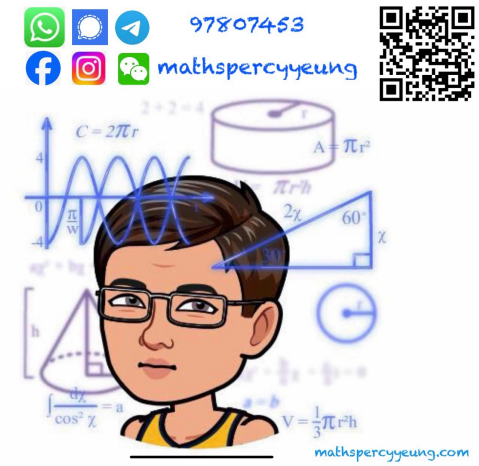
2022-2023 S3
1st TERM EXAM
MATH

2022 – 2023
S3 First Term Examination

MATHEMATICS

Question–Answer Book

5th January, 2023
9:45 am – 11:15 am (1 hour 30 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. Answer ALL questions in Section A. You should use an HB pencil to mark all the answers on the Answer Sheet, so that wrong marks can be completely erased with a clean rubber. You must mark the answers clearly; otherwise you will lose marks if the answers cannot be captured. You should mark only ONE answer for each question. If you mark more than one answer, you will receive NO MARKS for that question.

3. Attempt ALL questions in Sections B and C. Write your answers in the spaces provided in this Question – Answer Book.

4. Unless otherwise specified, all working must be clearly shown and numerical answers should be either exact or correct to 3 significant figures.

5. The diagrams in this paper are not necessarily drawn to scale.

Sections	Marks
A Total	**/30**
B (31 – 33)	
B (34 – 41)	
B Total	**/41**
C Total	**/29**
TOTAL	**/100**

Section A (30 marks)

Choose the best answer for each question.

1. If $(x+2)(x+A)-4 \equiv x^2+B$, then $B=$
   A. –8.
   B. –4.
   C. –2.
   D. 0.

2. The volume of a glass of orange juice is 450 mL, correct to the nearest 5 mL. Find the percentage error of the measurement correct to 2 significant figures.
   A. 0.28%
   B. 0.56%
   C. 1.1%
   D. 2.2%

3. The radius of a bicycle wheel is measured as 25.2 cm, correct to the nearest 0.1 cm. Find the range of the actual radius of the wheel.
   A. 25.1 cm ≤ Actual radius < 25.3 cm
   B. 25.15 cm ≤ Actual radius < 25.25 cm
   C. 25.19 cm ≤ Actual radius < 25.21 cm
   D. 25.14 cm ≤ Actual radius < 25.25 cm

4. Simplify $\frac{7}{a-b}+\frac{5}{b-a}$.
   A. $\frac{2}{a-b}$
   B. $\frac{2}{b-a}$
   C. $\frac{12}{a-b}$
   D. $\frac{12}{b-a}$

5. If $\frac{m+1}{a}=\frac{m-1}{b}$, then $m=$
   A. $\frac{a+b}{a-b}$.
   B. $\frac{a+b}{b-a}$.
   C. $\frac{a-b}{a+b}$.
   D. $\frac{b-a}{a+b}$.

6. The original marked price of a cup is $\$x$. The shop owner raises the marked price by 50% and then sells it at a discount of 20% on the new marked price. If the cup is sold for \$6, find x.
   A. 2.4
   B. 3.3
   C. 5
   D. 7.2

7. Simplify $\frac{(-p^3q^4)^{-3}}{-p^{-3}q^{-2}}$.
   A. $-p^3q^6$
   B. p^3q^6
   C. $-\frac{1}{p^6q^{10}}$
   D. $\frac{1}{p^6q^{10}}$

8. $-5x+3-2x^2=$
   A. $(x+3)(1-2x)$.
   B. $(x+3)(2x-1)$.
   C. $(x-3)(1-2x)$.
   D. $(x-3)(2x+1)$.

9. The population of a city is 1 687 296 this year. If the population has increased by 4% every year, find the population of the city three years ago.
   A. 540 800
   B. 1 500 000
   C. 1 506 514 (corr. to the nearest integer)
   D. 1 897 979 (corr. to the nearest integer)

10. $12m^2 - 12n(36n + 5m) =$
   A. $(9n - m)(m - 4n)$.
   B. $(m + 4n)(m - 9n)$.
   C. $12(m - 4n)(m - 9n)$.
   D. $12(m - 9n)(m + 4n)$.

