P(X=3) = \frac{1}{8}$.

Find the:

(a) mean of X,

(b) variance of X. ***(05 marks)***

SECTION B: (60 MARKS)

9. The table below shows the marks obtained in and examination by 200 candidates.

Marks%	Number of candidates
10-19	18
20-29	34
30-39	58
40-49	42
50-59	24
60-69	10
70-79	6
80-89	8

Calculate the;

(i) mean mark,x

(ii) modal mark. ***(05 marks)***

(b) Draw a cumulative frequency curve for the data. Hence estimate the lowest mark for a distinction 1 if the top 5% of the candidates qualify for the distinction.

(05 marks)

10. At 11:45 a.m, Ship A has as a position vector $\begin{pmatrix}5\\1\end{pmatrix}$ and moving at $8kmh^{-1}$ in the direction N 30^0 E. At 12 noon, another ship B, has apposition vector $\begin{pmatrix}8\\7\end{pmatrix}$ km and moving at $3kmh^{-1}$ in the direction South East.

Find the position vector of ship A at 12 noon.

(03 marks)

(b) If the ship after 12:00 noon maintain their courses, find the:

(i) time when they are closed,

(ii) least distance between them. ***(09 marks)***

11. (a) (i) Show that the equation $e^x -2x-1=0$ has a root between x=1 and x= 1.5.

(ii) Use linear interpolation to obtain approximately of the root. ***(06 marks)***

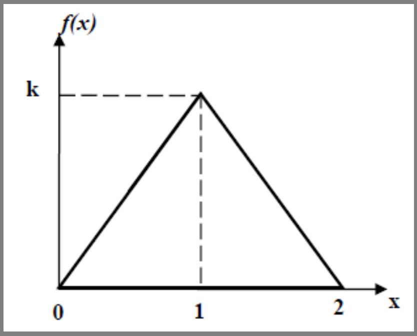
(b) (i) Solve the equation in (a) (i), Using each formula below twice. Take the approximation in (a)(ii) as the initial value.

Formular **1**: $^{x}n +1 = \frac{1}{2}(e^{x}n + 1)$.

Formular **2**: $x_{n+1} = \frac{e^{x_n}(x_n - 1) + 1}{e^{x_n} - 2}$.

(ii)Deduce with a reason which of the formulae is appropriate for solving the given equation in (a) (i) . Hence write down a better approximate root, correct to **two** decimal places. ***(06 marks)***

12. A continous random variable X has a probability density function (p.d.f) f(x) as shown in the graph below.



(a)Find the:

(i)value of k,

(ii) expression for the probability density function (p.d.f) of X. ***(05 marks)***

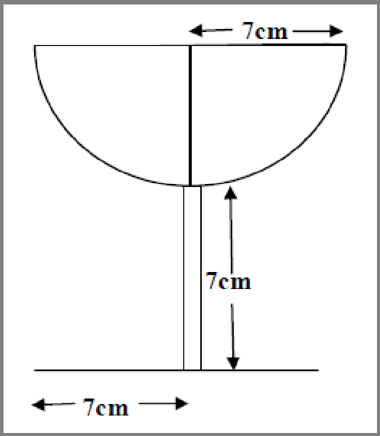
(b)Calculate the:

(i) mean of X,

(ii) P(X∠1.5 / X >0.5) ***(07 marks)***

13. (a) Show that the centre of gravity of a uniform thin hemispherical cup of radius, r is at a distance r/2 from the base. ***(05 marks)***

(b)The figure below is made up of a thin hemispherical cup of radius 7crn. It is welded to a stem of length 7cm and then to a circular base of the same material and of radius 7cm. The mass of the stem is one –quarter that of the cup.



Find the distance form the base, of the centre of gravity of the figure. ***(07 marks)***

14. The length, width and height of water tank were all rounded off to 3.65m, 2.5 m respectively.Determine in m^3 the least and greatest amount of water the tank can contain.

(05 marks)

(b) A shop offered 25% discount on all items in its store and a second discount of 5% to any customer who paid cash.

(i) Construct a flow chart which shows the amount paid for each item.

(ii) Using your flow chart in (i), compute the amount paid for the following items:

Item	Price	Mode of payment
Mattress	125,000	Cash
Television set	340,000	Credit

(07 marks)

15. (a) A box of oranges contains 20 good and 4 bad oranges. If 5 oranges are picked at random , determine the probability that 4 are good and the other is bad.

(03 marks)

(b) An examination has 100 questions. A student has 60% chance of getting each . A student fails the examination for a mark less than 55. A student gets a distinction for a mark of 68 or more . calculate the probability that a student:

(i)fails the examination,

(ii) gets a distinction. ***(09 marks)***

16. A gum of mass 3000kg fires horizontally a shell at an initial velocity of 300 ms^{-1}. If the recoil of the gun is brought to rest by a constant opposing force of 900 N in two seconds, find the:

(a) (i) initial velocity of the recoil of the gun,

(ii) mass of the shell,

(iii) gain in kinetic energy of the shell just after firing.

(08 marks)

(b) (i) displacement of the gun,

(ii) Work done against the opposite force.

(04 marks)

P425/1 , PAPER 1
PURE MATHEMATICS
Nov.Dec.2013. 3 hours.
SECTION

1. Solve $\log_x 5 + 4\log_x 5 = 4$. ***(05 marks)***

2. In a Geometric progression (G.P), the difference between the fifth and the second term is 156. The difference between the seventh and the fourth term is 404. Find the possible values of the common ratio.

(05 marks)

3. Given that r = 3 cos is an equation of a circle , find it's Cartesian form. ***(05 marks)***

4. The position vector of point *A* IS 2***i*** +3***j*** +***k***, of *B* is 5***j*** +4***k*** and of *C* is i +2j +12***k***. Show that *ABC* is a triangle.

(05 marks)

5.Solve $5\cos^2 3\theta = 3(1 + \sin 3\theta)$ for 90^0. ***(05 marks)***

6. If $y = x(x-0.5)e^{2x}$, find $\frac{dy}{dx}$.

Hence determine $\int_0^1 xe^{2x}\,dx$. ***(05 marks)***

7. The region bounded by the curve y = cos x, the y- axis and the x-axis from x=0 to $x = \frac{\pi}{2}$ is rotated about the x-axis . Find the volume of the solid formed.

(05 marks)

8. Solve $(1-x^2)\frac{dy}{dx} - xy^2 = 0$, given that y=1 when x=0.

(05 marks)

SECTION B: (60 MARKS)

9. (a) The complex number $Z=\sqrt{3+i}$. Z is the conjugate of Z.

(i) Express Z in the modulus argument form.

(ii) On the same Argand diagram plot Z and 2Z+3i.

(08 marks)

(b)What are the greatest and least values of lZl if I$|z-4i| \le 3$?

10. Given the equation $x^3 + x - 10 = 0$,

Show that x=2 is a root of the equation.

(05 marks)

(b) deduce the values of $\alpha+\beta$ and $\alpha\beta$ where α and β are the other roots of the equation.

Hence form a quadratic equation whose roots are α^2 and β^2. ***(09 marks)***

11. (a)Find the point of intersection of the lines

$$\frac{x-5}{4} = \frac{y-7}{4} = \frac{z+3}{-5} \text{ and } \frac{x-8}{7} = \frac{y-4}{1} = \frac{z-5}{3}$$

(06 marks)

(b) The equations of a line and a plane are $\frac{x-2}{1} = \frac{y-2}{2} = \frac{z-3}{2}$ and 2x +y +4z = 9 respectively. P is a point on the line where x =3. *N* is the foot of the perpendicular from point P to the plane.

Find the coordinates of *N*. ***(08 marks)***

12. (a) Find the equation of the tangents to the hyperbola whose points are of the parametric form (2*t*,2/*t*)in (a),

(05 marks)

(b) (i) Find the equations of the tangents in (a), which are parallel to y + 4 x = 0. ***(04 marks)***

(ii) Determine the distance between the tangents in (i)

(03 marks)

13. A curve has the equation $y = \frac{2}{1+x^2}$.

(a) Determine the nature of the turning point on the curve.

(07 marks)

(b) Find the equation of the asymptote.

Hence sketch the curve. ***(05 marks)***

14. (a) Prove that tan (A-B) = $\frac{\tan A-\tan B}{1+\tan A\tan B}$.

Hence show that $\frac{1-\tan 15^0}{1+\tan 15^0}=\frac{1}{\sqrt{3}}$. *(06 marks)*

(b)Given that cos A =3/5 and cos B=12/13 where A and B are acute, find the value of

(i) tan (*A* +*B*)

(ii) cosec (*A* + *B*) *(06 marks)*

15. Resolve y= $\frac{x^3+5x^2-6x6}{(x-1)^2(x^2+2)}$ into partial fractions.

Hence find $\int ydx$ and $\frac{dy}{dx}$. *(12 marks)*

16. The differential equation $\frac{dp}{dt}$=kp(c-p). shows the rate at which information flows in a student population c. p represents the number who have heard the information in t days and k is a constant.

(a) Solve the differential equation *(06 marks)*

(b) A school has a population of 1000 students. Initially, 20 students had heard the information. A day later, 50 students had heard the information. How many students heard the information by the tenth day?

(06 marks)

P425/2 , PAPER 2

PURE MATHEMATICS

Nov.Dec.2013. 3 hours.

1. A class performed an experiment to estimate the diameter of a circular object. A sample of five students had the following results in centimeters;

3,12,3.16,2.94,3.33, and 3.0.

