**20-21 F.3**
2nd TERM EXAM
MATH

2020 – 2021
Form 3 Second Term Examination

MATHEMATICS

Question–Answer Book

16th June, 2021
8:15 am – 10:00 am (1 hour 45 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 are advised to 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.
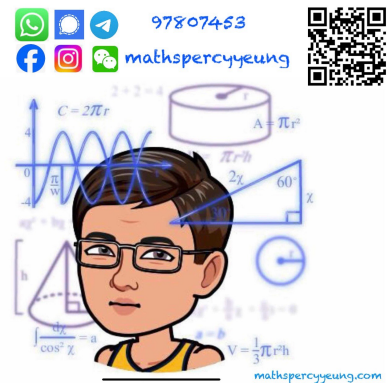
Sections	Marks
A Total	**/30**
B (31 - 33)	/10
B (34 - 40)	/30
B Total	**/40**
C Total	**/30**
TOTAL	**/100**

Section A: (30 marks)

1. $0.0604545 \approx$

   A. 0.061 (correct to 2 significant figures).
   B. 0.0605 (correct to 3 decimal places).
   C. 0.0605 (correct to 4 decimal places).
   D. 0.0604 (correct to 5 significant figures).

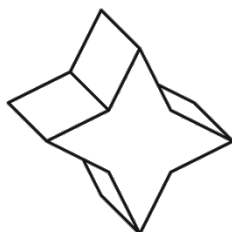2. The mode(s) of the numbers 23, 43, 23, 51, 24, 43, 50 is/are

   A. 23.
   B. 33.
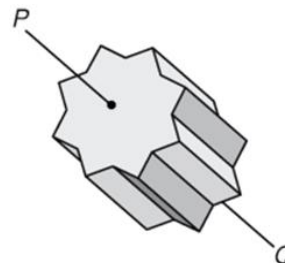   C. 43.
   D. 23 and 43.

3. $x^3 + \dfrac{27}{x^3} =$

   A. $(x+\dfrac{3}{x})(x^2-6+\dfrac{9}{x^2})$.

   B. $(x+\dfrac{3}{x})(x^2-3+\dfrac{9}{x^2})$.

   C. $(x-\dfrac{3}{x})(x^2+6+\dfrac{9}{x^2})$.

   D. $(x-\dfrac{3}{x})(x^2+3+\dfrac{9}{x^2})$.

4. How many planes of reflection does the given prism have?

   A. 2
   B. 3
   C. 4
   D. 5

5. In the figure, PQ is an axis of rotational symmetry of the given solid. What is the order of rotational symmetry for PQ?

   A. 6
   B. 8
   C. 10
   D. 12

6. Find the weighted mean of the following set of data.

Datum	22	28	30	44
Weight	1	4	3	2

   A. 16.75
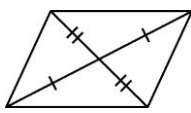   B. 29
   C. 31
   D. 31.2
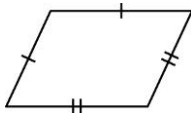
7. $\left(a^n\right)^3 =$

   A. $3a^n$.
   B. a^{n^3}.
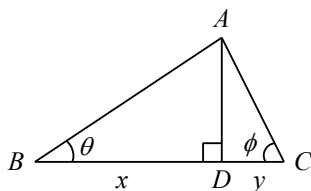   C. a^{3n}.
   D. a^{n+3}.

8. $3^{n-1} \times 3^{n+1} =$

A. 3^{n^2-1}.

B. 9^{n^2-1}.

C. 3^{2n}.

D. 6^{2n}.

9. Which of the following may NOT be a parallelogram?

A.

B.

C.

D.

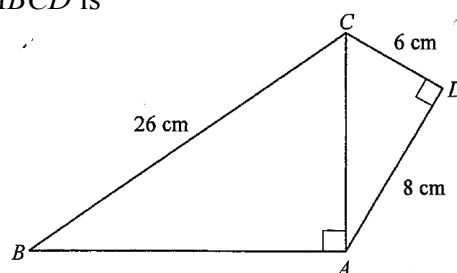
10. In the figure, $AD \perp BC$. Find $\dfrac{x}{y}$.

