SECTION A: (40 MARKS)

*Answer **all** the questions in this section.*

1. Without using a calculator, evaluate
$$\frac{6\sqrt{10} + 2\sqrt{40}}{\sqrt{2} \times \sqrt{20}}.$$
   (05 marks)

2. The mean of eight numbers 13, 5, 6, 10, k, 11, 8, and 7 is 9. Find the;
   (a) value of k. *(02 marks)*
   (b) standard deviation. *(03 marks)*

3. The sum of the first 16 terms of an arithmetic progression (A.P) is 1088. The 16th term is twice the 8th term. Determine the value of the first term of the A.P. *(05 marks)*

4. A school students' council consists of 7 girls and 5 boys. Two students are selected at random from the council. Find the probability that;
   (a) both are girls. *(02 marks)*
   (b) the first is a boy and the second is a girl. *(03 marks)*

5. Determine the equation of the tangent to the curve $y = 2x^3 + 3x$ at the point when $x = 2$. *(05 marks)*

6. The table below shows the enrollment of students in an institution over a period of 5 years.

Year	2003	2004	2005	2006	2007
Number of students	145	182	170	155	213

   Calculate the;
   (a) three-year moving averages. *(03 marks)*
   (b) number of students enrolled in 2008, given that the fourth moving average is 203. *(02 marks)*

7. Given $a = \begin{pmatrix} 5 \\ -12 \end{pmatrix}$ and $b = \begin{pmatrix} -3 \\ 4 \end{pmatrix}$, find the;
   (a) dot product of a and b. *(02 marks)*
   (b) angle between the vectors a and b. *(03 marks)*

8. A train moving in a straight line passes a point P with a velocity of 20 ms^{-1}. It then moves for 5 seconds with an acceleration of 2.5 ms^{-2}.
   Determine the;
   (a) velocity of the train after 5 seconds. *(03 marks)*
   (b) distance of the train from P after 5 seconds. *(02 marks)*

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*Answer only **four** questions from this section.*
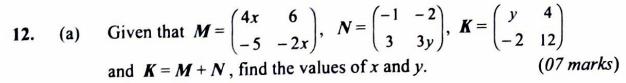**All** *questions carry equal marks.*

9. The table below shows marks obtained in Sub-Math and Physics by nine students.

Sub-Math (X)	51	62	64	47	54	44	68	61	56
Physics (Y)	45	54	58	46	49	43	59	56	53

(a)   (i)   Draw a scatter diagram for the data.

      (ii)   On your scatter diagram, draw a line of best fit.

      (iii)   Use the line of best fit to estimate the value of X when $Y = 55$.

                                 (09 marks)

(b)   Calculate the Spearman's rank correlation coefficient and comment on the result.   *(06 marks)*

10. (a)   Given that α and β are the roots of the quadratic equation
$x^2 - 3mx + n^2 = 0$, show that $\alpha + \beta = 3m$ and $\alpha\beta = n^2$.   *(06 marks)*

   (b)   If α and β are the roots of the equation $x^2 - 9x + 4 = 0$, find the;

      (i)   value of $\alpha^2 + \beta^2$.   *(03 marks)*

      (ii)   value of $\dfrac{1}{\alpha^2} + \dfrac{1}{\beta^2}$.   *(03 marks)*

      (iii)   quadratic equation whose roots are $\dfrac{1}{\alpha^2}$ and $\dfrac{1}{\beta^2}$.   *(03 marks)*

11. (a)   Find the number of all the possible arrangements of all the letters in the word DISAPPEAR.   *(05 marks)*

   (b)   In a school, there are nine A-level teachers. In the Science department, there is a teacher for each of the following subjects: Mathematics, Physics, Chemistry and Biology. In the Arts department, there is a teacher for each of the following subjects: Economics, Geography, History, Literature and Fine Art. Three teachers are to be sent for a workshop.

      (i)   Find the number of all possible combinations of teachers that may be sent for the workshop.   *(02 marks)*

      (ii)   What is the probability that at least two teachers from the Science department are sent for the workshop?   *(06 marks)*

      (iii)   If a Mathematics teacher must attend the workshop, determine the number of possible combinations of teachers to be sent.

                                  (02 marks)

12. (a) Given that $M = \begin{pmatrix} 4x & 6 \\ -5 & -2x \end{pmatrix}$, $N = \begin{pmatrix} -1 & -2 \\ 3 & 3y \end{pmatrix}$, $K = \begin{pmatrix} y & 4 \\ -2 & 12 \end{pmatrix}$

and $K = M + N$, find the values of x and y. *(07 marks)*

(b) In a football tournament, three teams Arsenal, Chelsea and Liverpool had the following results:

- Arsenal won two matches, drew once and lost one match.

- Chelsea won two matches and lost two matches.

- Liverpool won 1 match, drew twice and lost one match.

The teams are awarded 3 points for a win, 1 point for a draw and no point for a loss.

(i) Write a 3x3 matrix for the results and a column matrix for the points. *(04 marks)*

(ii) By matrix multiplication, determine the winner of the tournament. *(04 marks)*

13. A discrete random variable W has a probability distribution shown below.

w	-3	-2	-1	0	1
$P(W = w)$	0.1	0.25	0.3	0.15	d

Find;

(a) the value of d. *(02 marks)*

(b) $P(-3 \le W \le -1)$. *(03 marks)*

(c) $P(W > -1)$. *(02 marks)*

(d) (i) the mode, *(01 mark)*

(ii) the mean, *(02 marks)*

(iii) the variance *(05 marks)*
of the distribution.

14. A mass of 6 kg is lying on a smooth horizontal table. The mass is connected by two light inextensible strings passing over smooth pulleys at the edges of the table, to two masses of 5 kg and 9 kg on opposite sides of the table. With the strings taut and the masses hanging vertically, the system is released from rest.

Calculate the;
(a) acceleration of the masses. *(10 marks)*

(b) tensions in the strings. *(05 marks)*

4 **END**