Determine the sample;

(a) mean

(b) standard deviation. *(05 marks)*

2. The table below shows the values of a function f(x)

x	1.8	2.0	2.2	2.4
f(x)	0.52	0.484	0.436	0.384

Use linear interpolation to find the value of

(a) f(2.08).

(b) x corresponding to f(x) = 0.5 *(05 marks)*

3. The speed of a taxi decreased from 90 kmh^{-1} to 18kmh^{-1} in a distance of 120 metres. Find the speed of the taxi when it had covered a distance of 50 metres.

4. Events A and B are such that P(A∩B) = $\frac{1}{12}$

And P(A/B) =$\frac{1}{3}$

Find P(A∩B'). *(05 marks)*

5. Find the approximate value of $\int_0^2 \frac{1}{1+x^2}dx$ using the trapezium rule with 6 ordinates. Give your answer to 3 decimal places. *(05 marks)*

6. Forces of 7N and 4 N act away from a common point and make and angle of ^{0} with each other.Given that magnitude of their resultant is 10.75N,

Find the;

(a) value of .

(b) direction of the resultant. *(05 marks)*

7. An industry manufactures iron sheets of mean length 3.0 m and standard deviation of 0.05 m. Given that the lengths are normally distributed, find the probability that the length of any iron sheet picked at random will be between 2.95 m and 3.15 m. *(05 marks)*

8. A particle of mass m kg is released at rest from the highest point of asolid spherical object of radius a metres. Find the angle to the vertical at which the particle leaves the sphere. *(05 marks)*

SECTION B: (60 MARKS)

9. The heights (cm) and ages (years) of a random a random sample of ten farmers are given in the table below.

Height(cm)	156	151	152	160	146	157	149	142	158	140
Age(years)	47	38	44	55	46	49	45	30	45	30

(a) (i) Calculate the rank correlation coeffient.

(ii) Comment on your result . *(05 marks)*

(b) Plot a scatter diagram for the data.

Hence draw a line of best fit. *(05 marks)*

(c) Use your diagram in (b) to find

(i) y when x= 147.

(ii) x when y =43. *(05 marks)*

10. A mass of 12 kg rests on a smooth inclined plane which is 6 m long and 1 m high. The mass is connected by a light inextensible string, which passes over a smooth pulley fixed at the top of the plane, to a mass of 4 kg which is hanging freely. With the string taut, the system is released from rest.

(a) Find the

(i) acceleration of the system.

(ii) tension in the string. *(08 marks)*

(b) Determine the;

(i) velocity with which the 4kg mass hits the ground.

(ii) time the 4kg mass takes to hit the ground. .

(04 marks)

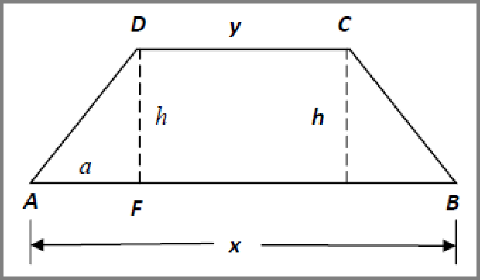
11. The probability density function (p.d.f) of a continous random variable X is given by

$$f(x)=\begin{cases} kx(16-x^2), & 0\le x\le 4 \\ 0 \quad , & \text{elsewhere;}\end{cases}$$

Where k is a constant.
Find the;
(a) value of k. ***(04 marks)***
(b) mode of X. ***(04 marks)***
(c) mean of X. ***(04 marks)***

12. (a) Particles of masses, 5kg, 2kg, 3kg and 2kg act at points with position vectors 3**i**-**j**,2**i** +3**j**, -2**i** +5**j** and –**i** -2**j** respectively.
Find the position vector of their centre of gravity. ***(06 marks)***

(b) The figure ABCD below shows a metal sheet of uniform material cut in the shape of trapezium .AB=x, CD=y, AF =A, EB = b and h is the vertical distance between AB and CD.



Show that the centre of gravity of the sheet is at a distance.
$\frac{h}{3}\left[\frac{3y+a+b}{x+y}\right]$ from side AB. ***(06 marks)***

13. The numbers x and yare measured with possible errors of Δx and Δy respectively.
(a) Show that the maximum absolute error in the quotient $\frac{x}{y}$ is given by $\frac{|y||\Delta x|+|x||\Delta y|}{y^2}$ ***(06 marks)***
(b) Find the interval within which the exact value of $\frac{2.58}{3.4}$ is expected to lie. ***(06 marks)***

14. A particle is projected with speed of 36 ms^{-1} at an angle of 40^0 to the horizontal from the point 0.5 m above the level ground. It just clears a wall which is 70 metres on the horizontal plane from the point of projection.
Find the
(a) (i) time taken for the particle to reach the wall.
(ii) height of the wall. ***(08 marks)***

(b) maximum height reached by the particle from the point of projection. ***(04 marks)***

15. (a) Show that the iterative formula based on Newton Raphson's method for solving equation $\ell n\, x + x - 2 = 0$ is given by
$x_{n+1}=\frac{x_n(3-\ell n x_n)}{1+x_n}$; n=0,1,2….. ***(04 marks)***
(b) (i) Construct a flow chart that:
- reads the initial approximation as r
- computers, using the iterative formula in (a) ,

and prints the root of the equation $\ell nx+x-2=0$, when the error is less that 1.0 $x10^{-4}$.

(ii) Perform a dry run of the flow chart when r=1.6. ***(08 marks)***

16. A research station supplies three varieties of seeds ***S₁***, ***S₂ and S₃*** in the ratio 4:2:1. The probabilities of germination of S_1, S_2 and S_3 are 50% ,60% and 80% respectively.
(a) Find the probability that a seed selected at random will germinate. ***(05 marks)***
(b) Given that 150 seeds are selectedat random, find the probability that less than 90 of the seeds will germinate. Give your answer to two decimal places. ***(07 marks)***

P425/1 , PAPER 1
PURE MATHEMATICS
Nov.Dec.2014. 3 hours.

1. Solve the simultaneous equations:
x-2y-2z=0
2x + 3y +z =1
3x-y -3z=3 ***(05 marks)***

2. A forcal chord *PQ*, to the parabola y^2 =4x, has a gradient m=1.F ind the coordinates of midpoint of *PQ*. ***(05 marks)***

3. Given that cos 2*A*-cos2*B*=-p and sin 2*A*-sin 2*B*=q, prove that sec(*A* +*B*)=$\frac{1}{q}\sqrt{p^2+q^2}$. ***(05 marks)***

4. Differetiate $\log_5\left(\frac{e^{\tan x}}{\sin^2 x}\right)$ with respect to x. ***(05 marks)***

5. Find the equation of a line through S(1,0,2) and T (3,2,1) in the form **r=a** + λ **b.**
Hence , deduce the Cartesian equation of the line. ***(05 marks)***

6.Solve the equation $\sqrt{2x+3}-\sqrt{x+1}=\sqrt{x-2}$. ***(05 marks)***

7. Find $\int x(1-x^2)^{1/2}\,dx$.

8. A cylinder has radius r and height 8r. The radius increases from 4cm to 4.1 cm. Find the approximate increase in the volume .(Use $\pi = 3.14$) ***(05 marks)***

SECTION B: (60 MARKS)

9. (a) Given that the complex number Z and it's conjugate Z satisfy the equation Z Z +2Iz = 12 + 6i, find Z. ***(07 marks)***

(b)One root of the equation $Z^3 - 3Z^2 - 9Z + 3 = 0$ is 2 + 3i. Determine the other roots. ***(05 marks)***

10. A circle is described by the equation $x^2 + y^2 - 4x - 8y + 16 = 0$. A line given by the equation y=2(x-1) cuts the circle at points A and B. A point P(xy) moves such that it's distance from the mid point of A B is equal to it's distance from the centre of the circle.

(a) Calculate the coordinates of A andB. ***(05 marks)***

(b) Determine the centre and radius of the circle. ***(03 marks)***

(c) Find the locus of P. ***(04 marks)***

11.(a) Differentiate $y=\cot^{-1}(1nx)$ with respect to x. ***(06 marks)***

(b) Evaluate $\int_{\frac{\pi}{3}}^{\pi} x \sin x \, dx$. ***(06 marks)***

12.(a) Find the Cartesian equation of the plane through the points whoseposition vectors are 2i +2j +3k, 3i +j+2k and -2j + 4k. ***(06 marks)***

(b) Determine the angle between the plane in (a) and the line. $\frac{x-2}{2} = \frac{y}{-4}$ = z-5. ***(06 marks)***

13. (a) Find the first three terms of expansion $(2-x)^6$ and use it to find $(1.998)^6$ correct to **two** decimal places. ***(07 marks)***

(b)Expand $(1-3x + 2x^2)^5$ in ascending powers of x as far as the x^2 term. ***(05 marks)***

14. (a) Find the equation of a normal to acurve whose parametic equations are $x=b\sec^2$,$y=b\tan^2$. ***(06 marks)***

(b) The area enclosed by the curve $x^2 + y^2 = a^2$, the y-axis and the line $y = -\frac{1}{2}a$ is rotated through 90^0 about the y – axis .Find the volume of the solid generated. ***(06 marks)***

15. Solve

(a) $4\sin^2 \quad -12 \sin 2 \quad + 35\cos^2 \quad =0$, for $0^0 \le \theta \le 90^0$. ***(06 marks)***

(b) 3cos -2sin =2, for $0^0 \le \theta \le 360^0$.***(06 marks)***

16. A substance loses mass at rate which is proportional to the amount M present at time t.

(a) Form a differential equation connecting M, t and the constant of proportionality k. ***(02 marks)***

(b) If initially mass of the substance is M_O, show that $M=M_Oe^{-kt}$. ***(05 marks)***

(c) Given that half of the substance is lost in 1600 years, determine the number of years 15 g of the substance would take to reduce to 13.6 g. ***(05 marks)***

P425/2 , PAPER 2
PURE MATHEMATICS
Nov.Dec.2014. 3 hours.