A. $\dfrac{\sin \phi}{\sin \theta}$

B. $\dfrac{\cos \phi}{\cos \theta}$

C. $\dfrac{\tan \theta}{\tan \phi}$

D. $\dfrac{\tan \phi}{\tan \theta}$

11. Which of the following cannot be factorized to the form of $(x + r)(x + s)$ where r and s are integers?
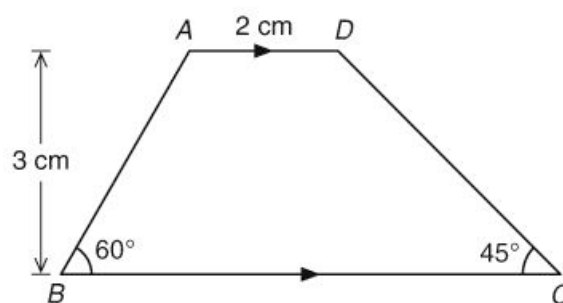
A. $x^2 - 4$

B. $x^2 + 4$

C. $x^2 - 3x - 4$

D. $x^2 + 4x + 4$

12. In the figure, the area of quadrilateral $ABCD$ is

A. 144 cm^2.

B. 160 cm^2.

C. 178 cm^2.

D. 288 cm^2.

13. In the figure, $ABCD$ is a trapezium. Find BC.

A. $(3+\sqrt{3})\text{ cm}$

B. $(5+\sqrt{3})\text{ cm}$

C. $3\sqrt{3}\text{ cm}$

D. $5\sqrt{3}\text{ cm}$

14. Which of the following are properties of a rectangle?

    I.   All interior angles are right angles.

    II.   The diagonals are perpendicular to each other.

    III. The diagonals bisect each other into four equal parts.

    A.   I and II only

    B.   I and III only

    C.   II and III only

    D.   I, II and III

15. $P(-10, -8)$ and $Q(4, 6)$ are two points. If R is a point on the x-axis such that $PR = RQ$, then the coordinates of R are

    A. $(-4, 0)$.

    B. $(-3, -1)$.

    C. $(-3, 0)$.

    D. $(-2, 0)$.

16. In the figure, ABD and ACE are straight lines. If $AC : CE = 3 : 4$, then $BC : DE =$
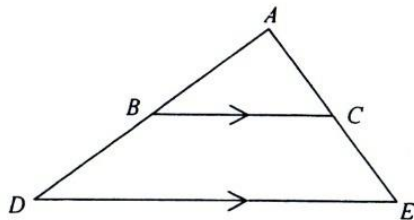
    A. $1 : 2$.

    B. $3 : 4$.

    C. $3 : 7$.

    D. $4 : 7$.

17. Which of the following is/are an identity/identities?

    I. $\cos 2\theta = 2\cos\theta$

    II. $\cos^2\theta + \sin^2\theta = \tan 45°$

    III. $\sin\dfrac{\alpha}{\beta} = \dfrac{\sin\alpha}{\sin\beta}$

    A.   II only

    B.   I and II only

    C.   II and III only

    D.   I, II and III

18. Elise deposits $100 000 in a bank at a simple interest rate of 5% p.a. How long will it take for Elise to receive an amount of $200 000?

    A.   5 years

    B.   10 years

    C.   15 years

    D.   20 years

19. Convert $21D_{16}$ into a binary number.

    A. 1000011101_2

    B. 1000011110_2

    C. 101011101_2

    D. 101011110_2

20. Each of the following cases lists the lengths of three line segments. Which set of line segments can form a triangle?

    A.   1 cm, 2 cm, 3 cm

    B.   2 cm, 4 cm, 6 cm

   C.   3 cm, 5 cm, 9 cm

    D.   4 cm, 5 cm, 6 cm

21. Two cards are drawn at random from five cards marked from 1 to 5. What is the probability that the sum of the numbers shown on the cards drawn is 7?

