3Exp
Session 1

KRANJI SECONDARY SCHOOL

END-OF-YEAR EXAMINATION 2022

MATHEMATICS 4052
PAPER 1

Level : Secondary Three

Stream : Express

Name : _____ ( )

Class : Secondary _____

Date : 30 Sep 2022

Duration : 2 hr

Total Marks Obtained : ____ / 80

READ THESE INSTRUCTIONS FIRST:

Do not open this question paper until you are told to do so.

Write your name, class and register number in the spaces at the top of this page.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions.

Give non-exact numerical answers correct to three significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
The use of an approved scientific calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

The number of marks is given in brackets [ ] at the end of each question or part question.
The total of the marks for this paper is **80**.

Set by: Mr Sim Zhi Wei

This Question Paper consists of 21 printed pages, including the cover page.

[Turn over

Answer **all** the questions.

1 **(a)** Calculate $\dfrac{12.7^2}{\sqrt{6.25}-\sqrt[3]{2.57}}$.

Write down the first five digits of your answer.

Answer ..... [1]

(b) Write your answer to **part (a)** correct to 2 significant figures.

Answer ..... [1]

---

2 Find the integer values of x which satisfy $-10+x<7-\dfrac{x}{2}\leq 2x-1$.

Answer ..... [3]

---

3 Calculate $\dfrac{1.23\times10^4+1.2\times10^5}{\left(1.4\times10^3\right)^3}$, giving your answer in standard form, correct to 3 significant figures.

Answer ..... [2]

---

4 Simplify $125x^3y^5\div5xy^{-2}z$.

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Answer ..... [2]

---

5 Factorise $12xy - 18x - 10y^2 + 15y$ completely.

DANYAL EDUCATION DANYAL EDUCATION

Answer ..... [2]

---

6 Solve the equation $\frac{2x-5}{4} + \frac{x+3}{5} = 4\frac{1}{4}$.

DANYAL EDUCATION DANYAL EDUCATION DANYAL EDUCATION

Answer $x =$ ..... [2]

---

7 In a sports club, there are 24 boys and 19 girls.
x boys transferred out of the club.

The probability of choosing a boy in the club is now $\frac{21}{40}$.

Calculate the value of x.

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Answer $x =$ ..... [2]

8 The stem-and-leaf diagram shows the times, in minutes, taken by some students to complete a task.

2	0	1	2	6	8
3	2	3	3	7	8
4	3	5	7	8	
5	1	4			

Key: 2 | 6 represents 26 minutes

For these times, find

(a) the mean,

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Answer ..... [1]

(b) the median,

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Answer ..... [1]

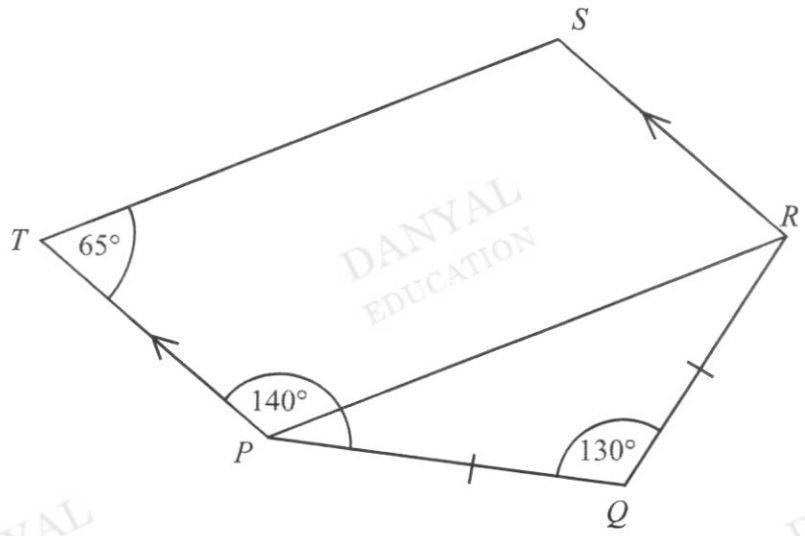
(c) the mode.

Answer ..... [1]

9 Expand and simplify $(3y-4)(2y+5)-3y(y+7)$.

Answer ..... [2]

10

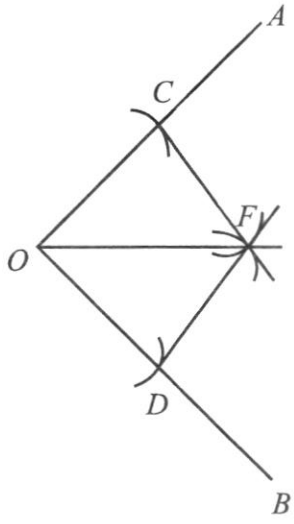


PQRST is a pentagon with *PT* parallel to *RS* and *PQ* = *QR*.
Angle *PQR* = 130°, angle *TPQ* = 140° and angle *PTS* = 65°.

Explain why the quadrilateral *PRST* is a parallelogram.

Answer.....
.....
.....
.....
.....
..... [2]

11 Two arcs, of length 4 cm, were constructed using a compass, along OA and OB at points C and D respectively.
Two arcs of length 2.8 cm, constructed from points C and D, intersect at point F.
Show that ΔCOF is congruent to ΔDOF.
Hence, explain why OF is the angle bisector of $\angle AOB$. [3]



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12 **(a)** Express 2520 as a product of its prime factors.

