Examination Number

SECTION A (100 marks)

Attempt <u>all</u> questions.   You should not spend more than <u>50 minutes</u> on this section
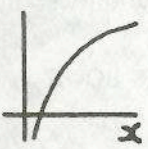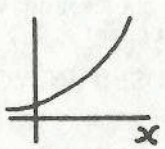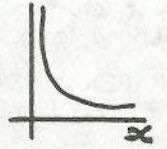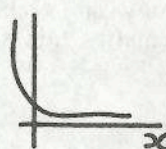Answer each question by writing one of (a), (b), (c), (d) in the box under each question number.
If you wish to change an answer, cross out your first choice and write your new answer near the box.
Mathematics tables may be obtained from the Superintendent.

THIS PAPER MUST BE ENCLOSED IN YOUR ANSWER BOOK

1. $121_3 \times 2_3 =$

(a) 112_3 (b) 1012_3 (c) 242_3 (d) 10120_3

2.   The speeds of a train and a car are in the ratio $1\frac{1}{2} : 1\frac{1}{3}$, respectively.   If the speed of the
      car is 44 km/hour, then the speed of the train in km/hour is

(a) 66   (b) $49\frac{1}{2}$ (c) $39\frac{1}{9}$ (d) $51\frac{1}{3}$

3.   Taxable income is taxed at 26%.   A person's tax bill is £156.   Then the taxable income
      is

(a) £4056   (b) £600   (c) £196.56   (d) £40.56

4.   If p is the radius of the outer circle and q is the radius of the inner
      circle, then the area of the shaded region is

(a) $\pi (p - q)^2$ (b) $2\pi (p - q)$

(c) $\pi (p + q)(p - q)$ (d) $2\pi p (p - q)$

5.   A man works 8 hours a day, five days a week.   His weekly wage is £56.   Then his
      hourly wage is

(a) £1   (b) $33\frac{1}{3}$p   (c) £1.40   (d) $46\frac{2}{3}$p

6.   The time to cook a meat dish is calculated thus:–   30 minutes to heat the dish plus
      20 minutes for each leg of meat.   The number of hours required to cook a dish
      containing x kg of meat is

(a) $\dfrac{5x}{6}$ (b) $\frac{1}{5} (x + \frac{1}{2})$ (c) $\dfrac{2x + 5}{10}$ (d) $\dfrac{2x + 3}{6}$

7.   It is 30 km from h to k.   A car goes from h to k at 60 km/hour and returns from
      k to h at 90 km/hour.   The average speed for the full journey is

(a) 72 km/h   (b) 50 km/h   (c) 75 km/h   (d) 150 km/h

8.   If when added together the sum of the first 15 999 terms of the sequence $1, \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \cdots$
      $\cdots , \frac{1}{n} , \cdots$ is $10\cdot2575283$, then the sum of the first 16 000 terms is

(a) $10\cdot2582158$ (b) $10\cdot2575908$ (c) $10\cdot2591283$ (d) $10\cdot0000625$

9.   If P and Q are sets, then $(P \cup Q) \cap (P \cap Q)$ is

(a) $P \cap Q$ (b) P (c) $P \cup Q$ (d) Q

10.   The nth term of a sequence is given by $T_n = 2 - \dfrac{2}{n}$.   The least value of n for which
      $T_n > 1\frac{3}{4}$ is

(a) 4   (b) 6   (c) 8   (d) 10

11. The equation which has roots 3 and -1 is

   (a) $x^2 = -3$ (b) $x^2 - 3 = 0$ (c) $x^2 - 2x - 3 = 0$ (d) $x^2 - 4x - 3 = 0$

12. If $2^{\frac{1}{2}} = (\frac{1}{2})^k$, then k is

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

13. A rough graph of the function $x \to \log_b x$ is

   (a) (b) (c) (d)

14. The highest common factor of two numbers is 6. Their least common multiple is 168. One of the numbers is 24. The other number is

   (a) 168 (b) 42 (c) 144 (d) 84

15. Let $f : x \to 2x - 2$ and $g : x \to \frac{x}{2} + 1$. If gf is the composite function, then $gf(k)$ is

   (a) $2(k - 1)(\frac{k}{2} + 1)$ (b) k (c) $k - 1$ (d) $k^2 - 2$

16. If $Q \subset P$, then $(P \triangle Q) \triangle \phi$ is

   (a) P (b) Q (c) ϕ (d) $P \backslash Q$

17. If $f : x \to 3 - 2x$, then $f^{-1}(x)$ is

   (a) $\dfrac{3 - x}{2}$ (b) $\dfrac{x - 3}{2}$ (c) $2x - 3$ (d) $\dfrac{1}{3 - 2x}$