A. $\dfrac{4}{25}$

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

C. $\dfrac{1}{5}$

D. $\dfrac{2}{5}$

22. The base of a hollow cylindrical metal pipe has an external radius of 5 cm and an internal radius of 4 cm. If the pipe is 1 m long, the volume of metal producing the pipe is

A. $9\pi\,\mathrm{cm}^3$.

B. $30\pi\,\mathrm{cm}^3$.

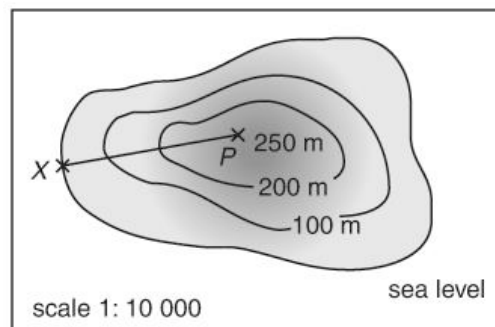C. $300\pi\,\mathrm{cm}^3$.

D. $900\pi\,\mathrm{cm}^3$.

23. In the figure, the volumes of the pyramids *VABC* and *VPQR* are 27 cm³ and 64 cm³ respectively. Planes *ABC* and *PQR* are parallel.
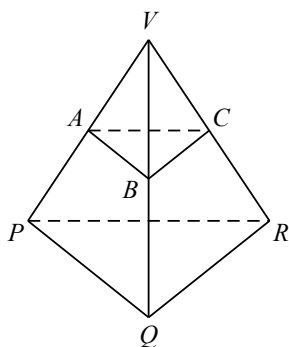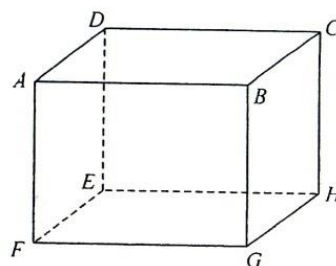

Area of Δ*ABC* : Area of Δ*PQR* =

A. $\sqrt{27} : \sqrt{64}$.

B. $\sqrt{37} : \sqrt{64}$.

C. 3 : 4.

D. 9 : 16.

24. The figure shows the map of an island. The length of *PX* is measured to be 2 cm on the map. Find the angle of elevation of *P* from *X*, correct to the nearest 0.1°.

A. 36.9°

B. 38.7°

C. 51.3°

D. 53.1°

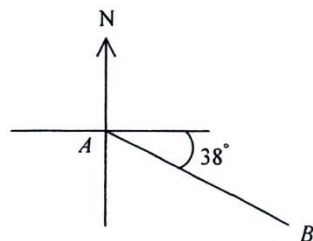25. The figure shows a cuboid. Which of the following are right angles?
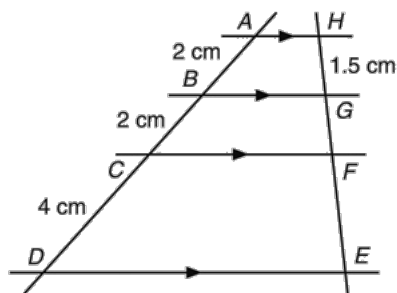

I. ∠*CAF*

II. ∠*DHG*

III. ∠*AGC*

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

26. In the figure, the bearing of A from B is

A. N 38° W.
B. N 52° W.
C. S 38° E.
D. S 52° E.

27. In the figure, $ABCD$ and $HGFE$ are straight lines. Find HE.
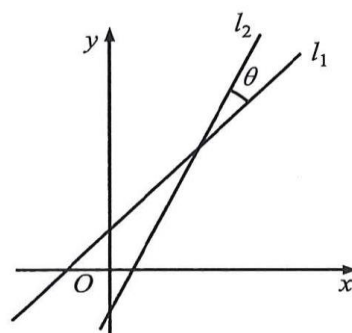

A. 4 cm
B. 5 cm
C. 6 cm
D. 7 cm

28. The table shows the salaries tax rate.

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%

The net chargeable income of Miss Cheung is $180 000. How much salaries tax should she pay?