1. The daily number of patients visitng a certain hospital is uniformly distributed between 150 and 210.

(a)Write down the probability distribution function (pdf) of the number of patients. ***(05 marks)***

(b) Find the probability that between 170 and 194 patients visit the hospital on a particular day. ***(05 marks)***

2. A particle starts from rest at the origin (0,0). It's acceleration im ms^{-2} at time t seconds is given by a= 6t i-4j. Find it's speed when t = 2 seconds. ***(05 marks)***

3. Use the trapezium rule with four sub –intervals to estimate

$\int_{0.2}^{1.0}\left(\frac{2x+1}{x^2+x}\right)dx$, correct two decimal places.***(05 marks)***

4. Tom's chance of passing an examination is $\frac{2}{3}$. If he sits for four examinations, find the probability that he passes:

(a) Only two examinations.

(b) more than half of the examinations. ***(05 marks)***

5.Forces of $\begin{pmatrix}1\\-4\end{pmatrix}$N, $\begin{pmatrix}3\\6\end{pmatrix}$N, $\begin{pmatrix}-9\\1\end{pmatrix}$N and $\begin{pmatrix}5\\-3\end{pmatrix}$N act at the points having positive vectors (3**i**-**j**)m, (2**i**+2**j**)m, (-**i**-**j**)m and (-3**i** + 4)m respectively. Show that the forces reduce to a couple. ***(05 marks)***

6.Given the table below;

x	0	10	20	30
Y	6.6	2.9	-0.1	-2.9

Use linear interpolation to find;

(a) y when x= 16.

(b), x when y= -1. ***(05 marks)***

7. The table below shows scores of students in Mathematics and english tests.
Calculate the rank correlation coefficient for the student's performance in the two subjects. ***(05 marks)***

8. A bullet of mass 50 grammes travelling horizontally at $80ms^{-1}$ hits a block of wood of mass 10 kg resting on a smooth horizontal plane. If the bullet emerges with a speed

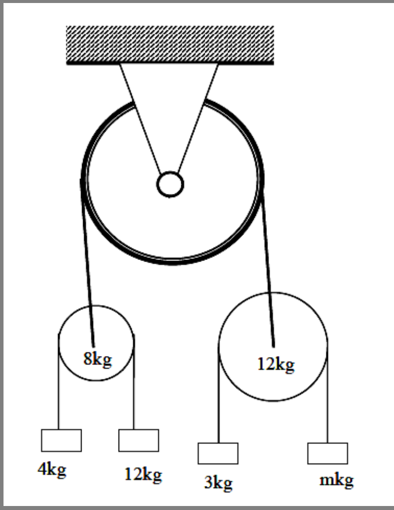
of $50ms^{-1}$, find the speed with which the block moves.
(05 marks)

SECTION B: (60 MARKS)

9. (a) A bag contains 30 White(W), 20 blue(B) and 20 red (R) balls. Three balls drawn at random one after the other without replacement. Determine the probability that the first ball is white and the third ball is also white. ***(05 marks)***

(a) Events A and B are such that $P(A) = \frac{4}{7}$, $P(A \cap B') = \frac{1}{3}$ and $P(A/B) = \frac{5}{14}$.
Find;
(i) P(B).
(ii) $P(A' \cap B')$. ***(07 marks)***

10. The diagram below shows two pulleys of 8 kg and 12 kg connected by a light inextensible string hanging over a fixed pulley.



The accelerations of 4kg and 12 kg masses are $g/2$ upwards and $g/2$ downwards respectively. The accelerations of the 3 kg and *m* kg masses are $g/3$ upwards and $g/3$ downwards respectively. The hanging portions of the strings are vertical. Given that the string of the fixed pulley remains stationary, find the:
(a) tensions in the strings, ***(09 marks)***
(b) value of ***m*** ***(03 marks)***

11. The numbers x and y are approximated with possible errors of Δx and Δy respectively.
(a) Show that the maximum absolute error in the quotient $\frac{x}{y}$ is given by $\frac{y\Delta x + x\Delta y}{y^2}$ ***(05 marks)***
(b) Given that x=2.68 and y=0.9 are rounded to given number of decimal places, find the interval within which the exact value of $\frac{x}{y}$ is expected to lie.
(07 marks)

12. A lorry starts from a point A and moves along a straight horizontal road with a constant acceleration of $2ms^{-2}$. At the same time a car moving with a speed of $20ms^{-1}$ and a constant acceleration of $3ms^{-2}$ is 400m behind the point A and moving in the same direction as the lorry. Find
(a) how far from A the car overtakes the lorry.***(10 marks)***
(b) the speed of the lorry when it is being overtaken .
(02 marks)

13. The cumulative frequency table below shows the ages in years of employees of a certain company.
(a) (i) Use the data in the table to draw a cumulative frequency curve (Ogive).
(ii) Use the curve to estimate the semi- interquartile range.
(06 marks)
(b)Calculate the mean age of the employees.
(06 marks)

14. (a) Show that the newton-Raphson formula for finding the root of the equation $x=N^{1/5}$ is given by

$$x_{n+1} = \frac{4x_n^5 + N}{5x_n^4}, n=0,1,2\ldots\ldots$$ ***(04 marks)***

(a) Construct a flow chart that
(i) reads N and the first approximation x_o,
(ii)computers the root to three decimal places,
(iii) prints the root (x_n) and number of iterations (n)
(05 marks)
(c) Taking N=50, x_o=2.2, perform a dry run for the flow chart. Give your root correct to three decimal places.
(03 marks)

15. (a) A non- uniform plank AB of length 4 metres rests in horizontal position on vertical supports at A and B. The centre of gravity is at 1.5 m from A. The reaction at B is 37.5 N. Determine the:
(i) mass of the plank.
(ii) Reaction at A. ***(05 marks)***

(b) Find the coordinates of the centre of gravity of a uniform lamina bounded by the curve y^2 =2x and the line x = 4. ***(07 marks)***

16. The mark in an examination were normally distributed with mean and standard deviation .20% of the candidates scored lessthan 40 marks and 10% scored more than 75 marks. Find the ;
(a) values of and . ***(08 marks)***
(b) Percentage of candidates who scored more than 50 marks. ***(04 marks)***

P425/1 , PAPER 1
PURE MATHEMATICS
Nov.Dec.2015. 3 hours.

1. The first term of an Arithmetic progression (A.P) is equal to the first term of a Geometric Progression (G.P) whose common ratio is 1/3 and sum to infinity is 9. If the common difference of A.P is 2, find the sum of the first ten terms of the A.P. ***(05 marks)***

2. Find the equations of the line through the point (5,3) and perpendicular to the line 2x –y +4 =0.

3. Solve for x in: $\log^a (x+3) + \dfrac{1}{\log_x a} = 2\log^a 2$.

(05 marks)

4. Given that ***D***(7,1,2), ***E***(3,-1,4) and ***F***(4,-2,5) are points on a plane, show that ***ED*** is perpendicular to ***EF***. ***(05 marks)***

5. In a Triangle ABC all the angles are acute. Angle ABC= 50^0, A= 10cm and b=9 cm. Solve the triangle. ***(05 marks)***

6. Differentiate $e^{-x^2} x^3 \sin x$ with respect to x. ***(05 marks)***

7. The region enclosed by the curve $y=x^2$, the x-axis and the line x=2, is rotated through one revolution about the x-axis. Find the volume of the solid generated. ***(05 marks)***

8. Solve $\dfrac{dy}{dx} = e^{x+y}$ given that y=2 when x=0.

SECTION B: (60 MARKS)

9. (a) Given that $f(x) = (x-a)^2 g(x)$, show that f'(x) is divisible by (x-a). ***(03 marks)***

(b) A polynomial $P(x) = x^3 + 4ax^2 + bx + 3$ is divisible by $(x-1)^2$. Use the result in (a) above , to find the values of a and b.

Hence solve the equation P(x)=0. ***(09 marks)***

10. Sketch on the same co-ordinate axes the graphs of the curve $y=2+x-x^2$ and the line y=x +1.

Hence determine the area of the region enclosed between the curve and the line. ***(12 marks)***

11. (a) Solve ZZ -5iz =5(9-7i), where Z is the complex conjugate of Z . ***(06 marks)***

(b) (i) Find the cartesian equation of the curve given as $|Z+2-3i| = 2|Z-2+i|$.

(ii) Show that it represents a circle. Find the centre and radius of the circle. ***(06 marks)***

12. (a) Simplify $\dfrac{\cos 3\theta + \cos 5\theta}{\sin 5\theta - \sin 3\theta}$.

(b) Show that $\cot 2\theta = \dfrac{1-\tan^2\theta}{2\tan\theta}$.

Hence solve the equation $\cot 2\theta = 4 - \tan\theta$ for values of θ between 0^0 and 360^0. ***(09 marks)***

13. Express $-\dfrac{1}{x^2(x-1)}$ as partial fractions.

Hence evaluate $\int_2^3 \dfrac{dx}{x^2(x-1)}$ correct to 3 decimal places.

