2023-2024 S3
2nd TERM EXAM
MATH
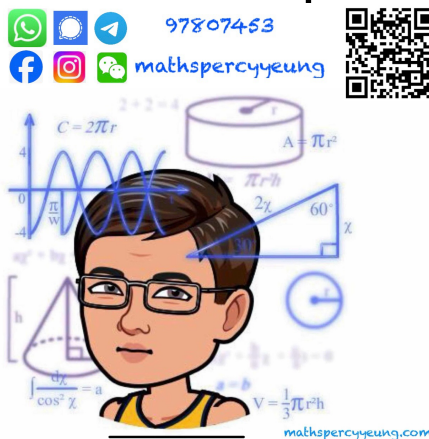
2023 –
S3 Second Term

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MATHEM

Question–Ans

12th June,

8:15 am – 10:00 am (1 h

This paper must be answered in English

Sections	Marks
A Total	**/30**
B (31 – 33)	
B (34 – 41)	
B Total	**/40**
C Total	**/30**
TOTAL	**/100**

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.

Section A   (30 marks)

Choose the best answer for each question.

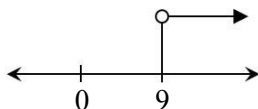1. Express 22 500 in scientific notation.

   A. 0.225×10^5

   B. 0.225×10^{-5}

   C. 2.25×10^4

   D. 2.25×10^{-4}

2. Which of the following are algebraic fractions?

   I. $\dfrac{81}{10x^2}$

   II. $\dfrac{9-r^2}{9-r}$

   III. $\dfrac{2}{7} + \dfrac{x}{14}$

   A.   I and II only

   B.   I and III only

   C.   II and III only

   D.   I, II and III

3. Refer to the diagram.
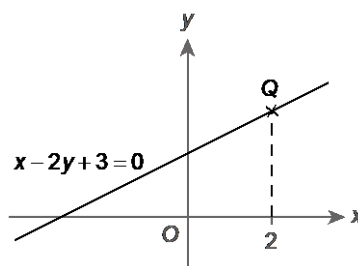

   Which of the following inequalities can be represented by the above diagram?

   A. $x \geq 9$

   B. $x \leq 9$

   C. $x > 9$

   D. $x < 9$

4. If $(x+4)(3x-5) \equiv Ax^2 + Bx + C$, then

   A. $A = 3$, $B = -7$ and $C = -20$.

   B. $A = 3$, $B = -7$ and $C = 20$.

   C. $A = 3$, $B = 7$ and $C = -20$.

   D. $A = -3$, $B = 7$ and $C = 20$.

5. In the figure, Q is a point on the graph of the equation $x - 2y + 3 = 0$. The y-coordinate of Q is

   A.   0.

   B.   1.

   C.   2.

   D.   2.5.

6. Michael weighed 100 kg last year. His weight is 110 kg this year. Find the percentage change of his weight.

   A.   Increased by 9.09%

   B.   Increased by 10%

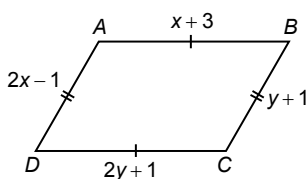   C.   Decreased by 9.09%

   D.   Decreased by 10%

7. In a 110 m hurdle race, Emily made a record of 15.87 s, correct to the nearest 0.01 s. Find the maximum absolute error of the measurement.

   A.   0.005 s

   B.   0.01 s

   C.   0.05 s

   D.   0.1 s

8. A scarf is now worth $120. If its yearly depreciation rate is 5%, find its value after 2 years.

   A. $30
   B. $108.3
   C. $110
   D. $118.803

9. The figure shows a parallelogram $ABCD$, where $AB = DC$ and $AD = BC$. Find the perimeter of $ABCD$.

   A. 4
   B. 8
   C. 15
   D. 16

10. $P(-4, -2)$ undergoes a rotation to $P'(-2, 4)$. Which of the following is the way of rotation?
    A. Rotate anticlockwise about the origin through $90°$
    B. Rotate clockwise about the origin through $90°$
    C. Rotate about the origin through $180°$
    D. None of the above

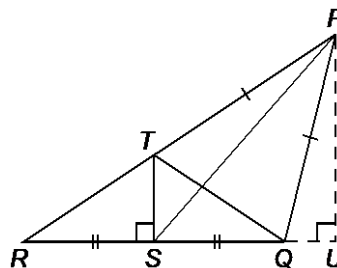11. Which of the following must have $x + 8$ as a factor?
    I. $2x^2y^2 + 16xy^2$
    II. $x^2 + 2x - 48$
    III. $96 - 4x - x^2$

