P425/2
APPLIED
MATHEMATICS
PAPER 2
July. 2017
3 hour

Uganda Advanced Certificate of Education

MOCK EXAMINATIONS 2017

APPLIED MATHEMATICS

Paper 2

3 hours

INSRUCTIONS TO CANDIDATES:

Answer **all** the **eight** questions in section **A** and only **five** questions in section **B**.

Additional question(s) answered will **not** be marked.

All working **must** be shown clearly.

Graph paper is provided.

Where necessary, take acceleration due to gravity, $g = 9.8 \text{ m s}^{-2}$.

Silent, non-programmable scientific calculators and mathematical tables with a list of formulae may be used.

SECTION A (40 MARKS)

(Answer **all** questions in this section.)

Qn 1: Projectile is fired from the ground with initial velocity $3\underset{\sim}{i} + 4\underset{\sim}{j}$ m s^{-1}.

Find its:

(i). position vector at any time t.

(ii). horizontal range. [5]

Qn 2: The ages and systolic pressure of 12 women working in an organisation were recorded as shown below.

Age	56	42	72	36	63	42	68	60	47	55	49	72
Blood pressure	147	125	160	118	149	140	152	155	128	150	145	160

Calculate the rank correlation coefficient for the data and comment on your result. [5]

Qn 3: Determine the range of values in which $\frac{3.02\times1.2}{6.1} - 1.2$ lies. Hence find the maximum possible error in the expression. [5]

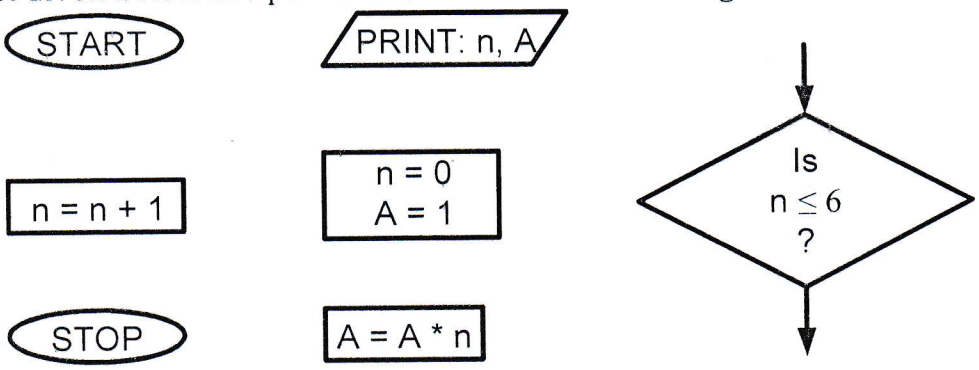
Qn 4: A particle was projected with speed $\sqrt{\frac{4gr}{5}}$ m s^{-1} from the lowest point inside a smooth sphere of radius r. Find the greatest height above the point of projection reached by the particle. [5]

Qn 5: At a certain supermarket, consumers only pay by cash or use credit cards. The ratio of customers who pay by cash to those who pay by credit cards is 3: 2. If a random sample of 10 customers is selected, calculate:

(i). the expected number of customers who pay by cash.

(ii). the probability that exactly two customers pay by cash. [5]

Qn 6: Given below are points of a flow chart not arranged in order.



Rearrange them and draw a complete logical flow chart. [5]

Qn 7: Particles of masses 3 g, 5 g, 2 g and 4 g act at points $(1, 6)$, $(1, 5)$, $(2, -3)$ and $(-1, -4)$ respectively in the $x - y$ plane. Find the coordinates of their centre of gravity and its distance from the origin $(0, 0)$. [5]

Qn 8: The probability that two independent events occur together is $\frac{2}{15}$. The probability that either one of the events or both of them occur is $\frac{3}{5}$. Find the individual probabilities of the two events. [5]

SECTION B (60 MARKS)

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

Question 9:

The data below shows the ages of some students in a certain college given to the nearest year.

Age in years	17 – 19	20 – 22	23 – 25	26 – 28	29 - 31
No. of Students	3	7	13	25	12

(a). On a graph paper, draw a cumulative frequency curve for the data

(b). Use the graph in (a) above to determine the:

(i). median age.

(ii). 80^{th} percentile age

(iii). percentage of students whose ages lie in the range 24 years to 30 years. [12]

Question 10:

Five forces 10 N, 3 N, 5 N, 6 N and $2\sqrt{3}$ N act along sides AD, DC, CB, BA and AC of an isosceles trapezium, where $AD = DC = CB = 1$ m and $AB = 2$ m, their directions being indicated by order of the letters.

(a). Find the magnitude and direction of the resultant of the forces. [8]

(b). Calculate the distance from A, where the line of action of the resultant cuts AB. [4]

Question 11:

(a). Use the trapezium rule with 6 ordinates to estimate the area of

$$y = \int_1^2 xe^{-2x}\,dx$$

Give your answer correct to **three** significant figures.

(b). (i). Find the exact value of $\int_1^2 xe^{-2x}\,dx$, correct to **three** significant figures.

(ii). Calculate the percentage error in your estimation in (a) above.

(iii). Suggest how the percentage error may be reduced. [12]

Question 12:

X is a uniform continuous random variable such that

$$P(X \leq x) = \begin{cases} 0 & ; \quad x \leq a \\ \dfrac{x-2}{4} & ; \quad a \leq x \leq b \\ 1 & ; \quad x \geq b \end{cases}$$

(i). Find the values of the constants a and b.

(ii). Calculate $E(X)$ and $Var(X)$.

(iii). Sketch the graphs of the p.d.f and c.d.f of X. [12]

Question 13:

A particle of mass 0.5 kg is acted upon by an accelerating force of $(18t^2\boldsymbol{i} - 9t\boldsymbol{j})$ N and passes through point $(-4, 6)$ with a speed of $(4.5\boldsymbol{i} - 6\boldsymbol{j})$ m s^{-1}.

(a). Find the velocity and position vector of the particle t seconds after passing through the point $(-4, 6)$.

(b). Calculate the power developed at $t = 2\ s$. [12]

Question 14:

(a). (i). On the same axes, draw graphs of $y = x^2$ and $y = \cos x$ for $0 \leq x \leq \frac{\pi}{2}$ at intervals of $\frac{\pi}{8}$.

(ii). From your graphs, obtain to **one** decimal place, an approximate root of the equation $x^2 - \cos x = 0$.

(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. [12]

Question 15:

The weight of bars of soap produced in a certain factory are normally distributed.

(a). Given that 1% of the bars weigh less than 140 g and 2% weigh more than 165 g, find the mean and variance of the distribution.

(b). If the variance in (a) above is reduced by 30%, find the proportion of bars that would be expected to weigh less than 145 g. [12]

Question 16:

(a). To a person on a ship A moving due east at 15 km h^{-1}, ship B appears to be moving at 12 km h^{-1} in the direction $N\ 30°\ E$. Find the true velocity of ship B.

(b). Two ships A and B have the following position vectors, r, and velocity vectors, v, at the times stated.

$r_A = (-2\boldsymbol{i} + 3\boldsymbol{j})$ km, $v_A = (12\boldsymbol{i} - 4\boldsymbol{j})$ km h^{-1}, at 11:45 am

$r_B = (8\boldsymbol{i} + 7\boldsymbol{j})$ km, $v_B = (2\boldsymbol{i} - 14\boldsymbol{j})$ km h^{-1}, at 12:00 noon

Assuming that the ships do not alter their velocities, find the least distance between A and B hence the bearing of A from B when they are nearest each other. [12]

END