11. Which of the following are NOT the factors of $x^4 - 16y^4$?
   I. $x + y$
   II. $x - 2y$
   III. $x^2 + y^2$

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

12. If n is an integer, simplify $\dfrac{3^{n-4} \times 9^{1-n}}{27^{n+1}}$.
   A. 3^{2n+1}
   B. 3^{3n+1}
   C. $\dfrac{1}{3^{3n+5}}$
   D. $\dfrac{1}{3^{4n+5}}$

13. Which of the following binary numbers is/are odd number(s)?
   I. 11011_2
   II. 10010_2
   III. 10111_2

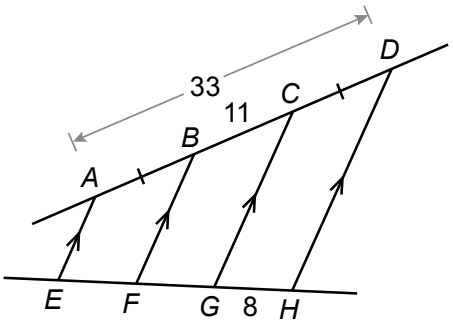
   A. II only
   B. III only
   C. I and III only
   D. I, II and III

14. The number of boys and girls in a tutorial centre were in the ratio of 3 : 2 last year. If the number of boys increased by 14% this year while that of girls decreased by 18%, find the percentage change in the total number of students in the tutorial centre.
   A. –5.2%
   B. –1.2%
   C. +1.2%
   D. +6%

15. Mr. Chan borrows a sum of money from a credit company at a simple interest rate of 15% p.a. and he will pay an interest of $21 000 after 2 years, how much does he borrow?
   A. $6 300
   B. $27 300
   C. $48 300
   D. $70 000

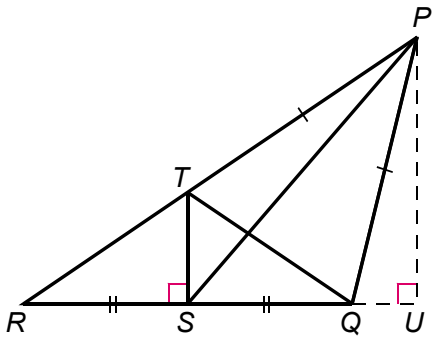
16. Solve the inequality $3(x + 8) \geq 8(x - 2)$.
   A. $x \geq -8$
   B. $x \leq -8$
   C. $x \geq 8$
   D. $x \leq 8$

17. In the figure, $ABCD$ and $EFGH$ are straight lines. It is given that $AE \parallel BF \parallel CG \parallel DH$ and $AB = CD$. $AD = 33$, $BC = 11$ and $GH = 8$. Find the length of EG.



A. 8
B. 16
C. 22
D. 24

18. In the figure, PTR and $RSQU$ are straight lines. Which of the following is a median of ΔPQR?



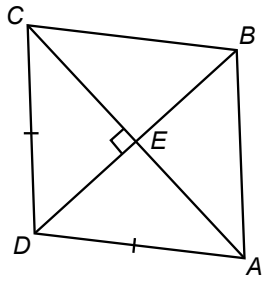
A. TS
B. TQ
C. PS
D. PU

19. The annual income of Mr. Ho is \$189 000. If he has an allowance of \$180 000, consider the salaries tax rates as follows, find his salaries tax payable.

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

A. \$180
B. \$800
C. \$20 130
D. \$28 350

20. In the figure, AC and BD intersect at E perpendicularly, and $CD = AD$.



Which of the following must be true?

I. $\angle CDE = \angle ADE$
II. BD is the angle bisector of $\angle ABC$.
III. AC is the angle bisector of $\angle DCB$.

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

21. William borrows a sum of money from a bank at an interest rate of 18% p.a., compounded half-yearly. If the interest for the first year is \$13 167, find the interest for the second year correct to the nearest dollar.

A. \$14 352
B. \$15 537
C. \$15 644
D. \$18 334

22. The sum of three consecutive multiples of 3 is greater than 100, find the smallest value of the smallest number.

A. 30
B. 33
C. 36
D. 39

23. If $p > q > 0$, which of the following must be true?

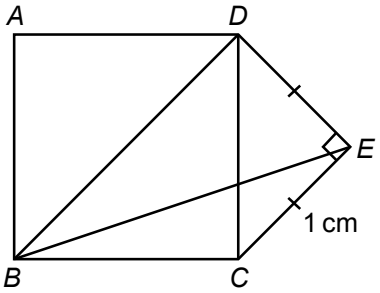
I. $\frac{p}{q} > 1$
II. $pq < q^2$
III. $-p > -q$

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

24. A charity has prepared some goods for a senior visit. The goods are going to be carried by 8 volunteers evenly. If there are 4 more volunteers available, the goods carried by each volunteer can reduce by at least 3 kg. At least how many goods (in kg) has the charity prepared?