A. $17 100
B. $18 600
C. $22 400
D. $30 600

29. In the figure, l_1 and l_2 are straight lines with slopes 1 and 2 respectively. Find θ.

A. 18.4°
B. 21.7°
C. 26.6°
D. 45°

30. Let O be the origin. The coordinates of the point P are $(26 , -18)$. If the coordinates of the orthocenter of $\triangle OPQ$ are $(21, -3)$, then the y-coordinates of Q is

A. −30.
B. −10.
C. 10.
D. 30.

Section B : (40 marks)

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

32. Solve the inequality $\dfrac{2x-3}{7} \geq \dfrac{1+x}{4}$. (3 marks)

33. Solve the simultaneous equations $\begin{cases} 2x - y = 5 \\ x - 2y = 4 \end{cases}$. (4 marks)

34. Simplify $\left(\dfrac{3a^{-3}}{a^0 b^2} \right)^3$ and express your answer with positive indices. (3 marks)

35. Factorize the following.
    (a) (i) $x^2 + 2xy + y^2$
        (ii) $3x^2 + 5xy + 2y^2$
    (b) $2x^2 + 4xy + 2y^2 - 3x^2 - 5xy - 2y^2$

(5 marks)

36. Prove the trigonometric identity $\dfrac{1}{\sin\theta\tan\theta} \equiv \dfrac{\cos\theta}{1-\cos^2\theta}$.

(4 marks)

37. Amy has bought some roses, tulips and carnations. She put them into three vases *A, B* and *C*. The number of flowers in each vase is as follows:

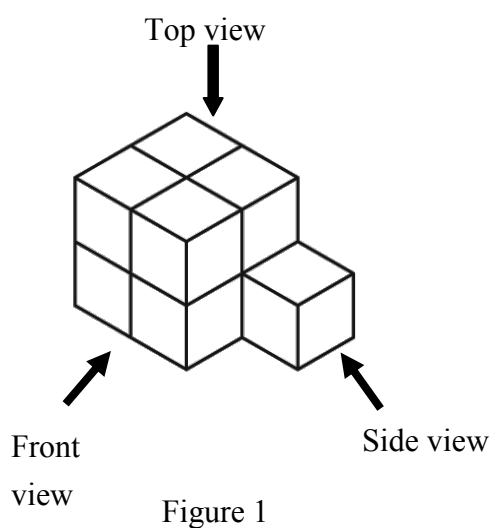|	Rose	Tulip	Carnation
Vase A	2	3	7
Vase B	4	5	4
Vase C	1	8	2

(a) If a flower is randomly picked, find the probability that it is picked from vase *A*.

(b) If a flower is randomly picked, find the probability that it is not a tulip and it is not picked from vase *C*.

(c) If a flower is randomly picked from vase *B*, find the probability that it is a rose.

(6 marks)

38. Draw the orthographic projection of Figure 1 on the grid. (4 marks)

Top view

Front view

Side view

Figure 1

39. The surface area of a sphere is $196\pi\,\text{cm}^2$, find its volume in terms of π. (3 marks)

40. In Figure 2, *ABC* is an isosceles triangle with $AB = AC$. *D* and *E* are points lying on *AB* such that $AD = DE = 2EB$ while *F* is a point lying on *AC* such that $DF \parallel EC$. If $\angle ADF = 90°$ and $CE = 60$ cm,

    (a) show that $AF = FC$;

    (b) find *EF*. (5 marks)

Figure 2

Section C (30 marks)

41. Figure 3 shows a rectangular coordinate plane. $A(-4, 0)$, $B(1, 6)$ and $C(8, 0)$ are the vertices of $\triangle ABC$ and BD is an altitude of $\triangle ABC$. E is a point on AB such that $DE \parallel CB$.
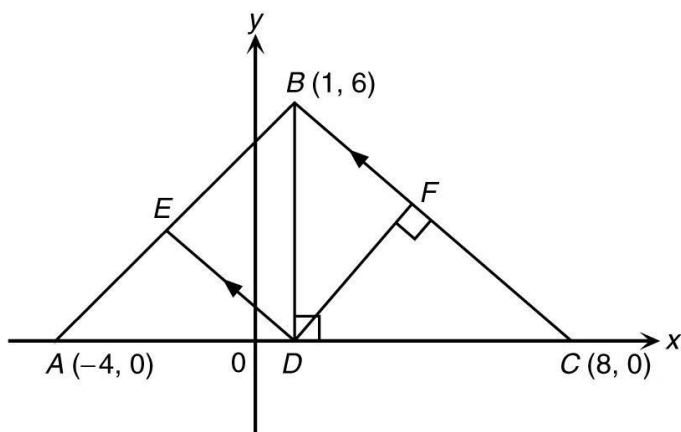

Figure 3

(a) Write down the coordinates of D. (1 mark)

(b) (i) Find the area of $\triangle BCD$.

