BEDOK VIEW SECONDARY SCHOOL
END-OF-YEAR EXAMINATION 2022

CANDIDATE NAME			
REGISTER NUMBER		CLASS	

MATHEMATICS
Secondary 3 Express/
3 Normal Academic (Express Syllabus)
Paper 1

4052/01
30 September 2022
2 hours

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your index number and name on all the work you hand in.
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.
If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
The use of an approved scientific calculator is expected, where appropriate.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

At the end of the examination, fasten all your work securely together.
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.

Total	

Setter : Mrs Christina Lee

Parent's / Guardian's Signature: .....

This document consists of **17** printed pages.

[Turn over

Answer **all** the questions.

1 **(a)** **(i)** Calculate $\dfrac{4.9^2}{\sqrt[3]{726}-4.3}$ and write down the first 5 digits on your calculator display.

Answer ..... [1]

(ii) Write down your answer to part **(a)(i)** correct to 2 significant figures.

Answer ..... [1]

(b) Write the following numbers in ascending order.

$$\sqrt[5]{0.0045}, \quad -0.3, \quad -\frac{13}{24}, \quad 0.089^{\frac{4}{9}}$$

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

---

2 **(a)** Simplify $(3a+1)^2-(3a-1)^2$.

Answer ..... [2]

(b) Factorise $2aq+4p-8a-pq$ completely.

Answer ..... [2]

---

3 The cash price of a coffee machine is \$480.

The hire purchase price of the same machine is made up of deposit of 25% of the cash price and 24 monthly instalments of \$22.50.

What is the percentage increase in the hire purchase price as compared to its cash price?

Answer ..... % [3]

---

4 Solve the simultaneous equations.

$$4x + 3y = 8$$
$$3x - 4y = 5$$

Answer $x =$ ....., $y =$ ..... [3]

---

5 **(a)** Simplify $7\left[4x^4y^2 \times \sqrt[3]{x^6}\right] - \left(3x^3y\right)^2$.

Answer ..... [3]

(b) Given that $9 \times 27^{\frac{2}{3}} = \frac{1}{81^m}$, find the value of m.

Answer $m =$ ..... [2]

---

6 The radius of an oxygen atom is approximately 60 picometres.
(1 picometre = 10^{-12} metre)

Calculate the total length, in metres of 105 of these atoms when they are lined up in a straight line. Express your answer in standard form.

Answer ..... m [2]

[Turn over

7 Sarah has just inherited \$20 000 and she is deciding between two banks, Bank *A* and Bank *B*, to put her money into for the next 5 years.

The following table shows what the two banks are offering.

Bank *A*	Bank *B*
Simple Interest at 3% per annum	Compound Interest of 2.4% per annum compounded quarterly

Which bank should Sarah put her money into and why? Explain your answer with clear working.

Answer

Sarah should put her money into Bank ..... because .....

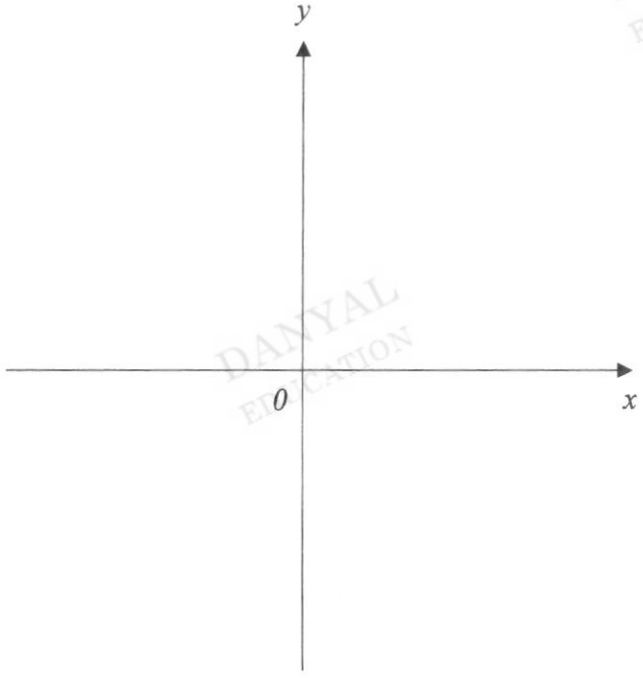
..... [5]

8 **(a)** Express $x^2 + 2x - 2$ in the form $(x+a)^2 + b$ where a and b are integers.

Answer ..... [2]

(b) Sketch the graph of $y = x^2 + 2x - 2$ on the axes below, showing clearly the turning point, x-intercept(s) and y-intercept (if any).

