SECTION A (100 marks)

Attempt all questions.   You should not spend more than 50 minutes on this section.
Answer each question by writing either (a), (b), (c), (d) in the box under each question number.
If you wish to change an answer, cross out your first choice and write your new answer near the box.
This paper must be enclosed in your answer book.

1. $121_3 + 33_5 = y_{10}.$ Then y is

☐   (a) 16   (b) 18   (c) 30   (d) 34.

2.   £840 is divided between A, B and C in the ratio 4 : 2 : 1, respectively.   A's share is

☐   (a) £420   (b) £120   (c) £480   (d) £105.

3.   A rectangular piece of hardboard 20 cm long and 15 cm wide has a mass of 1500 grammes. A piece measuring 5 cm long and 3 cm wide is cut off.   The mass in grammes of the piece cut off is

☐   (a) 70   (b) 100   (c) 60   (d) 75.

4.   When rates are at £6·60 in the £, a man pays £66 per annum on a house whose rateable valuation is £25.   The fraction of the full rates paid is

☐   (a) $\frac{2}{5}$ (b) $\frac{1}{2}$ (c) $\frac{3}{5}$ (d) $\frac{7}{10}$.

5.   A man's weekly wage is £40.   His weekly tax–free allowance is £12.   He pays income tax at 35p in the £.   His weekly tax is

☐   (a) £14   (b) £12·53   (c) £9·80   (e) £4·20.

6.   The frequency distribution table for marks awarded in a test given to 100 pupils is

Mark per pupil	1	2	3	4	5
Number of pupils	2	14	60	20	4

The mean mark per pupil is

☐   (a) 3   (b) 3·1   (c) 5   (d) 1·15.

7.   A = {1, 3, 5, 7},   B = {1, 2, 3}.   Then #(A △ B) is

☐   (a) 3   (b) 2   (c) 5   (c) 7.

8. $x * y$ is defined by $x * y = x^2 - 3xy - y^2$.
When $x = 1$, $y = -1$, $z = 0$, $(x * y) * z$ is

☐   (a) 25   (b) 9   (c) 1   (d) 6.

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9. If (x, y) satisfies both $2x + 3y = 9$ and $3x + 2y = 1$, then (x, y) is

(a) $(3, 1)$ (b) $(3, -4)$ (c) $(-3, 5)$ (d) $(1, 1)$

10. $x^3 - 8y^3$ is divided by $x - 2y$.   The result is

(a) $x^2 + 4xy + 4y^2$ (b) $x^2 + 4y^2$ (c) $x^2 - 2xy + 4y^2$ (d) $x^2 + 2xy + 4y^2$.

11. $27^{-\frac{2}{3}}$ is

(a) $1/9$ (b) -18 (c) $-2/3$ (d) -9.

12. $(x - 5)(y - 2) = 0$.   One of the following conclusions is false.   Which is the <u>false</u> conclusion ?

(a) $(x = 5) \Rightarrow (y = 2)$ (b) $(x = 3) \Rightarrow (y = 2)$ (c) $(x = 5) \Rightarrow y$ can have any value
(d) $(x \neq 5) \Rightarrow (y = 2)$.

13. The domain of the relation $\{(x, y) \mid y = \sqrt{x}\}$ is $\{0, 1, 4\}$.   The range is

(a) $\{0, 1, 2\}$ (b) $\{0, -i, -2\}$ (c) $\{-2, -1, 0, 1, 2\}$ (d) $\{0, 1, 16\}$.

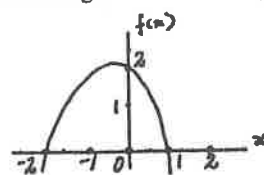14. $f : x \rightarrow 2x - 1$.   Then $f^2(x)$ [i.e $f(f(x))$] is

(a) $4x - 2$ (b) $4x - 3$ (c) $(2x - 1)^2$ (d) $4x^2 + 1$.

15. $\log_4 8$ is

(a) 2 (b) -2 (c) $3/2$ (d) $\frac{1}{2}$.

16. The graph of the function f is shown here.   Which one of the following is most likely correct ?

(a) $f(x) = (2 + x)(1 - x)$ (b) $f(x) = (x + 2)(x - 1)$
(c) $f(x) = (x - 2)(x + 1)$ (d) $f(x) = (2 - x)(1 + x)$.

