

NAME:..... STREAM:.....

P425/2

APPLIED MATHEMATICS

PAPER 2, 2023

3 hours

JUNE

PRE-MOCK SET ONE

Instructions to candidates:

- Attempt **all** questions in section **A** and any **five** in section **B**.
- For numerical work, take $g = 9.8ms^{-2}$
- Graph papers are provided.

SECTION A (40 marks)

Attempt **all** questions in this section

1. A bullet of mass $0.15kg$ travelling at a speed $750ms^{-1}$ hits a block of wood and penetrates it to a depth $45mm$. If the resistance exerted on the bullet by the block of wood is constant, calculate the magnitude of the resistive force. (05 marks)

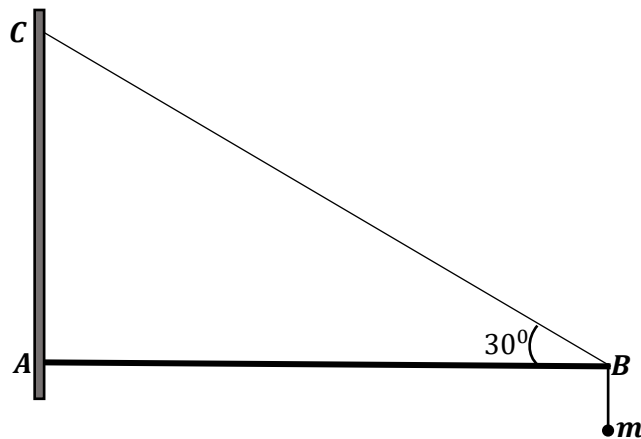
2. Two teachers marked an exercise given to five students and the marks recorded as below.

Student	A	B	C	D	E
Teacher 1	73	67	60	48	39
Teacher 2	62	50	61	76	65

Calculate the spearman's rank correlation between the marks of teacher 1 and teacher 2 (04 marks)

3. The numbers $P = 4.8$ and $Q = 5.25$ are rounded to the given number of decimal places. State the limits within which the exact value of $\frac{P}{P-Q}$ lies correct to 4 d.ps. (05 marks)
4. The position vector of a particle at any time, t is given by $\mathbf{r}(t) = (2t^2\mathbf{i} - 3t^3\mathbf{j} + 4cost\mathbf{k})$ meters. Find the speed of the particle at $t = 2seconds$ (05 marks)
5. Given that $X \sim N(\mu, \sigma^2)$ and that $10\sigma = 3\mu$, if $P(X \leq 10) = 0.75$, find the values of μ and σ (05 marks)
6. Show that the equation $5e^x - 4x = 6$ has a root between -2 and -1 . Hence use the linear interpolation once to find the root correct to 2 dps. (05 marks)
7. The probability that a team plays a home football game in the first round of the tournament is 0.6 . If it plays a home game, the probability that it wins it is 0.8 and the probability that it lost an away game is 0.7 . Find the probability that
- (i) Find the probability that It wins
- (ii) It plays a home game given that it will lose. (05 marks)

8. A uniform rod AB of mass $2m$ and length a is smoothly hinged at a point A and held at equilibrium by a light inextensible string BC and a particle of mass m suspended from the rod at the end B as shown below.



If the string makes an angle of 30° with the horizontal,

Show that the magnitude of the force exerted by the hinge on the rod at A is given by $mg\sqrt{13}$
(06 marks)

SECTION B (60 marks)

Attempt any **five** questions.

9. The table below shows the times taken (in minutes) of a group of senior six students to think of the right solution to an examination question.

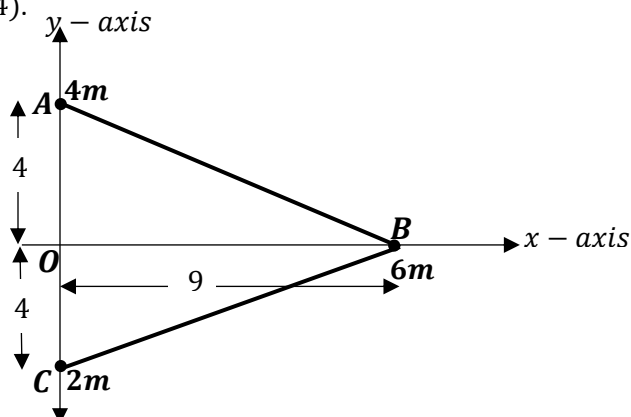
Time(minutes)	$0 \leq x \leq 2$	$2 \leq x \leq 4$	$4 \leq x \leq 6$	$6 \leq x \leq 10$	$10 \leq x \leq 14$	$14 \leq x \leq 18$
Frequency	2	12	20	14	8	4

(a) Calculate the;

- Mean time taken by the student
- Probability that a student selected at random used a time between 6 and 15 minutes.