Answer ..... [1]

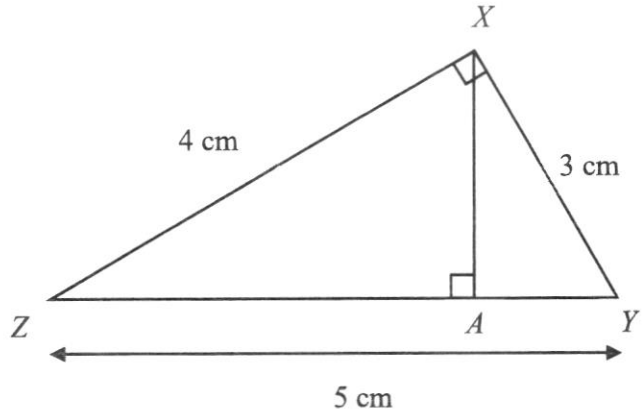
(b) The number $2520k$ is a perfect square.
Find the smallest positive integer value of k.

Answer $k =$ ..... [1]

(c) x is a number between 800 and 1000.
The highest common factor of x and 2520 is 84.
Find the smallest possible value of x.

Answer $x =$ ..... [2]

13 In the figure, $\angle YXZ$ is a right-angle. XA is perpendicular to YZ. $XZ = 4$ cm, $XY = 3$ cm and $YZ = 5$ cm.



(a) Prove that ΔYXA is similar to ΔXZA.

Answer .....
.....
.....
.....
..... [2]

(b) Calculate the length of ZA.

Answer ZA = ... cm [3]

14 Amy and Bernard saved some money in their bank account.
The ratio of Amy's savings : Bernard's savings is 12 : 11.
After spending \$120 each to purchase some books, the new ratio of Amy's savings : Bernard's savings is 56 : 51.
Find out how much more money Amy has than Bernard initially.

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Answer \$ ..... [3]

---

15 Given that $p-\sqrt{q^3+r}=s$, express q in terms of p, r and s.

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Answer q = ... [3]

---

16 Mr Lim invest in a bank which pays 3.5% per annum compound interest, compounded half-yearly. At the end of 5 years, he received $2025 as interest. Find the original amount Mr Lim invested. Leave your answer correct to the nearest dollar.

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Answer $ ..... [3]

---

17 The interior angle of a regular polygon is 132° greater than its exterior angle. Calculate the number of sides that the polygon has.

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Answer ..... [3]

---

18 A Mass Rapid Transit (MRT) car-train, 138 m long, travels through a tunnel of length 4.2 km.
The average speed of the MRT car-train is 45 km/h.

(a) Convert 45 km/h into m/s.

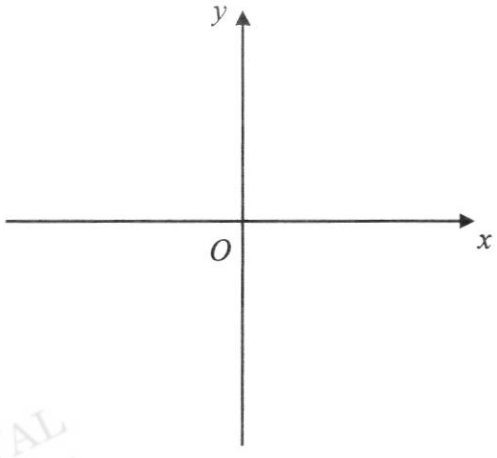
Answer ..... m/s [1]

(b) Calculate the time taken for the MRT car-train to travel **completely** through the tunnel.
Give your answer in minutes and seconds, correct to the nearest second.

Answer ..... min ..... s [2]

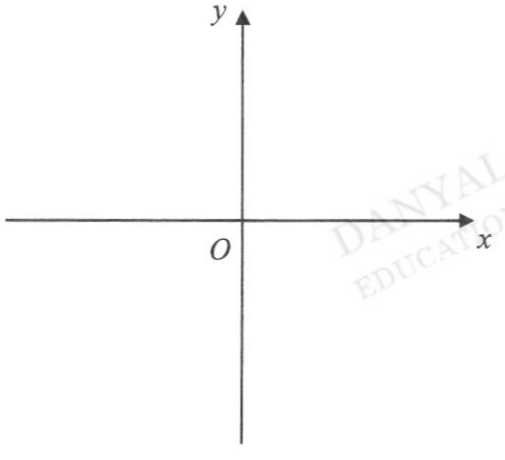
19 Sketch the graph of

(a) $y = -2x^3$,



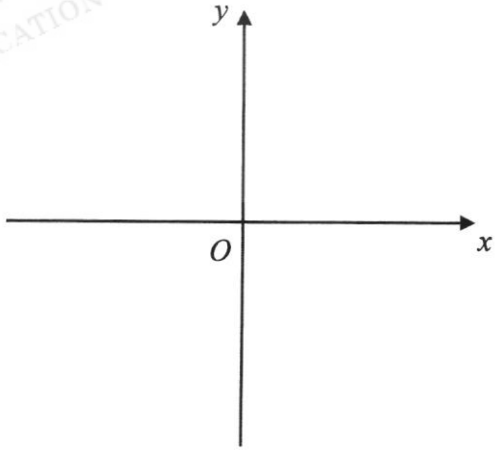
[1]

(b) $y = \frac{5}{x}$,



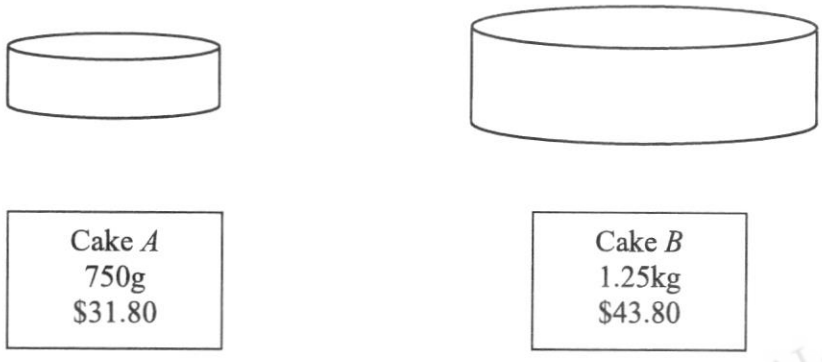
[1]

(c) $y = 3^x$.



