20-21 F.6
MOCK EXAM
MATH CP
PAPER 1

2020 – 2021
Form 6 Mock Examination

MATHEMATICS Compulsory Part

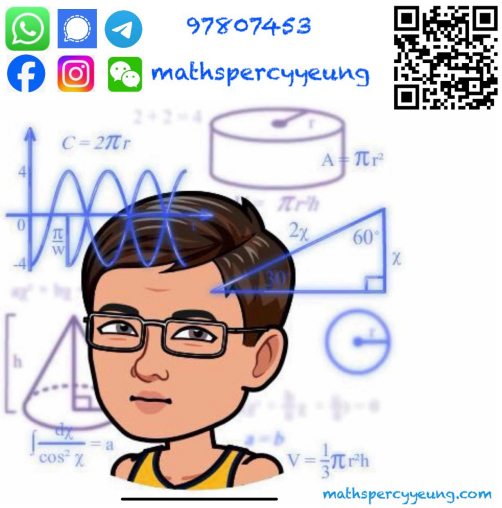
Question-Answer Book

11th January, 2021.
8:15 – 10:30 am
Time allowed: 2 hours 15 minutes

This paper must be answered in English.

INSTRUCTIONS

1. Write your name, class and class number in the spaces provided on this cover.
2. This paper consists of THREE sections, A(1), A(2) and B.
3. Attempt ALL questions in this paper. Write your answers in the spaces provided in this Question-Answer Book. Do not write in the margins. Answers written in the margins will not be marked.
4. Unless otherwise specified, all working must be clearly shown.
5. Unless otherwise specified, numerical answers should be either exact or correct to 3 significant figures.
6. The diagrams in this paper are not necessarily drawn to scale.



Section	Marks
A (1 – 3)	/ 9
A (4 – 14)	/ 61
A Total	**/ 70**
B Total	**/ 35**
TOTAL	**/ 105**

Section A(1) (35 marks)

1. Simplify $\dfrac{\left(2a^{-3}b^{2}\right)^{5}}{8a^{-1}b^{4}}$ and express your answer with positive indices. (3 marks)

2. Factorize
   (a) $4a^{2}-4ab+b^{2}$,
   (b) $4a^{2}-4ab+b^{2}-9$.

   (3 marks)

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

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4. (a) Solve the compound inequality $\frac{28+3x}{4} \geq 2x-3$ and $9-3x<0$.

(b) Write down all integers satisfying the compound inequality in (a).

(4 marks)

5. Simplify $\frac{\sin(180°-\theta)}{\tan(270°-\theta)} - \frac{1}{\cos(360°-\theta)}$. (4 marks)

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6. The quadratic equation $x^2 + (3 - k)x + 1 = 3k$ has equal roots, where k is a constant. Find the values of k. (3 marks)

7. The following table shows the distribution of the numbers of films watched by a group of students last month, where $a > 5$, $b < 11$ and $c > 0$.

Number of films	0	1	2	3	4	5
Number of students	$c + 1$	4	a	8	$b - a$	c

The median of the distribution is 2.5.

(a) Find a and b. (3 marks)

(b) Find the greatest and the least possible value of the inter-quartile range. (2 marks)

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8. The polar coordinates of the points A, B and C are (56, 65°), (33, 155°) and (42, 335°) respectively.
   (a) Find the area of $\triangle ABC$.
   (b) Find the perpendicular distance from C to AB. (5 marks)

9. The weight of a watermelon is measured as 6.8 kg, correct to the nearest 0.1 kg.
   (a) Find the least possible weight of the watermelon.
   (b) Sarah cuts the watermelon equally into 8 slices. Is it possible that the weight of each slice of watermelon is measured as 844 g, correct to the nearest g? Explain your answer. (5 marks)

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Section A(2) (35 marks)

10. Andy plans to start a retail business. He intends to rent one or two shops. The monthly rent (\$$R$) of a shop consists of two parts. One part varies directly as the area (A m^2) of the shop and the other part varies inversely as the time (T months) that he rents the shop. If he rents a shop of 40 m^2 for 18 months, the monthly rent is \$25 000; if he rents a shop of 80 m^2 for 12 months, the monthly rent is \$49 500.