Answer



[2]

(c) State the equation of the line of symmetry of the graph $y = x^2 + 2x - 2$.

Answer ..... [1]

9 **(a)** Solve $\frac{x-15}{6} < \frac{7x-4}{3} \leq 15-3x$ and represent your solution on a number line.

Answer

[4]

(b) Hence, state the largest prime number that satisfies the inequalities in part **(a).**

Answer ..... [1]

10 **(a)** Express 756 as a product of its prime factors.

Answer ..... [1]

(b) Given that $756k$ is a perfect cube, find the smallest possible integer value of k.

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

---

11 The first four terms of a sequence are 5, 11, 17 and 23.

(a) Write down the next two terms in the sequence.

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

(b) Find an expression for the nth term of the sequence.

Answer ..... [2]

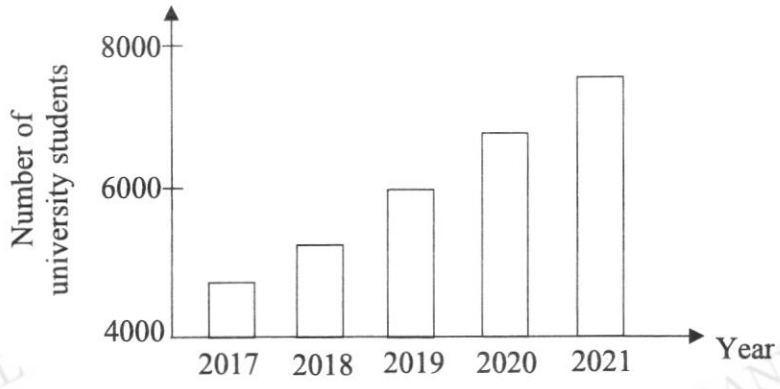
(c) Is 119 a term in this sequence? Explain your answer with clear working.

Answer

[2]

---

12 The graph below shows the number of university students staying in hostels in Singapore between 2017 to 2021.



Explain one way in which the graph may be misleading and suggest how the graph can be improved to address that misleading feature.

Answer

Misleading feature: .....

.....

Suggestion: .....

..... [2]

13 In Singapore, Jessica pays \$2.87 for one litre of petrol.

On a visit to Los Angeles, she paid 8.57 US dollars for one gallon of petrol.

Given 1 US dollar = 1.39 Singapore dollars and 1 galloon = 3.785 litres, is petrol cheaper in Singapore or Los Angeles?

Show your calculations clearly.

Answer

Petrol is cheaper in ……..…….. [3]

---

14 A water tumbler, which is in the shape of a cylinder, has a height of 20 cm and a capacity of 350 ml.

A geometrically similar water tumbler has a height of 28 cm and a base diameter of 9.8 cm.

(a) Find the base diameter of the smaller tumbler.

Answer ..... cm [2]

(b) Find the capacity of the larger tumbler.

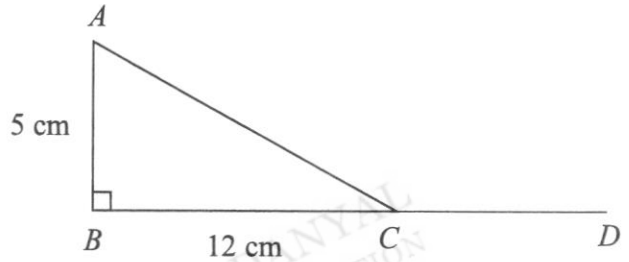
Answer ..... ml [2]

15 Solve $15x^2 + 8 = 22x$.

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

---

16 ΔABC is a right-angled triangle. The line BC is produced to point D.
$AB = 5$ cm and $BC = 12$ cm.



Write down the value of

(a) $\sin \angle ACB$,

Answer ..... [2]

(b) $\cos \angle ACD$.