(12 marks)

14. (a) Show that the lines a= $\begin{pmatrix}3\\-4\\2\end{pmatrix} + a\begin{pmatrix}-1\\1\\2\end{pmatrix}$ and $\begin{pmatrix}5\\0\\-2\end{pmatrix} + \beta\begin{pmatrix}-1\\-1\\2\end{pmatrix}$ intersect. ***(06 marks)***

(b) Find the

(i) point of intersection, P of the two line in (a).

(ii) Cartesian equation of the plane which contains a and b. ***(06 marks)***

15. The tangents at the points P(cp,c/p) and Q(cq, c/q) on the rectangular hyperbola $xy=c^2$ intersect at R. Given that R lies on the curve $xy = \dfrac{c^2}{2}$, show that the locus of the mid-point of PQ is given by $xy = 2c^2$.

(12 marks)

16. The rate of increase of a population of certain birds is proportional to the number in the population present at that time. Initially, the number in the population was 32,000.After 70 years the population was 48,000.

Find the

(a) number of birds in the population after 82 years.

(b) time when the population doubles the initial number.

(12 marks)

P425/2 , PAPER 2
PURE MATHEMATICS
Nov.Dec.2015. 3 hours.

1. Find the direction and magnitude of the resultant of the forces.

$\begin{pmatrix}-3\\1\end{pmatrix}$N, $\begin{pmatrix}4\\2\end{pmatrix}$N, and $\begin{pmatrix}1\\2\end{pmatrix}$N. ***(05 marks)***

2. Use the trapezium rule with five subintervals to estimate $\int_2^4 \frac{5}{(x+1)}\,dx$. Give your answer correct to 3 decimal places. *(05 marks)*

3. The table below shows the mass of boys in a certain school.

Mass (kg)	15	20	25	30	35
Number of boys	5	6	10	20	9

Calculate the mean mass. *(05 marks)*

4. Two cyclists A and B are 36m apart on a staright road. Cyclist B starts from rest with an acceleration of 6ms^{-2} while A is in pursuit of B with velocity of 20ms and acceleration of 4ms^{-2}. Find the times when A overtakes B. *(05 marks)*

5. Events A and B are independent. P(A) = x, P(B) = x + 0.2 and P(A $\cup$ B) = 0.65.
Find the value of x. *(05 marks)*

6. The table below shows the values of a function f(x) for given values of x.

x	f(x)
9	2.66
10	2.42
11	2.18
12	1.92

Use linear interpolation or extrapolation to find:
(a) f(10.4).
(b) the value of x, corresponding to f(x)=146.
(05 marks)

7. The marks in an examination were found to be normally distributed with Mean 53.9 and standard deviation 16.5.20% of the candidates who sat this examination failed. Find the pass mark for the examination.
(05 marks)

8. A fixed hollow hemisphere has centre O and is fixed so that the plane of the rim is horizontal. A particle A of weight $30\sqrt{2}$ N can move on the inside surface of the hemisphere. The particle is acted upon by a horizontal force P, whose line of action is in a vertical plane through O and A. OA makes an angle of 45^0 with the vertical . If the coefficient of friction between the particle and the hemisphere is 0.5 and the particle is just about to slip downwards, find the
(a) normal reaction.
(b) value of P. *(05 marks)*

SECTION B: (60 MARKS)

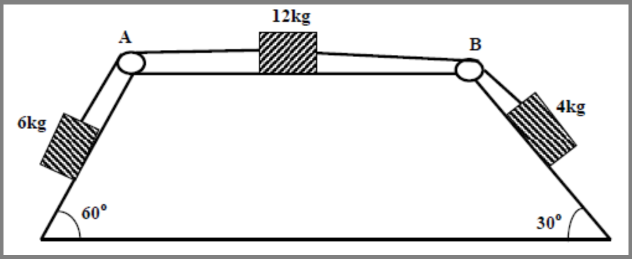
9. The probability density function (p.d.f) of a random variable Y is given by

$$f(x) = \begin{cases} (\frac{y+1}{4}), & 0 \le y \le k \\ 0, & \text{elsewhere} \end{cases}$$

Find
(a) the value of k *(06 marks)*
(b) the expectation of Y. *(03 marks)*
(c) P(1≤Y≤1.5) *(03 marks)*

10. The numbers A=6.341 and B=2.6 have been rounded to the given number of decimal places.
(a) Find the maximum possible error in AB. *(05 marks)*
(b) Determine the interval within which $\frac{A^2}{B}$ can be expected to lie.
Give your answer correct to 3 decimals. *(07 marks)*

11. The diagram below shows a 12 kg mass on a horizontal rough plane. The 6 kg and 4 kg masses are on rough planes inclined at angles of 60^0 and 30^0 respectively. The masses are connected to each other by light inextensible strings passing over light smooth fixed pulleys A and B.



The planes are equally rough with coefficient of friction $\frac{1}{12}$. If the system is released from rest, find the;
(a) acceleration of the system. *(08 marks)*
(b) tensions in the strings. *(04 marks)*

12. The table below gives the points awarded to eight schools by the judges J_1, J_2 and J_3 during a music competition. J_1 was the chief judge.

J_1	72	50	50	55	35	38	82	72
J_2	60	55	70	50	50	50	73	70
J_3	50	40	62	70	40	48	67	67

(a) Determine the rank correlation coefficient between the judgments of
(i) J_1 and J_2.
(ii) J_1 and J_3. *(10 marks)*
(b) Who of the two other judges had a better correlation with chief judge? Give a reason. *(02 marks)*

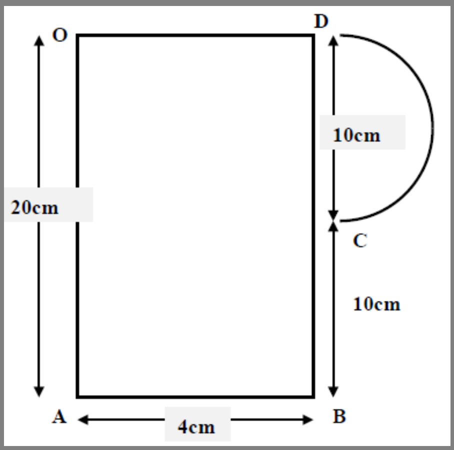
13. A ball is projected from a point A and falls at a point B which is in level with A and at adistance of 160m from A. The greatest height of the ball attained is 40m.
Find the;
(a) Show that the iterative formula based on Newton Raphson's method for approximating the root of the equation 2 In x-x +1=0 is given by

$x_{n+1} = x_n\left(\frac{2\,\text{In}x,,-1}{x,,-2}\right), n = 0,1,2\ldots\ldots$ ***(03 marks)***

(b) Draw a flow chart that:
(i) reads the initial approximation x_0 of the root.
(ii) computers and prints the root correct to two decimal places, using the formula in (a).
(05 marks)

(c) Taking x_0=3.4, perform a dry run to find the root of the equation . ***(04 marks)***

15. The figure below represents a lamina formed by welding together a rectangular metal sheet and semi-circular metal sheet.
Find the position of the centre gravity of the lamina from the side OA.



16. A box A contains 4 white and 2 red balls .Another box B contains 3 white and 3 red balls. A box is selected at random and two balls are picked one after the other without replacement,
(a) Find the probability that the two balls picked are red. ***(07 marks)***
(b) Given that two white balls are picked, what is the probability that they are from box B? ***(05 marks)***

P425/1 , PAPER 1
PURE MATHEMATICS
Nov.Dec.2016. 3 hours.

1. Without using mathematical tables or a calculator, find the value of

$$\frac{\left(\sqrt{5}+2\right)^2 - \left(\sqrt{5}-2\right)^2}{8\sqrt{5}}$$ ***(05 marks)***

2. Find the angle between the lines 2x-y=3 and 11x +2y=3. ***(05 marks)***

3. Evaluate $\int_{½}^{1} 10x\sqrt{(1-x)}\,dx$. ***(05 marks)***

4. Solve the equation $\frac{dy}{dx} = 1 + y^2$ given that y=1 when x= 0. ***(05 marks)***

5. Given that $2x^2 + 7x - 4$, $x^2 + 3x - 4$ and $7x^2 + ax - 8$ have a common factor, find the:
(a) factor of $2x^2 + 7x - 4$ and $x^2 + 3x - 4$.
(b) value of a in $7x^2 + ax - 8$. ***(05 marks)***

6.Solve the equation sin 2 cos 4 = cos 4 cos 6 for 0 $\frac{1}{405} \le \theta \le \frac{\pi}{4}$. ***(05 marks)***

7.Using small changes, show that $(244)^{⅕} = 3\frac{1}{405}$. ***(05 marks)***

8. Three points A(2,-1,0), B(-2,5,-4) and C are on a straight line such that 3AB=2AC. Find the coordinates of C. ***(05 marks)***

SECTION B: (60 MARKS)

9. (a) If $Z_1 = \frac{2i}{1+3i}$ and $Z_2 = \frac{3+2i}{5}$, Find $|Z_1 - Z_2|$ ***(06 marks)***
(b) Given the complex number Z= x + iy;
(i) find $\frac{Z+i}{Z+2}$.
(ii) Show that the locus of $\frac{Z+i}{Z+2}$ is straight line when its maginary part is zero. State the gradient of the line. ***(06 marks)***

10. (a) Solve the equation $\cos 2x = 4\cos^2 x - 2\sin^2$ for $0 \le x \le 180^0$. ***(06 marks)***
(b) Show that if sin (x+a) =P sin (x-a) then

$$\tan x = \left(\frac{P+1}{p-1}\right)\tan a.$$

Hence solve the equation $\sin(x+20^0) = 2\sin(x-20^0)$ for $0^0 \le x \le 180^0$. ***(06 marks)***

11. Given that $x = \frac{t^2}{1+t^3}$ and $y = \frac{t^3}{1+t^3}$, find $\frac{d^2y}{dx^2}$. ***(12 marks)***

12. (a) Line A is the intersection of two planes whose equations are
3x-y +Z=2 and x +5y +2Z=6.
Find the Cartesian equation of the line. ***(05 marks)***

13. (a) Find $\int \frac{1+\sqrt{x}}{2\sqrt{x}}\,dx$. ***(03 marks)***

(b) The gradient of the tangent at any point on a curve is $x-\frac{2y}{x}$. The curve passes through the point (2,4). Find the equation of the curve. ***(09 marks)***

14. (a) The points P(at_1^2, $2at_1$,) and Q(at_2^2, $2at_2$,) are on the parabola $y^2 = 4ax$. OP is perpendicular to OQ, where O is the origin . Show that $t_1t_2 + 4 = 0$.

