# ADVANCED LEVEL MATHEMATICS QUESTIONS

## REVISION QUESTIONS

## PROBABILITY THEORY

1. (a) Event A and B which are not mutually exclusive are such that P(A) = $\frac{19}{30}$, P(B) = $\frac{3}{5}$ and P(AUB)' = $\frac{1}{10}$. Find P (A n B) and hence determine P (A n B')

   (b) A box contains 3 red cards and 2 blue cards. If two cards are picked randomly from the box in succession, find the probability that the second card picked is red if picking is done.

   (i) With replacement (ii) Without replacement

2. (a) Events A and B are such that P (A) = ½, P(B) = $\frac{3}{8}$ and P $(A/B) = \frac{7}{12}$.

   Find (i) P (A n B) (ii) P $\left(B/A^1\right)$

   (b) Two events A and B are neither independent non- mutually exclusive. Given that P(B) = $\frac{1}{3}$, P(A) = $\frac{1}{2}$ and P(A n $B^1$) = $\frac{1}{3}$.

   Find (i) P ($A^1$ u $B^1$) (ii) P $\left(A^1/B^1\right)$

3. (a) Given that A and B are mutually exclusive events P(A) = $\frac{2}{5}$ and P(B) = $\frac{1}{2}$. Find:

   (i) P (A u B) (ii) P(A n $B^1$) (iii) P($A^1$ n $B^1$)

   (b) A and B are two events such that P(A) = $\frac{2}{5}$, P(A/B) = $\frac{1}{3}$ and P(B/A) = $\frac{1}{2}$

   Find P(A U $B^1$)

4. (a) Two events A and B are such that P(A) = 0.4 and P($A^1$ n B) = 0.3 and P(B/A) = 0.6. Find; (i) P(A n B) (ii) P(B) (iii) P(A/B)

   (b) Given that A and B are intersecting sets using the data below P(A n $B^1$) = X , P (A n B ) = y , P($A^1$ n B ) = z. P $(A \text{ u } B)^1$ = 0.15, P(A) = 0.6, P($A^1$/ B) = $\frac{5}{7}$ and P(A u B) = 0.85. Find the

   (i) Value of x, y and z (ii)P(A/$B^1$)

5. Given that A and B are two events such that P(A) = 0.5, P(B) = 0.7 and P(AUB) = 0.8. Find (i) P(A n B) (ii) P(A n $\overline{B}$)

6. Events A and B are such that P(A) = ½ , P(B) = $^3/_8$ and P(A/ B) = $^7/_{12}$

   Find (i) P (A n B) (ii) P (B/$\overline{A}$)

7. (a) Two mutually exclusive events A and B such that $P(A) = {}^{2}/_{5}$ and $P(B) = {}^{3}/_{7}$ find $P\ (A \cup B)'$

(b) Two independent events M and N are such that $P(M) = 0.5$ and $P(N) = 0.7$ find $P\ (M \cup N)$

(c) A box contains 4 red and 7 black pens. Two pens are picked at random one after another without replacement. Find the probability that;

(i) Both pens are red (ii) the pens are of different colours

## DESCRIPTIVE STATISTICS

8. (a) The time in seconds for phone calls made by twelve customers at a public telephone booth were recorded as follows;

110, 132, 101, 91, 89, 122, 115, 106, 109, 112, 105, 106

Find the; (i) median time (ii) mean time

(b) 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;

(i) Mean length (ii) Standard deviation

9. The heights in (cm) of senior five students in a certain School were recorded as in the frequency table below;

| Height / 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 and standard deviation of the heights

**(b)** Plot a cumulative frequency curve for the data above and use it to estimate the median height and Quartile range of the heights

10. The table below shows the monks scored by 50 students in mathematics

| Marks | 25 – 34 | 35 – 44 | 45 – 54 | 55 – 64 | 65 - 74 | 75 – 84 | 85 – 94 |
|---|---|---|---|---|---|---|---|
| Frequency | 3 | 7 | 16 | 14 | 6 | 3 | 1 |

