S.6 APPLIED MATHEMATICS, P425/2

MECHANICS AND NUMERICAL ANALYSIS

ASSIGNMENT 2

INSTRUCTIONS:

- Attempt all questions in section A and section B.
- In numerical work, use $g = 9.8ms^{-2}$

SECTION A (40 MARKS)

Attempt all questions in this section

1. The speed of a taxi decreased from $90km^{-1}h$ to $18km^{-1}h$ over a distance of 120 m. find the speed of the taxi when it had covered a distance of 50 m.

(05 marks)

2. (a) Round off the following as required: -
   (i) $\sqrt{2}$ to 3 significant figures
   (ii) 6415000 to 2 significant figures
   (iii) 3.0085 to decimal places

   (b) Truncate the following as required:

   (i) $\frac{2}{3}$ to three significant figures
   (ii) $e^{0.6}$ to three decimal places

(05 marks)

3. A car is travelling along a straight motor way at a constant speed, Vms$^{-1.}$ Ten seconds after passing a speed limit sign, the driver brakes and the car decelerates uniformly for 5s, reducing its speed to $30ms^{-1}$.
   Given that the car covers a distance of 600 m in the 15 seconds period, find: -
   (i) Value of V
   (ii) Deceleration of the car.

(05 marks)

4. The table below shows how T varies with S.

T	-2.9	-0.1	2.9	3.1
S	30	20	12	9

   Use linear interpolation or extrapolation to estimate the value of: -
   a) T when S = 26
   b) S when T = 3.4

(05 marks)

5. A ball is thrown vertically upwards with a velocity of 14.7 ms-1 from a platform 19.6m above the ground level.
   Fine the: -
   (i) Time taken for the ball to reach the ground
   (ii) Velocity of the ball when it hits the ground

(05 marks)

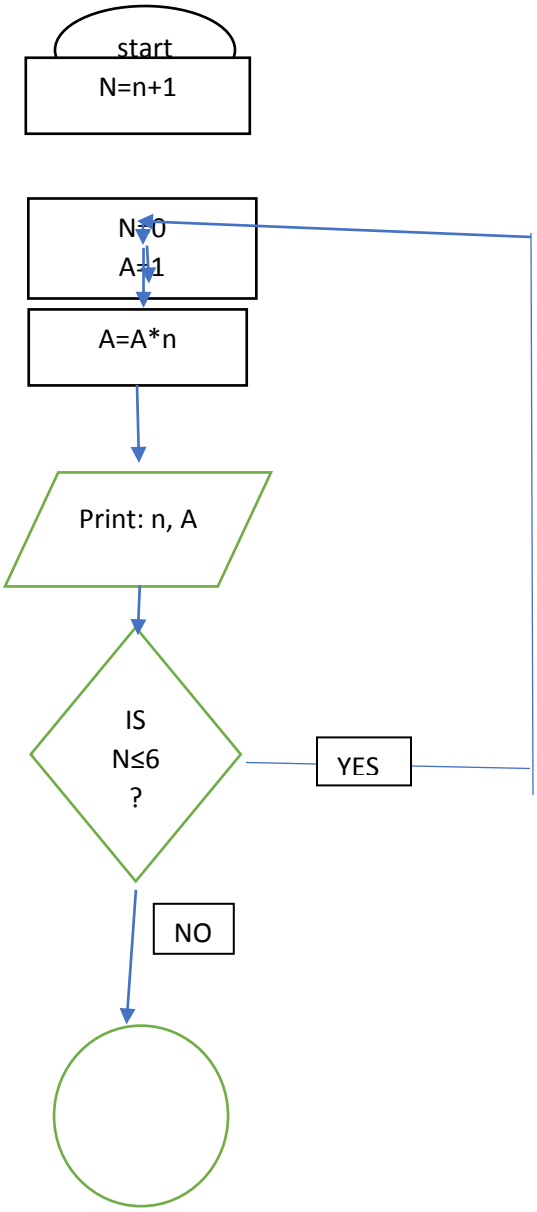
6. A cylindrical pipe has a radius of 3.5 cm measured to the nearest number of decimal places indicated. If the relative absolute error made in calculating its volume is 0.056, find the relative absolute error made in measuring its height.

(05 marks)

7. The initial velocity of a particle moving with a constant acceleration is $(3i - 5j)ms^{-1}$. After 2s, the velocity of the particle is of magnitude $6ms^{-1}$ and parallel to the vector $i + j$. Find the magnitude of the acceleration of the particle.

