

MATHEMATICS – HIGHER COURSE – PAPER II (300 marks)

FRIDAY, 9 JUNE – MORNING, 9.30 to 12

SECTION A (100 marks)

Attempt all questions. You should not spend more than 50 minutes 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. $101_4 + 110_5 =$

Handwritten: $17 + 30 = 47$

B

- (a) 211_{10} (b) 47_{10} (c) 35_{10} (d) 43_{10}

~~X~~

2. The areas of two discs are in the ratio 9 : 4. The ratio of the lengths of their radii is

B

- (a) 9 : 4 (b) 3 : 2 (c) 81 : 16 (d) $\pi : 2\frac{1}{4}$

Handwritten: $9\pi = 4\pi \quad \pi R^2 \quad 3 = 2$

Handwritten: $(x-3)(x-3)x^2 = 3x^3 - 6x^2 + 9x$

3. {3} is the solution set of $x^2 + mx + n = 0$. The value of m is

B

- (a) 3 (b) -6 (c) 6 (d) 9

Handwritten: $9 - 18 + n = 0$

Handwritten: $(x-2)$

4. $x - 2$ is a factor of $x^2 + p$ where $p \in \mathbb{Z}$. The value of p is

A

- (a) -4 (b) -2 (c) 2 (d) 4

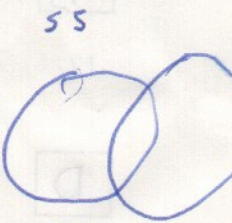
5. If $x\%$ of 240 is 84, then $(x + 20)\%$ of 240 is

D

- (a) 48 (b) 70 (c) 104 (d) 132

Handwritten: $\frac{2 \cdot 4}{3 \cdot 3} = \frac{120}{840}$

Handwritten: $x\% = \frac{84}{240} = \frac{7}{20}$



6. The set A has x elements. The set B has y elements. $x > y$. The number of elements in $A \cap B$ can never be

B

- (a) 0 (b) x (c) y (d) $x - y$



7. The n th term of a sequence is $n - \frac{n}{n+1}$.

The term with the least value is the

A

- (a) first (b) second (c) third (d) 100th.

Handwritten: $x + y + z = 3m$

Handwritten: $(x-m) + y -$

*Handwritten: $1 - \frac{1}{2} = \frac{1}{2}$
 $2 - \frac{2}{3} = 1\frac{1}{3}$*

*Handwritten: $3 - \frac{3}{4} = 2\frac{1}{4}$
 $100 - \frac{100}{101} = 99\frac{1}{101}$*

8. The mean of x , y and z is m . The mean of $(x - m)$, $(y - m)$, $(z - m)$ is

D

- (a) $3m$ (b) $-3m$ (c) m (d) 0

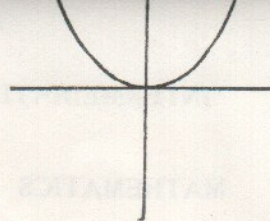
9. If $x * y = x^2 - \frac{1}{y^2}$, then $4 * (-\frac{1}{4}) =$

A

- (a) 0 (b) $16\frac{1}{16}$ (c) 20 (d) 32

Handwritten: $16 - \frac{1}{(\frac{1}{16})} = 16 - 16 = 0$

10. The graph in the diagram could represent $x \rightarrow$



- C (a) x (b) $-x$ (c) x^2 (d) $-x^2$

11. $(8)^{-\frac{2}{3}} = \frac{1}{\sqrt[3]{8^2}} = \frac{1}{2^2} = \frac{1}{4}$

- C (a) -4 (b) $-\frac{1}{4}$ (c) $\frac{1}{4}$ (d) 4

12. $\{(x, x), (x, y), (y, x), (y, y), (y, z), (z, y), (z, z)\}$ is not

- B (a) symmetric (b) a relation (c) reflexive (d) transitive

$\frac{1}{4} - 7 = -6\frac{3}{4}$

13. If $f : x \rightarrow \frac{x}{4} - 7$ then $f^{-1} : x \rightarrow 4(x+7)$

- B (a) $\frac{x+7}{4}$ (b) $4(x+7)$ (c) $\frac{4}{x+7}$ (d) $\frac{4}{x-7}$

14. $\text{Log}_{\frac{1}{2}} x = \frac{1}{2} \Rightarrow x \text{ is } \frac{1}{2}^{\frac{1}{2}} = x = \sqrt{\frac{1}{2}} = \frac{1}{\sqrt{2}}$