(a) Using an assumed mean of 49.5, calculate the actual mean

(b) Using a histogram, estimate the modal mark

11. A random sample of 120 broad bean seeds was collected. Each seed was weighed to the nearest 0.01g and the results were summarized in the table below;

| **Weight /g** | **Number of beans** |
|---|---|
| 1.10 – 1.29 | 7 |
| 1.30 – 1.49 | 24 |
| 1.50 – 1.69 | 33 |
| 1.70 – 1.89 | 32 |
| 1.90 – 2.09 | 14 |
| 2.10 –2.29 | 8 |
| 2.30 – 2.49 | 1 |
| 2.50 – 2.69 | 1 |

Calculate an estimate for the mean and standard deviation of the weight of these broad bean seeds. Give your answer to 3 decimal places.

12. The table below shows marks scored by some students in a tests

| Marks | No. of students |
|---|---|
| 10 - < 15 | 2 |
| 15 - < 20 | 8 |
| 20 - < 30 | 17 |
| 30 - < 35 | 26 |
| 35 - < 40 | 24 |
| 40 - < 50 | 16 |
| 50 - < 60 | 6 |
| 60 - < 65 | 1 |

(a) Calculate the mean and median

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(b) Draw a histogram and use it to estimate the modal mark

(c) Find the number of students who passed given that the pass mark was 37

13. Below are points scored by 50 teams in a certain football league in Italy;

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 45 | 31 | 46 | 25 | 57 | 39 | 42 | 55 | 20 | 37 |
| 40 | 59 | 11 | 38 | 34 | 22 | 62 | 33 | 48 | 43 |
| 57 | 37 | 43 | 51 | 29 | 14 | 35 | 66 | 45 | 32 |
| 44 | 42 | 46 | 54 | 65 | 17 | 35 | 53 | 27 | 47 |
| 38 | 22 | 33 | 39 | 45 | 32 | 43 | 41 | 57 | 45 |

(a) Make a grouped frequency distribution table for the data above; starting with the interval 10 – 19 and all classes should have the same range.
(b) Draw a Histogram to illustrate the data and use it to estimate the mode
(c) Calculate the median

## CORRELATION

14. The table below shows the scores of time employees in interview (x) and job performance (y)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| X | 57 | 35 | 56 | 57 | 66 | 79 | 81 | 84 | 52 |
| Y | 66 | 51 | 63 | 34 | 47 | 70 | 84 | 84 | 53 |

(a) Draw a scatter diagram for the data

(b) Comment on the relationship between the interview and job performance of the employees

(c) Calculate the rank correlation coefficient between x and y

15. The following table gives the grades given to six candidates of 2012 in external and internal mocks of a certain school. (Grade A = 6 points)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Internal mock | E | C | B | F | D | A | B | O |
| External mock | O | B | C | O | C | C | B | F |

(i) Calculate the rank correlation coefficient and comment on your results

(ii) Comment on the signifance of giving external mocks to candidates. (Spearman's $\rho = 0.86$, based on 8 observations at 1% level of signifance)

16. The tabulated values are of marks of ten students in physics and economics.

| Subjects | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Physics | A | B | C | E | B | F | D | A | O | A |
| Economics | C | D | C | A | O | E | D | A | F | B |

Calculate the rank correlation coefficient and comment on the performance of physics and economics at 5% level of significance using Spearman's ranks.

17. During a music festival, two judges scored 8 schools as follows;

| School | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| Judge 1 | 40 | 80 | 77 | 56 | 68 | 77 | 72 | 77 |
| Judge 2 | 52 | 78 | 80 | 54 | 62 | 73 | 52 | 80 |

(a) Draw a scatter diagram for the scores of the two judges and comment on it
(b) Calculate the rank correlation coefficient and comment on your results.

