UGANDA ADVANCED CERTIFICATE OF EDUCATION

RESOURCEFUL MOCK EXAMINATIONS 2012

APPLIED MATHEMATICS

Paper 2

3 hours

INSTRUCTIONS TO CANDIDATES:

Answer **all** *the* **eight** *questions in section* **A** *and* **only five (5)** *from section* **B**.

All *the necessary working* **must** *be shown clearly.*

Begin each question on a fresh page.

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

In numerical work, take g to be 9.8 ms⁻².

Turn over.

SECTION A: (40 MARKS)
*Answer **all** questions in this section.*

1. Two forces **P** and **Q** act on a particle. The force **P** has magnitude 7 N and acts due north. If the resultant of **P** and **Q** is a force of magnitude 10 N acting in a direction with bearing 120º, find the;
   (i)   magnitude of Q.
   (ii)   direction of Q.

   (05 marks)

2. Given that $x = 5.73$, $y = -2.496$ and $z = 5.9765$ are rounded off to the given decimal places indicated,
   (i)   state the maximum possible errors in x, y and z.
   (ii)   find the limits with in which the exact value of the expression $\dfrac{x}{y-z}$ lies.

   (05 marks)

3. A car battery needs to be recharged. The probability that it starts a car engine straight away is 0.4. If it fails, the probability of starting after the first push is 0.75 and that of starting after a second push is 0.9. Determine the probability that the car;
   (i)   starts after being pushed once.
   (ii)   fails to start after being pushed twice.

   (05 marks)

4. A body of weight 50 N is placed a smooth plane inclined at arc sin ½ to the horizontal. Find the horizontal force P, required to keep the body in equilibrium and the normal reaction.   (05 marks)

5. (i) Show that the equation $x\sin\sqrt{x}=1$ has a root in the interval 1 and 2.
   (ii) Using linear interpolation, find the first approximation to the root giving your answer correct to 2 decimal places.

   (05 marks)

6. The table below shows motorcycle casualties by age in 2011.

Age (years)	Percentage casualties
16 – 19	36
20 – 24	26
25 – 29	15
30 – 39	11
40 – 80	12

(i)   Calculate the mean number of casualties.
(ii)   Draw a histogram and estimate the mode.
(05 marks)

7. A particle of mass 1.5 kg is attached to one end of a spring of natural length 0.5 m and modulus of elasticity 6 N. The other end, O, of the spring is attached to a point on a smooth horizontal surface. If the particle is held at rest on the surface with distance between particle and O being 75 cm and the released from rest, show that the particle performs S.H.M and then find the maximum acceleration.   (05 marks)

8. A machine manufacturing nails makes approximately 15% that are outside 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.
(05 marks)

SECTION B (60 MARKS)
*Answer **only five** questions from this section. **All** questions carry equal marks.*

9. The speeds of cars passing a certain point on a motor way can be taken to be normally distributed. Observations show that of the cars passing the point, 20% are travelling at less than 35 mph and 65% are gravelling between 35mph and 45 mph.
   (a) Find the mean speed and standard deviation of the cars.   (08 marks)
   (b) Calculate the probability of cars that travel at more than 56.4 mph.
(04 marks)

10. A pigeon is released from a point which is at a distance of 80 m on a bearing of 300° from a shooter. The pigeon travels with a constant speed of 40 ms^{-1} on a bearing of 050°. Given that as soon as the pigeon is released, the gun is fired and the bullet has a speed of 200 ms^{-1}.
   (a) Determine the direction in which the gun must be fired so as to hit the pigeon.   (07 marks)
   (b) Find how long it takes the bullet to hit the bird.   (05 marks)

11. (a) Use the trapezium rule with 6 strips to estimate $\int_0^1 \dfrac{1}{1+\sqrt{\sin x}}dx$, correct to 3 decimal places. (07 marks)

