KING'S COLLEGE, BUDO

DEPARTMENT OF MATHEMATICS

EXERCISE 1

Instructions:

• Attempt all the questions.

• Acceleration due to gravity, g = 9.8 ms^{-2}

1. 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 sec 40^0 20$^/$

(ii) angle whose tangent is 0.8555.

2. A drawer contains 8 brown socks and 4 blue socks. A sock is taken from the drawer at random, its colour is noted and it is then replaced. This procedure is performed twice more. If X is the r.v. "the number of brown socks taken", find the probability distribution of X. Hence find E(X) and Var(X).

3. Forces of magnitude 4, 6, 8 ,3 and 5 N act on a particle in the directions of 320^0, 280^0, 220^0, 160^0 and 060^0 respectively. Find the magnitude of the resultant force acting on the particle.

4. A box contains five black balls, 6 yellow balls and 9 green balls. Two balls are picked without replacement. Find the probability that the two balls are (i) black and yellow, (ii) of the same colour.

5. Two forces have magnitudes P and q and the angle between them is θ. If the resultant of these two forces has magnitude R, and makes an angle α with the force P, show that:
   (a) $R^2 = P^2 + Q^2 + 2PQ\cos θ$, (b) $tanα = \dfrac{Q \sin θ}{P + Q \cos θ}$. If P = Q and θ = 40^0, find α.

6. The resultant of two forces P and Q is of magnitude R newtons and acts at an angle θ to the direction of P. Find R and θ, given that the magnitudes of P and Q and the angle between their directions is 12N, 5N ; 90^0 respectively.

7. A set of observations has got m zeros and n ones. (i) Find the mean of this set. (ii) Show that the standard deviation δ for this set is $σ = \dfrac{\sqrt{mn}}{m + n}$.

8. Seven army recruits (A, B, C,……..,G) were given two separate aptitude tests. Their orders of merit in each test were.

Order of merit	1st	2nd	3rd	4th	5th	6th	7th
Ist test	G	F	A	D	B	C	E
2nd test	D	F	E	B	G	C	A

   Compute Spearman's coefficient of rank correlation between the performances in the two tests. Comment on your results.

9. The continuous random variable X has p.d.f. f(x) where

$$f(x) = \begin{cases} \dfrac{x}{3} - \dfrac{2}{3} & 2 \le x \le 3 \\ α & 3 \le x \le 5 \\ 2 - βx & 5 \le x \le 6 \end{cases}$$

Find (a) α and β, (b) F(x) and sketch y = F(x), (c) $P(2 \leq X \leq 3.5)$, (d) $P(X \geq 5.5)$, (e) E(X).

10. A vertical pole of height 24m is held in position by three straight wires fixed to its top and to points on the horizontal ground. The wires are of lengths 25m, 30m and 26m and their fixing points are at bearings 060^0, 150^0 and 270^0 respectively from the base of the pole. If the tensions in the wires are each 50N, find (a) the vertical components of the tensions, (b) the horizontal components of the tensions. Hence find (c) the resultant force downwards caused by the wires, (d) the resultant horizontal force on the pole.

11. The table below shows the cumulative distribution of the age (in years) of 400 students of a girls'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:

(i) median age,

(j) 20th to 80th percentile age range.