18. Below are marks scored by 8 students A, B, C, D, E, F, G, H I Mathematics, Economics and Geography in the end of term examination

| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| Mathematics | 52 | 75 | 41 | 60 | 81 | 31 | 65 | 52 |
| Economics | 50 | 60 | 35 | 65 | 66 | 45 | 69 | 48 |
| Geography | 35 | 40 | 60 | 54 | 63 | 40 | 55 | 72 |

Calculate the rank correlation coefficients between the performances of the students in;

(i) Mathematics and Economics
(ii) Geography and Mathematics

Comment on the significance of Mathematics in the performances of Economics and Geography. (Spearman's $\rho = 0.86$ at 1% level of significance based on 8 observations)

## DISCRETE RANDOM VARIABLES

19. A random variable X has a probability distribution given in the table below

| Marks (X) | 94 | 95 | 96 | 100 |
|---|---|---|---|---|
| P(X = x) | $^2/_{14}$ | $^3/_{14}$ | $^4/_{14}$ | $^5/_{14}$ |

Find; (i) the expectation, E(X) (ii) the variance, Var(X)

20. (a) A random variable X has a probability distribution shown below

| X | 1 | 2 | 5 | 10 |
|---|---|---|---|---|
| f(x) | 0.5 | P | 0.12 | Q |

Given that X can take on the given values and that E(X) = 2.5, find the values of p and q.

(b) The random variable X has a probability density function given by;

$$f(x) = \begin{cases} k2^x; & x = 0, 1, 2, 3 \\ 0; & elsewhere \end{cases}$$

Find; (i) the value of the constant k (ii) E(X)

21. (a) A discrete random variable X has the following probability distribution function;

| X | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| P(X = x) | K | 2k | 3k | 4k | 5k |

Determine the; (i) value of k (ii) Mean (iii) Standard deviation

(b) A discrete random variable X has a probability density function given by;

$$f(x) = \begin{cases} \frac{x}{k} \; ; x = 1, 2, 3, \ldots\ldots, n \\ 0 \; ; otherwise \end{cases}$$

Given that the expectation E(X) = 3, find the values of n and k.

22. A random variable X has probability density function given by
P(X = 0) =0.1, P(X = 1) = 0.3, P(X = 2) = 0.4 and P(X = 3) = 0.2. Find the;
(i) Expectation of X (ii) Variance of X (iii) Standard deviation and
(ii) E (3x + 2)

23. (a) The table gives the probability distribution function of a variable X

| X | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| P(X = x) | $C$ | $2C$ | $2C$ | $3C$ | $C^2$ | $2C^2$ | $7C^2 + C$ |

Find the; (i) value of $C$ (ii) P($x \geq 5$) (iii) Mean and variance of X

24. A random variable Y has a probability distribution function given by

$$f(y) = \begin{cases} k(2)^y, & y = 0, 1, 2, \ldots\ldots\ldots\ldots.6 \\ & 0, elsewhere \end{cases}$$

(i) Determine the value of k (ii) E(Y) and $P\left(\frac{(Y < 4)}{(Y > 1)}\right)$

25. The probability distribution of a random variable X is given by the function

$$f(x) = \frac{1}{81}\binom{5}{x}\binom{4}{3-x}, x = 0, 1, 2, 3$$

Calculate the numerical probabilities and hence estimate the expected value

26. The discrete random variable Y can take on values 0, 1, 2, 3, 4, 5. Given that
P(Y = 0) = P(Y =1) = P(Y = 2) = m
P(Y = 3) = P(Y = 4) = P(Y = 5) = n and $P(Y \geq 2) = 3P(Y < 2)$. Find the;
(i) Values of m and n (ii) E(Y) (iii) Var(2Y +3)

## INDEX NUMBERS

27. (a) The table below shows prices of items in 1999 and 2000

| **Item** | **1999** | **2000** |
|---|---|---|
| Meat | 1800 | 2200 |

| | | |
|---|---|---|
| Rice | 700 | 900 |
| Bread | 800 | 700 |

Calculate the price relative of each item using 1999 as the base year

(b). The prices of items in 2012 and 2013 are given the table below

| **Items** | **2012 (Price in Shs)** | **2013 (Price in Shs)** |
|---|---|---|
| A pair of shoes | 30000 | 35200 |
| A ream of papers | 8000 | 10500 |
| A bar of soap | 1200 | 1050 |
| A pen | 250 | 200 |