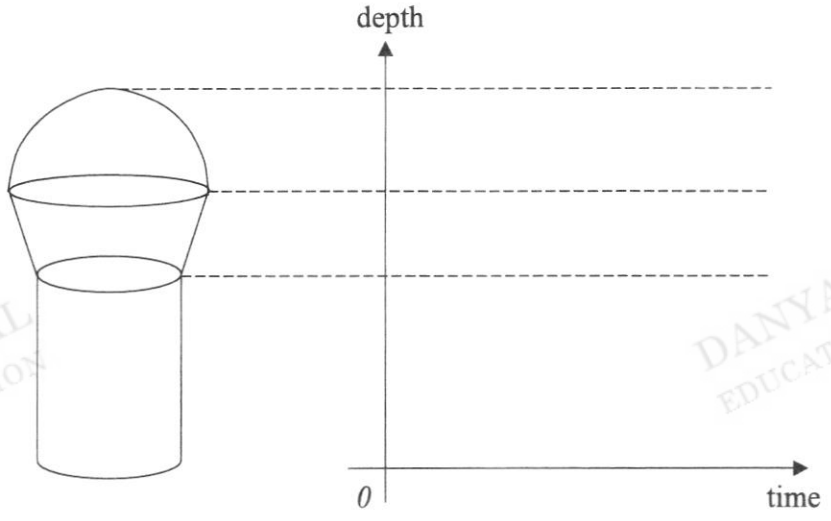
Answer ..... [1]

---

17 Water is poured into the container below at a constant rate.

In the space below, complete the graph showing the depth of water against time.

Answer



[3]

---

18 A map has a scale of 1 : 50 000.

(a) Given that the actual length of a road is 8 km, calculate the length of the road on the map.

Answer ..... cm [1]

(b) A plot of land on the map is represented by an area of 14 cm^2. Calculate the actual area of the plot of land in km^2.

Answer ..... km^2 [2]

---

19 Tom wants to construct a scale drawing of quadrilateral $ABCD$ where $AB = 75\,\text{m}$, $BC = 46\,\text{m}$, $AD = 52\,\text{m}$, $\angle ABC = 120^\circ$ and $\angle BAD = 98^\circ$.

(a) Given that he uses a scale of 1 cm to represent 10 m, construct quadrilateral $ABCD$ in the space below.

Answer (a) and (b)

[2]

(b) The point M in quadrilateral $ABCD$ is such that it is equidistant from A and B and equidistant from AB and AD. By drawing appropriate bisectors, find and label point M. [3]

(c) Hence, find the actual distance from M to C.

Answer ..... m [1]

---

20 Daisy, Suzy and Mary share the cost of a birthday present for their friend, Emily, in the ratio 6 : 3 : 4 respectively.

Given that Suzy paid \$15, what was the cost of the present?

Answer \$ ..... [2]

---

21 The sine of an angle is 0.5859.

Give two possible values for the angle.

Answer .....° or .....° [2]

---

22 Jasmine eats at a restaurant with her husband, 2 sons and a daughter. They each order a set meal which costs \$18 per person. How much will their bill come up to if they have to pay a 10% service charge as well as 7% GST?

Answer \$ ..... [2]

---

23 The following table shows the recipe to make carrot and coriander soup for 2 people.

1	small onion
15 g	margarine
350 g	carrots
1 g	ground coriander
500 ml	vegetable stock

Patricia has 2.9 kg worth of carrots and plenty of the other ingredients.

(a) Using this recipe, find the maximum number of people she will be able to make the soup for.

Answer ..... people [2]

(b) How many packets of vegetable stock will she need to have to make the soup for this maximum number of people, given that each packet of vegetable stock is 890 ml?

Answer ..... packets [3]

END OF PAPER

BEDOK VIEW SECONDARY SCHOOL
END-OF-YEAR EXAMINATION 2022

CANDIDATE NAME			
REGISTER NUMBER		CLASS	

MATHEMATICS
Secondary 3 Express/
3 Normal Academic (Express Syllabus)
Paper 2

4052/02
4 October 2022
2 hours

Candidates answer on the Question Paper.

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Total	

Setter : Mrs Christina Lee

Parent's / Guardian's Signature: .....

This document consists of **22** printed pages.

Answer **all** the questions.

1 **(a)** It is given that $U = mgh + \frac{1}{2}mv^2$.

(i) Find the value of U when $m = 15$, $g = 10$, $h = 3.6$ and $v = 4.8$.

Answer $U =$ ..... [1]

(ii) Express v in terms of U, m, g and h.

Answer ..... [3]

(b) Simplify $\frac{8ax - 20a}{4x^2 + 8x - 45}$.

Answer ..... [3]

[Turn over

(c) **(i)** Express $\frac{4}{2x+7}-\frac{3}{2x-7}$ as a single fraction.

Answer ..... [2]

(ii) Hence, solve $\frac{4}{2x+7}-\frac{3}{2x-7}=1$.

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

2 Mr Lee planned to drive 508 km from Tokyo to Osaka and started his journey at 0745.

After travelling one quarter of the distance at an average speed of x km/h, he decided to increase his average speed by 10 km/h. With this increase in speed, he was able to complete his journey 1 hour and 15 minutes earlier than planned.