(04 marks)

(b) The normal to the rectangular hyperbola xy = 8 at a point (4,2) meets the asymptotes at M and N. Find the length of MN. ***(08 marks)***

15. (a) Prove by induction

$1.3 + 2.4 + \ldots\ldots + n(n+2) = \frac{1}{6}n(n+1)(2n+7)$ for all integral values of n. ***(06 marks)***

(b) A man deposits Shs150,000 at the beginning of every year in a micro-finance bank with the understanding that at the end of seven years he is paid back his money with 5% per annum compound interest. How much does he receive?

(06 marks)

16. (a)If $x^2 + 3y^2 = k$, where k is a constant, find $\frac{dy}{dx}$ at the point (1,2). ***(04 marks)***

(b) A rectangular field of area 7200cm^2 is to be fenced using a wire mesh. On one side of the field, is a straight river. This side of the field is not to be fenced. Find the dimension of the field that will minimize the amount of wire mesh to be used. ***(08 marks)***

P425/2 , PAPER 2
PURE MATHEMATICS
Nov.Dec.2016. 3 hours.

1. A ball is projected vertically upwards and it returns to it's point of projection 3 seconds later. Find the:

(a) speed with which the ball was projected.

(b) greatest height reached. ***(05 marks)***

2. The table below shows the values of two variables P and Q.

P	14	15	25	20	15	7
Q	30	25	20	18	15	22

Calculate the rank correlation coefficient between the two variables. ***(05 marks)***

3. Use the trapezium rule with 4 sub- intervals to estimate

$$\int_0^{\frac{\pi}{2}} \cos.x dx$$

Correct to three decimal places. ***(05 marks)***

4. A body of mass 4 kg is moving with initial velocity of 5ms^{-1} on plane. The kinetic energy of the body is reduced by 16 Joules in a distance of 40 ms^{-2} .Find the deceleration of the body.

5. A continous random variable X has a cumulative distribution function:

$$F(x) = \begin{cases} 0, & x \le 0, \\ \lambda x^3, & 0 \le x \le 4, \\ 1, & x \ge 4. \end{cases}$$

Find the

(a) value of the constant λ. ***(02 marks)***

(b) probability density function, f(x) ***(03 marks)***

6. The table below shows the values of f(x) for given values of x.

X	0.4	0.6	0.8
f(x)	-0.9613	-0.5108	-0.2231

Use linear interpolation to determine $f^{-1}(-0.4308)$ correct to 2 decimal. ***(05 marks)***

7. A particle of mass 2kg rests in limiting equilibrium on a rough plane inclined at 30^0 to the horizontal. Find the value of the coefficient of friction.

(05 marks)

8. A bag contains 5 pepsiCola and 4 Mirinda bottle tops. Three bottle tops are picked at random from the bag one after the other without replacement . Find the probability that the bottle tops picked are of the same type.

(05 marks)

SECTION B: (60 MARKS)

9. The data table below shows the length in centimeters of different calendars produced by a printing press. A cumulative frequency distribution was formed.

Length (cm)	**∠20**	**∠30**	**∠35**	**∠40**	**∠50**	**∠60**
Cumulative frequency	**4**	**20**	**32**	**42**	**48**	**50**

(a) Construct a frequency distribution table.

(02 marks)

(b) Draw a histogram and use it to estimate the modal length. ***(06 marks)***

(c) Find the mean length of the calendars.

(05 marks)

10. Five forces of magnitude 3N,4N,4N,3N, and 5N act along the lines AB,BC,CD,DA,and AC respectively, of square ABCD of side 1m.The direction of the forces is given by the order of the letters . Taking AB and AD as reference axes; find the

(a) magnitude and direction of the resultant force.

(08 marks)

(b) point where the line of action of the resultant force cuts the side AB. ***(04 marks)***

11. Given the equation $x^3-6x^2+9x+2=0$;

(a) Show that the equation has a root between -1 and 0.

(03 marks)

(b) (i) Show that the Newton Raphson formula for approximating the root of the equation is given by

$x_{n+1}=\frac{2}{3}\left[\frac{x_n^3-3x_n^2-1}{x_n^2-4xn+3}\right]$. *(04 marks)*

(ii) Use the formula in (b)(i) above, with an initial approximation of x_0 =-5, to find the root of the given equation correct to two decimal places.

12. A newspaper vendor buys 12 copies of a sports magazine every week. The probability distribution for the number of copies sold in a week is given in the table below.

Number of copies	9	10	11	12
Probability	0.2	0.35	0.30	0.15

(a) Estimate the
(i) expected number of copies that she sells in a week.
(ii) variance of the number of copies sold in a week.
(05 marks)

(b) The vendor buys the magazine at Shs 1,200 and sells it at Shs 1,500. Any copies not sold are destroyed. Construct a probability distribution table for the vendor's weekly profit from the sales.
Hence calculate her mean weekly profit.
(07 marks)

13. A particle starts from rest at a point (2,0,0) and moves such that it's acceleration at any time t>0 is given by
a = [16 cos 4t I + 8sin 2t j + (sin t-2sin 2t) k]ms^{-2}
Find the:

(a) speed when t = $\frac{\pi}{4}$. *(06 marks)*

(b) distance from the origin when t= $\frac{\pi}{4}$.*(06 marks)*

14. The numbers x and y are approximated by X and Y with errors Δx and Δy respectively.

(a) Show that the maximum relative error in xy is given by

$\left|\frac{\Delta x}{X}\right|+\left|\frac{\Delta y}{Y}\right|$ *(05 marks)*

(b) If x =4.95 and y=2.013 are aech rounded off to the given number of decimal places, calculate the
(i) percentage error in xy,
(ii) limits within which xy is expected to lie. Give your answer to three decimal places. *(07 marks)*

15. The drying time of a newly manufactured paint is normally distributed with mean 110.5 minutes and standard deviation 12 minutes.
(a) Find the probability and the paint between 104 and 109 minutes. *(06 marks)*
(b) If a random sample of 20 tins of the paint was taken , find the probab2ility that the mean drying time of the sample is between 108 and 112 minutes.
(06 marks)

16. A particle of mass 2 kg moving with Simple Harmonic Motion (SHM) along the x-axis, is attracted towards the origin O by a force of 32x Newtons. Initially the particle is at rest at x=20.Find the
(a) amplitude and period of the oscillation.
(05 marks)
(b) velocity of the particle at any time, t > 0. *(05 marks)*
(c) speed when t= $\frac{\pi}{4}$ s. *(02 marks)*

P425/1 , PAPER 1
PURE MATHEMATICS
Nov.Dec.2017. 3 hours.

1.The coefficients of the first three terms of the expansion of $\left(1+\frac{x}{2}\right)^n$ are in an arithmetic Progression (AP). Find the value of n. *(05 marks)*

2. Solve the equation $3\tan^2\theta+2\sec^2\theta=2(5-3\tan\theta)$ for $0^0\le x\le 180^0$. *(05 marks)*

3. Differentiate $\left(\frac{1+2x}{1+x}\right)^2$ with respect to x. *(05 marks)*

4. Solve for x in the equation $4^{2x}-4^{x+1}+4=0$. *(05 marks)*

5. The verticles of a triangle are P(4,3), Q(6,4) and R(5,8). Find angle RPQ using vectors.

6. Show that $\int_2^4 x\ln x\,dx = 14\ln 2-3$. *(05 marks)*

7. The equation of a curve is given by y^2 -6y +20x +49=0.
(a) Show that the curve is a parabola. *(03 marks)*
(b) Find the coordinates of the vertex. *(02 marks)*

8. A container is in the form of an inverted right circular cone.Its height is 100cm and base radius is 40 cm.The container is full of water and has a small hole at it's vertex. Water is flowing through the hole at a rate of $10cm^3S^{-1}$. Find the rate at which the water level in the container is falling when the height of water in the container is halved.
(05 marks)

SECTION B: (60 MARKS)

9. (a) Given that the complex number Z and its conjugates Z satisfy the equation Z Z -2Z +2Z =5-4i, find the possible values of Z. *(06 marks)*

(b) Prove that if $\frac{z-6i}{z+8}$ is real,then the locus of the point representing the complex number Z is a straight line.
(06 marks)

10. A circle whose centre is in the first quadrant touches the x- and y- axes and the line 8x-15y=120.
Find the :
(a) equation of the circle. *(10 marks)*
(b) point at which the circle touches the x-axis.