Taking the base to be 2013, calculate;

(i) the price relatives for each item

(ii) the simple aggregate price index

(iii) the simple average price relative

28. (a)Using the table below, calculate the weighted aggregate price index of the data. (Take 2011 as the base year)

| | **Prices** | | **Quantities** | |
|---|---|---|---|---|
| **Item** | **2011** | **2012** | **2011** | **2012** |
| Soya beans | 400 | 500 | 1.0 | 1.2 |
| Salt | 200 | 200 | 0.5 | 0.5 |
| Sugar | 1000 | 1200 | 1.4 | 1.4 |
| G. nuts | 1000 | 1400 | 2.0 | 2.5 |

(b).The cost of servicing a car depends on 3 items. These together with their price relative in 2005 using 2003 as the base year and their weights as listed below

| **Item** | **Price Relative** | **Weights** |
|---|---|---|
| Materials | 115 | 2 |
| Labour | 110 | 5 |
| Head gear | M | 3 |

If the weighted index was 114, find the value of m

29. The price relatives for five commodities A, B, C, D and E are shown in the table below, with their respective weights

| **Commodity** | **A** | **B** | **C** | **D** | **E** |
|---|---|---|---|---|---|
| Price Relative | 145 | 125 | 130 | N | 120 |
| Weight | 2 | 3 | 4 | 5 | 1 |

Find the value of n if the weighted price index is 127

30. The table below shows prices (in Ug Shs) of some items during January and March and price indices in percentages May of a certain year

| **Items** | **Jan (Price)** | **March (Price)** | **May (Price index Jan as a base)** |
|---|---|---|---|
| Margarine (1kg) | 3000 | 3600 | 113.33 |
| Sugar (1kg) | 1500 | 1200 | 86.67 |
| Baking flour (1kg) | 1000 | 900 | 95.00 |
| Washing soap (1 bar) | 700 | 750 | 114.29 |
| Salt (1kg) | 500 | 400 | 90.00 |

(a) Calculate the actual prices of each items in May to the nearest shilling

(b) Taking the price of baking flour as the base, calculate the index numbers for the month of January

(c) Taking January as the base, calculate the index numbers for march

31. The expenses of a house hold (in thousands of Uganda shillings) for the first month of three successive years (2000 – 2002) were as follows

| **Year** | **2000** | **2001** | **2002** |
|---|---|---|---|
| **Item** | | | |
| Food | 240 | 300 | 320 |
| Fuel | 40 | 50 | 56 |
| Transport | 80 | 120 | 120 |
| Others | 12o | 150 | 160 |

(a) Taking the year 2000 as the base year, find the price relatives for the year 2001 and 2002

(b) Using weights of 4, 1, 2 and 3 for food, fuel, transport and others respectively, calculate the weighted aggregate index for 2001 and 2002

32. The price in shillings of commodities A, B and C in 2001 and 2010, are given in the table below

| Commodity | 2001 | 2010 |
|---|---|---|
| A | 18,500 | 27,750 |
| B | 15,000 | 21,000 |
| C | 10,000 | 13,000 |

Using, 2001 as the base year, find the;

(i) Price relative of each commodity

(ii) Simple aggregate price index

## BINOMIAL DISTRIBUTION

33. (a) Find the probability of obtaining exactly three 4's if an ordinary die is tossed 5 times

(b). 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 probability of getting;

(i) Exactly 12 heads (ii) At least 14 heads (iii) At most 2 tails

34. (a) The probability that Junior wins a Lotto game is $^2/_3$. He plays 8 games. What is the probability that he wins;

(i) Exactly 8 games (ii) At least 7 games (iii) At most 5 games

(b). The probability that a patient recovers from a disease is 0.4. If 15 patients are known to have contracted the disease, what is the probability that;

(i) At least 10 will survive (ii) Between 3 and 8 inclusive survive (iii) At most 5 survive

35. (a) Of the people who stay in Janda village, 80% are known to have malaria, if 12 people awaiting to see the doctor, what is the most likely number of them to have malaria?

