HOLIDAY ASSESSMENTS
APPLIED MATHEMATICS P425/2
TIME: 3HOURS

INSTRUCTIONS

Answer all the eight questions in section A and any five from section B
*For numerical work, use $g = 9.8ms^{-2}$*

SECTION A (**40Marks**)
Attempt all questions in this section

1. Find the limits between which the exact value of $\frac{2.89+7.301}{8.89-7.301}$ lies (**5marks**)
2. Forces **P** and **Q** of magnitudes 14N and 27N act in the directions of the vectors $2i - 6j + 3k$ and $4i + 4j - 7k$ respectively. Find the
   a. forces **P** and **Q** (**3marks**)
   b. resultant of the forces **P** and **Q** (**2marks**)
3. A bag contains 3yellow, 4black and 5green beads. Three beads are drawn from the bag find the probability that
   a. atleast one of them is yellow (**3marks**)
   b. the beads picked are of the same color (**2marks**)
4. The table below shows the frequency distribution of the heights of 40 students

 | Height/cm | Number of students |
   |-----------|--------------------|
   | 131—140 | 2 |
   | 141—150 | 11 |
   | 151—160 | 14 |
   | 161—170 | 10 |
   | 171—180 | 3 |

   Calculate:
       (i)   the median (**2marks**)
       (ii)   the number of students whose height is below 164.5cm (**3marks**)
5. The following system of forces is in equilibrium
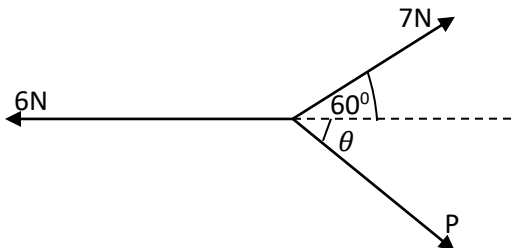
   Find the values of P and θ (5marks)
6. A discrete random variable X has the pdf defined over the numbers 1, 2, 3 and 4 such that: P(X = 1) = 2P(X = 2) = 3P(X = 3) = 4P(X = 4) Find the
     (i) P(X = 1) (ii)   expectation of X (5marks)
7. Given the numbers $x = 2.75, \ y = 3.000 \ $ and $z = 6.2329$
       (i)   State the maximum possible errors in each of the numbers

(ii)   Find the value of $x - \frac{y}{xz}$ with its error bound   **(5marks)**

8. A body of mass $7kg$ rests on a smooth horizontal table and is connected to masses of $5kg$ and $2kg$ which are hanging freely, by strings passing over pulleys fixed at the opposite edges of the of the table as shown below
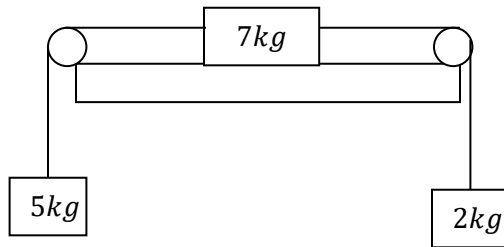
If the system is released from rest, find the acceleration of the $2kg$ mass   **(5marks)**

SECTION B (60MARKS)

Attempt any five from this section

9. (a) A soft drink machine is regulated to discharge an average volume of $300ml$ per bottle. If the amount of drink is normally distributed with a standard deviation of $12ml$.
    (a) Find the probability that a bottle selected at random has a volume of
    (i)   greater than $302.4ml$ **(3marks)**
    (ii)   between $290ml$ and $319ml$ inclusive   **(4marks)**
    (b) For a discrete random variable X, defined over the numbers 1, 2, 3, 4, 5 the cumulative probability function is given by $F(x) = kx^2$. Find the
    (i)   value of the constant k **(2marks)**
    (ii)   probability distribution of X   **(3marks)**

10.   **(a)** Given that the numbers A, B and C were rounded off to the numbers a, b, c respectively such that $a = 2.39, b = 18.0$ and $c = 6.005$. Find the minimum values of : (i) $\frac{b}{c} - \frac{a}{b}$ (ii) $\frac{c^2}{ab} + \frac{1}{c}$ (iii) $c(ab + c)$ **(6mks)**

    (b) Find the percentage error of $6.3421\left(1.02 - \frac{0.045}{0.005}\right)$ if the numbers were rounded off to the given number of decimal places.   **(6mks)**

11.   **(a**) A civil aviation firm uses only three hotels namely: Sheraton, Colline and Africana to provide accommodation for its clients. Experience has it that
    30% go to Sheraton, 38% go to Colline and the rest to Africana.
    If the electrical installation is faulty in 5% of the rooms at Sheraton, in 4% of the rooms at Colline and in 9% of the rooms at Africana.
    Find the probability that a client:
    (i)   Is accommodated in a room with no faulty electrical installation   **(4marks)**
    (ii)   was assigned accommodation in Africana hotel, given that has a room with faulty electrical installation.   **(3marks)**

    (b) A bag contains 4 green and some red balls of identical size. Two balls are drawn at random, one after the other without replacement. If the probability of drawing two

green ball is $\frac{2}{15}$. Find the number of red balls which were in the bag at the start and the probability that the two balls drawn are of the different colours **(5marks)**

12. In a study of population density in eight suburbs of a town , the statistics shown in the table below were obtained. The population density denoted by y and the distance of the suburb from the centre of the town by x.

Suburb	y/persons/ hectare	x/km
A	55	0.7
B	11	3.8
C	68	1.7
D	38	2.6
E	46	1.5
F	43	2.6
G	21	3.4
H	25	1.9

a. Plot a scatter diagram for the data and comment on the result **(4mks)**
b. Draw the line of best fit and use it to find x when $y = 39$ **(3mks)**
c. Calculate the rank correlation coefficient for the data **(5mks)**

13. A motorist starts a car from rest and accelerates uniformly to a speed of **V**ms^{-1} in **8**s. He maintains this speed for another **18**s and then applies the brakes and retards uniformly to rest. His deceleration is numerically equal to twice his previous acceleration. By sketching the velocity – time graph or otherwise, find
(a) Time for retardation **(3marks)**
(b) The value of **V** if the total distance moved is **120**m **(4marks)**
(c) The initial acceleration **(2marks)**
(d) Average velocity **(3marks)**

14. (i) Show that the iterative formula based on Newton Raphson for approximating the root of the equation $x = \frac{1}{\sqrt[4]{3}}$ is $x_{n+1} = \frac{x_n}{4}(5 - 3x_n^4)$, $n = 0, 1, 2 \dots$ **(3marks)**

(ii) Hence taking $x_0 = 0.5$ find the root correct to 3decimal places **(9marks)**

15. (**a**) The numbers A and B were approximated to numbers a and b with errors p and q respectively. Prove that the maximum absolute relative error made in approximating $\frac{A^2}{B}$ by $\frac{a^2}{b}$ is $2\left|\frac{p}{a}\right| + \left|\frac{q}{b}\right|$ **(6marks)**

(**b**) Find the maximum value of each of the following

(i) $\frac{2.31-1.009}{1.55+3.40}$ (ii) $\frac{5.2}{1.452-2.51}$ (iii) $1.32+3.54-7.123$ **(6marks)**

END