

P425/2  
APPLIED MATHEMATICS  
Paper 2  
Jul./Aug. 2022  
3 hours



**WAKISO-KAMPALA TEACHERS' ASSOCIATION (WAKATA)**  
**WAKATA MOCK EXAMINATIONS 2022**  
**Uganda Advanced Certificate of Education**

**APPLIED MATHEMATICS**

**Paper 2**

**3 hours**

**INSTRUCTIONS TO CANDIDATES:**

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

*Any additional question(s) answered will **not** be marked.*

*All necessary working must be clearly shown.*

*Begin each answer on a fresh sheet of paper.*

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

*Assume where necessary, acceleration due to gravity  $g = 9.8\text{ms}^{-2}$ .*

*Graph paper is provided.*

*Neat work is a must!!*

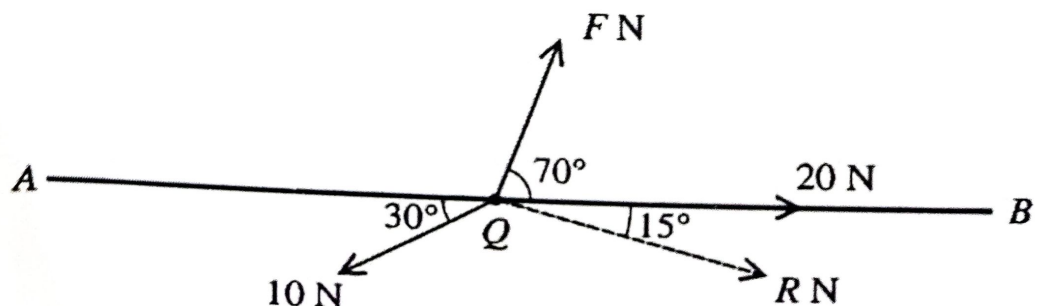


# SECTION A: (40 MARKS)

Answer **all** questions in this section.

1. A particle P moves in a straight line, starting from point, O. The velocity  $V$ , measured in  $\text{ms}^{-1}$ , at a time,  $t\text{s}$  after leaving O is given by  $V = 0.6t - 0.03t^2$ . Find the values of  $t$  at which the particle is travelling at half of its maximum velocity. (05 marks)
2. Two people, A and B, roll an unbiased die. The first to toss a 6 wins sh.11,000. Find A's expected winnings, if he goes first. (05 marks)
3. Given that the error in measuring an angle is  $0.5^\circ$ . Show that the maximum possible error in  $\frac{\sin x}{\cos x}$  is  $\frac{\pi\sqrt{3}}{270}$ , if  $x = 30^\circ$ . (05 marks)
4. One end of a light inextensible string of length 0.5m is attached to a fixed point A. A particle, P of mass 0.2kg is attached to the other end of the string. P moves with constant speed in a horizontal circle with centre O which is 0.4m vertically below A.
  - (a) Show that the tension in the string is 2.5N. (03 marks)
  - (b) Find the speed of P. (02 marks)

(Take  $g = 10\text{ms}^{-2}$ )
5. Hibah measured her pulse rate while resting,  $x$  beats per minute, at the same time each day on 30 days. The results are summarized below.
 
$$\sum(x - 80) = -147 \quad \sum(x - 80)^2 = 952$$
 Find the:
  - (a) mean (03 marks)
  - (b) standard deviation, of Hibah's pulse rate. (02 marks)
6. Use four – figure tables and linear interpolation to evaluate
  - (a)  $\sqrt{60.535}$  (03 marks)
  - (b)  $\sec 78.38^\circ$  (02 marks)
7. A small bead Q can move freely along a smooth horizontal straight wire AB of length 3m. Three horizontal forces of magnitudes  $F\text{N}$ ,  $10\text{N}$  and  $20\text{N}$  act on the bead in the direction shown in the diagram. The magnitude of the resultant of the three forces is  $R\text{N}$  in the direction shown in the diagram below.



Find the values of  $F$  and  $R$ .

(05 marks)



8. In Kampala, 76% of cars are fitted with satellite navigation equipment. A random sample of 11 cars from this town is chosen. Find the probability that fewer than 10 of these cars are fitted with this equipment. (05 marks)

### SECTION B: (60MARKS)

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

9. Kayz has a part-time job delivering newspapers. On a number of days he noted the time; correct to the nearest minute, that it took him to do his job. Kayz used his results to draw up the following table, two of the values in the table are denoted by  $a$  and  $b$ .

Time ( $t$ minutes)	21 – 25	26 – 30	31 – 35	36 – 40	41 – 50	51 – 65	66 – 75
Frequency (number of days)	10	20	15	10	30	45	$b$
Frequency density	2	$a$	3	2	3	3	0.5

- (a) Find the: (i) values of  $a$  and  $b$ ,  
(ii) mode (05 marks)

- (b) Draw a cumulative frequency curve and use it to estimate the semi-interquartile range. (07 marks)

10. A particle,  $P$  of mass  $0.5\text{kg}$  is projected vertically upwards from a point on a horizontal surface. A resisting force of magnitude  $0.02V^2\text{N}$  acts on  $P$ , where  $V\text{ms}^{-1}$  is the upward velocity of  $P$  when it is at a height of  $x\text{m}$  above the surface. The initial speed of  $P$  is  $8\text{ms}^{-1}$ .