(b) In a group of University ladies, the expected number of ladies who wear glasses is 2 and variance is 1.6. Find the probability that;

(i) A lady chosen from the group wears glasses

(ii) Six ladies in the group wear glasses

36. (a) Two people play a game in which each tosses a balanced die, numbered from1 to 6. The game is a success if both players get the same results

(i) Determine the probability that one success will occur at the first trial

(ii) In four trials, determine the probability of getting at most 2 successes

(b). Of the students in a certain school in Kampala District, 30% travel to school by the school van. From a sample of 10 students chosen at random, find the probability that;

(i) Only 3 travel to school by the school van

(ii) More than 8 travel by the school van

(iii). At most 7 travel by the van

37. (a) In a certain family, the probability of having a boy is 0.6. If they are 5 children in that family, determine the;

(i) Expected number of girls

(ii) Probability that they are at least 3 girls

(iii). Probability that they are all boys

(b). The probability of winning a game is $^4/_5$. Ten games are played. What is the,

(i) Mean number of successes

(ii) Variance

(iii) Probability of getting at least 8 successes in the ten games

## CONTINUOUS RANDOM VARIABLES

38. (a) The continuous random variable is given by the probability density function

$$f(x) = \begin{cases} 2kx, & 0 \leq x < 1 \\ k(3-x), & 1 \leq x \leq 2 \\ 0, & elsewhere \end{cases}$$

(i) Sketch the function f(x). Hence find the constant k

(ii) Mean of X

(iii) Var(3x+ 2)

(b) A continuous random variable X has a probability density function

$$f(x) = \begin{cases} 3c(x^2+3), & -3 \leq x \leq 0 \\ 3c(x+3), & 0 \leq x \leq 3 \\ 0, & otherwise \end{cases}$$

Determine the; (i) constant c

(ii) Expectation E(X) and variance of X

(iii) Cumulative distribution function

39. (a) A continuous random variable X has distribution function given by

$$f(x) = \begin{cases} k(1+\frac{1}{2}x), & 0 \le x \le 2 \\ \frac{2}{3}k(5-x), & 2 \le x \le 5 \\ 0, & otherwise \end{cases}$$

(i) Sketch the graph of f(x) and find the value of k

(ii) Find the mean of X and $P(^{X > 1.5}/_{X < 3})$

(b) A continuous random variable X is defined by a p.d.f

$$f(x) = \begin{cases} k(x+2), & -2 \le x \le 0 \\ \frac{1}{2}k(3-x), & 0 \le x \le 3 \\ 0, & elsewhere \end{cases}$$

(i) Sketch f(x) (ii) Determine the value of k (iii) Find the cumulative distribution function f(x) (iv) $P(-1 < x < 1)$

40. The continuous random variable X has the probability density function (p.d.f) given by $f(x) = \begin{cases} k_1 x, & 1 \le x \le 3 \\ k_2(4-x), & 3 \le x \le 4 \\ 0, & otherwise \end{cases}$

Where $k_1$ and $k_2$ are constants

(a) Show that $k_2 = 3k_1$

(b) Find; (i) the values of $k_1$ and $k_2$ (ii) E(x), the expectation of X

41. A continuous random variable X has the probability density function

$$f(x) = \begin{cases} \beta(1-\cos x), & 0 \le x \le \pi \\ \beta \sin x, & ^{\pi}/_{2} < x \le \pi \\ 0, & otherwise \end{cases}$$

(a) Find; (i) the value of $\beta$ (ii) $P(^{\pi}/_{3} < x < {}^{3\pi}/_{4})$

(b) Show that the mean, $\mu$ of the distribution is $1 + {}^{\pi}/_{4}$

42. (a) The continuous random variable X has p.d.f given by

$$f(x) = \begin{cases} kx, & 0 \le x \le 1 \\ kx^2, & 1 \le x \le 2 \\ 0, & elsewhere \end{cases}$$