(02 marks)

11. A curve whose equation is $x^2 y + y^2 - 3x = 3$ passes through points A(1,2) and B(-1, 0). The tangent at A and the normal to the curve at B intersect at point C. Determine the :

(a) equation of the tangent. ***(06 marks)***

(b) coordinates of C. ***(06 marks)***

12. (a) Express cos $(\theta + 30^0) - \cos(\theta + 48^0)$ in the form Rsin Psin Q, where R, is a constant. Hence solve the equation. $(\theta + 30^0) - \cos(\theta + 48^0) = 0.2$

(06 marks)

(b) Prove that in any triangle ABC;

$\frac{\sin(A-B)}{\sin(A+B} = \frac{a^2 - b^2}{c^2}$. ***(06 marks)***

13. (a) Solve for x and y in the following simultaneous equations.

$(x-4y)^2 = 1$

$3x + 8y = 11$. ***(06 marks)***

(b) Find the set of values of x for which $4x^2 + 2x \angle -3x + 6$.

(06 marks)

14. (a) The points A and B have positions vectors a and b. A point C with a position vector c lies on AB such that $\frac{AC}{AB}\lambda$.

Show that c = $(1-\lambda)$ a+ λ b. ***(04 marks)***

(b) The vector equations of two lines are

$\mathbf{r_1}$=2i +j+ λ (I +j 2k) and

$\mathbf{r_2}$=2i +2j+t k + μ (i+2j +k) where I,j and k are unit vectors and λ, μ and t are constants. Given that two lines intersect, find

(i) the value of t.

(ii) the coordinates of the point of intersection.***(08 marks)***

15. (a) Sketch the curve $y = x^3 - 8$. ***(08 marks)***

(b) The area enclosed by the curve in (a), the y-axis and the x-axis is rotated about the line y= 0 through 360^0. Determine the volume of the solid generated. ***(04 marks)***

16. (a) Solve the differential equation

$\frac{dy}{dx} = (xy)^{½}$ In x, given that y = 1 when x=1.

Hence find the value of y when x= 4. ***(12 marks)***

P425/2 , PAPER 2
PURE MATHEMATICS
Nov.Dec.2017. 3 hours.

1. A particle is projected from a point O with speed 20m/s at an angle of 60^0 to the horizontal. Express in vector form it's velocity v and it's displacement r, from O at any time t seconds. ***(05 marks)***

2. The probability that a patient suffering from a certain disease recovers is 0.4. If 15 people contracted the disease, find the probability that:

(a) more than 9 will recover. ***(02 marks)***

(b) between five and eight will recover. ***(03 marks)***

3. The table below gives values of x and the corresponding values of f(x).

x	0.1	0.2	0.3	0.4	0.5	0.7
f(x)	4.21	3.83	3.25	2.85	2.25	1.43

Use linear interpolation / extrapolation to find

(a) f(x) when x =0.6. ***(03 marks)***

(b) the value of x when f(x)= 0.75. ***(02 marks)***

4. In a square ABCD, three forces of magnitudes 4N, 10N, and 7N act along AB,AD and CA respectively. Their directions are in the order of the letters. Find the magnitude of the resultant force. ***(05 marks)***

5. A box A contains 1 white ball and 1 blue ball. Box B contains only 2 white balls. If a ball is picked at random, find the probability that it is :

(a) white. ***(03 marks)***

(b) from boxA given that it is white. ***(02 marks)***

6. Given that y= $\frac{1}{x}$ + x and x = 2.4 correct to one decimal place, find the limits within which y lies. ***(05 marks)***

7. The table below shows retail prices (Shs)and amount of each item bought weekly by a restaurant in 2002 and 2003.

Item	Price (Shs)		Amount bought
	2002	2003	
Milk (Per litre)	400	500	200
Eggs (Per litre)	2,500	3,000	18
Cooking oil (Per litre)	2,400	2,100	2
Baking flour (per packet)	2,000	2,200	15

(a)Taking 2002 as the base year, calculate the weighted aggregate price index. ***(03 marks)***

(b) In 2003, the restaurant spent Shs 450,000 on buying these items. Using the weighted aggregate price index obtained in (a), calculate what the restaurant could have spent in 2002. ***(02 marks)***

8. The engine of a lorry of mass 5,000kg is working at asteady rate of 350Kw against a constant resistance force of 1,000N.The lorry ascends a slope of inclination θ^0 to the horizontal . If the maximum speed of the lorry is $20ms^{-1}$, find the value of θ. *(05 marks)*

SECTION B: (60 MARKS)

9. A discrete random variable X has a probability distribution given by

$$P(X=x) = \begin{cases} kx, & x = 1,2,3,4,5. \\ 0, & \text{Otherwise,} \end{cases}$$

Where ***k*** is a constant.

Determine;

(a) the value of k. *(03 marks)*

(b) $P(2\angle X\angle 5)$. *(02 marks)*

(c) Expectation, E(X). *(03 marks)*

(d) Variance, Var(X). *(04 marks)*

10. A particular mass 3 kg is acted upon by a force $F=6i-36t^2j+54tk$ Newtons at time t. At time t=0, the particle is at the point with a position vector i-5j-k and it's velocity is 3i +3j m/s. Determine the

(a) position vector of the particle at time t=1 second. *(09 marks)*

(b) distance of the particle from the origin at time t=1 second. *(03 marks)*

11. A student used atrapezium rule with five sub-intervals to estimate

$\int_2^3 \frac{x}{(x^2-3)}dx$ correct to three decimal places.

Determine;

(a) the value the student obtained. *(06 marks)*

(b) the actual value of the integral. *(03 marks)*

(c) (i) the error the student made in the estimate.

(ii) how the student can reduce the error. *(03 marks)*

12. The times taken for 55students to have their lunch to the nearest minute are given below.

Time (minutes)	3-4	5-9	10-19	20-29	30-44
Number of students	2	7	16	21	9

(a) Calculate the mean time for the students to have lunch. *(04 marks)*

(b) (i) Draw a histogram for the given data.

(ii) Use your histogram to estimate the modal time for the students to have lunch. *(08 marks)*

13. A non-uniform rod AB of mass 10kg has its centre of gravity at a distance ¼ AB from B. The rod is smoothly hinged at A. It is maintained in equilibrium at 60^0 above the horizontal by a light inextensible string tied at B and at a right angle to AB .Calculate the magnitude and direction of the reaction at A. *(12 marks)*

14. By plotting graphs of y = x and y = 4 sin x on the same axes, show that the root of the equation x - 4sinx = 0 lies between 2 and 3.

Hence the Newton Raphson's method to find the root of the equation correct to 3 decimal places. *(12 marks)*

15. The number of cows owned by residents in a village is assumed to be normally distributed. 15% of the residents have less than 60 cows. 5% of the residents have over 90 cows.

(a) Determine the values of the mean and standard deviation of the cows. *(08 marks)*

(b) If there are 200 residents, find how many have more than 80 cows. *(04 marks)*

16. At 12:00noon a Ship A is moving with constant velocity of $20.4kmh^{-1}$ in the direction $N\theta^0E$, where tan ¾ $\theta = \frac{1}{5}$ .A second Ship B is 15 km due north of A. Ship B is moving with constant velocity of $5kmh^{-1}$ in the direction $S\alpha^0W$, where tan $\alpha = \frac{3}{4}$ .If the shortest distance between the ships is 4.2 km, find the time to the nearest minute when the distance between the two ships is shortest. *(12 marks)*

P425/1 PURE MATHEMATICS
Paper 1: 2018
SECTION A:

1. In triangle ABC, a = 7cm, b = 4cm and c = 5cm. Find the value of:

a) cos A

b) sin A *(05 marks)*

2. Determine the angle between the line $\frac{x+4}{8} = \frac{y-2}{3} = \frac{z+1}{-4}$ and the plane 4x + 3y – 3z + 1 = 0 *(05 marks)*

3. Find $\int x^2e^x dx$ *(05 marks)*

4. Express the function $f(x) = x^2 + 12x + 32$, in the form $a(x+b)^2 + c$. Hence find the minimum value of the function f(x). *(05 marks)*

5. A point P moves such that its distances from two points A (-2, 0) and B (8, 6) are in the ratio AP : PB = 3 : 2. Show that the locus of P is a circle. *(05 marks)*

6. Determine the equation of the tangent to the curve $y^3 + y^2 - x^4 = 1$ at the point (1, 1). *(05 marks)*

7. Show that $2\log 4 + \frac{1}{2}\log 25 - \log 20 = 2\log 2$.

(05 marks)

8. The region bounded by the curve $y = x^2 - 2x$ and the x – axis from x = 0 to x = 2, is rotated about the x – axis. Calculate the volume of the solid formed. ***(05 marks)***

SECTION B : (60 MARKS)

Answer any five ***questions from this section. All questions carry equal marks.***

9. The position vectors of the vertices of a triangle are o, r and s, where O is the origin. Show that its area (A) is given by

$$4A^2 = |r|^2|s|^2 - (r.s)^2 \qquad \textit{(06 marks)}$$

Hence, find the area of a triangle when $r = \begin{pmatrix}2\\3\end{pmatrix}$ and $s = \begin{pmatrix}1\\4\end{pmatrix}$

(06 marks)

10. Express 5 + 12i in polar form.

Hence, evaluate $\sqrt[3]{5+12i}$, giving your answers in the form a + ib where a and b are corrected to two decimal places (12 marks)

11. (a) Differentiate $\dfrac{x^3}{\sqrt{(1-2x^2)}}$ with respect to x.

(06 marks)

(b) The period, T of a swing of a simple pendulum of length, l is given by the equation

$$T^2 = \frac{4\pi^2 l}{g}.$$

Where g is the acceleration due to gravity. An error of 2% is made in measuring the length, l. Determine the resulting percentage error in the period, T. ***(06 marks)***

12. (a) Show that $\tan 4\theta = \dfrac{4t(1-t^2)}{t^4 - 6t^2 + 1}$,

where $t = \tan\theta$ ***(06 marks)***

(b) Solve the equation

$\sin x + \sin 5x = \sin 2x + \sin 4x$ for $0^o , x , 90^o$.