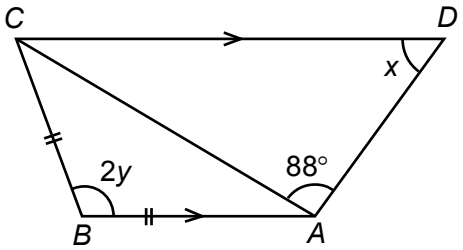
A. 71 kg
B. 72 kg
C. 73 kg
D. 74 kg

25. In the figure, *ABCD* is a square and ΔCDE is a right-angled isosceles triangle. Find *BE*.



A. $\sqrt{3}$ cm
B. 2 cm
C. $\sqrt{5}$ cm
D. $(\sqrt{2}+1)$ cm

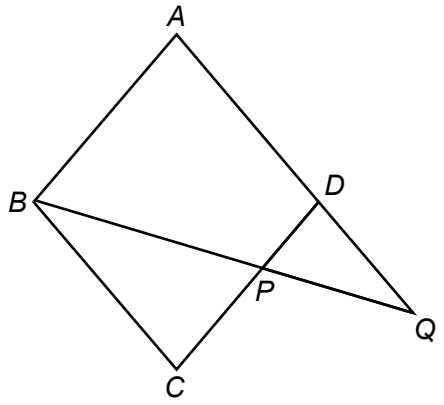
26. In the figure, *ABCD* is a trapezium.



Which of the following must be correct?

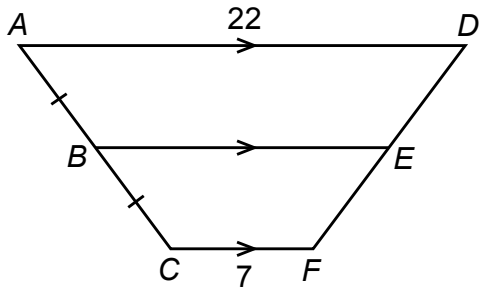
A. $x + y = 92°$
B. $x = 2y - 88°$
C. $x + 2y = 178°$
D. $x = y + 2°$

27. In the figure, $ABCD$ is a rhombus. Q is a point on AD produced. BQ and CD intersect at P. If $DQ = 5$ cm and $DP = 3$ cm, find the perimeter of $ABCD$.



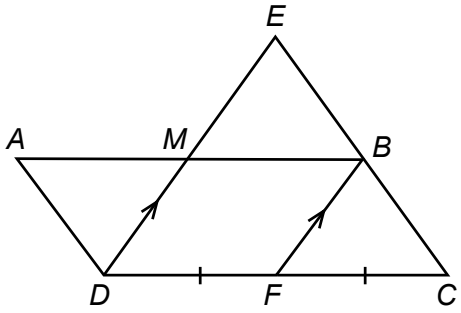
A. 16 cm
B. 27 cm
C. 30 cm
D. 38 cm

28. In the figure, ABC and DEF are straight lines. It is given that AD // BE // CF. Find the length of BE.



A. 12
B. 14.5
C. 15
D. 17

29. In the figure, $ABCD$ is a parallelogram. AMB, DME, DFC and EBC are straight lines.

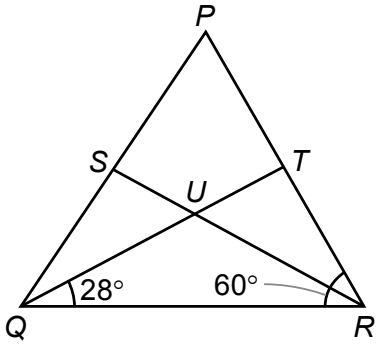


Which of the following must be correct?

I. $\Delta AMD \cong \Delta BME$
II. $\angle MEB = \angle MDF$
III. $MB = DF$

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

30. In the figure, PSQ and PTR are straight lines. QT and RS are the angle bisectors of $\angle PQR$ and $\angle PRQ$ respectively, and they intersect at U. $\angle RQT = 28°$ and $\angle PRQ = 60°$. Find $\angle PSR$.



A. 134°
B. 92°
C. 88°
D. 86°

Section B (41 marks)

31. (a) Factorize $-8pq - 12p^2$.

    (b) Factorize $2x^2 + 20x + 50$.

(3 marks)

32. Make y the subject of the formula $\frac{xy}{3} = \frac{x-y}{7}$. (3 marks)

33. The cost of a camera is \$2 500. If the camera is sold at its marked price, the percentage profit will be 50%.

    (a) Find the marked price of the camera.

    (b) If the camera is sold at a 40% discount on its marked price, find the percentage profit or loss.