(i) Sketch f(x) (ii) Determine the value of k (iii) Find the cumulative distribution function of X (iv) find, correct to two decimal places the median, m of X

(b) A random variable X has the probability density function

$$f(x) = \begin{cases} \beta x^2, & 0 \le x \le 2 \\ \beta(6-x), & 2 \le x \le 6 \\ 0, & otherwise \end{cases}$$

(i) Sketch f(x) (ii) Find the value of $\beta$ and hence find E (1600x - 300)

43. (a) A continuous random variable has a probability function given by

$$f(x) = \begin{cases} x^2/_{27}, & 0 \le x < \alpha \\ 1/_{3}, & \alpha \le x < \beta \\ 0, & elsewhere \end{cases}$$

Find the value of $\alpha$ and $\beta$

(b) A continuous random variable has a probability function given by

$$F(x) = \begin{cases} x^2/_{4}, & 0 \le x \le 1 \\ qx - 1/_{4}, & 1 \le x \le 2 \\ p(5-x)(x-1), & 2 \le x \le 3 \\ 1, & x \ge 3 \end{cases}$$

(i) Find the value of p and q (ii) Determine f(x) and E(X)

44. (a) A continuous random variable has a probability function given by

$$f(x) = \begin{cases} kx^2, & 0 \le x \le 2 \\ 2k(4-x), & 2 \le x \le 4 \\ 0, & otherwise \end{cases}$$

Where k is a constant

(i) Sketch f(x), determine the; (ii) value of k (iii) median (iv) cumulative distribution function of x, F(x), hence find $P(x < 3)$

(b) X is a continuous random variable such that $F(x) = \begin{cases} \text{atan}^{-1} x, & 0 \le x \le 1 \\ bx, & 1 \le x \le 2 \\ 1, & x \ge 2 \end{cases}$

(i) Find the value of the constants a and b

(ii) Show that the mean of x, $\mu = {}^{ln2}/_{\pi} - {}^{3}/_{4}$

(iii) Find $P(|X - \mu|) \leq 0.5$

45. A continuous random variable has a probability function given by

$$f(x) = \begin{cases} kx, & 0 \leq x \leq 1 \\ kx^2, & 1 \leq x \leq 2 \\ 0, & elsewhere \end{cases}$$

(i) Show that $k = {}^{6}/_{17}$ (ii) Sketch f(x)

(iii) Find correct to two decimal places the median, m of X

(iv) Find correct to two decimal places $P(|X - m|) < 0.75$

(v).Find F(x), the distribution of x and sketch it

**Linear Motion**

46. (a) A motor car, starting from rest and moving with uniform acceleration, goes 9.5m in the $10^{th}$ second after starting. Find the acceleration of the car, and the distance covered during 5 seconds from starting.

(b) A car increases its speed from $18kmh^{-1}$ to $72kmh^{-1}$ in a distance of 50m, the acceleration being uniform. Find the acceleration and speed when the car has covered 25m of the distance.

47. (a) A train is timed between successive posts A, B and C, each 2km apart. If it takes 100s to travel from A to B and 150s from B to C, find the retardation of the train, assuming that remains uniform after the post A. find also how far beyond C the train travels before it stops

(b) A particle starts from rest with a constant acceleration which ceases after an interval. It then moves uniformly at 5 $ms^{-1}$ for 10 s after which it is uniformly retarded and is brought to rest. If the whole motion occupies 16 s, find the distance traversed. The initial acceleration being 1.5 $ms^{-2}$, find the final retardation

48. (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

$$\mathrm{V} = [\mathrm{u}^2 + 2\mathrm{ax}]^{1/2}$$

(b). Find the value of x in (a) if V = 30 $ms^{-1}$, u = 10 $ms^{-1}$ and a = 5 $ms^{-2}$

49. (a) If an express train reduced its speed from 96kmh$^{-1}$ to 24 kmh$^{-1}$ in 0.8 km, for how long were the brakes applied; and how much longer would it take to come to rest

(b) A train moves 3.6 km from rest to rest in 3 minutes. The greatest speed being 90kmh$^{-1}$ and the acceleration and retardation being uniform, find the distance travelled at full speed