17. $\log x = 2\log 3 + \log 4 + \log 6$.   Then x is

(a) 144 (b) 16 (c) 216 (d) 19.

18. The factors of $x^2 - 4y^2 - x - 2y$ are

(a) $x(x - 1) - 2y(2y + 1)$ (b) $(x - 2y)(x + 2y - 1)$ (c) $(x + 2y)(x - 2y) + 1$
(d) $(x + 2y)(x - 2y - 1)$.

19. Which <u>one</u> of the following conclusions is <u>not always true</u> ?

(a) $2x > 6 \Rightarrow x > 3$ (b) $-3x > 3 \Rightarrow x < -1$ (c) $(x < 3$ and $y < 2) \Rightarrow xy < 6$.
(d) $(x > 3$ and $y > 2) \Rightarrow x + y > 5$.

20. The perimeter of a rectangle is 20 cm and its area is 24 cm². If the length of one of its sides is x cm, then the quadratic equation which gives the lengths of the sides is

(a) $x^2 - 10x + 24 = 0$ (b) $x^2 - 20x + 24 = 0$ (c) $x^2 + 10x - 24 = 0$
(d) $x^2 - 10x - 24 = 0$.

Attempt <u>QUESTION 21</u> and <u>THREE</u> other questions

21 (a) Using logarithmic tables, slide rule, or otherwise, calculate, correct to two significant figures,

$$\frac{a}{bc}$$

where $a = 0 \cdot 825$, $b = 18 \cdot 1$, $c = 0 \cdot 0094$.

(20 marks)

(b) Using the tables, page 20 to page 27, or otherwise, find, correct to three significant figures, the value of

$$\frac{1}{\sqrt{x}} + y^4$$

where $x = 0 \cdot 0682$, $y = 1 \cdot 069$.

(20 marks)

22. (a) Find, to one place of decimals, the roots of the equation $3x^2 - x - 1 = 0$.

(20 marks)

(b) Express as a single fraction

$$\frac{2}{2x - 1} - \frac{1}{2x + 1} - \frac{1}{x - 2}$$

and verify your answer by putting $x = 0$.

(20 marks)

23. The function f is defined by $f : x \to x^2 - 2$, $x \in R$.

(i) What is $f(-1)$? (ii) For what values of x is $f(x) = x$?

(iii) If g is the function $x \to 2x + 1$, what is $f(g(x))$?

(iv) For what value of x is $f(g(x)) = g(f(x))$?

(40 marks)

24. Draw the graph of the function $f : x \to 2x^2 - x - 3$, $x \in R$, in the domain $-2 \leqslant x \leqslant 2$. Use your graph (i) to solve the inequality $2x^2 - x - 3 \leqslant 0$,

(ii) to estimate the minimum value of $2x^2 - x - 3$.

(40 marks)

25. A person calculated that by increasing his average walking speed by 1 km per hour he would save 20 minutes on a 10 km journey. What was his original speed ?

(50 marks)

26. (a) Solve the simultaneous equations

$$2x = y + 2$$
$$2y = x - 1.$$

(25 marks)

(b) Let $k - \frac{1}{k} < 0$, $k \in R$, and $k \neq 0$.

Then $k - \frac{1}{k} < 0 \Rightarrow k < \frac{1}{k} \Rightarrow k^2 < 1$.

Verify that $k = \frac{1}{2}$ and $k = -\frac{1}{2}$ satisfy $k^2 < 1$ but not $k - \frac{1}{k} < 0$. Explain why this is so.

(25 marks)

27. An ice-cream distributer divides his year into quarters for sales recording purposes. The value in thousands of pounds of each quarterly sales is given in the following table:

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Year 1	$1 \cdot 2$	$4 \cdot 6$	$6 \cdot 1$	$2 \cdot 5$
Year 2	$1 \cdot 6$	$5 \cdot 0$	$6 \cdot 5$	$2 \cdot 9$
Year 3	$1 \cdot 6$	$5 \cdot 4$	$6 \cdot 5$	$3 \cdot 3$

(i) Illustrate these sales by a trend graph.

(ii) Calculate the 4 point moving average and illustrate this on your graph.

(60 marks)