- A (a) $\frac{1}{\sqrt{2}}$ (b) $\sqrt{2}$ (c) 1 (d) $\frac{1}{4}$

15. If P and R are sets, $P \neq R$, then $P \Delta (P \Delta R) =$

- (a) P (b) R (c) $R \setminus P$ (d) $\{ \}$

16. If $x = \frac{y}{z} + 3$ then $z =$ $1 = \frac{y}{xz} + \frac{3}{x}$ $z = \frac{y+3z}{x}$

- B (a) $\frac{y+3}{x}$ (b) $\frac{y}{x-3}$ (c) $y+3$ (d) $x-y-3$

17. $\frac{3}{\sqrt{\frac{1}{10}} - \frac{1}{100}} = \frac{3}{\sqrt{\frac{10}{100}} - \frac{1}{100}} = \frac{3}{\frac{\sqrt{10}}{10} - \frac{1}{100}} = \frac{3}{\frac{10\sqrt{10}-1}{100}} = \frac{300}{10\sqrt{10}-1} = \frac{300}{10\sqrt{10}} = \frac{30}{\sqrt{10}} = \frac{3\sqrt{10}}{10}$

- D (a) $\frac{1}{10}$ (b) $\frac{9}{10}$ (c) 9 (d) 10

$5x = 4(x+60)$

18. Driving x km per day for 5 days gives the same total km as driving an extra 60 km per day for only four of the days. This is represented by

- D (a) $4x = 5x - 60$ (b) $4x = 5(x - 60)$
(c) $5x = 4x - 60$ (d) $5x = 4(x + 60)$

19. A sum of money was shared in the ratio 6 : 5 : 4. The largest of the shares was IR£12. The sum of money was IR£

$12 \quad 10 \quad 8$
 30

- C (a) 45 (b) 36 (c) 30 (d) 12.

20. $\frac{1}{x} > 1 \Rightarrow$

- A (a) $x < 1$ (b) $x > 1$
(c) $x \geq 1$ (d) $x \leq 1$.

MATHEMATICS – HIGHER COURSE – PAPER II

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SECTION B (200 marks)

Attempt QUESTION 1 and THREE other questions

Marks may be lost if all your work is not clearly shown

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

$$-x + xy - 2y$$

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

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

1

(a) If $p\sqrt{a - x^2} = 1$, find the value of x , as accurately as the tables allow, when $p = 0.4166$ and $a = 45.2$.

$$6.28 \checkmark$$

(b) A manufactured blend is produced by mixing two materials A and B in the ratio $4 : 7$ respectively.

A costs IR£84 a tonne.
 B costs IR£40 a tonne.

$$56$$

$$x^2 - xy + 2xy + 2y^2$$

Calculate the cost of a tonne of the blend correct to the nearest IR£.

$$39.4384$$

2

(a) Factorise (i) $6x^2 + 23x - 4$.

$$(6x - 1)(x + 4)$$

$$\frac{(x+2y)(x-y)}{-(x+2y)}$$

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

$$(x)(x+y)$$

$$(4x+2)(x+2)$$

$$x^2 y^2 + xy$$

(b) Using factors, or otherwise, simplify

$$n^3 - (n - 1)^3$$

$$3n^2 - 3n + 1 \checkmark$$

Hence solve, correct to two decimal places

$$n^3 - (n - 1)^3 = 22$$

$$.78 \cdot 23$$

$$+ 2xy + 3xy$$

3

(a) $S : \{(1, 3), (2, 1), (2, 4), (3, 4), (4, 2)\}$.