[1]

20 Jill decides to buy a birthday cake for his siblings.
The weight of the cakes and the selling prices are shown in the diagram below.



Cake *A*	Cake *B*
750g	1.25kg
$31.80	$43.80

Determine which cake size gives better value for money.
Support your answers with calculations. [3]

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21 **(a)** Solve the equation $2x^2 + 7x - 30 = 0$.

Answer x = ... or ..... [3]

(b) Hence, solve the equation $2(y-1)^2 + 7(y-1) - 30 = 0$.

Answer y = ... or ..... [2]

22 The equation of a straight line l_1 is $2y+3x=5$. It intersects the x-axis at A and the y-axis at B.

(a) Write down the coordinates of A and of B.

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Answer A: (..... , ...)

B: (..... , ...) [2]

(b) Find the length of AB.

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Answer ..... units [2]

(c) Another line l_2 is parallel to l_1 and passes through the point $(4,7)$.
Find the equation of the line l_2.

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Answer ..... [3]

23 Simplify each of the following, leaving your answer in positive index form.

(a) $\dfrac{\left(2x^3y^{-2}\right)^3\times\left(-2x^{-3}y\right)^0}{4x^5y^6}$,

Answer ..... [3]

(b) $\left(\dfrac{27}{p^6}\right)^{-\frac{1}{3}}\times\sqrt[3]{8p^3q^{-6}}$.

Answer ..... [3]

24 **(a)** Express $x^2 - 8x + 11$ in the form $(x + p)^2 + q$.

Answer ..... [2]

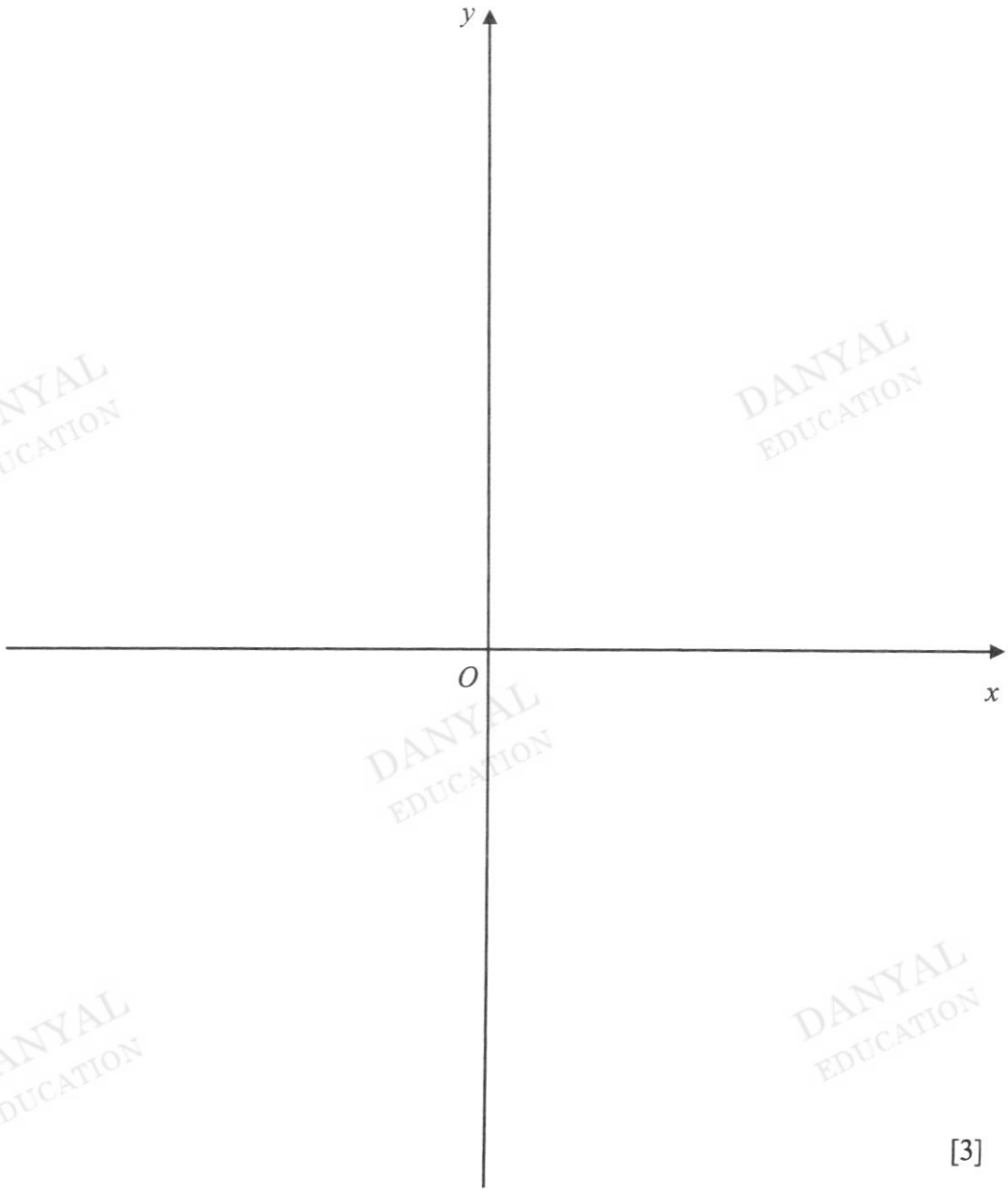
(b) Write down the coordinates of the minimum point of the graph $y = x^2 - 8x + 11$.

Answer (..... , ...) [1]

(c) Write down the equation of the line of symmetry of the graph $y = x^2 - 8x + 11$.

Answer ..... [1]

(d) Sketch the graph of $y = x^2 - 8x + 11$ on the axes below.
Indicate clearly the coordinates of the points where the graph crosses the y-axis and the minimum point on the curve.