18. If $x * y = \frac{1}{5}(2x + 3y)$, then

   (a) $1 * 1 = 2$ (b) $-2 * 4 = 2$

   (c) $(2 * 2) * 2 = 2$ (d) $x * y = 0 \Rightarrow x = 0$ or $y = 0$

19. The relation "X" (i.e. Cartesian product) defined on $\{1, 2, 3\}$ is

   (a) reflexive but not symmetric (b) symmetric but not transitive

   (c) not reflexive (d) reflexive, symmetric and transitive

20. If $\dfrac{3 - 2x}{4} < \dfrac{3 - 2x}{6}$, then

   (a) the inequality is never true (b) $3 > 2x$

   (c) $3 < 2x$ (d) $3 = 2x$

MATHEMATICS – HIGHER COURSE – PAPER II (300 marks)

WEDNESDAY, 13 JUNE – MORNING, 9.30 to 12

SECTION B   (200 marks)

Attempt **QUESTION** 1 and **THREE** other questions

1. (a) If $v^2 = u^2 + 2as$, find the value of s when

$$u = 2\tfrac{1}{2}, \qquad v = 5\tfrac{1}{2}, \qquad a = 6 \times 10^{-2}.$$

(b) Given that $k = 3{\cdot}825$ and $m = 2{\cdot}575$, evaluate

$$\frac{(m + 2)^2}{k\sqrt{k^2 - m^2}}$$

correct to two significant figures.

(50 marks)

2. (a) Simplify: $\left(\dfrac{1}{x + h} - \dfrac{1}{x} \right) \div h$.

(b) Solve the simultaneous equations

$$3x - 6y = 6$$
$$4y - 5x = -1 .$$

(c) If $h = \dfrac{2uv}{u + v}$, express v in terms of u and h and hence find the value of v when $h = 1 = u$.

(40 marks)

3. Draw a graph of the function

$$f : x \rightarrow 4x^2 - 4x - 15$$

in the domain $-2 \leqslant x \leqslant 3$ for $x \in \mathbf{R}$.

(i) Draw as accurately as you can the axis of symmetry of the graph.

(ii) Find from your graph the range of values of x for which $f(x) < 0$.

(iii) Find from your graph the values of x which satisfy $x^2 - x - 4 = 0$.

(40 marks)

4. (a) Factorise fully

(i) $a(x - 1) - x(b - c) + b - c$

(ii) $x^2 - y^2 - x + y$

(iii) $12x^2 - 3x - 15$.

(b) Justify the formula $\log_c ab = \log_c a + \log_c b$.

If $p = \log_c 5\tfrac{1}{4}$, $q = \log_c 2\tfrac{1}{3}$, $r = \log_c 3\tfrac{1}{2}$,
express $(p + q)$ in terms of r.

(50 marks)

OVER →

5. (a) Using the same axes and the same scales, draw a trend graph of the monthly sales and the three monthly moving averages of the sales detailed in the following table:

Month	Jan.	Feb.	March	April	May	June
Number of items sold	12	18	30	15	21	6

(b) A test consisted of 10 questions, 1 mark per question and 0 mark for incorrect solution. The following table shows how a class of students scored in the test.

Mark	3	4	5	6	8	9
Number of Students	3	2	6	10	3	1

(i) How many students were in the class ?

(ii) Write down the mode of the data and calculate the mean mark per student.

(iii) How many students scored better than the mean mark ?

(iv) What percentage of students had more incorrect answers than correct answers ? (Assume all questions are attempted by each student)

(50 marks)

6. (a) The function $f : x \rightarrow \dfrac{1}{x + 1}$ is defined for all $x > 0$.

Evaluate $f(3)$ and $f(\frac{1}{3})$ and write $\dfrac{1}{x} f\left(\dfrac{1}{x}\right)$ in terms of $f(x)$.

Investigate if $[f(x)]^2 = f^2(x)$, where f^2 is the composite function.

(b) Find, correct to two places of decimals, the maximum value of x and the minimum value of y for which
$$x < \sqrt{41} < y .$$

Find also, correct to two places of decimals, the least number that is greater than the positive root of $5 + t - 2t^2 = 0$.

(50 marks)

7. x cars are available to carry a class of students on a picnic.
If the students are shared 3 to a car, there is one student left over.
If the students are shared 4 to a car, two cars get no students.
Find the value of x and the number of students in the class.

(50 marks)