(06 marks)

13. a) The first three terms of a Geometric Progression (G.P) are 4, 8, and 16. Determine the sum of the first ten terms of the G.P. ***(04 marks)***

(b) An Arithmetic Progression (A.P) has a common difference of 3. A Geometric Progression (G.*P)* has a common ratio of 2. A sequence is formed by subtracting the terms of the A.P from the corresponding terms of the G.P. The third term of the sequence is 4. The sixth term of the sequence is 79. Find the first term of the

i) A.P.

ii) G.P ***(08 marks)***

14. Evaluate: $\int_0^{\frac{x}{2}} \sin 5x \cos 3x dx$

(b) A basket contains 30 bananas. Ten of them are ripe and the rest are unripe. Two bananas are selected at random from the basket with replacement. Find the probability that;

(i) both are ripe.

(ii) one is ripe and one is unripe. ***(08marks)***

15. The height y metres of a wave on a certain day is given by y = 5 + cos (30x)o where x is the number of hours after midnight. .

(a) Use x at intervals of one hour from 0 to 6 hours to find the corresponding values of y. Put the values of x and y in a table . ***(04 marks)***

(b Use the table to draw a graph of y against x.

(06 marks)

(c) From your graph, find the;

(i) height of the wave at 3:30am

(ii) time when the height of the wave is 5.2m

(02 marks)

16. A triangle ABC with vertices A(-4, 2), B(-5, 5) and C(-1, 4) is mapped onto triangle A'B'C' by a transformation matrix

$$T = \begin{pmatrix}0 & 1\\-1 & 0\end{pmatrix}.$$

The triangle A'B'C' is mapped onto triangle A"B"C" by another transformation matrix

$$M = \begin{pmatrix}-2 & 0\\0 & -2\end{pmatrix}.$$

(a) Determine the coordinates of the vertices

(i) A', B' and C'.

(ii) A", B" and C" ***(04 marks)***

(b) On the same axes draw the triangles ABC, A'B'C' and A"B"C" ***(04 marks)***

(c) Determine fully the transformation represented by

(i) T.

(ii) M ***(04 marks)***

17. A school has organized a Geography study tour for 90 students. Two types of vehicles are needed; taxis and costa buses. The maximum capacity of the taxi is 15 passengers while that of the costa bus is 30 passengers. The number of taxis will be greater than the number of costa buses. The number of taxis will be less than five. The cost of hiring a taxi is Shs. 60,000 while that of the costa is Shs. 100,000. There is only Shs. 600,000 available.

(a)If x represents the number of taxis and y the number of costa buses; write six inequalities for the given information.
(05 marks)

(b) Represent the inequalities on graph paper by shading the unwanted regions. (Use the scale of 2cm to 1 unit on both axes)
(04 marks)

(c) Find from your graph the number of taxis and costa buses which are full to capacity that must be ordered so that all students are transported. ***(03 marks)***

456/2 APPLIED MATHEMATICS
Paper 2: 2018
SECTION A:

1. A stone is thrown vertically upwards with a velocity of $21ms^{-1}$.
Calculate the:
a) maximum height attained by the stone.
(03 marks)
b) time the stone takes to reach the maximum height.
(02 marks)

2. Two events A and B are such that $P\left(A/_B\right) = \left(2/_5\right)$, P(B) $= \frac{1}{4}$ and P(A) $= \frac{1}{5}$.
Find:
a) $P(A \cap B)$ ***(02 marks)***
b) $P(A \cup B)$ ***(03 marks)***

3. The table below shows how T varies with S.

T	-2.9	-0.1	2.9	3.1
S	30	20	12	9

Use linear interpolation / extrapolation to estimate the value of
a) T when S = 26 ***(03 marks)***
b) S when T = 3.4 ***(02 marks)***

4. A particle of mass 15kg is pulled up a smooth slope by a light inextensible string parallel to the slope. The slope is 10.5m long and inclined at $\sin^{-1}\left(4/_7\right)$ to the horizontal.
The acceleration of the particle is $0.98ms^{-2}$
Determine the:
a) tension in the string. ***(03 marks)***
b) Work done against gravity when the particle reaches the end of the slope. ***(02 marks)***

5. The price index of an article in 2000 based on 1998 was 130. The price index for the article in 2005 based on 2000 was 80.
a) price index on the article in 2005 based on 1998.
(03 marks)
b) price of the article in 1998 if the price of the article was 45,000 in 2005. ***(02 marks)***

6. Two numbers A and B have maximum possible errors e_a and e_b respectively. a) Write an expression for the maximum possible error in their sum.
b) If A = 2.03 and B = 1.547, find the maximum possible error in A + B ***(05 marks)***
7. In an equilateral triangle PQR, three forces of magnitude 5N, 10N and 8N act along the sides PQ, QR and PR respectively. Their directions are in the order of the letters. Find the magnitude of the resultant force.
(05 marks)

8. A biased coin is such that a head is three times as likely to occur as a tail. The coin is tossed 5 times. Find the probability that at most two tails occur.
(05 marks)

SECTION B: (60 MARKS)

9. The frequency distribution below shows the ages of 240 students admitted to the certain University.

Age (years)	Number of students
18-<19	24
19-<20	70
20-<24	76
24-<26	48
26-<30	16
30-<32	6

a) Calculate the mean age of the students
(04 marks)

b) (i) Draw a histogram for the given data.
(ii) Use the histogram to estimate the modal age. ***(08 marks)***
10. A particle of mass 4 kg starts from rest at a point (2i – 3j + k) m. It moves with acceleration a = $(4i + 2j - 3k)ms^{-2}$ when a constant force F acts on it.
Find the:
a) force F. (02 marks)
b) velocity at any time t. (04 marks)
c) work down by the force F after 6 seconds
(06 marks)
11. a) Use the trapezium rule with 6 –ordinates to estimate the value of $\int_0^{\frac{\pi}{2}}(x+\sin x)dx$, correct to three decimal places. (03 marks)

b) i) Evaluate $\int_0^{\frac{\pi}{2}}(x+\sin x)dx$, correct to three decimal places. ***(03 marks)***

ii) Calculate the error in your estimation in

(a) above . ***(02 marks)***

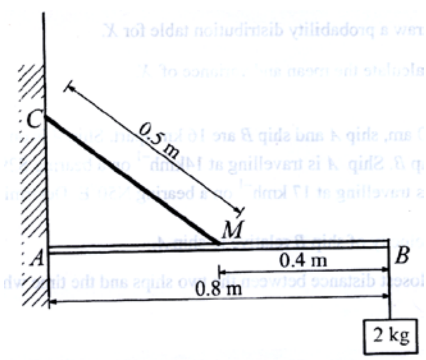
iii) Suggest how the error may be reduced ***(01 mark)***

12.A random variable X has a normal distribution where $P(X>9) = 0.9192$ and $P(X<11) = 0.7580$. Find:

a) the values of the mean and standard deviation. ***(08 marks)***

(b) P(X.10) ***(04 marks)***

13The figure below shows a uniform beam of length 0.8 metres and mass 1kg. The beam is hinged at A and has a load of mass 2kg attached at B.



The beam is held in a horizontal position by a light inextensible string of length 0.5 metres. The string joins the mid-point M of the beam to a point C vertically above A.

Find the:

(a) tension in the string. ***(08 marks)***

(b) magnitude and direction of the force exerted by the hinge. ***(04 marks)***

14. a) Draw on the same axes the graphs of the curves $y = 2 - e^{-x}$ and $y = \sqrt{x}$ for $2 \le x \le 5$ ***(05 marks)***

(b) Determine from your graphs the interval within which the root of the equation $e^{-x} + \sqrt{x}\ ^{-2} = 0$ lies. Hence, use Newton –Raphson's method to find the root of the equation correct to 3 decimal places. ***(07 marks)***

(c) Calculate the distance travelled by the car in the 13 seconds. ***(05 marks)***

15. The table below shows the number of red and green balls put in three identical boxes A, B and C

Boxes	A	B	C
Red balls	4	6	3
Green balls	2	7	5

A box is chosen at random and two balls are then drawn from it successively without replacement. If the random variable X is "the number of green balls drawn".

(a)draw a probability distribution table for X.
(06 marks)

(b)calculate the mean and variance of X.
(06 marks)

16. At 10:00am, ship A and ship B are 16km apart. Ship A is on a bearing N35°E from ship B. Ship A is travelling at $14kmh^{-1}$ on a bearing S29°E. Ship B is travelling at $17kmh^{-1}$ on a bearing N50°E. Determine the;.

(a)velocity of ship B relative to ship A. ***(05 marks)***

(b) closest distance between the two ships and the time when it occurs.. ***(07 marks)***

P425/1 , PAPER 1
PURE MATHEMATICS
Nov.Dec.2019. 3 hours.