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[3]

End of paper

3Exp
Session 1

KRANJI SECONDARY SCHOOL

END-OF-YEAR EXAMINATION 2022

MATHEMATICS 4052
PAPER 2

Level : Secondary Three

Stream : Express

Name : _____ ( )

Class : Secondary _____

Date : 3 Oct 2022

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Set by: Mr Sim Zhi Wei

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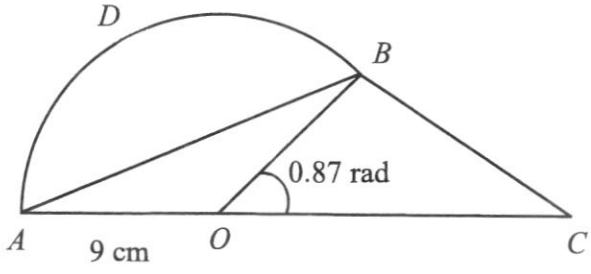
[Turn over

Answer **all** the questions.

1 In the figure, $OADB$ is a sector of a circle with centre O and radius 9 cm. AOC is a straight line such that $\angle BOC = 0.87$ rad.



Calculate

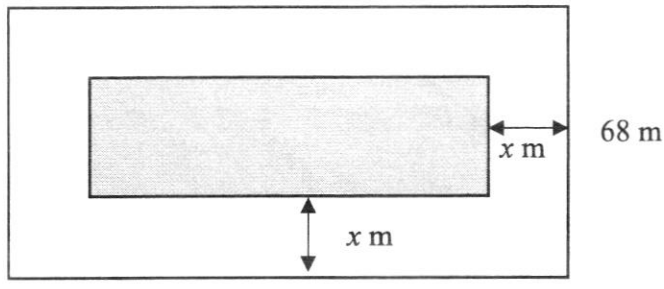
(a) the length of the arc ADB,

Answer ..... cm [2]

(b) the area of segment ADB.

Answer ..... cm^2 [3]

2 A rectangular stadium has dimensions 105 m by 68 m. The shaded rectangular area represents the football field. A running track surrounds the football field.



(a) Given that the running track has a uniform width of x m, write down an expression, in terms of x, for the length and the breadth of the football field.

Answer length is ..... m

breadth is ..... m [2]

(b) The area of the football field is 6713.75 m^2. Write down an equation to represent this information and show that it reduces to $16x^2 - 1384x + 1705 = 0$. [2]

(c) Solve the equation $16x^2 - 1384x + 1705 = 0$.

Answer $x =$ ..... or ..... [3]

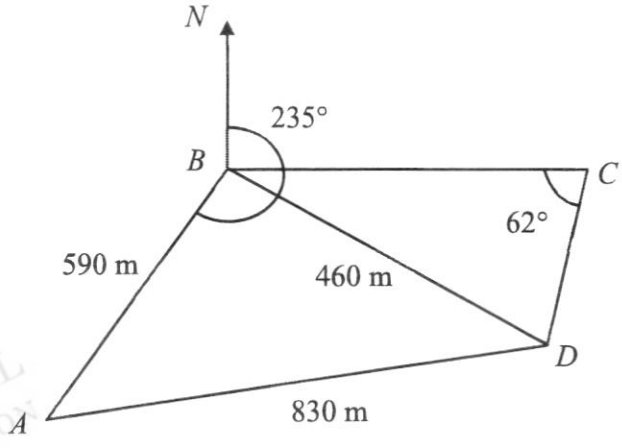
(d) Explain why one of the solutions in part **(c)** need to be rejected.

Answer .....
.....
.....
..... [1]

(e) Hence, find the length of the football field.

Answer ..... m [2]

3 B is the base of a building, of height 36 m. Point A, C and D lie on the horizontal ground. Point C is due east of B. D is 460 m from B. A is 590 m from B on a bearing of $235°$. $AD = 830$ m and $\angle BCD = 62°$.



(a) Find

(i) $\angle ABD$,

Answer ..... [3]

(ii) the bearing of D from C,

Answer ..... [2]

(iii) the shortest distance from B to AD.

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Answer ..... m [2]

(b) A man walks from A towards D and reaches a point P where the angle of elevation of the top of the building from P is the greatest. Find the angle of elevation of the top of the building from P.

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Answer ..... [2]

4 **(a)** Construct a parallelogram $WXYZ$ such that $ZY = 6$ cm, $XY = 3.5$ cm and $\angle WXY = 50°$.
WX has already been drawn. [2]

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(b) Measure and write down the length of the diagonal WY.

Answer ..... cm [1]

(c) Construct the perpendicular bisector of WX such that it cuts YZ at point M.
Measure and write down the length of ZM.

Answer ..... cm [2]

(d) Construct the angle bisector of $\angle WXY$. [1]

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5 **(a)** These are the first four terms in a sequence.

9 −2 −13 −24

(i) Find an expression, in terms of n, for the nth term of the sequence.

Answer ..... [1]

(ii) Find the 57^{th} term of the sequence.

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Answer ..... [2]

(iii) Explain why it is not possible for −55 to be a term in the sequence.

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Answer .....

.....

.....

..... [2]

(b) The nth term of another sequence is given by $T_n = \dfrac{3n+1}{198-4n}$.

Find the least value of n for which $T_n > 2$.

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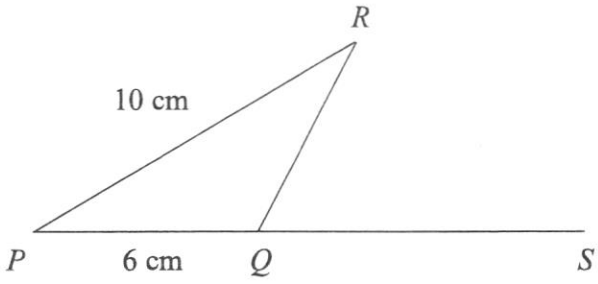
Answer ..... [2]

6 In the figure, PQS is a straight line. $PQ = 6$ cm, $PR = 10$ cm and $\sin \angle RQS = \frac{4}{7}$.



(a) Find, giving your answer as a fraction in its simplest form,

(i) $\sin \angle PQR$,

Answer ..... [1]

(ii) $\sin \angle PRQ$.

