Heep Yunn School

Mid-year Examination 2019-2020

Form 3 Mathematics

F. 3A, B, C, D, E **December, 2019**

Time Allowed : 1 hour 30 minutes

Total : 60 marks

F. 3 _____ Name: _____ ( ) Group: _____

Instructions:

1. Do not turn over the exam paper until you are told to do so.
2. Attempt ALL questions in this paper (except Section D, which is optional). All the answers should be written on the respective answer sheets.
3. Write down your Name, Class and Class number on the first page of the Question Paper and each Question-Answer Booklet.
4. Note that you may only choose one answer to each question in Section A. Two or more answers will score NO MARKS.
5. All questions in Section A carry equal marks. No marks will be deducted for wrong answers.
6. In Sections B, C and D, all working must be clearly shown. Unless otherwise specified, numerical answers should either be exact or correct to 3 significant figures.
7. The diagrams in this paper are not necessary drawn to scale.

Section A: Multiple Choice Questions (15 marks)

Please write your answers on the answer sheets provided.

1. Factorise $x^2 - x - xy + y$.
   A. $(x-y)(x-1)$
   B. $(x-y)(x+1)$
   C. $(x+y)(x-1)$
   D. $(1-x)(x+y)$

2. It is given that $\frac{1}{a} - \frac{1}{b} = \frac{1}{c}$. Find the value of b when $a = \frac{1}{2}$ and $c = \frac{1}{3}$.
   A. -1.
   B. 1.
   C. 5.
   D. 6.

3. $125^x \cdot 5^y =$
   A. 625^{x+y}.
   B. 625^{xy}.
   C. 125^{x+3y}.
   D. 5^{3x+y}.

4. $\left(\frac{1}{3}\right)^{-2019} (-3)^{-2020} =$
   A. -3.
   B. $-\frac{1}{3}$.
   C. $\frac{1}{3}$.
   D. 3.

5. $\dfrac{7^{m+2}-315\left(7^{m-1}\right)}{4\left(7^{m+1}\right)}=$

A. $\dfrac{1}{7}$

B. $\dfrac{1}{4}$

C. 7

D. 7^{m}

6. Convert the decimal number $11\times16^{11}+12\times16^{10}+2019$ to a hexadecimal number.

A. AB00000007E3_{16}

B. BC00000007E3_{16}

C. AB0000007E3_{16}

D. BC0000007E3_{16}

7. Write the expression $3\times2^{8}+8\times2^{7}+3\times2^{4}-2^{4}$ as a binary number.

A. 1101010000_2

B. 1110010000_2

C. 11010100000_2

D. 11100100000_2

8. $2.5\times10^{2020}-1.5\times10^{2019}=$

A. 1×10^{1}.

B. 1×10^{4039}.

C. 2.35×10^{2020}.

D. 2.35×10^{4039}.

9. A rectangular piece of meadow will be set aside as a new wildlife refuge. Its dimensions are 5×10^{5} metres by 4×10^{4} metres. Find the area of the land in square metres.

A. 9×10^{1} square metres

B. 9×10^{9} square metres

C. 2×10^{10} square metres

D. 20×10^{10} square metres

10. The present price of a laser printer is \$2551.5. If it depreciates at a constant rate of 10% per year, find the price of the laser printer 3 years ago.
    A. \$3 889
    B. \$3 500
    C. \$3 396
    D. \$2 835

11. Elizabeth deposits \$7500 in a bank at 6% p.a. compounded half-yearly. Find the amount she will receive after 5 years, correct to the nearest \$0.1.
    A. \$10 079.4
    B. \$10 036.7
    C. \$9 750.0
    D. \$8 694.6

12. If the base of a triangle is increased by 10% and the corresponding height is decreased by 10%, which of the following is true?
    A. Its area is decreased by 1%.
    B. Its area is increased by 1%.
    C. Its area is decreased by 10%.
    D. Its area is increased by 10%.

13. If y is a negative integer satisfying the inequality $y+9 \geq 3-y$, then the greatest value of y is
    A. -3.
    B. -2.
    C. -1.
    D. 0.

14. The height of a trapezium is 5 cm. The lower base of the trapezium is 4 cm longer than its upper base. If the area of the trapezium is at most 50 cm^2, the maximum length of the upper base of the trapezium is
    A. 7 cm.
    B. 8 cm.
    C. 11 cm.
    D. 12 cm.