50. (a) A car starts from rest with a constant acceleration of 2.5 ms$^{-2}$. It attains a velocity of 30 ms$^{-1}$ after t seconds. Find the; (i) value of t (ii) distance moved by the car

(b) A bus accelerates uniformly from rest. At the same a passenger who is 100m behind the bus runs at a constant speed and just catches up with the bus after 1 minute. Find the; (i) acceleration of the bus (ii) speed of the passenger

51. (a) A car travels along a straight road between two towns, Kampala and Entebbe (K and E). The car starts from rest at K and accelerates at 2.5 ms$^{-2}$ until it reaches a speed of 40 ms$^{-1}$. It then travels at this speed for a distance of 3120m and then decelerates at 4 ms$^{-2}$ to come to rest at E

(i) Sketch a velocity – time graph for the motion of the car

(ii) Determine; the total time taken for the car to move from K to E, distance from K to E and the average speed of the car

(b). the table below shows the velocity of a particle during the course of its motion

| **Time/s** | 0 | 5 | 10 | 20 | 30 | 60 |
|---|---|---|---|---|---|---|
| **Velocity(ms$^{-1}$)** | 0 | 10 | 20 | 20 | 20 | 0 |

Plot a graph of velocity against time and use it to find the;

(i) Acceleration in the first 10s

(ii) Total distance covered

(iii) Describe the motion of the particle during the period t = 10s to t = 30s

(c) A motorist decelerated uniformly from 20kmh$^{-1}$ to 8kmh$^{-1}$ in traveling 896m. find the rate of deceleration in ms$^{-2}$

**Resultant and Component of Forces**

52. (a) The resultant of the forces $F_1 = 3i + (a - c)j$, $F_2 = (2a + 3c)j$ and $F_3 = 4i + 6j$ acting on a particle is $10i + 12j$. Find the; (i) value of a and c (ii) magnitude of $F_2$

(b) A particle of mass 2 kg moves under the action of three forces $F_1$, $F_2$ and $F_3$. At a time, t, $F_1 = \left({}^1\!/_4\,t - 1\right)i + (t - 3)jN, F_2 = \left({}^1\!/_2\,t + 2\right)i + \left({}^1\!/_2\,t - 4\right)jN \text{ and } F_3 = \left({}^1\!/_4\,t - 4\right)i + \left({}^3\!/_2\,t + 1\right)jN$. Find the acceleration of the particle when t = 2 seconds

(c) Four forces, $bi + (b+1)j$, $3i + 2bj$, $5i - 6j$ and $-2i - 3j$ act on a particle. The resultant of the forces makes an angle of $45^0$ with the horizontal. Find the value of b. hence find the magnitude of the resultant force

(d) Forces $F_1 = (ai + bj)$ N and $F_2 = (2i - 3j)$ N acting in the same direction on a body of mass 2.5 kg cause it to accelerate at $(4i + 5j)$ $ms^{-2}$. Find the constants a and b. Hence determine the resultant force

53. (a) A particle of unit mass is acted on by three forces with the following magnitudes and directions $\sqrt{3}$ N due North, 3N in the direction of S$30^0$E, $2\sqrt{3}$ N in the direction S$60^0$W. (i) Find the magnitude and direction of the resultant force

(ii) If an additional force now acts on the particle, so that it has an acceleration of 3 $ms^{-2}$ due East. Calculate the magnitude of the extra force

(b). Forces of magnitude 10N, 14N, 12N and 8N act on a particle in the directions of N$50^0$E, S$80^0$E, S$20^0$W and N$50^0$W respectively

(i) Magnitude of the resultant force acting on the particle

(ii) Direction of the resultant force

54. (a) PQRS is a square. Forces of magnitude 60N, 40N, 180N and 40N act along the lines PQ, QR, RP and SQ respectively in each case the direction of the forces being given by the order of the letters. Given that SR is horizontal, determine;

(i) the magnitude of the resultant force

(ii) the inclination of the resultant to SR