(b) Draw an ogive and use it to estimate the middle 60th percentile range of the times used by the students while thinking.
(12 marks)

10. The figure below shows a triangular lamina ABC with coordinates $A(0,4)$, $B(9,0)$ and $C(0,-4)$.



If particles of masses $4m$, $6m$ and $2m$ are attached at the points A, B and C

- (a) Calculate the coordinates of the center of mass of the three particles. (Without the lamina)

The lamina ABC is uniform and of mass km . If the center of mass of the combined system consisting of the three particles and the lamina has coordinates $(4, \lambda)$,

- (b) Show that $k = 6$
 (c) Calculate the value of λ
 (d) The combined system is freely suspended at O so as to rest in equilibrium, calculate the angle between AC and the vertical. (12 marks)

11. A random variable X has a rectangular distribution over an interval $[e, f]$.

- (a) Show that;

$$E(X) = \frac{(e + f)}{2}$$

- (b) Given that $E(X) = 1$ and $P(X \leq 0.25) = 0.25$, find the;

- (i) Values of e and f
 (ii) Variance hence standard deviation of X (12 marks)

12. (a) Use the trapezium rule with 6 ordinates to estimate $\int_0^{\frac{3\pi}{2}} 3 \cos\left(\frac{x}{3}\right) dx$, correct to **three** decimal places.

- (b) Find the exact value of $\int_0^{\frac{3\pi}{2}} 3 \cos\left(\frac{x}{3}\right) dx$, correct to **three** decimal places.

- (c) Find the percentage error made in the estimates in (a) and (b) above. (12 marks)

13. A particle P of mass $2m$ rests on a rough plane inclined at 30° to the horizontal, with a frictional force equal to one half of the normal reaction. P is attached to one end of a light inelastic string which passes over a smooth pulley fixed at the top of the plane and carries a particle Q of mass $3m$ hanging freely at the other end. Find in terms of g

- (a) The normal reaction between P and the plane.
 (b) The acceleration of P
 (c) The force exerted by the string on the pulley. (12 marks)

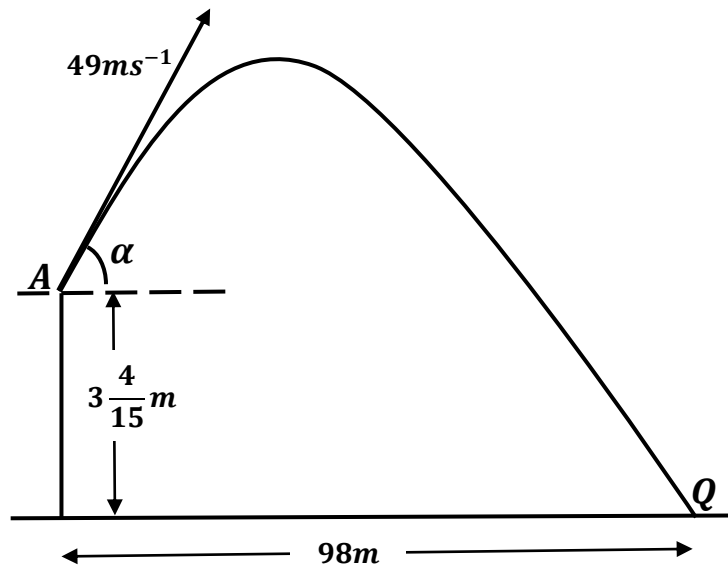
14. (a) Show graphically that the equation $0 = x - 2 + \ln x$ has a root between 1 and 2.

- (b) Write the Newton-Raphson method equation for solving the equation in (a) above.

- (c) Taking x_0 , from (a) above, find the root of the equation correct to 3 decimal places.

(12 marks)

15.



A golf ball is projected with a speed 49ms^{-1} at an angle of elevation α from a point A vertically above the ground. The ball first strikes the ground at a point Q which is at a point horizontally a distance 98m from the point A as shown above.

(a) Show that

$$6\tan^2\alpha - 30\tan\alpha + 5 = 0$$

(b) Find the two possible angles of elevation.

(c) Find the smallest possible time of direct flight from point A to point Q

(12 marks)

16.

(a) Events A and B are independent such that $P(A) = P(B) = p$ and $P(A \cup B) = 0.84$. Using the probability tree diagram, show that $p = 0.6$

(b) The events A and C are such that $P(A) = \frac{3}{5}$, $P(A \cup C) = \frac{7}{10}$ and $P(C/A) = \frac{1}{3}$. Find

(i) $P(A \cap C)$

(ii) $P(A/C)$

(iii) $P(A' \cap C)'$

(12 marks)

END

PRACTICE, PERFECT AND PERFORM