(4 marks)

34. Simplify $\left(\frac{-2x^4y^{-3}}{x^0y^{-2}}\right)^3$ and express your answers with positive indices. (3 marks)

35. The diameter of a type of virus is 120 nanometres. Given that 1 nanometre is equal to 10^{-9} m, express the diameter of the virus in cm and in scientific notation. (2 marks)

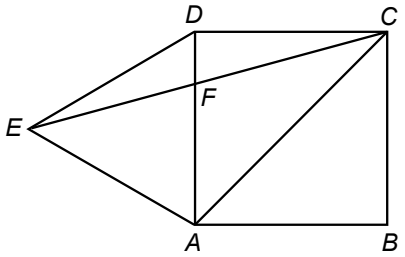
36. (a) Factorize $3x^2-16x-12$.
(b) Hence, factorize $12+16(y+7)-3(y+7)^2$.

(3 marks)

37. Solve the inequality $\frac{5x}{3}-2<\frac{10x}{9}+3$ and represent the solutions graphically. (4 marks)

38. If the difference between two integers is 5, and their sum is not less than 50, find the smallest value of the smaller integer. (3 marks)

39. In the figure, $ABCD$ is a square and ΔADE is an equilateral triangle. AFD and EFC are straight lines.



(a) Find $\angle DCA$ and $\angle EDC$.

(b) Find $\angle ECA$.

(6 marks)

40. If Emily's salaries tax charged at progressive rates is \$12 476, consider the salaries tax rates as follows, find her net chargeable income. (4 marks)

Net chargeable income	Tax rates
On the first \$45 000	2%
On the next \$45 000	7%
On the next \$45 000	12%
Remainder	17%

41. The population of a country increases at a constant rate every 10 years. It is known that the population in 2010 was 44% more than that in 1990.

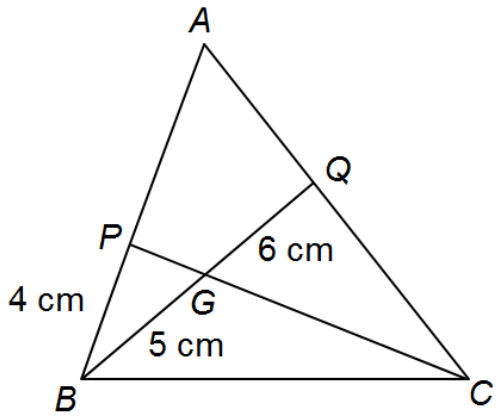
(a) Find the growth rate of the population every 10 years.

(b) Since when will the population be more than twice the population in 2000?

(6 marks)

Section C (29 marks)

42. The figure shows $\triangle ABC$. P and Q are points on AB and AC respectively such that BQ and CP intersect at G, where G is the orthocentre of $\triangle ABC$. It is given that $BP = 4$ cm, $BG = 5$ cm and $GQ = 6$ cm.

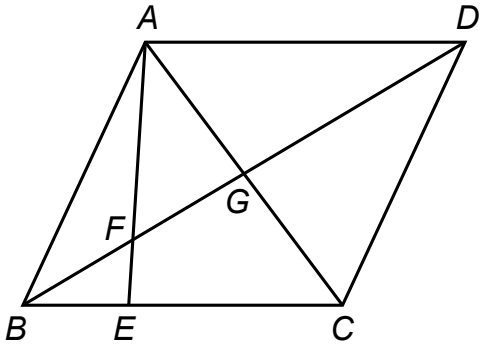


(a) Prove that $\Delta BGP \sim \Delta BAQ$. (2 marks)

(b) Find the lengths of AQ and AP. (4 marks)

(c) Hence, find the area of quadrilateral $APGQ$. (4 marks)

43. In the figure, $ABCD$ is a parallelogram. E is a point lying on BC such that $BE:EC=1:2$. AE and AC cut BD at F and G respectively.



(a) Prove that $\Delta BGC \cong \Delta DGA$. (2 marks)

(b) Given that $\Delta BEF \sim \Delta DAF$, find $BF:FG:GD$. (5 marks)

(c) Find the ratio of the area of ΔBEF to that of ΔAGD. (3 marks)

44. Derek deposits $73 000 in Wealthy Bank for 1 year and he will receive a simple interest of $3 285.

(a) Find the interest rate per annum. (2 marks)

(b) If Derek withdraws the amount and deposits it in Fortune Bank at the same interest rate per annum for 3 years but the interest is compounded every 2 months, find the interest obtained in these 3 years. (Give your answer correct to the nearest dollar.) (3 marks)

(c) Derek deposits a sum of money in Master Bank at an interest rate of 3% p.a. for 1 year, compounded monthly. If the interest rate increases by 1.8% p.a., find the percentage change in the interest obtained. (4 marks)

END OF PAPER