15. Which of the following must be true?

I. If $a > b$, then $a + 3 < b + 3$.

II. If $p \leq q$, then $-4p \geq -4q$.

III. If $x \geq y$, then $\frac{y}{2} \leq \frac{x}{2}$.

A. I only

B. II only

C. I and III only

D. II and III only

End of Section A

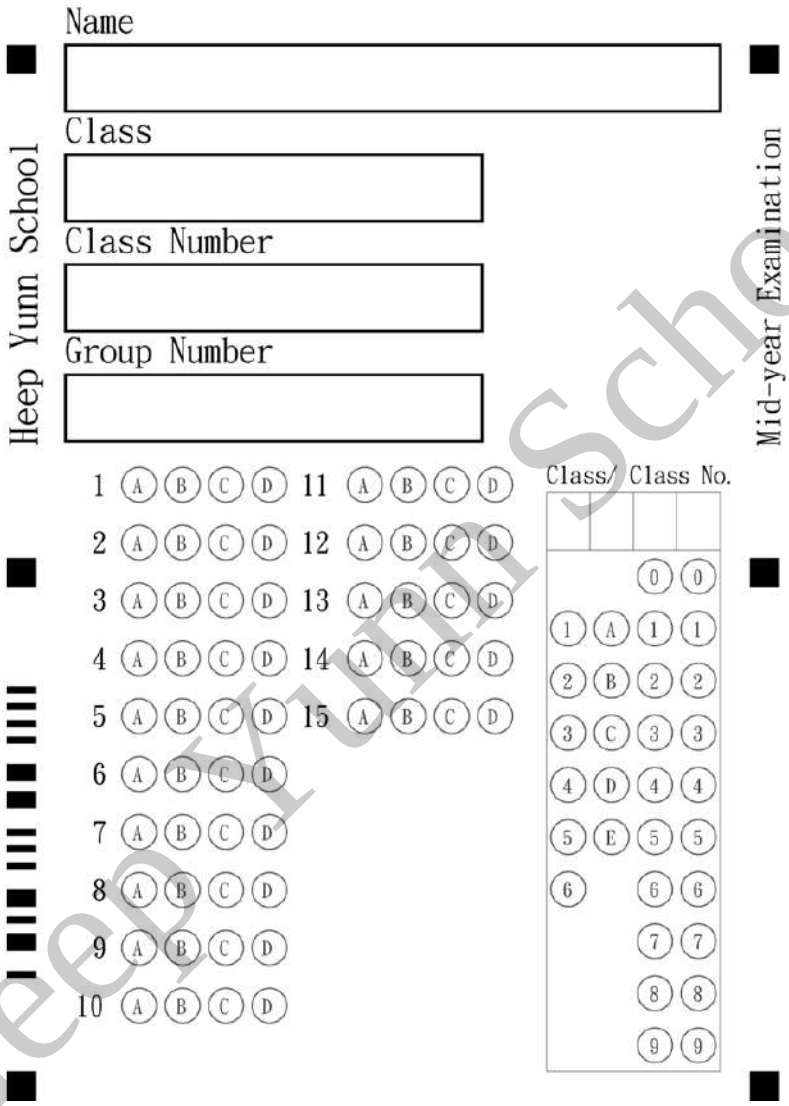
Heep Yunn School

F3 Mid-year Examination 2019-2020

Mathematics – Compulsory Part

Answer Sheet

Section A: Multiple Choice (15 marks)



Section B: Short Questions (15 marks)

1. Make y the subject of the formula $\dfrac{3x+5y-7}{y}=8$. (3 marks)

2. Simplify $\dfrac{a^2}{(a^{-7}b)^3}$ and express your answer with positive indices. (3 marks)

3. Solve the inequality $\frac{-3t+1}{4} > t-5$ and represent the solution graphically.

(4 marks)

4. The table below shows the salaries tax rate for the financial year 2019/20:

Net chargeable income	Tax rate
On the first \$40 000	2%
On the next \$40 000	7%
On the next \$40 000	12%
Remainder	17%

If a man pays \$10 950 as the salaries tax and he is eligible for a tax allowance of \$200 000, find his annual income. (5 marks)

End of Section B

Heep Yunn School

Mid-year Examination 2019-2020

Form 3 Mathematics

F. 3 ___ Name: _____( ) Group: __

Section C Conventional Questions (30 marks)

1. Peter owns two shops in Hong Kong. The rateable value of the first shop is $660000. If he has to pay a total rates of $18000 in each quarter of a year, find the rateable value of his second shop. The rates percentage charge is set as 5%. (3 marks)

2. A sum of money is invested for 9 months at an interest rate of 8% p.a. If the difference between the simple interest and the compound interest (compounded quarterly) on the investment is $151, find the sum of money. (7 marks)

3. Consider the following five numbers:
   $2019_{(10)}$, $10100100_{(2)}$, $11101010_{(2)}$, $B4C_{(16)}$, $13AC_{(16)}$ (6 marks)

   a) John claims that $13AC_{(16)}$ must be greater than $B4C_{(16)}$ because $13AC_{(16)}$ has more digits than $B4C_{(16)}$. Do you agree? Explain your answer.

   b) Convert $11101010_{(2)}$ and $B4C_{(16)}$ into denary numbers without using a calculator. Then arrange the above five numbers in descending order.