    (a) Find the monthly rent of a shop of 60 m^2 for 24 months. (5 marks)

    (b) For the sake of saving rent, Andy thinks that it is always better to rent one shop than two shops of the same total area for the same period of time. Do you agree? Explain your answer. (2 marks)

Answers written in the margins will not be marked.

11. In Figure 1, $ABCD$ is a circle. $AB = BC$, $\angle ABD = 58°$ and $\angle BAC = 32°$.

(a) Find $\angle CAD$. (3 marks)

(b) Peter claims that AB is longer than the radius of the circle. Do you agree? Explain your answer. (3 marks)

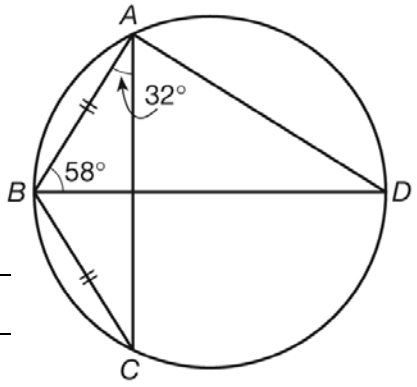

Figure 1

Answers written in the margins will not be marked.

12. Let $f(x) = x(3x + 5)^2 + px + q$, where p and q are constants. It is given that $x - 2$ is a factor of $f(x)$. When $f(x)$ is divided by $x^2 - 4$, the remainder is $kx + 64$, where k is a constant.

(a) Find k, p and q. (5 marks)

(b) How many rational roots does the equation $f(x) = 0$ have? Explain your answer. (2 marks)

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13. $A(5, -1)$ and $B(-3, 5)$ are two points in a rectangular coordinate plane. A point $P(x, y)$ moves in the same coordinate plane such that PA and PB are perpendicular to each other.

(a) (i) Find the equation of the locus of P.

(ii) Describe the locus of P.

(4 marks)

(b) The equation of a circle C is $(x-9)^2 + (y-8)^2 = 25$. Marco claims that there is no intersection between C and the locus of P. Do you agree? Explain your answer.

(3 marks)

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14. An inverted right circular conical vessel of base radius 4 cm and height 5 cm contains water to a depth of 3.5 cm . All the water in the vessel is now poured into an empty right circular cylindrical cup with base radius 2.1 cm without overflow.

(a) Find the depth of water in the cylindrical cup. (3 marks)

(b) A solid metal sphere is then put into the cylindrical cup. The metal sphere is completely immersed in water and no water spill out of the cup. The total area of the wet surface of the cup is 21.21π cm^2 .

(i) Eric claims that the sum of the volumes of the water and the metal sphere is greater than $55\,000$ mm^3 . Do you agree? Explain your answer.

(ii) Find the radius of the metal sphere.

(5 marks)

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Section B (35 marks)

15. 6 men and 3 women randomly form a queue at a minibus stop.
    (a) Find the probability that the 3 women are standing together. (2 marks)
    (b) A minibus arrives at the minibus stop. If only the first 4 people in the queue get on the minibus, find the probability that 3 men and 2 women are remaining in the queue, and they are standing alternately. (2 marks)

16. The graph in Figure 2 shows the linear relation between x and $\log_2 y$. The line passes through (4, 11) and the intercept of the vertical axis is 3. Express the relation between x and y in the form of $y = a\,b^{x}$, where a and b are non-zero constants. (3 marks)

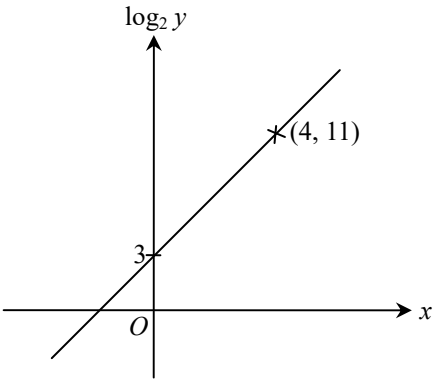

Figure 2

Answers written in the margins will not be marked.