Answer ..... [3]

(b) The sine of an angle is 0.7254.
Give two possible values for the angle.

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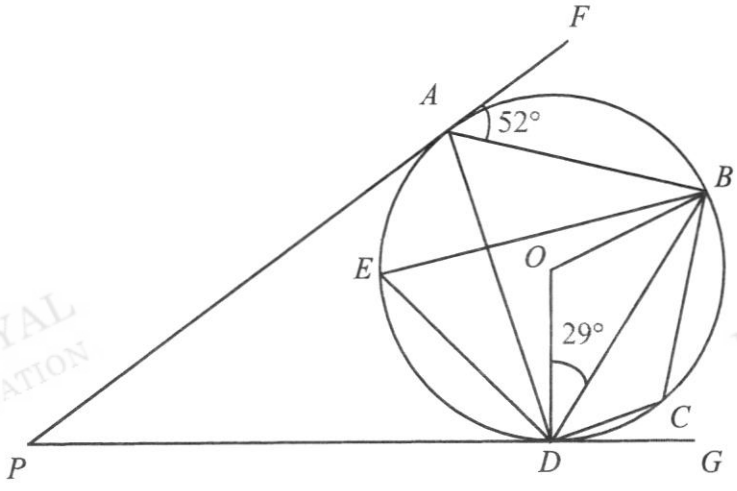
Answer ..... or ..... [2]

7 A, B, C, D and E lie on the circle with centre O.
OB and OD are the radii of the circle.
PF and PG are tangents to the circle.
$\angle BAF = 52°$ and $\angle BDO = 29°$.



Find, giving reasons for your answers,

(a) $\angle DEB$,

Answer ..... [3]

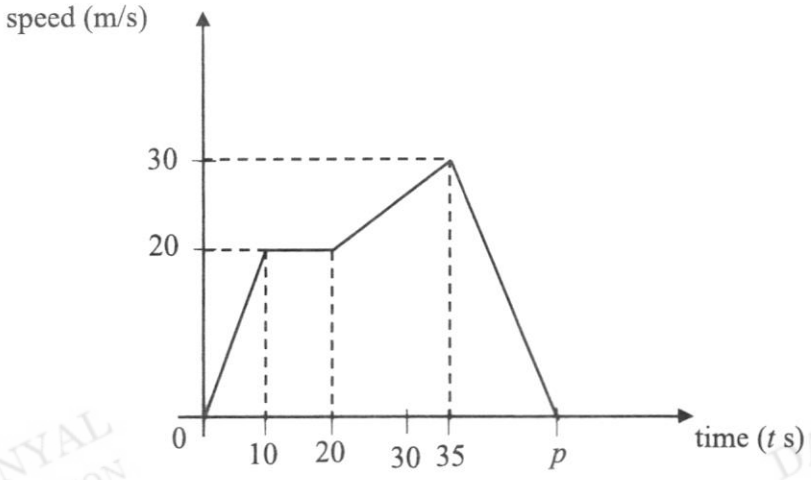
(b) $\angle BCD$,

Answer .....[2]

(c) $\angle ODA$.

Answer ..... [3]

8 The graph shows the speed-time graph of a car.



Find

(a) the acceleration of the car when $t = 5$,

Answer ..... m/s^2 [2]

(b) the speed of the car when $t = 32$,

Answer ..... m/s [2]

(c) the value of p if the total distance travelled by the car is 885 m,

Answer ..... [3]

(d) the average speed of the car for the whole journey.

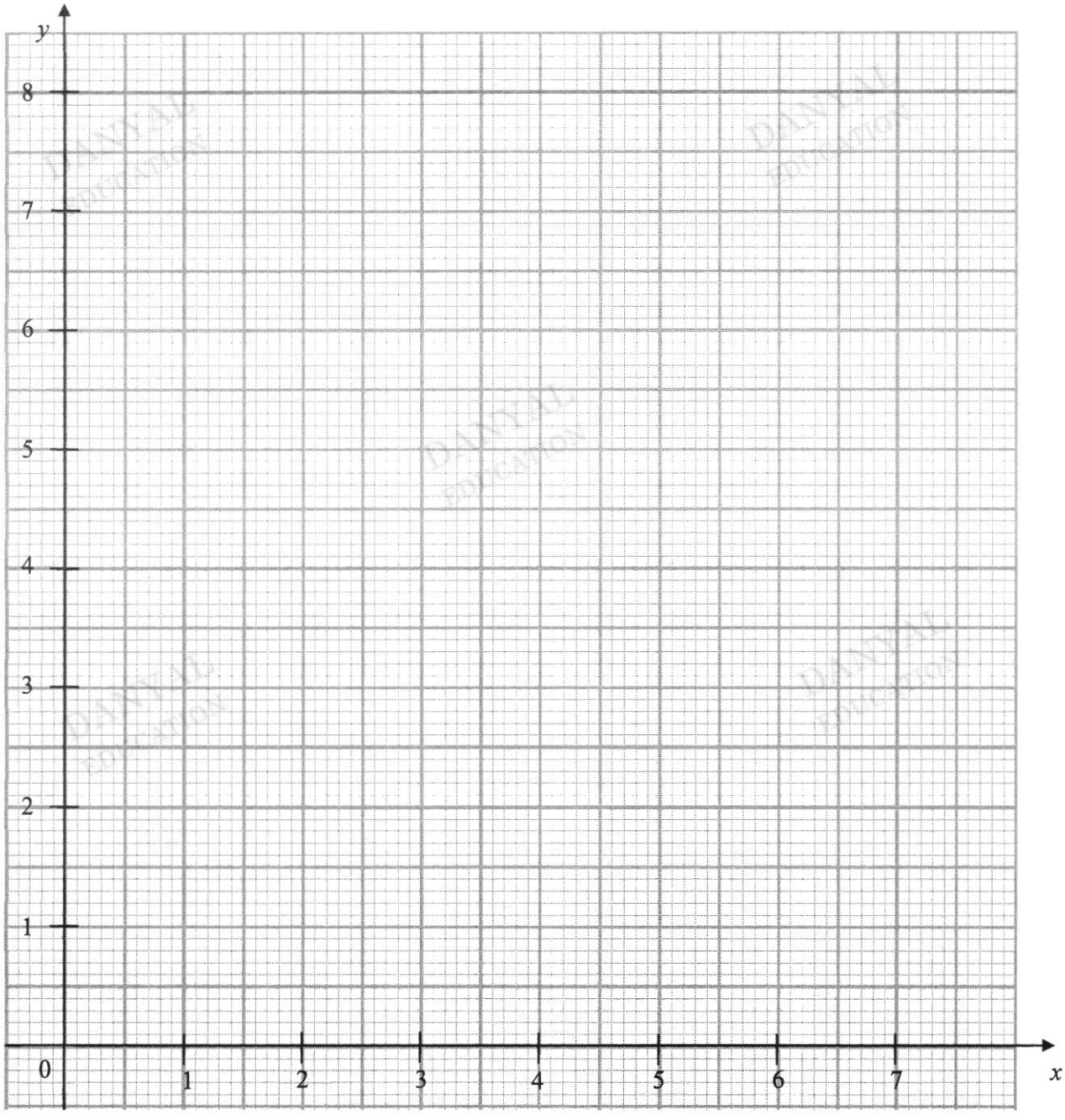
Answer ..... m/s [2]