4. The mass of the Sun is 2×10^{33}g, where 90% of it is hydrogen gas. If there are
6×10^{23} hydrogen atoms in 1g of hydrogen gas, find each of the following in scientific notation. (7 marks)
(Give your answers in scientific notation.)

a) The mass of a hydrogen atom in kg.

b) The number of hydrogen atoms in the Sun.

5. Mary is organizing a party and she wants to buy 150 drinks. The budget is $1550. The price of drink A is $12 and that of drink B is $8. If Mary wants to buy as many drink A as possible, (7 marks)

   a) Find the number of each kind of drink she should buy.

   b) Mary thinks that if the budget increases by 5%, the number of drink A she can buy will also increase by 5%. Do you agree with her? Explain your answer.

Section D Challenging question (Optional) (4 marks)

1. At the beginning of 2005, the price of a flat was $ 20,000,000. From 2005 to 2010, it increased at a rate of 8% per year. After the government launched a price control policy at the end of 2010, it decreased at a rate of 6% per year. Polly wanted to buy the flat at the end of 2012 and deposited $p in a bank at an interest rate of 5% p.a. compounded quarterly. Find the minimum amount $p (correct to the nearest $10 000) she deposited at the beginning of 2005 so that she could pay the full price of the flat at the end of 2012. (4 marks)

*** End of paper***

Section A: Multiple Choice Questions (15 marks)

Please write your answers on the answer sheets provided.

1. Factorise $x^2 - x - xy + y$. [A]
   A. $(x-y)(x-1)$
   B. $(x-y)(x+1)$
   C. $(x+y)(x-1)$
   D. $(1-x)(x+y)$

2. It is given that $\frac{1}{a} - \frac{1}{b} = \frac{1}{c}$. Find the value of b when $a = \frac{1}{2}$ and $c = \frac{1}{3}$. [A]
   A. -1.
   B. 1.
   C. 5.
   D. 6.

3. $125^x \cdot 5^y =$ [D]
   A. 625^{x+y}.
   B. 625^{xy}.
   C. 125^{x+3y}.
   D. 5^{3x+y}.

4. $\left(\frac{1}{3}\right)^{-2019} (-3)^{-2020} =$ [C]
   A. -3.
   B. $-\frac{1}{3}$.
   C. $\frac{1}{3}$.
   D. 3.

5. $\dfrac{7^{m+2}-315\left(7^{m-1}\right)}{4\left(7^{m+1}\right)}=$ [A]

A. $\dfrac{1}{7}$

B. $\dfrac{1}{4}$

C. 7

D. 7^m

6. Convert the decimal number $11\times16^{11}+12\times16^{10}+2019$ to a hexadecimal number. [B]

A. $AB00000007E3_{16}$

B. $BC00000007E3_{16}$

C. $AB0000007E3_{16}$

D. $BC0000007E3_{16}$

7. Write the expression $3\times2^8+8\times2^7+3\times2^4-2^4$ as a binary number. [D]

A. 1101010000_2

B. 1110010000_2

C. 11010100000_2

D. 11100100000_2

8. $2.5\times10^{2020}-1.5\times10^{2019}=$ [C]

A. 1×10^1.

B. 1×10^{4039}.

C. 2.35×10^{2020}.

D. 2.35×10^{4039}.

9. A rectangular piece of meadow will be set aside as a new wildlife refuge. Its dimensions are 5×10^5 metres by 4×10^4 metres. Find the area of the land in square metres. [C]

A. 9×10^1 square metres

B. 9×10^9 square metres

C. 2×10^{10} square metres

D. 20×10^{10} square metres

10. The present price of a laser printer is \$2551.5. If it depreciates at a constant rate of 10% per year, find the price of the laser printer 3 years ago. [B]
    A. \$3 889
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11. Elizabeth deposits \$7500 in a bank at 6% p.a. compounded half-yearly. Find the amount she will receive after 5 years, correct to the nearest \$0.1. [A]
    A. \$10 079.4
    B. \$10 036.7
    C. \$9 750.0
    D. \$8 694.6

12. If the base of a triangle is increased by 10% and the corresponding height is decreased by 10%, which of the following is true? [A]
    A. Its area is decreased by 1%.
    B. Its area is increased by 1%.
    C. Its area is decreased by 10%.
    D. Its area is increased by 10%.