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

12. Simplify $[(x^{-2}y^0)^{-3}]^{-2}$.
    A. x^{12}
    B. $x^{12}y^6$
    C. $\dfrac{1}{x^{12}}$
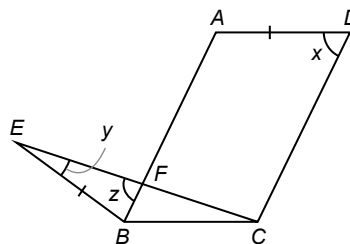   D. $\dfrac{1}{x^{12}y^6}$

13. In the figure, PTR and $RSQU$ are straight lines.

    Which of the following must be a median of $\triangle PQR$?
    A. PS
    B. PU
    C. TS
    D. TQ

14. In the figure, $ABCD$ is a parallelogram. AFB and EFC are straight lines. It is given that $AD = EB$.

    Which of the following must be correct?
    A. $x + y = z$
    B. $y + z = x$
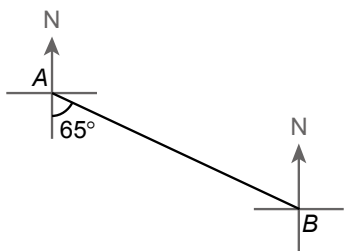   C. $x + y + z = 180°$
    D. $x + 2y + z = 180°$

15. Which of the following inequalities means that 'the sum of half of a and 4 times a is not greater than 57'?

A. $\dfrac{a}{2}+4a \le 57$

B. $\dfrac{a}{2}+4a < 57$

C. $\dfrac{a}{2}+4a \ge 57$

D. $\dfrac{a}{2}+4a > 57$

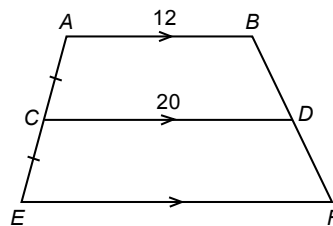16. Which of the following COULD NOT be the probability of an event?

A. $\dfrac{9}{10}$

B. 0.7

C. 0

D. $-\dfrac{1}{3}$

17. In the figure, find the compass bearing of A from B.

A. N25°W
B. N65°W
C. S25°E
D. S65°E

18. In the figure, ACE and BDF are straight lines. Find the length of EF.

A. 24
B. 28
C. 32
D. 36

19. Express $1\times2+1\times2^2+1\times2^5$ as a binary number.

A. 10011_2
B. 100110_2
C. 11001_2
D. 110010_2

20. Find the mode of the following set of data.

$x, x, x, x+2, x+2, x+8, x+10, x+10, x+10$

A. $x+2$
B. $x+5$
C. $x+10$
D. x and $x+10$

21. Which of the following is an identity?

A. $\dfrac{2x-7}{2}=x-7$

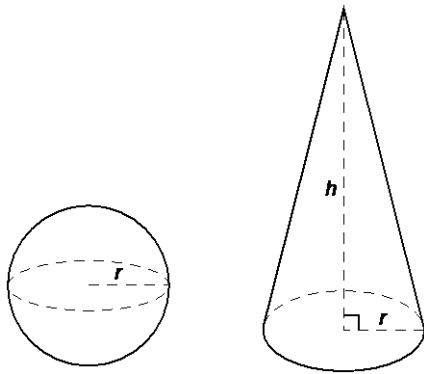B. $(x+7)^2 = x^2 +49$

C. $-(x+7)=-x-7$

D. $-(x+7)=0$

22. Sam deposits $25 000 in a bank at a simple interest rate of 3% p.a. Find the amount after 15 months.
    A. $25 937.5
    B. $25 975
    C. $26 000
    D. $32 187.5

23. Two points $A(7, 4)$ and $B(1, -4)$ are given. If AB is produced to P such that $AB:BP = 2:1$, find the coordinates of P.
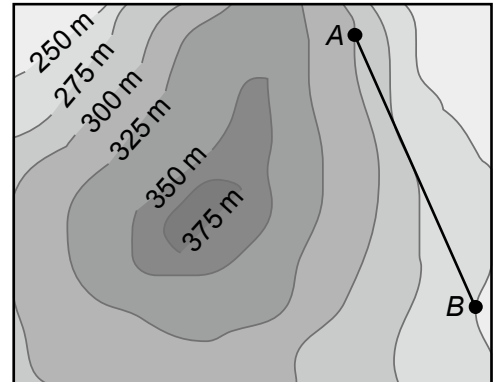   A. $(-11, -20)$
    B. $(-2, -8)$
    C. $\left(3, \ -\dfrac{4}{3}\right)$
    D. $\left(5, \ \dfrac{4}{3}\right)$

24. In the figure, the volumes of the sphere and the right circular cone are the same. Find $h:r$.

    A. $1:3$
    B. $1:4$
    C. $3:1$
    D. $4:1$

25. The figure below shows a map with the scale of $1:10\,000$. From the map, we have $AB = 3$ cm. Find the gradient of AB.

