

SECTION A  
[ 48 marks]

Answer **all** the questions in this section. All questions carry equal marks.

1. Akua's initial salary is GH¢ 4,000.00 a year and that of Boateng is GH¢ 1,000.00 a year. If they started work the same day and Akua has an annual increment of GH¢ 80.00 while that of Boateng is GH¢ 200.00, when will Boateng receive more than Akua?
2. How many **odd** numbers of 4 or 5 digits can be formed from the digits 0, 1, 2, 3, 4 without repetition?
3. Find, from *first principles*, the derivative of  $3x^2 - x$ .
4. (a) Find the range of values of  $x$  for which  $2x^2 + x - 15 \leq 0$ .  
(b) A binary operation  $\Delta$  is defined on a set of real numbers,  $\mathbf{R}$  by  $p \Delta q = 2(p - q) - \left(\frac{1}{p} + \frac{1}{q}\right)$  where  $p, q \in \mathbf{R}$ . Evaluate  $\frac{1}{2} \Delta \left(\frac{-1}{4}\right)$ .
5. The probability that a contractor will get a plumbing contract is  $\frac{2}{3}$  and the probability that he will not get an electrical contract is  $\frac{5}{9}$ . Calculate the probability that he will get **at least one** contract.
6. The table shows the distribution of the masses of 50 junior weight-lifters.
 

Mass (kg)	41-50	51-60	61-70	71-80	81-90	91-100
Frequency	5	9	20	5	3	8

Using an assumed mean of 65.5, calculate, correct to **two** decimal places, the mean mass.
7. A particle of mass 2 kg is placed on a rough plane which is inclined at  $30^\circ$  to the horizontal. A force of 20 N acts on the particle up the plane. If the particle is just about to move up the plane, find the value of  $\mu$ , the coefficient of friction. [Take  $g = 10 \text{ m s}^{-2}$ ]
8. The position vectors of points  $A, B, C$  and  $D$  with respect to the origin are  $(-2\mathbf{i} - 4\mathbf{j})$ ,  $(5\mathbf{i} + 3\mathbf{j})$ ,  $(8\mathbf{i} - 2\mathbf{j})$  and  $(x\mathbf{i} + y\mathbf{j})$  respectively. If  $ABCD$  is a parallelogram, find the position vector of  $D$ .

 $\frac{11}{2}$ SECTION B  
[52 marks]

Answer **four** questions **only** from this section with **at least one** question from **each** part.

All questions carry **equal** marks.

PART I  
PURE MATHEMATICS

9. (a) Without using Mathematical tables or calculator, find, leaving the answer in surd form, the value of  $\sin 15^\circ$ .

- (b) Express  $\frac{4x-1}{3x^2+19x-14}$  in partial fractions.
10. (a) If  $h(x) = 3x^2 - 7x + 2$  is expressed as  $h(x) = P(x - Q)^2 + R$ , where  $P$ ,  $Q$  and  $R$  are real numbers, find the value of:  
 (i)  $P$ ;  
 (ii)  $(Q + R)$ .
- (b) Calculate the area of the finite region bounded by the curve  $y = x^2 - 3$  and the line  $y = 1$ .
11. Two linear transformations,  $P$  and  $Q$  in the  $0xy$  plane, are defined by  
 $P: (x, y) \rightarrow (x + 2y, -x + y)$   
 $Q: (x, y) \rightarrow (2x + 3y, x + 2y)$ .
- (a) Write down the matrices of  $P$  and  $Q$ .
- (b) Given that  $R(2P + Q) - 4P^2 = 2I$ , where  $I$  is the  $2 \times 2$  unit matrix, find the matrix  $R$ .

PART II  
STATISTICS AND PROBABILITY

12. A fair coin is tossed 6 times. Calculate the probability of obtaining at:  
 (a) **least one tail**;  
 (b) **least one head and one tail**;  
 (c) **most two tails**.
13. The table shows the marks scored by 285 students in a test.

Marks	66-70	71-75	76-80	81-85	86-90	91-95	96-100
Number of students	9	42	69	66	81	15	3

- (a) Draw a cumulative frequency curve for the distribution.
- (b) Using the curve in (a), calculate the probability that a student selected at random scored a mark between the median and 80<sup>th</sup> percentile.

## VECTORS AND MECHANICS

14. (a) If the velocity,  $v$ , of a particle is given by  $v = 3t^2 + 2t$ , find the distance travelled in the fourth second.
- (b) Three houses **X**, **Y** and **Z** are situated along a straight horizontal road. The distance between **X** and **Y** is 50 m and that of **Y** and **Z** is 136 m. A bus moving along the road with a constant acceleration  $p \text{ m s}^{-2}$  passes **X** with velocity  $q \text{ m s}^{-1}$ . The bus passes **Y** 2 seconds after passing **X** and passes **Z** 4 seconds after passing **Y**. Find the value of:
- $p$ ;
  - $q$ .
15. (a) Two objects **X** and **Y** of masses 8 kg and 5 kg move towards each other in a straight line with velocities  $20 \text{ m s}^{-1}$  and  $34 \text{ m s}^{-1}$  respectively and collide. After collision, **X** is observed to have a velocity of  $15 \text{ m s}^{-1}$  in the opposite direction. Calculate the magnitude of the velocity of **Y**.
- (b) A boat on the seashore is acted upon by three forces  $\mathbf{F}_1(120 \text{ N}, 180^\circ)$ ,  $\mathbf{F}_2(50 \text{ N}, 030^\circ)$  and  $\mathbf{F}_3(P \text{ N}, 315^\circ)$ .
- Express **each** force as a column vector;
  - If the resultant force on the boat is in the direction  $225^\circ$ , calculate, correct to **one** decimal place, the value of **P**.

**END OF PAPER**