- (a) Show that, while  $P$  is moving upwards,  $V \frac{dV}{dx} = -10 - 0.04V^2$ . (03 marks)

- (b) Find the: (i) greatest height of  $P$  above the surface,  
(ii) speed of  $P$  immediately before it strikes the surface after descending. (Take  $g = 10\text{ms}^{-2}$ ) (09 marks)

11. The equation  $x^3 - x^2 - 6 = 0$  has one real root denoted by  $\alpha$ .

- (a) (i) Find by calculation the pair of consecutive integers between which  $\alpha$  lies.  
(ii) Use the iterative formula  $x_{n+1} = \sqrt{\left(x_n + \frac{6}{x_n}\right)}$  twice to determine  $\alpha$  to four decimal places. (07 marks)

- (b) (i) Use the Newton-Raphson method twice to determine  $\alpha$  correct to four decimal places.  
(ii) Deduce with a reason which of the formulae in a(ii) and b(i) is appropriate for solving the equation  $x^3 - x^2 - 6 = 0$  (05 marks)

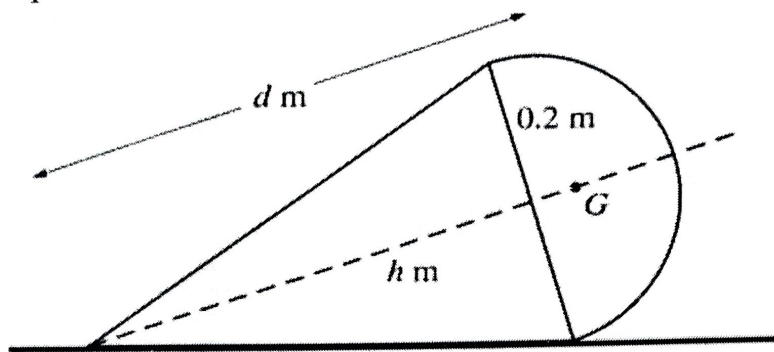
12. A random variable  $X$  has a probability density function given by  $(x) = \begin{cases} k(3-x); & 1 \leq x \leq 2 \\ 0, & \text{otherwise} \end{cases}$  where  $k$  is a constant.

- (a) (i) Show that  $k = \frac{2}{3}$ .

(ii) Find the median of  $X$ . (08 marks)

(b) Find the probability  $P\left(1 < x < \frac{3}{2}\right)$ . (04 marks)

13. The diagram below shows an object formed by joining a hemispherical shell of radius 0.2m and a solid cone with base radius 0.2m and height  $h$ m along their circumferences. The centre of mass,  $G$ , of the object is  $d$ m from the vertex of the cone on the axis of symmetry of the object. The object rests in equilibrium on a horizontal plane, with the curved surface of the cone in contact with the plane. The object is on the point of toppling.



- (a) Show that  $d = h + \frac{0.04}{h}$ . (05 marks)
- (b) It is given that the cone is uniform and of weight  $4N$ , and that the hemispherical shell is uniform and of weight  $WN$ . Find  $W$ , if  $h = 0.8$ . (07 marks)
14. (a) Use the trapezium rule with 5 strips to estimate the area of  $y = 3^x$  between the  $x$ -axis,  $x = 1$  and  $x = 2$ ; correct to three decimal places. (06 marks)
- (b) A public servant earns  $A$  millions and invests in a bank at a rate of 8% compound interest for  $n$  years. Construct a flow chart and perform a dry run for  $n = 4$  and  $A_0 = 2$  million. (06 marks)
15. The life times, in days of LG Televisions and Samsung Televisions have the independent distributions  $N(1020, 45^2)$  and  $N(2800, 52^2)$  respectively.
- (a) Find the probability that the total of the life times of five randomly chosen LG Televisions is less than 5200 days. (05 marks)
- (b) Find the probability that the life time of a randomly chosen Samsung Television is at least three times that of a randomly chosen LG Television. (07 marks)
16. A particle  $P$  of mass  $M$ kg is attached to one end of a light elastic string of natural length 0.8m and modulus of elasticity 12.5N. The other end of the string is attached to a fixed point  $A$ . The particle is released from rest at  $A$  and falls vertically until it comes to instantaneous rest at the point  $B$ . The greatest speed of  $P$  during its descent is  $4.4\text{ms}^{-1}$  when the extension is  $e$ m.
- (a) (i) Show that  $e = 0.64M$ .  
(ii) Find a second equation in  $e$  and  $M$ , and hence find  $M$ . (08 marks)
- (b) Calculate the distance  $AB$ . (04 marks)

END