9 **(a)** Complete the table of values for $y = x + \frac{5}{x} - 3$.

Give your answer correct to 1 decimal place. [1]

x	0.5	1	1.5	2	3	4	5	6	7
y	7.5	3	1.8	1.5	1.7	2.3	3	3.8	

(b) On the grid, draw the graph of $y = x + \frac{5}{x} - 3$ for $0.5 \leq x \leq 7$. [3]



(c) Find the range of values of x for which $y < 2.2$.

Answer ..... [1]

(d) By drawing a tangent, find the gradient of the graph at the point where $x = 4$.

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Answer ..... [2]

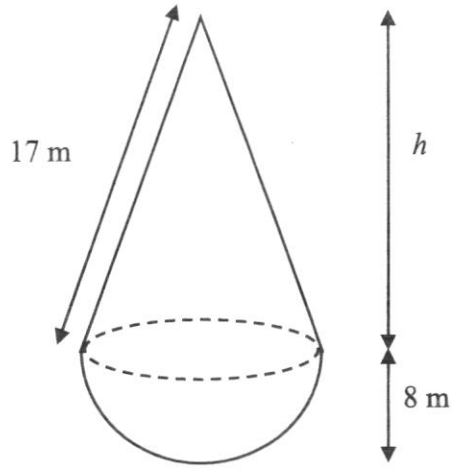
(e) The equation $x - \frac{5}{x} = 1$ can be solved by drawing a suitable straight line on the grid.

(i) Find the equation of the straight line. [1]

(ii) By drawing this straight line for $2 \leq x \leq 6$, solve the equation $x - \frac{5}{x} = 1$.

Answer x = ... [3]

10 The diagram below shows a solid made from a cone and a hemisphere.

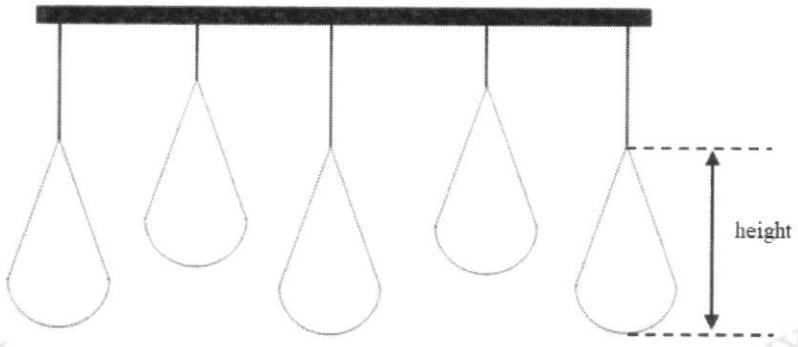


(a) Show that the height, h, of the cone is 15 m. [1]

(b) Calculate the total surface area of the solid.

Answer ..... m^2 [3]

(c) The solid is melted to form geometrically similar solids, to be used as lighting ornaments. The height of the ornament should not exceed 0.1 m. Suggest the number of such ornaments to be produced.
Show your workings clearly.



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Answer ..... [5]

End of paper

Sec 3E End-of-Year Examination_2022_ Mathematics_P1 (Solutions)

1	**(a)** 142.70 **(b)** 140
2	$-10+x<7-\frac{x}{2}$ $x<11\frac{1}{3}$ $7-\frac{x}{2}\leq 2x-1$ $x\geq 3.2$ $x=4,5,6,7,8,9,10,11$
3	$\frac{1.23\times10^4+1.2\times10^5}{(1.4\times10^3)^3}=\frac{1.23\times10^4+12\times10^4}{1.4^3\times10^9}\approx 4.82\times10^{-5}$ or 0.000048214
4	$\frac{125x^3y^5}{5xy^{-2}z}=25x^{3-1}y^{5-(-2)}z^{-1}=25x^2y^7z^{-1}$
5	$12xy-18x-10y^2+15y=6x(2y-3)-5y(2y-3)=(6x-5y)(2y-3)$
6	$\frac{2x-5}{4}+\frac{x+3}{5}=4\frac{1}{4}$ $5(2x-5)+4(x+3)=5(17)$ $10x-25+4x+12=85$ $x=7$
7	$\frac{24-x}{24+19-x}=\frac{21}{40}$ $40(24-x)=21(43-x)$ $960-40x=903-21x$ $x=3$
8a	$\text{mean}=\frac{578}{16}=36.125$
8b	$\text{median}=\frac{33+37}{2}=35$
8c	mode = 3
9	$(3y-4)(2y+5)-3y(y+7)=6y^2+15y-8y-20-3y^2-21y=3y^2-14y-20$

10

$$\angle RPQ = \frac{180° - 130°}{2} \text{(base angle of an isosceles triangle)} = 25°$$

$$\angle TPR = 140° - 25° = 115°$$

$\angle PTS + \angle TPR = 65° + 115°$ (sum of interior angles, // lines) $= 180°$

Therefore, $PRST$ is a parallelogram.