13. If y is a negative integer satisfying the inequality $y+9 \geq 3-y$, then the greatest value of y is [C]
    A. -3.
    B. -2.
    C. -1.
    D. 0.

14. The height of a trapezium is 5 cm. The lower base of the trapezium is 4 cm longer than its upper base. If the area of the trapezium is at most 50 cm^2, the maximum length of the upper base of the trapezium is [B]
    A. 7 cm.
    B. 8 cm.
    C. 11 cm.
    D. 12 cm.

15. Which of the following must be true? [D]

I. If $a > b$, then $a + 3 < b + 3$.

II. If $p \leq q$, then $-4p \geq -4q$.

III. If $x \geq y$, then $\frac{y}{2} \leq \frac{x}{2}$.

A. I only
B. II only
C. I and III only
D. II and III only

End of Section A

Section B: Short Questions (15 marks)

1. Make y the subject of the formula $\dfrac{3x+5y-7}{y}=8$. (3 marks)

$$\frac{3x+5y-7}{y}=8$$

$3x+5y-7=8y$ [1M]

$5y-8y=7-3x$ [1M for putting y on one side]

$y=\dfrac{3x-7}{3}$ [1A]

2. Simplify $\dfrac{a^2}{(a^{-7}b)^3}$ and express your answer with positive indices. (3 marks)

$$\frac{a^2}{(a^{-7}b)^3}$$

$=\dfrac{a^2}{a^{-21}b^3}$ [1M for $(xy)^k=x^k y^k$]

$=\dfrac{a^{2+21}}{b^3}$ [1M for $\dfrac{1}{z^{-m}}=z^m$ or $\dfrac{z^n}{z^m}=z^{n-m}$]

$=\dfrac{a^{23}}{b^3}$ [1A]

3. Solve the inequality $\frac{-3t+1}{4} > t-5$ and represent the solution graphically.

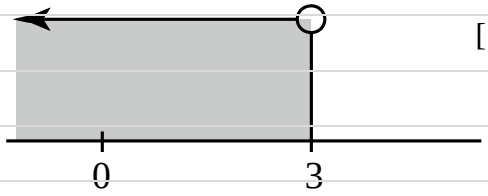
(4 marks)

$\frac{-3t+1}{4} > t-5$

$-3t+1>4t-20$ [1M]

$-7t > -21$ [1M for putting t on one side]

$t < 3$ [1A]



[1A]

4. The table below shows the salaries tax rate for the financial year 2019/20:

Net chargeable income	Tax rate
On the first $40 000	2%
On the next $40 000	7%
On the next $40 000	12%
Remainder	17%

If a man pays $10 950 as the salaries tax and he is eligible for a tax allowance of $200 000, find his annual income. (5 marks)

Let $\$x$ be the net chargeable income.

$\$10\,950 > \$40\,000 \times 2\% + \$40\,000 \times 7\% + \$40\,000 \times 12\%$

$\therefore$ The net chargeable income is greater than $\$40\,000 \times 3$

$10\,950 = 40\,000 \times 2\% + 40\,000 \times 7\% + 40\,000 \times 12\% + (x - 120\,000) \times 17\%$ [1M + 1A]

$x = 135\,000$ [1A]

Annual income = $135 000 + $200 000 [1M]

= $335 000 [1A]

End of Section B

Heep Yunn School

Mid-year Examination 2019-2020

Form 3 Mathematics

F. 3 ___ Name: _____( ) Group: __

Section C Conventional Questions (30 marks)

1. Peter owns two shops in Hong Kong. The rateable value of the first shop is $660000. If he has to pay a total rates of $18000 in each quarter of a year, find the rateable value of his second shop. The rates percentage charge is set as 5%. (3 marks)

   Let $x be the rateable value of his second shop.