Write down the couples of and draw arrow diagrams of

(i) $S \circ S$.

$$\{(1,4), (2,3), (2,2), (3,2), (4,1), (4,4)\}$$

(ii) $S \circ S \circ S$.

$$\{(1,2), (2,4), (3,1), (2,1), (3,4), (4,3), (4,2)\}$$

Is (ii) a symmetric relation? Give a reason.

No

(b) $f : x \rightarrow 3x - 4$ and $g : x \rightarrow ax + b$ where $a, b \in \mathbb{Z}$.

(i) Find the value of x such that $f(x) = (f \circ f)(x)$.

(ii) If $(g \circ f)(x) = 3x - 3$ for all values of x , find the value of a and the value of b .

$$a = 1$$

$$b = 1$$

4.

The function $f : x \rightarrow 9 - 5x - 2x^2$, $x \in \mathbb{R}$, is defined in the domain $-2 \leq x \leq 4$.

(i) Complete the table

x	-2	-1	0	1	2	3	4
$f(x)$	-9	2	4	12	11	+6	-3

(ii) Draw the graph of f .

Use the graph to estimate the range of values

(iii) of x for which $f(x)$ is increasing. ≤ 1.3

(iv) of $f(x)$ for $0 \leq x \leq 3$. $-1.3 \leq x \leq -0.8$

(v) of x for $f(x) \geq 0$. $-1.3 \leq x \leq 3.8$

Handwritten notes and equations:

$$2yx - 2y^2 - 2y + x^2$$

$$-xy - x$$

$$3.4 \leq x \leq 3.8$$

$$x^2 - 2x + xy - 2y^2$$

5.

The number of engagement rings sold in a jeweller's shop in each of the first 4 months of the year was

Month	Jan.	Feb.	March	April
Number of rings sold	63	72	75	78

The 3-monthly moving average of engagement rings sold from March to June was a constant 80.

Find the number of engagement rings sold in each of May and June.

If (i) the mean number of engagement rings sold per month in the seven months to the end of July was 76,

(ii) the 3-monthly moving average for June, July and August was 84, find how many engagement rings were sold in August ?

Handwritten calculations for question 5:

May	June
87	75
90	90
90	90
95	95
53	53
25	25
16	16
9/25	9/25
16	25

Handwritten equation:

$$\frac{1}{-9} \left(\frac{-16}{(-9)(-25)} \right) = \frac{1}{-25}$$

6.

(a) Solve for x

Equation for part (a):

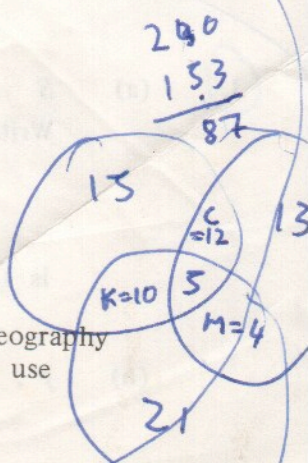
$$\frac{1}{2x - 1} - \frac{3x - 4}{(7x + 3)(2x - 1)} = \frac{1}{7x + 3} \quad (-4)$$

(b) In a school-survey, it was found that

- 15 pupils studied French only
- 13 pupils studied Geography only
- 21 pupils studied Physics only
- 5 pupils studied French, Geography and Physics
- c pupils studied French and Geography but not Physics
- k pupils studied French and Physics but not Geography
- m pupils studied Geography and Physics but not French

- (i) Represent the above data on a Venn diagram.
- (ii) If, in total, 42 pupils studied French, 34 pupils studied Geography and 40 pupils studied Physics, write three equations which use two elements of $\{c, k, m\}$ in each equation.

Calculate the value of each of c, k and m .



7.

(a) If $x = \log_2 10$ and $y = \log_{10} 2$, express in terms of x or y

(i) $\log_{10} 5$

$1-y$

(ii) $\log_5 2$

(iii) $\log_2 3\frac{1}{8}$

$2x-5$

(b) A journey was organised by a group of students and the total cost of IR£126 was shared equally between them. If 7 extra students had gone on the journey, the total cost would have been the same but the cost to each student would have been IR£1.50 less.

How many students went on the journey ?

24.12