1. Show that the modulus of $\frac{(1-i)^6}{1+i} = 4\sqrt{2}$. ***(05 marks)***

2. Solve 2cos 2 - 5 cos =4 for $0^0 \le \theta \le 360^0$. ***(05 marks)***

Using the substitution $u = \tan^{-1} x$,

show that $\int_0^1 \frac{\tan^{-1} x}{1+x^2}dx = \frac{\pi^2}{32}$. ***(05 marks)***

4. Given the plane $4x + 3y - 3z - 4 = 0$;

(a) show that the point A (1,1,1) lies on the plane. ***(02 marks)***

(b) find the perpendicular distance from the plane to the point B(1,5,1). ***(03 marks)***

5. Find the equation of the tangent to the curve $y=\frac{a^3}{x^2}$ at the point $P\left(\frac{a}{t}, at^2\right)$. ***(05 marks)***

6. Given that $\alpha+\beta=\frac{-1}{3}$ and $\alpha\beta=\frac{2}{3}$, form a quadratic equation whose roots are $\frac{\alpha}{\beta}$ and $\frac{\beta}{\alpha}$. ***(05 marks)***

7. Find the area enclosed between the curve $y=2x^2-4x$ and the x- axis. ***(05 marks)***

8. Given that $Q=\sqrt{80-0.1P}$ and $E=\frac{-dQ}{dP}\bullet\frac{P}{Q}$, find E when P = 600. ***(05 marks)***

SECTION B: (60 MARKS)

9. (a) Determine the perpendicular distance of the point (4,6) form the line $2x + 4y - 3 = 0$. ***(12 marks)***

(b) Show that the angle θ between two lines with gradients λ_1 and λ_2 is given by $\theta = \tan^{-1}\left(\frac{\lambda_1 + \lambda_2}{1+\lambda_1\lambda_2}\right)$.

Hence find the acute angle between the lines $x+y+7=0$ and $\sqrt{3x - y + 5 = 0}$. *(09 marks)*

10. (a) Given that $26\left(1 - \frac{1}{26^2}\right)^{\frac{1}{2}} = a\sqrt{3}$, find the values of a. *(05 marks)*

(b) Solve the simultaneous equations:

$2x = 3y = 4z,$

$x^2 - 9y^2 - 4z + 8 = 0.$ *(07 marks)*

11. Express $7\cos\theta + 6\sin 2\theta$ in the form $R\cos(2\theta - \alpha)$, where R is a constant and a is an acute angle.

Hence solve $7\cos 2\theta + 6\sin 2\theta = 5$ for $0^o \leq \theta \leq 180^0$ *(12 marks)*

12. (a) Given that $y = \ln\left\{e^x\left(\frac{x-2}{x+2}\right)^{\frac{3}{4}}\right\}$, show that $\frac{dy}{dx} = \frac{x^2 - 1}{x^2 - 4}$. *(05 marks)*

(b) Evaluate $\int_0^4 \frac{dx}{x^2\sqrt{(25 - x^2)}}$. *(07 marks)*

13. Four points have coordinates A(3,4,7), B(13,9,2), C(1,2,3) and D(10,k,6). The lines AB and CD intersect at P. Determine the;

(a) vector equations of lines AB and CD. *(06 marks)*

(b) value of k. *(06 marks)*

(c) coordinates of P. *(06 marks)*

14. Expand $\sqrt{\left(\frac{1+2x}{1-2x}\right)}$ up to the term in x^2.

Hence find the value of $\sqrt{\left(\frac{1.04}{0.98}\right)}$ to four significant figures. *(12 marks)*

15.(a) Differentiate $y = 2x^2 + 3$ from first principles. *(04 marks)*

(b) A rectangular sheet is 50 cm long and 40 cm wide > A square of x cm by x cm is cut off from each corner. The remaining sheet is folded to form an open box. Find the maximum volume of the box. *(08 marks)*

16. (a) Find $\int \frac{\ln x}{x^2} dx$. (04 *marks)*

(b) Solve the differential equation

$\frac{dy}{dx} + y\cot x = x$, given that $y = 1$ when $x = \frac{\pi}{2}$,

(08 marks)

456/2 APPLIED MATHEMATICS
Paper 2: 2019
SECTION A:

1. The table below shows the masses of bolts bought by a carpenter.

Mass (grams	98	99	100	101	102	103	104
Number of bolts	8	11	14	20	17	6	4

Calculate the:

a) median mass,

b) mean mass of the bolts *(05 marks)*

2. A uniform rod AB of length 3m and mass 8kg is freely hinged to a vertical wall at A. A string BC of length 4m attached to B and to a point C on the wall, keeps the rod in equilibrium. If C is 5 m vertically above A, find the;

a) tension in the string *(03 marks)*

b) magnitude of the normal reaction at A. *(02 marks)*

3. Use the trapezium rule with seven ordinates of estimate.

$\int_0^3 [(1.2)x - 1]^{\frac{1}{2}} dx$ correct to 2 decimal places

(05 marks)

4. A discrete random variable X has the following probability distribution:

X	0	1	2	3	4	5
P(X = x)	0.11	0.17	0.2	0.13	p	0.09

Find the;

a) value of p. *(02 marks)*

b) expected value of X. *(03 marks)*

5. A stone is thrown vertically upwards with velocity $16ms^{-1}$ from a point H meters above the ground level. The stone hits the ground 4 seconds later.

Calculate the;

a) value of H *(03 marks)*

b) velocity of the stone as it hits the ground. *(02 marks)*

6. The table below shows the commuter bus fares from stage A to stages B, C, D and E.

Stage	A	B	C	D	E
Distance (km)	0	12	16	19	23
Fare (Shs)	0	1300	1700	2200	2500

a) Jane boarded from A and stopped at a place 2km after E. How much did shs pay?

(03 marks)

b) Okello paid Shs 2000. How far from A did the bus leave him? ***(02 marks)***

7. The amount of meat sold by a butcher is normally distributed with mean 43kg and standard deviation 4kg. Determine the probability that the amount of meat sold is between 40kg and 50kg. ***(05 marks)***

8. A particle is moving with Simple Harmonic Motion (SHM). When the particle is 15m from the equilibrium, its speed is $6ms^{-1}$. When the particle is 13m from the equilibrium, its speed is $9ms^{-1}$. Find the amplitude of the motion.

(05 marks)

SECTION B: (60 MARKS)

9. Car A is 80m North West of point O. Car B is 50m N 30^oE of O. Car A is moving at $20ms^{-1}$ on a straight road towards O. Car B is also moving at $10ms^{-1}$ on another straight road towards O. Determine the;

a) initial distance between the two cars ***(03 marks)***

b) Velocity of A relative to B ***(05 marks)***

c) shortest distance between the two cars as they approach O ***(04 marks)***

10. The table below shows the marks obtained in a Mathematics test by a group of students.

Marks	5-<15	15-<25	25-<35	35-<45	45-<55	55-<65	65-<75	75-<85
Number of students	5	7	19	17	7	4	2	3

a) Construct a cumulative frequency curve (Ogive) for the data. (05 marks)

b) Use your Ogive to find the;

(i) range between the 10^{th} and 70^{th} percentiles

(ii) probability that a student selected at random scored below 50 marks ***(07 marks)***

11. a) Show that the equation $x – 3 \sin x = 0$ has a root between 2 and 3 ***(03 marks)***

b) Show that the Newton-Raphson iterative formula for estimating the root of the equation in (a) is given by

$$X_{n+1} = \frac{3(\sin x_n = x_n \cos x_n)}{1-3\cos x_n}, \quad n = 0, 1, 2\ldots.$$

Hence find the root of the equation correct to 2 decimal places ***(09 marks)***

12. A force F = (2ti + j – 3tk) N acts on a particle of mass 2kg. The particle is initially at a point (0, 0,0) and moving with a velocity $(i + 2j – k)ms^{-1}$. Determine the:

a) magnitude of the acceleration of the particle after 2 seconds. ***(04 marks)***

(b) velocity of the particle after 2 seconds ***(04 marks)***

(c) displacement of the particle after 2 seconds ***(04 marks)***

13.Two events A and B are such that $P(B) = \frac{1}{8}$, $P(A \cap B) = \frac{1}{10}$ and $P(B/A) = \frac{1}{3}$,

Determine the;

(a) P(A). ***(03 marks)***

(b) $P(A \cup B)$. ***(03 marks)***

(c) P(A/B). ***(06 marks)***

14. a) Given that $y = e^x$ and x = 0.62 correct to two decimal places, find the interval within which the exact value of y lies. ***(05 marks)***

(b) Show that the maximum possible relative error in y sin 2x is

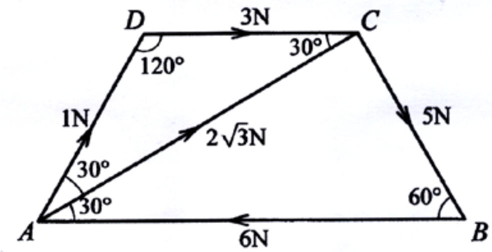
$\left|\frac{\Delta y}{y}\right| + 2 \cot x\, |\Delta x|$, where Δx and Δy are errors in x and y respectively.

Hence find the percentage error in calculating $y \sin^2 x$ if

$y = 5.2 \pm 0.05$ and $x = \frac{\pi}{6} \pm \frac{\pi}{360}$

(07 marks)

15. The diagram below shows a trapezium ABCD, AD = DC = CB = 1 metre and AB = 2 metres.



Forces of magnitude 1N, 3N, 5N, 6N and $\sqrt[2]{3}$ Nact in the directions AD, DC, CB, BA and AC respectively.

(a)Calculate the magnitude of the resultant force and the angle it makes with side AB. ***(09 marks)***

(b)Given that the line of action of the resultant force meets AB at X, find the distance AX. ***(03 marks)***

16. A biased die with faces labeled 1, 2, 2, 3, 5 and 6 is tossed 45 times. Calculate the probability that 2 2qill appear;

(a)more than 18 times ***(07 marks)***

(b) exactly 11 times ***(05 marks)***