(05 marks)

8. Study the flow chart below and answer the questions that follow;



(i) Perform a dry run for the flow chart
(ii) State the purpose of the flow chart
(iii) State the relationship between A and n

(05 marks)

SECTION B (60 MARKS)

Attempt all questions from this section

9. The bus stages along soroti – lira road are 10 km apart. An express bus travelling between the two towns only stops at these stages except in case of an emergency when it is permitted to stop at a point in between the two stages. The fares up to the first, second, third and fourth stages from soroti are shs. 110, shs. 150, shs. 185 and shs. 200 respectively.
    a) On a certain day Okello paid to travel from soroti up to the fourth stage but fell sick and had to be left at the health Centre 33 km away from soroti. Given that he was refunded money for the part of the journey he had not travelled, find the approximate amount he received.
    b) Apio had only shs. 165 and was allowed to board the bus but had to be left at a point worth her money. How far from soroti was she to be left.
    c) If Geoffrey was allowed to board from soroti up to his home trading Centre stage, 5km after the fourth stage, how much did he pay?

(12marks)

10. A salon car travelling at a constant velocity of $25ms^{-1}$ overtakes a stationary police patrol car. Two seconds later, after realizing that it was a stolen car, the police patrol car sets off in pursuit, accelerating at a uniform rate of $6ms^{-2}$.
    a) How far does the police patrol car travel before catching up with the saloon car?
    b) What is the velocity of the police patrol car at the time of overtake?

(12 marks)

11. (a) obtain the range of values within which the exact value of;

$2.7654 + 3.8006 - \frac{15.176}{0.9876}$ lies, correct to 4 decimal places.

(b) The numbers A and B are measured as a and b with errors e_1 and e_2 respectively. Show that the maximum possible relative error in approximating A^2B by a^2b is given by;

$2|\frac{e_1}{a}| + |\frac{e_2}{b}|$. Hence find the percentage error in the above approximation if;
$a = 5.676 \; and \; b = 12.5$

(12 marks)

12. A particle is projected vertically upwards from the top of a building of height, H meters with a speed of $4ms^{-1}$. After a time of $(\frac{1}{g})$ seconds, another particle is projected vertically upwards from ground level at a speed of $8ms^{-1}$. The particles meet each other at the top of the building.

    a) Show that; $H = \frac{63}{2g}$

    b) Determine the velocity of each particle just prior to collision.

(12 marks)

13. (a) Use the trapezium rule with six ordinates to estimate $\int_0^1 sin\ ^2\text{X}dx$, correct to three significant figures.

    (b) Determine the error made in your calculation in (a) above and suggest how this error can be reduced.

(12 marks)

14. (a) A body of mass 5kg is in limiting equilibrium on its own when it is placed on a rough inclined plane. If the angle of friction is $\tan^{-1}\left(\frac{3}{4}\right)$. Find the: -

    (i) Inclination of the plane to the horizontal.

    (ii) Minimum force acting parallel to the incline that will just move the body up the incline.

(b) if a force, P, inclined at an angle α, to the surface of the plane is applied to the body, find the minimum value of p, with the corresponding value of α when the body is on the point of moving up the plane.

(12 marks)

15.(a) (i) Show that the equation; $x^3 = 5x + 1$ has a root between $x = 2$ and $x = 2.5$

(ii)Use linear interpolation to estimate the root of the above equation correct to two decimal places

(b) (i) Show that the two iterative formulae for solving the above equation can be expressed as;

$$x_{n+1} = \frac{x_n^3 - 1}{5} \quad \text{and} \quad x_{n+1} = \sqrt{5 + \frac{1}{x_n}}$$

(iii) Use the root in (a) (ii) above to deduce with a reason, the more suitable formula for solving the equation;

$x^3 = 5x + 1$. Hence use it once to find a better approximation of the root, correct to three decimal places.

(12 marks)

16.Two strings AB and BC are tied to a particle of mass 0.3kg at B and the end A is fixed. A second particle of mass 0.4kg is attached at C. A horizontal force of magnitude, P newtons at C maintains the system in equilibrium with the string BC making an angle of 60° with the downward vertical, and with the string AB making an angle Ø with the downward vertical.

(a) Calculate the magnitude of the tension in the string BC, hence determine the value of P.

(b) Show that $\tan Ø = \frac{4\sqrt{3}}{7}$ and hence calculate the magnitude of the tension in AB.

(12 marks)

END

(BEST WISHES)