11

$S: OC = OD = 4\,\text{cm}$ (given)

$S: CF = DF = 2.8\,\text{cm}$ (given)

$S: OF$ (common length)

Hence, $\Delta COF \equiv \Delta DOF$ (SSS), $\angle COF = \angle DOF$, therefore OF bisects $\angle AOB$

12a $2520 = 2^3 \times 3^2 \times 5 \times 7$

12b 70

12c $84 \times 11 = 924$

13a

Let $\angle AZX$ be x.

$\angle ZXA = 90° - x$; $\angle YXA =$

$A: \angle YXA = \angle XZA = x$

$A: \angle YAX = \angle XAZ = 90°$

ΔYXA is similar to ΔXZA since two pairs of corresponding angles are equal.

13b

Let AY be y.

$$\frac{3}{4} = \frac{\sqrt{3^2 - y^2}}{5 - y}$$

$$3(5 - y) = 4\sqrt{3^2 - y^2}$$

$$9(5 - y)^2 = 16\left(3^2 - y^2\right) \ldots$$

$$25y^2 - 90y + 81 = 0 \ldots$$

$$y = \frac{-(-90) \pm \sqrt{(-90)^2 - 4(25)(81)}}{2(25)} = 1.8$$

$ZA = 5 - 1.8 = 3.2\,\text{cm}$

14

A : B	
$12x$: $11x$	$12x - 120 = 56y$
$-\$120$: $-\$120$	$11x - 120 = 51y$
$56y$: $51y$	$132x - 1320 = 616y - (1)$
	$132x - 1440 = 612y - (2)$
	Solving (1) & (2), $x = 150$ and $y = 30$

15

$$p-\sqrt{q^3+r}=s$$
$$\sqrt{q^3+r}=p-s$$
$$q^3+r=(p-s)^2$$
$$q=\sqrt[3]{(p-s)^2-r}$$

16

$$P\left[1+\frac{\left(\frac{3.5}{2}\right)}{100}\right]^{5\times 2}-P=\$2025$$

$$P=\frac{2025}{\left[1+\frac{\left(\frac{3.5}{2}\right)}{100}\right]^{5\times 2}-1}\approx\$10689$$

17

$$\frac{(n-2)\times 180^\circ}{n}=\frac{360^\circ}{n}+132$$
$$(n-2)\times 180=360+132n$$
$$n=15$$

18a 12.5 m/s

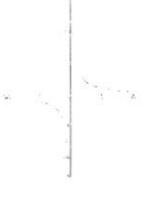
18b

$$\frac{4.2\text{ km}+138\text{ m}}{12.5\text{ m/s}}=\frac{4200\text{ m}+138\text{m}}{12.5\text{ m/s}}=347.04\text{ s}=5\text{ min }47\text{ s}$$

19

(a)

(b)

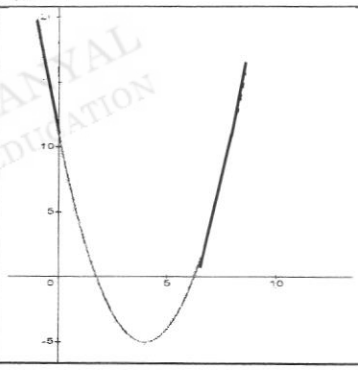


(c)

20

Cake A: $\frac{\$31.80}{750g}=\$0.0424/\text{g}$; Cake B: $\frac{\$43.80}{1250g}=\$0.03504/g$

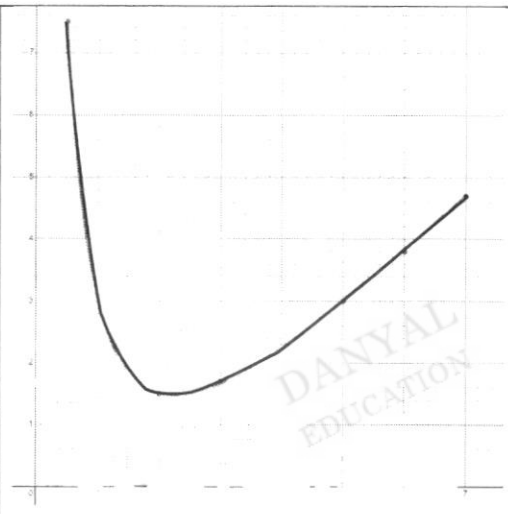
Cake B is better value for money as it is cheaper by \$0.0073/g