Scale 1 : 10 000

    A. 6
    B. $\dfrac{6}{5}$
    C. $\dfrac{5}{6}$
    D. $\dfrac{1}{6}$

26. If $\tan\left(\dfrac{\theta}{2} - 35°\right) = \dfrac{1}{\tan 2\theta}$, then $\theta =$
    A. $14°$.
    B. $25°$.
    C. $50°$.
    D. $70°$.

27. If the mean of a, b, c, d and e is m, what is the mean of $4a + 7$, $4b + 7$, $4c + 7$, $4d + 7$, $4e + 7$?
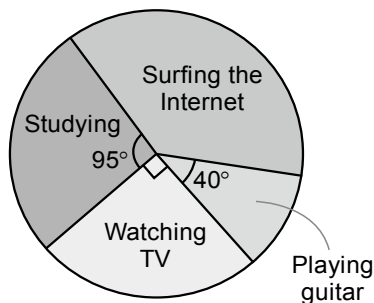   A. m
    B. $4m$
    C. $4m + 7$
    D. cannot be determined

28. A number is randomly chosen among all integers from 1 to 50 inclusive. Find the probability that the number has at least one digit '3' in it.

A. $\dfrac{1}{10}$

B. $\dfrac{3}{25}$

C. $\dfrac{13}{50}$

D. $\dfrac{7}{25}$

29. The time spent by Leon in a morning is as follows:

Time spent by Leon in a morning

If Jenny called Leon at a random time this morning, find the probability that Leon was Surfing the Internet at that moment.

A. $\dfrac{1}{3}$

B. $\dfrac{25}{72}$

C. $\dfrac{13}{36}$

D. $\dfrac{3}{8}$

30. The following table shows the distribution of the capacities of 100 bottles carried by a group of students, where x and y are positive integers. Find the median capacity of the bottles.

Capacity (mL)	350	400	450	500	550	600
Number of bottles	12	20	15	32	x	y

A. 450 mL

B. 475 mL

C. 500 mL

D. 525 mL

Section B (40 marks)

31. Make y the subject of the formula $\dfrac{xy}{3} = \dfrac{x-y}{7}$. $\hspace{2cm}$ (3 marks)

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

33. Factorize

    (a) $x^2 - 13x + 30$,

    (b) $x^2 - 13x + 30 - 2xy + 6y$.

    $\hspace{11cm}$ (3 marks)

34. Solve the inequality $2(15-2x) \geq 5(3x+25)$.   (3 marks)

35. In Figure 1, *ABCD* is a parallelogram. *E* is a point lying on *AD* such that $AE = AB$.
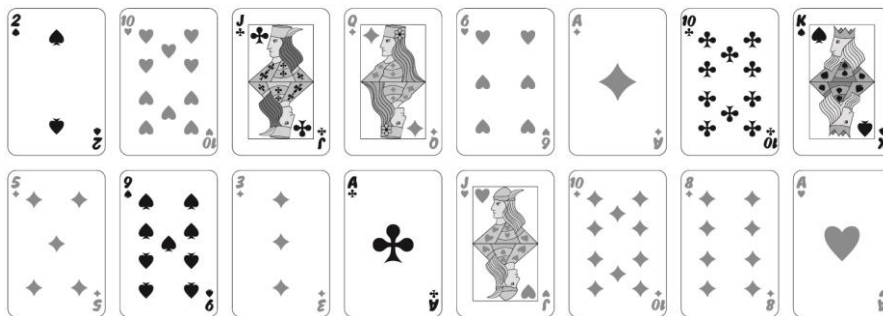

Figure 1

(a) Find $\angle ABE$.

(b) Find $\angle BCD$.

(4 marks)

36. Prove that $\dfrac{1}{\cos^2\theta} - 1 = \dfrac{\cos^2(90° - \theta)}{\sin^2(90° - \theta)}$ is an identity. (4 marks)

37. A card is drawn randomly from the following cards.

Find the probability of each of the following events.
(a) The card drawn is a red card.
(b) The card drawn is not a heart.
(c) The card drawn is neither an 'A' nor a red '10'.