(b) Study the flow chart below and answer the questions that follow.
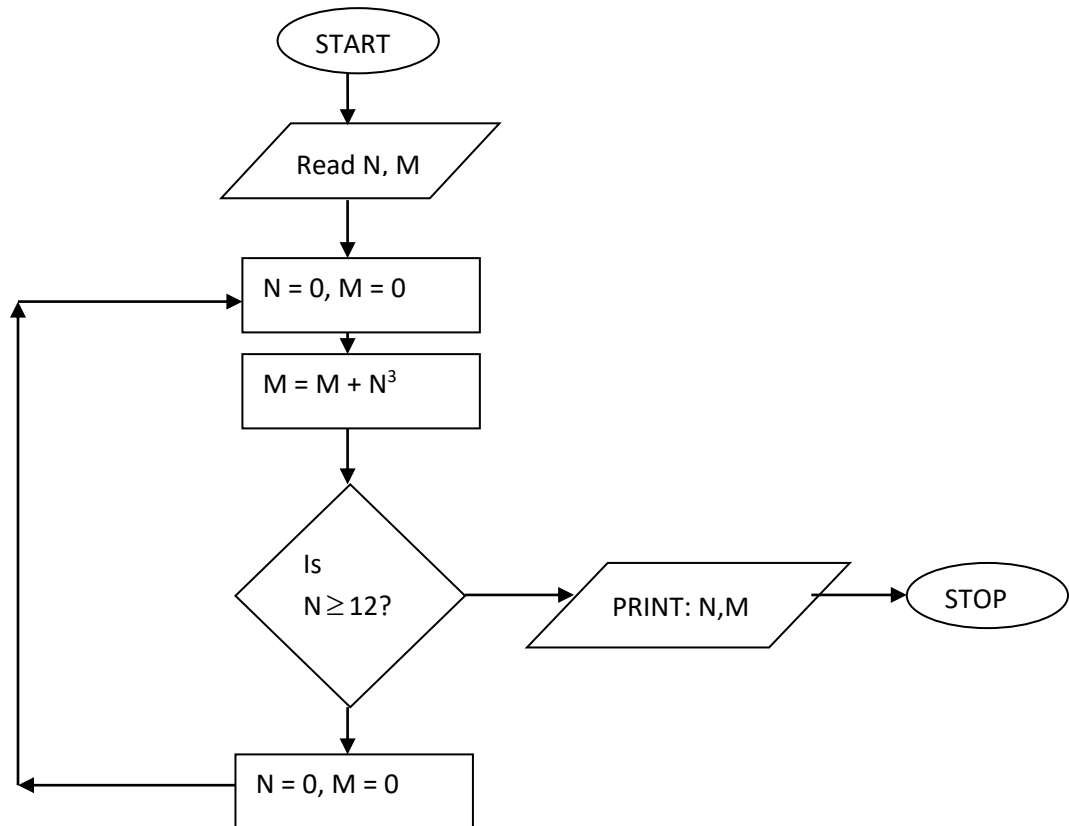
(i) Perform a dry run of the flow chart above.

(ii) State the purpose of the flow chart.

(05 marks)

12. (a) Events A, B and C are such that $P(A) = x$, $P(B) = y$ and $P(C) = x + y$. If $P(A \cup B) = 0.6$ and $P(B/A) = 0.2$,

(i) show that $4x + 5y = 3$.

(ii) Given that B and C are mutually exclusive and that $P(B \cup C) = 0.9$, determine another equation in x and y.

(iii) Hence find the values of x and y. Deduce whether A and B are independent events.

(07 marks)

(b) The events A and B are independent with $P(A) = \frac{1}{2}$ and $P(A \cup B) = \dfrac{2}{3}$.

Find; (i) P(B)   (ii) P(A/B)   (iii) $P(B^{I}/A)$

(05 marks)

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13. A smooth bead of mass 0.2 kg is threaded on a smooth circular wire of radius r metres which is held in a vertical plane. If the bead is projected from the lowest point on the circle with speed $\sqrt{3rg}$. Find the;
   (a) speed of the bead when it has gone one sixth of the way round the circle.
   (09 marks)
   (b) force exerted on the bead by the wire at this point. (03 marks)

14. (a) Show that the root of the equation $f(x) = Inx - sinx - 2 = 0$ lies between 3 and 4. (03 marks)
   (b) By using the Newton Raphson method, find the root to 2 decimal places.
   (09 marks)

15. The table below shows the frequency distribution of marks obtained in a test by a group of senior six students in a certain school.

Marks	10-	20-	30-	40-	50-	60-	70-	80-90
Frequency	18	34	58	42	24	10	6	8

   (a) Calculate the mean mark and standard deviation. (06 marks)

   (b) Draw a cumulative frequency curve and use it to estimate;
       (i)   the median mark.
       (ii)   how many would fail if the pass mark is fixed at 40.
       (iii) the least mark if the top 10% of the students are given grade one.
   (06 marks)

16. A uniform rod XY of length 2 m and weight W is hinged to a vertical post at X. It is supported in a horizontal position by a string attached at Y and to a point Z vertically above X. A weight w is hung from Y.
   (a) If the reaction at the hinge is at 90° to YZ, show that the length of the string YZ is $4\sqrt{\dfrac{2(W+w)}{W}}$. (07 marks)

   (b) Find the tension in the string. (05 marks)

END