APPLIED MATHEMATICS P425/2

PAPER 2

3 HOURS

INSTRUCTIONS TO CANDIDATES

Attempt **all** the **eight** questions in section **A** and **five** questions from section **B.**

- In numerical work take g to be 9.8 ms^{-1}.
- State the degree of accuracy at the end of each answer given.
- If a calculator or a mathematical table is used, indicate **CAL** for calculator, or **TAB** for mathematical tables. For mathematical tables whenever used.

SECTION A: (40 MARKS)

Attempt **all** the questions in this section.

1. A particle of mass 6kg moves such that it position vector at time t is equal to $\begin{pmatrix} t^2-5 \\ t^2-3t+2 \end{pmatrix}$.

   (a) Calculate the times when the particle crosses the x-axis.

   (b) Find an expression for v in terms of t, and hence calculate the speed of the particle at t = 6s.

2. In an experiment two bags A and B containing red and green balls are used. Bag A contains 4 red balls and 1 green ball and bag B contains 2 red balls and 7 green balls. An unbiased coin is tossed. If a head turns up, a ball is drawn at random from bag A while if a tail turns up, a ball is drawn at random from bag B. Given that a red ball is drawn, calculate the probability that when the coin was tossed a head was obtained.

3. A trader in Tvs and Radios makes a profit in Tvs of sh. 500, 000 with a margin of error of ±15 % and a loss in radios of sh.100, 000 with a margin of error of ± 5 %. Find the range of values representing his gross income.

4. In the table below, is part of an extract of tan x^0.

$X = 40^0$	$6^/$	$12^/$	$18^/$	$24^/$	$30^/$

tan x	0.8421	0.8451	0.8481	0.8511	0.8541

Use linear interpolation or extrapolation to estimate the;

(i) value of tan $40^0\ 20'$

(ii) angle whose tangent is 0.8555.

5. 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 **pi + qj** is added to the system which is then in equilibrium. Find the values of the constants p and q.

6. 1 % of a box of light bulbs is faulty. What is largest sample size which can be taken if it is required that the probability that there are no faulty bulbs in the sample is greater than 0.5?

SECTION B: (60 MARKS)

Attempt any **five** questions from this section. All questions carry equal marks.

7. A trader sells rice in bags of mean weight 40 kg and standard deviation 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 42.5 kg. (ii) The percentage of bags whose weight exceeds 43 kg. (iii) The number of bags rejected out of a 500, bag purchase by a retailer whose consumers cannot accept a bag whose weight is below 38.5 kg.

8. Two particles are projected with the same speed from the same point. The angles of projection are 2α and α and a time T elapses between the instants of projection. If the particles collide in flight, find the speed of projection in terms of T and α. If the collision occurs when one of the particles is at its greatest height, show that α is given by $4\cos^4\alpha - \cos^2\alpha - 1 = 0$.

9. (a) The effect of waves on a ball floating in the sea is to make it bob up and down with simple harmonic motion. If the ball encounters 20 waves every minute and for each wave the vertical distance from peak to trough is 80 cm, find the amplitude and period of the motion and the maximum speed of the drum.
(b) The velocity of a particle moving in a straight line is given by the equation $v = k\sqrt{\left(a^2 - x^2\right)}$, where k and a are constants, and x is the distance of the particle from a fixed point in the line; prove that the motion is SHM, and find the amplitude and periodic time of the motion.

10. (a) Two decimal numbers a and b are rounded off to give A and B with errors E_1 and E_2 respectively. Show that the maximum relative error made in approximating a^2b by A^2B is given by $2\left|\frac{E_1}{A}\right| + \left|\frac{E_2}{B}\right|$.

    b. If W = 0.5, X = 4.50, Y = 2.5 and Z = 26, all measured to the nearest number of decimal places of x, y and z, respectively.
    Find the:

    (i) the errors in W, X, Y and Z.

    (ii) range within which the exact value of the expression $W(X - \frac{Z}{Y})$ lies.

11. To a plane flying due north at 40 kmh^{-1} the wind appears to come from direction N 60^0 E at 50 kmh^{-1}.

    (i) Find the true velocity of the wind.

    (ii) if the wind velocity remains constant, but the speed of the plane is increasing, find its speed when the wind appears to be blowing from the direction N 45^0 E.

12. (a) A chord subtends angle θ radians at the center of a circle. θ obeys the equation $3\theta - 3\sin\theta - 2\pi = 0$. Use a graphical method to find a first approximation to the real root of the equation in the interval $0 \leq \theta \leq 4$.

    (b) Use Newton-Raphson iteration to solve this equation to 3 significant figures, starting with $\theta = 2.6$.

13. The heights (in cm) of people in a certain sub-county were recorded as in the frequency table below:

Heights (cm)	Frequency (f)
149 – 152	8
153 – 156	16
157 – 160	20
161 – 164	26
165 – 168	12
169 – 173	30
174 – 177	4

    a. Calculate the:

    (i) mean height,

    (ii) standard deviation of the candidates,

(iii) mode.

b. Draw a histogram and use to estimate the mode.

14. A uniform ladder of mass 10kg and length 4m rests with one end on a smooth horizontal floor and the other end against a smooth vertical wall. The ladder is kept in equilibrium, at an angle $\tan^{-1}2$ to the horizontal, by a light horizontal string attached to the base of the ladder and to the base of the wall, at a point vertically below the top of the ladder. A man of mass 100kg ascends the ladder. If the string will break when the tension exceeds 490N, find how far up the ladder the man can go before this occurs. What tension must the string be capable of withstanding if the man is to reach the top of the ladder?

15. (a) X and Y are judges at a beauty contest in which there were 10 competitors. Their rankings are shown below.

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

Calculate a coefficient of rank correlation between these two sets of ranks and comment briefly on your result.

(b) The table below shows consumer commodities bought by the Headmaster of Tip Top High school.

Commodity	Weight	Price 1990	Price 1992 = 100
A	30	1000	1100
B	5	100	80
C	10	30	20

(ii) Calculate the weighted average price relative index.

(iii) If the Headmaster bought a fourth commodity in 1992 worth Sh.2000, what is likely to have been its cost in 1990?