17. In Figure 3, the equation of L_1 is $4x + 3y = 48$. The x-intercept of L_2 is 22 . L_1 and L_2 intersect at $x = 6$.

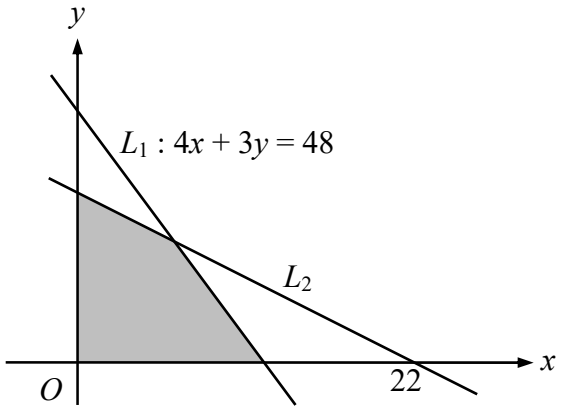

Figure 3

(a) Find the system of inequalities which is represented by the shaded region (including the boundary). (3 marks)

(b) Find the maximum value of $C(x, y) = x + 3y$ subject to the system of inequalities in (a). (3 marks)

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18. Henry borrows a loan of $ 300 000 from a finance company at an interest rate of 6 % per annum, compounded monthly. For each successive month after the day when the loan is taken, loan interest is calculated and then a monthly instalment $ x is immediately paid to the finance company until the loan is fully repaid (the last instalment may be less than $ x), where $x < 300\,000$.

(a) Express, in terms of x , the amount that Henry still owes the finance company after paying the 1st instalment. (2 marks)

(b) Show that if Henry has not yet fully repaid the loan after paying the n^{th} instalment, he still owes the finance company $ $[300\,000\,(1.005)^n - 200x(1.005^n - 1)]$. (3 marks)

(c) Suppose that the loan should be fully repaid within 10 years. Henry claims that his monthly instalment can be $ 3 400. Do you agree? Explain your answer. (2 marks)

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19. Let $f(x) = -4x^2 + 20x - 24$. The graph of $y = f(x)$ is enlarged to 2 times the original along the x-axis to become the graph of $y = g(x)$.

(a) Find $g(x)$. (2 marks)

(b) By using the method of completing the square, rewrite $g(x)$ in the form $a(x-h)^2 + k$, where a, h and k are constants. (2 marks)

(c) Under a transformation, $g(x)$ is changed to $-(x+5)^2 + 1$. Describe the geometric meaning of the transformation. (2 marks)

Answers written in the margins will not be marked.

20. In Figure 4(a), $PTQSR$ is a paper card in the shape of a pentagon. It is given that $PT = 10$ cm, $TQ = SQ = 8$ cm, $\angle TPR = 96°$ and $\angle PTQ = 38°$. PQS and TQR are straight lines.

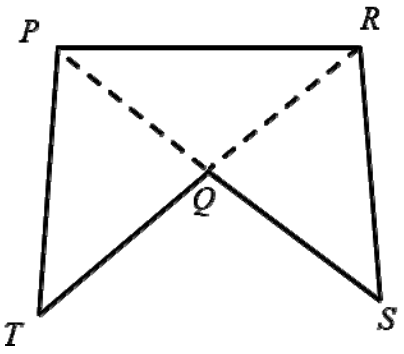

Figure 4(a)

(a) (i) Find the lengths of PR and QR.
(ii) Find $\angle QPR$.

(5 marks)

(b) The paper card in Figure 4(a) is folded along PQ and QR such that T and S meet at a point V (see Figure 4(b)). Let C be a point lying on PQ such that VC is perpendicular to PQ.

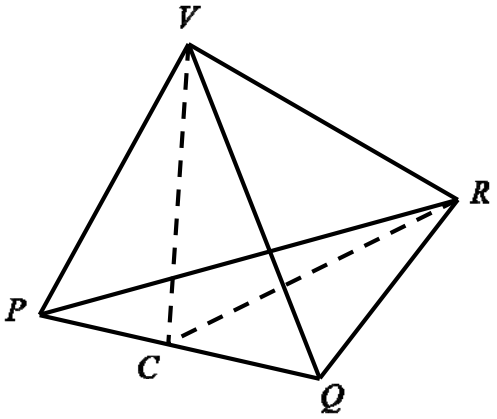

Figure 4(b)

(i) Find the length of CR.
(ii) Someone claims that $\angle VCR$ is the angle between the face VPQ and the face PQR. Is the claim correct? Explain your answer.

(4 marks)

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