

P425/2

APPLIED MATHEMATICS

JULY 2017

3 HOURS

GREENHILL ACADEMY KIBULI INTERNAL MOCK 2017

UGANDA ADVANCED CERTIFICATE OF EDUCATION

APPLIED MATHEMATICS

TIME: 3 HOURS

INSTRUCTIONS TO CANDIDATES

- *Attempt **ALL the eight** questions in section A and any **five** from section B.*
- *All necessary calculations must be done on the same page as the rest of the answers. Therefore there is no paper for rough work.*
- *Mathematical tables with a list of formulae and squared papers are provided.*
- *Silent non-programmable scientific calculators may be used.*
- *In numerical work, take g to be 9.8ms^{-2}*

SECTION A: (40 Marks)

- Two hunters A and B shoot at an animal. The probability that A hits the animal is $\frac{1}{2}$ and the probability that B does not hit the animal is $\frac{1}{3}$. A shoots at the animal first, and then B. find the probability that:
 - Both A and B hit the animal
 - only one hits the animal. (5mks)
- A car approaching a town does two successive half-kilometers in 16 and 20 seconds respectively. Assuming the retardation is uniform. Find the further distance the car runs before stopping. (5mks)
- Given that $f(0.9) = 0.2661$, $f(1.0) = 0.2420$ and $f(1.1) = 0.2179$, estimate:
 - $f(0.96)$
 - $f^{-1}(0.2372)$ using linear interpolation or extrapolation (5mks)
- A machine manufacturing nails make approximately 85% that are within the set tolerance limits. If a random sample of 200 nails is taken, find the probability that more than 21 nails will be outside the tolerance limits. (5mks)
- Two forces of magnitude 8 N and P N are inclined at an angle 60° . Find P if the resultant is of magnitude 17 N. (5mks)
- Using a Trapezium rule with six ordinates estimate the value of $\int_0^\pi x^2 e^x dx$ to 2 d.p. (5mks)
- The mock examination and average final examination marks are given in the table below:

Mock marks	28	34	36	42	48	52	54	60
Average final marks	54	62	68	70	76	66	76	74

Calculate the rank correlation coefficient between the marks and comment on your result.

(5mks)

8. To a motor cyclist travelling due North at 50 kmh^{-1} , the wind appears to come from North West at 60 kmh^{-1} . Find the true velocity of the wind. (5mks)

SECTION B: (60 Marks)

Attempt five questions

9. The following table summarizes the distance to the nearest mile, travelled to work by a random sample of commuters

Distance (miles)	0-9	10-19	20-29	30-39	40-49	50-59
No. of commuters	15	38	22	15	8	2

- a) Calculate the:
- Mean
 - Median
 - Standard deviation
- b) Draw a histogram to represent the data and use it to estimate the mode. (12 mks)
10. a) Given the equation $ax^2 + bx + c = 0$, show that the Newton Raphson method for solving the above equation is given by $x_{n+1} = \frac{ax_n^2 - c}{2ax_n + b}$, $n = 0, 1, 2, \dots$
- b) Show that the equation $3x^3 + x - 4 = 0$ has a root between 0 and 2. Hence using Newton Raphson's method, find the root correct to three decimal (12 mks)
11. 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 length a units. The directions of the forces are indicated by the order of the letters.
- Find the magnitude and direction of the resultant force.
 - If the line of action of the resultant force cuts AB produced at E, find the length AE. (12 marks)
12. A continuous random variable x is defined by the p.d.f

$$f(x) = \begin{cases} \frac{1}{5}(x+2), & -2 < x < 0 \\ \frac{2}{15}(3-x), & 0 < x < 3 \\ 0, & \text{elsewhere} \end{cases}$$

- a) sketch $f(x)$
 b) Determine the
 i) expectation of x
 ii) Cumulative distribution function, $F(x)$ hence find $P(-1 \leq x < 1)$ (12mks)

13. a) The position vector of ship P relative to Q at any time t is given by

$${}_P\mathbf{r}_Q = \begin{pmatrix} 4 \\ 13 \end{pmatrix} + \begin{pmatrix} -2 \\ -4 \end{pmatrix}t \text{ metres. Find the:}$$

- i) time when they are nearest together
 ii) closest distance between the two ships
 b) Projectile is fired from the ground with initial velocity $3\mathbf{i} + 4\mathbf{j} \text{ ms}^{-1}$. Find its ;
 i) Position vector at any time t
 ii) Horizontal range (12 mks)

14. Strips of a metal are cut to length (cm) which follows a normal distribution with mean 50 cm and variance 0.25cm^2 . find the;

- i) probability that the length selected at random will lie between 49.25cm and 50.75cm.
 ii) length range of the middle 70% of the cut of the strips. (12 mks)

15. a) Two decimal number X and Y are rounded to give x and y with errors e_1 and e_2 respectively. Show that maximum absolute relative error committed when x^2y is used instead of X^2Y is given by $2\left|\frac{e_1}{x}\right| + \left|\frac{e_2}{y}\right|$

- b) Determine the limits within which the exact value of $\frac{6.042-3.21}{12.1}$ lie. (12mks)

16. A body of mass m kg lies on a rough plane inclined at θ^0 to the horizontal. When a force of $\frac{mg}{2}$ N parallel to and up the plane is applied to the body, it is just about to move

up the plane. When a force of $\frac{mg}{4} N$ parallel to and down the plane is applied to the body, it just about to move down the plane. Calculate correct to two decimal places the value of:

- i) θ
- ii) The coefficient of friction between the body and the plane. (12 mks)

END

Practice, Perfect and Perform