(a) Write an expression, in terms of x, for the time he would have taken for the whole journey based on the original speed.

Answer ..... hours [1]

(b) Write an expression, in terms of x, for the actual time he took for the whole journey.

Answer ..... hours [1]

(c) Form an equation and show that it reduces to $x^2 + 10x - 3048 = 0$.

Answer

[3]

(d) Solve the equation $x^2 + 10x - 3048 = 0$, correct to 3 significant figures.

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

(e) Hence, find the time Mr Lee arrived in Osaka, correct to the nearest minute.

Answer ..... [3]

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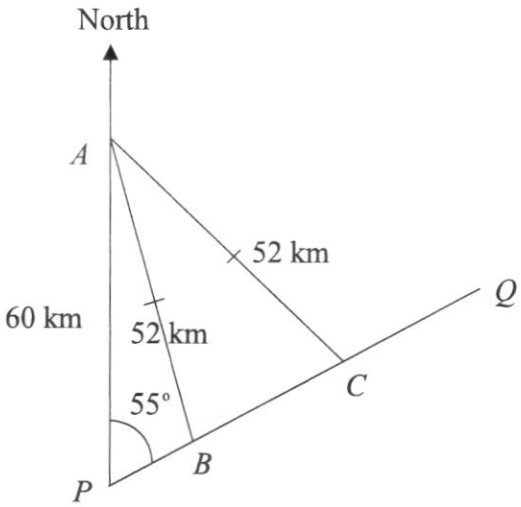
3



A ship sails from P to Q on a bearing of $055°$.
A lighthouse is situated at point A, which is due north of P.
$AP = 60$ km and the light from the lighthouse is visible for a range of 52 km
i.e. $AB = AC = 52$ km.

(a) Show that $\angle ABP = 109.1°$, given that $\angle ABP$ is obtuse.

Answer

[3]

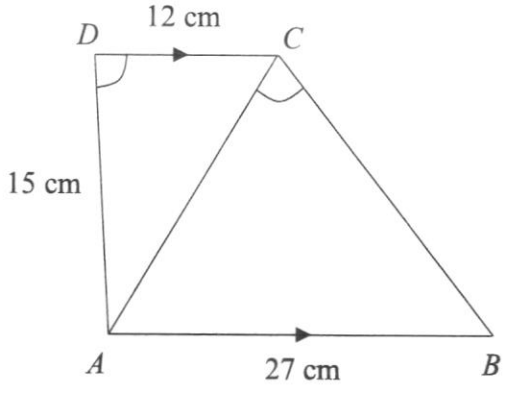
(b) Calculate the length of BC.

Answer ..... km [3]

(c) Given that the ship travels at a speed of 70 km/h, find the length of time for which the light is visible to the ship. Give your answer in minutes correct to the nearest minute.

Answer ..... mins [2]

4 **(i)** In the diagram below, AB is parallel to DC, $AB = 27$ cm, $DC = 12$ cm, $AD = 15$ cm and $\angle ACB = \angle CDA$.



(a) Show that ΔABC is similar to ΔCAD.

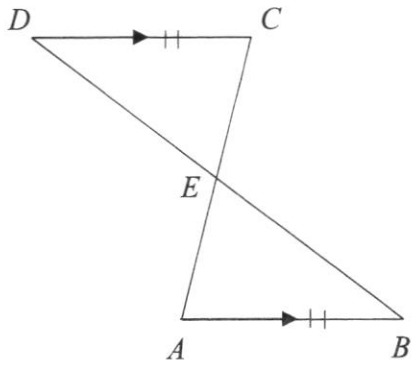
Answer

[2]

(b) Find the length of AC.

Answer ..... cm [2]

(ii)



In the diagram above, AB and DC are two equal and parallel rods in an engine. E is the joint of the rods AC and BD.

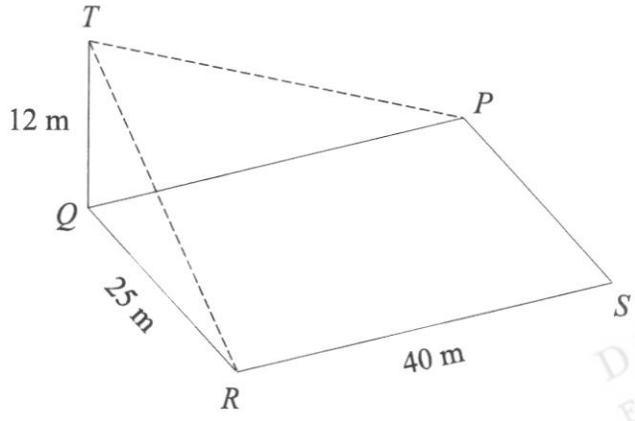
Show that ΔABE and ΔCDE are congruent.