   $\frac{(660000+x)(5\%)}{4} = 18000$ 1M1A

   $x = 780000$

   ∴The rateable value of his second shop is $780000. 1A

2. A sum of money is invested for 9 months at an interest rate of 8% p.a. If the difference between the simple interest and the compound interest (compounded quarterly) on the investment is $151, find the sum of money. (7 marks)

   Let $P be the sum of money

   Simple interest=P(8%)(9/12) 1M 1A

   Compound interest = $P[1 + \frac{8}{4 \times 100})^3 - P$ 1M,0.5M1A

   $\{P[1 + \frac{8}{4 \times 100})^3 - P] - P(8\%)(9/12) = 151$ 0.5M1A

   $P = 125000$

   ∴ The sum of money is $125000. 1A

3. Consider the following five numbers:
$2019_{(10)}$, $10100100_{(2)}$, $11101010_{(2)}$, $B4C_{(16)}$, $13AC_{(16)}$ (6 marks)

a) John claims that $13AC_{(16)}$ must be greater than $B4C_{(16)}$ because $13AC_{(16)}$ has more digits than $B4C_{(16)}$. Do you agree? Explain your answer.

John's claim is agreed as numbers of same base the more the digit the larger the number. 1A

b) Convert $11101010_{(2)}$ and $B4C_{(16)}$ into denary numbers without using a calculator. Then arrange the above five numbers in descending order.

$11101010_{(2)} = 1(2^7) + 1(2^6) + 1(2^5) + 0(2^4) + 1(2^3) + 0(2^2) + 1(2) + 0(1)$ 1M

$= 128 + 64 + 32 + 8 + 2$

$= 234_{(10)}$ 1A

$B4C_{(16)} = 11(16^2) + 4(16) + 12(1)$ 1M

$= 2892_{(10)}$ 1A

$13AC_{(16)} > B4C_{(16)} > 2019_{(10)} > 11101010_{(2)} > 101001001_{(2)}$ 1A

4. The mass of the Sun is 2×10^{33}g, where 90% of it is hydrogen gas. If there are
6×10^{23} hydrogen atoms in 1g of hydrogen gas, find each of the following in scientific notation. (7 marks)
(Give your answers in scientific notation.)

a) The mass of a hydrogen atom in kg.

Mass of a hydrogen atom $= 1/(6 \times 10^{23})$g 1M1A

$= 1.67 \times 10^{-24}$g (cor. to 3 sig. fig) 1A

b) The number of hydrogen atoms in the Sun.

Mass of hydrogen gas in the Sun $= 2 \times 10^{33} \times 90\%$ g 1M

∴ The number of hydrogen atoms in the Sun is

$2 \times 10^{33} \times 90\% (6 \times 10^{23})$ 1M1A

$= 1.08 \times 10^{57}$ 1A

5. Mary is organizing a party and she wants to buy 150 drinks. The budget is $1550. The price of drink A is $12 and that of drink B is $8. If Mary wants to buy as many drink A as possible, (7 marks)

a) Find the number of each kind of drink she should buy.

Let a be the number of drink A

$12a + 8(150 - a) \leq 1550$ 1M1A

$12a + 1200 - 8a \leq 1550$

$4a \leq 350$

$a \leq 87.5$ 0.5A

$\therefore$ She should buy 87 drink A and $150 - 87 = 63$ drink B. 0.5A0.5M0.5A

b) Mary thinks that if the budget increases by 5%, the number of drink A she can buy will also increase by 5%. Do you agree with her? Explain your answer.

When the budget increased by 5%

$12a + 8(150 - a) \leq 1550(1 + 5\%)$ 0.5M 0.5A

$12a + 1200 - 8a \leq 1627.5$

$4a \leq 427.5$

$a \leq 106.875$

$\frac{106-87}{87}(100\%) = 21.8\%$ (cor. to 3 sig. fig) 0.5M 0.5A

$21.8\% \neq 5\%$ 0.5M

$\therefore$ The number of drink A does not increase by 5%. Mary's claim is not agreed. 0.5A

Section D Challenging question (Optional) (4 marks)

1. At the beginning of 2005, the price of a flat was $ 20,000,000. From 2005 to 2010, it increased at a rate of 8% per year. After the government launched a price control policy at the end of 2010, it decreased at a rate of 6% per year. Polly wanted to buy the flat at the end of 2012 and deposited $p in a bank at an interest rate of 5% p.a. compounded quarterly. Find the minimum amount $p (correct to the nearest $10 000) she deposited at the beginning of 2005 so that she could pay the full price of the flat at the end of 2012. (4 marks)

Let $P be the money Polly deposit in the bank.

$P(1 + \frac{5}{400})^{4(8)} = 20000000(1 + 8\%)^6(1 - 6\%)^2$ 0.5M0.5A0.5M0.5A

$P = 18844613$ (cor. to the nearest $1) 1A

$\therefore$ The minimum amount of P correct to the nearest $10000 is $18850000. 1A

*** End of paper***