   (ii) If F is a point on BC such that $DF \perp BC$, find the length of DF. (Leave your answer in surd form.)

   (4 marks)

(c) (i) Prove that $\triangle AED \sim \triangle ABC$.

   (ii) Find the coordinates of E.

   (5 marks)

42. Figure 4a , 4b , 4c shows a solid right circular cylinder X, a solid right circular cone Y and a solid right circular cone Z respectively. The base radius of X is equal to the base radius of Y. The height of X and Y are 10cm and 12cm respectively. The volume of Z is equal to the sum of the volume of X and the volume of Y. The base radius of Z is equal to the base diameter of X. A craftsman finds that the volume of Y is $400\pi\text{cm}^3$.
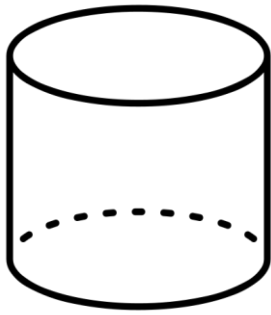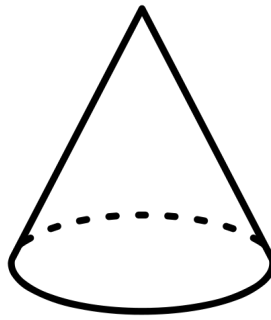
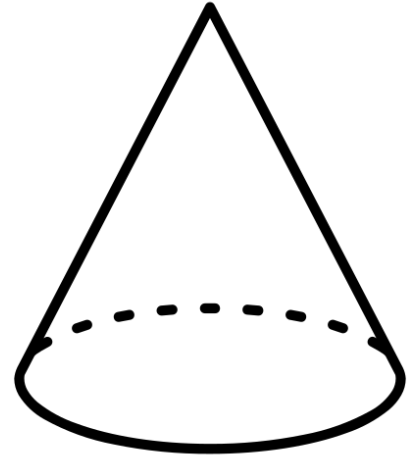| X	Y	Z
Figure 4a	Figure 4b	Figure 4c

(a) Find the base radius of Y. (2 marks)

(b) Find the volume of X in terms of π. (2 marks)

(c) Find the volume of Z in terms of π. (1 mark)

(d) Are Y and Z similar? Explain your answer. (2 marks)

(e) The craftsman claims that the sum of the curved surface area of X and the curved surface area of Y is greater than the curved surface area of Z. Do you agree? Explain your answer. (3 marks)

43. In Figure 5, ship P sails in the direction N30ºE at a constant speed of 50 km/h from A along route AB. At the same time, ship Q sails due west from C along route CD at a constant speed. Suppose that D is due north of A and west of C, $AD = 20\sqrt{3}$ km and $CD = 84$ km. E is the point of intersection of AB and CD.
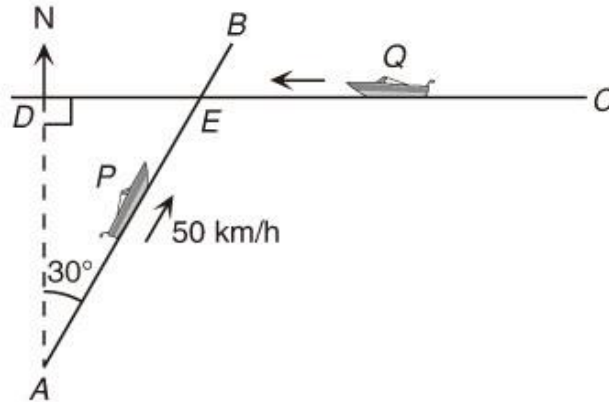

Figure 5

(a) (i) Find the distance of ship P travelling from A to E.
    (ii) How long does it take for ship P to travel from A to E?

(4 marks)

(b) (i) Find DE.
    (ii) If the two ships meet at E, find the speed of ship Q.

(3 marks)

(c) If the two ships continue to sail without changing their speeds, find the true bearing of ship P from ship Q when ship Q arrives at D. (3 marks)

End of Paper