(4 marks)

38. The following table shows Judy's results for 3 tests in Mathematics this term.

	Test 1	Test 2	Test 3
Marks	85	78	82
Weight	4	y	2

If the weighted mean mark of Judy is 82, find the value of y.　　　　(3 marks)
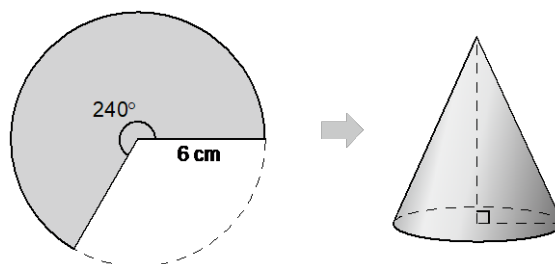
39. In Figure 2, a sector is rolled up into a right circular cone.

Figure 2

(a) Find the base radius of the circular cone.

(b) Find the volume of the circular cone.

(5 marks)

40. Sam borrows $20 000 from a bank and the interest is compounded monthly. If she will repay an amount of $20 808 after 2 months, find the interest rate per annum. (3 marks)

41. In Figure 3, the height of an observatory tower is 50 m. The angle of depression of the top C of a truck on the horizontal ground from the top A of the tower is 28°. Given the height of the truck is 2.5 m.

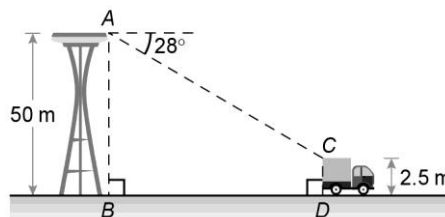
Figure 3

(a) Find the distance between the foot B of the tower and the foot D of the truck.
(b) Find the angle of elevation of A from D.

(5 marks)

Section C (30 marks)

42. Figure 4 shows the position of three island A, B and C. B is due east of A and C is due south of A. Two ships R and S leave A and B respectively towards C at the same time. Ship R sails at a speed of 20 km/h and ship S sails at a speed of 30 km/h. After t hours, Ship R and S arrive at island C at the same time.

Figure 4

    (a) Express AC and BC in terms of t.   (2 marks)

    (b) (i)   Find the true bearing of B from C.

         (ii) Find the compass bearing of C from B.   (5 marks)

    (c) Assume the distance between A and B is 54 km. Someone claims that if ships R and S leave A and B respectively at 9:00 am, the two ships will arrive at C before 11:30 am. Do you agree? Explain your answer.   (3 marks)

43. Figure 5 shows an inverted right pyramid vessel with a square base $ABCD$. There is 1350 cm^3 of water in the vessel and the depth of water is 18 cm. Points O and T are the centres of water surface $PQRS$ and base $ABCD$ respectively.

Figure 5

(a) Find the length of PQ.   (2 marks)

(b) Find the area of the wet surface of the vessel.   (4 marks)

(c) If more water is added to the vessel such that the depth of water increases 4.5 cm, will the area of the wet surface of the vessel increase by more than 50%? Explain your answer.

(4 marks)

44. In Figure 6, straight line L_1 passes through points $A(7, 8)$ and cuts the x-axis at B. Straight line L_2 passes through point $C(12, -5)$ and cuts the y-axis at D. It is given that $L_1 \perp L_2$ and the slope of L_1 is $\dfrac{2}{3}$.
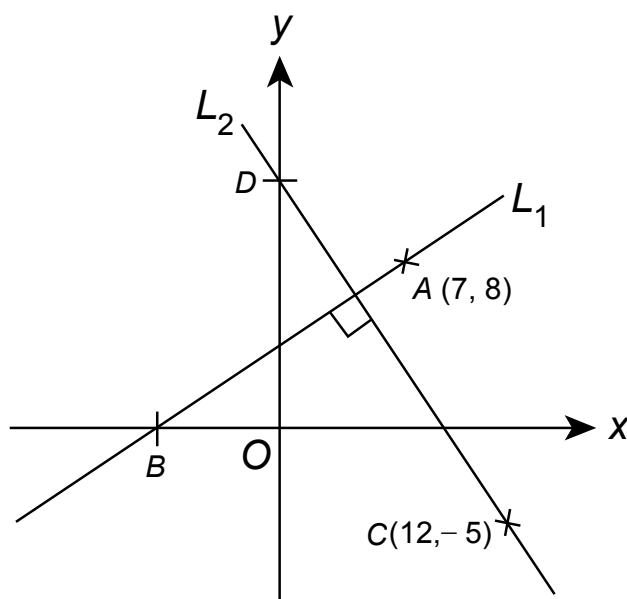

Figure 6

(a) Find the coordinates of B and D. (4 marks)

(b) Determine whether CD is the perpendicular bisector of AB. (2 marks)

(c) Find the length of AB and CD. Hence, or otherwise, find the area of quadrilateral $ACBD$. (4 marks)

END OF PAPER