21(a)	$2x^2+7x-30=0$ $(2x-5)(x+6)=0$ $x=2.5$ or $x=-6$
21(b)	$y=3.5$ or $y=-5$
22	**(a)** $A\left(1\frac{2}{3},0\right)$; $B\left(0,2\frac{1}{2}\right)$ **(b)** $\sqrt{\left(1\frac{2}{3}-0\right)^2+\left(0-2\frac{1}{2}\right)^2}\approx 3.00 units$
22(c)	$2y=-3x+5$ $y=-\frac{3}{2}x+2\frac{1}{2}$ → Gradient of line $l_2=-\frac{3}{2}$ Since line l_2 : $y=-\frac{3}{2}x+c$ passes through (4, 7), $7=-\frac{3}{2}(4)+c$ → $c=13$ Hence, equation of line l_2 : $y=-\frac{3}{2}x+13$
23a	$\frac{\left(2x^3y^{-2}\right)^3\times\left(-2x^{-3}y\right)^0}{4x^5y^6}=\frac{8x^9y^{-6}\times 1}{4x^5y^6}=\frac{2x^4}{y^{12}}$
23b	$\left(\frac{27}{p^6}\right)^{-\frac{1}{3}}\times\sqrt[3]{8p^3q^{-6}}=\left(\frac{p^6}{27}\right)^{\frac{1}{3}}\times 2pq^{-2}=\frac{p^2}{3}\times 2pq^{-2}=\frac{2p^3}{3q^2}$
24a	$x^2-8x+11=x^2-8x+\left(\frac{8}{2}\right)^2-\left(\frac{8}{2}\right)^2+11=(x-4)^2-5$
24b	$(4,-5)$
24c	$x=4$
24d	

Sec 3E End-of-Year Examination_2022_ Mathematics_P2 (Solutions)

1a	$9(\pi-0.87)\approx 20.4cm$
1b	$\frac{1}{2}(9)^2(\pi-0.87)-\frac{1}{2}(9)(9)\sin(\pi-0.87)\approx 61.0cm^2$
2a	Length: $105-2x$; Breadth: $68-2x$
2b	$(105-2x)(68-2x)=6713.75$ $7140-210x-136x+4x^2=6713.75$
2c	$x=\frac{-(-1384)\pm\sqrt{(-1384)^2-4(16)(1705)}}{2(16)}$ $=\frac{1384\pm\sqrt{1806336}}{32}=1.25 \text{ or } 85.25$
2d	x represents the width of the running track, hence it cannot be longer than the breadth of the stadium which is 68 m. $105-2(1.25)=102.5$
3a(i)	$830^2=590^2+460^2-2(590)(460)\cos\angle ABD$ $\cos\angle ABD=\frac{590^2+460^2-830^2}{2(590)(460)}$ $\angle ABD\approx 103.8°$
3a(ii)	$360°-90°-62°=208°$
3a(iii)	$\frac{1}{2}(830)h=\frac{1}{2}(590)(460)\sin 103.77°$ $h\approx 317.589996\approx 318m$
3b	$\tan\theta=\frac{36}{317.589996}$ $\theta\approx 6.467°\approx 6.5°$
4a	Correct angle 50°; Correct parallelogram
4b	4.6 cm (accept 4.4 cm to 4.8 cm)
4c	Correct perpendicular bisector ; 5.2 cm (accept 5.0 cm to 5.4 cm)
4d	Correct angle bisector

5a(i)	$20-11n$
5a(ii)	$20-11(57)=-607$
5a(iii)	$20-11n=-55$ $n=6\frac{9}{11}$ (not a positive integer)
5b	$\frac{3n+1}{198-4n}>2$ $n>35.9091$ Least $n=36$
6a(i)	$\frac{4}{7}$
6a(ii)	$\frac{6}{\sin\angle PRQ}=\frac{10}{\sin\angle PQR}$ $\frac{6}{\sin\angle PRQ}=\frac{10}{\left(\frac{4}{7}\right)}$ $\sin\angle PRQ=\frac{6}{\left(\frac{35}{2}\right)}=\ldots$
6b	$46.5°$ or $133.5°$
7a	$\angle BOD=180°-29°-29°=122°$ $\angle DEB=\frac{122°}{2}$ (angle at centre $=2\times$ angle at circumference) $=61°$
7b	$180°-61°$ (sum of angles in opposite segments) $=119°$
7c	$\angle DAP=180°-52°-61°=67°$ $\angle ODA=90°-67°$(tangent perpendicular to radius) $=23°$
8a	$\frac{20-0}{10-0}=2$ m/s^2
8b	$\frac{s-20}{32-20}=\frac{30-20}{35-20}\rightarrow s=28$
8c	$\frac{1}{2}(10)(20)+20(20-10)+\frac{1}{2}(20+30)(15)=675$ $885-675=210$ $\frac{1}{2}(p-35)(30)=210\rightarrow p=49$

8d	$\frac{885}{49} = 18.1$ m/s	
9	**(a)** 4.7	
	(c) $1.3 < x < 3.9$ (accept ± 0.2)	
	(d) 0.688 (3s.f) (accept answer 0.650 - 0.710)	
	(e) $x - \frac{5}{x} = 1$ **(i)** $2x - 4 = x + \frac{5}{x} - 3$ $y = 2x - 4$	
	(ii) Draw graph of $2x - 4$ in the domain $2 \le x \le 6$; $x \approx 2.8$	
10a	$h^2 + 8^2 = 17^2$ $h^2 = 17^2 - 8^2$ $h = 15 (shown)$	
10b	$\pi(8)(17) + \frac{1}{2}(4)\pi(8)^2 \approx 829$	

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10c

$\frac{1}{3}\pi(8)^2(15)+\frac{1}{2}\left(\frac{4}{3}\right)\pi(8)^3$

(Accept also if students assume vol of solid is V and vol of ornament would be $\frac{V}{n}$.)

≈ 2077.63994

Let height of ornament be h and n be the number of ornaments.

Since solids are geometrically similar,

$$\left(\frac{h}{23}\right)^3 \approx \frac{\left(\frac{2077.63994}{n}\right)}{2077.63994}$$

$$\left(\frac{h}{23}\right)^3 = \frac{1}{n}$$

$$n = \left(\frac{23}{h}\right)^3$$

Since $h < 0.1m$, $n > \left(\frac{23}{0.1}\right)^3 \rightarrow n > 12167000$

We could produce 12500000 ornaments. (Accept any ans more than 12167000)

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