Answer

[2]

5 A lamp post of height 12 m stands at Q which is at the corner of a rectangular field $PQRS$ with dimensions of 40 m by 25 m.

T represents the top of the lamp post.



Find

(a) QS,

Answer ..... m [2]

(b) the angle that TP makes with the horizontal QP,

Answer .....° [2]

(c) *TS*,

Answer ..... m [2]

(d) the angle of depression from *T* to the point *S*.

Answer ..... ° [2]

6 A triangle has vertices $A(1,-2)$, $B(2,1)$ and $C(-4,3)$.

(a) Find the equation of the line AC.

Answer ..... [2]

(b) Determine if ΔABC is a right-angled triangle.

Answer

[3]

(c) Find the area of ΔABC.

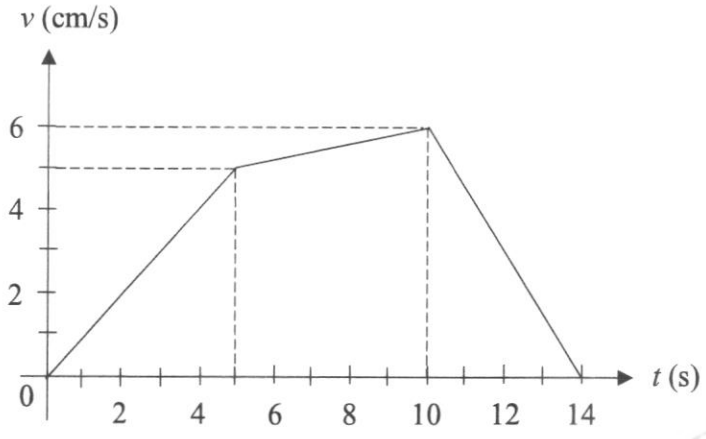
Answer ..... units^2 [1]

(d) Hence, find the perpendicular distance from B to AC.

Answer ..... units [2]

[Turn over

7 The graph below shows the how the speed, v cm/s, of an ant varies with time, t seconds.



(a) Find the acceleration of the ant in the 3rd second.

Answer ..... cm/s^2 [1]

(b) Find the speed of the ant in the 11th second.

Answer ..... cm/s [2]

(c) Describe the motion of the ant between the 10th and 14th second.

Answer

.....

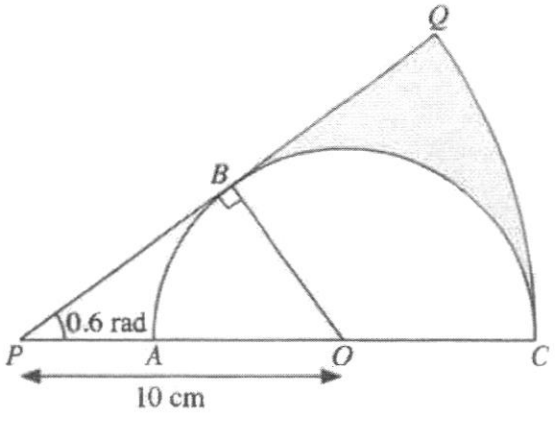
..... [1]

(d) Given that the distance travelled is given by the area under the speed-time graph, find the average speed of the ant during these 14 seconds of its motion.

Answer ..... cm/s [3]

8 In the figure below, a semi-circle ABC has centre at O and AC as its diameter. QC is an arc of another circle with centre at P. PBQ and $PAOC$ are straight lines.

$PO = 10$ cm, $\angle BPO = 0.6$ radians and OB is perpendicular to PB.



(a) Find the perimeter of the shaded region.

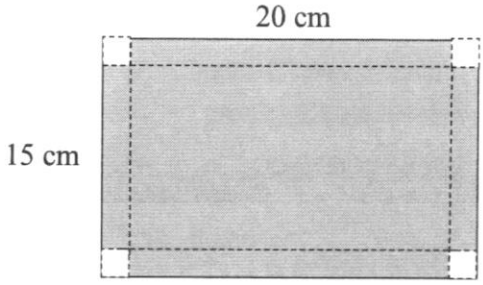
Answer ..... cm [6]

(b) Find the area of the shaded region.

Answer ..... cm^2 [4]

9 Karen runs a business selling sweets and she is designing a container to hold the sweets.

She uses rectangular pieces of cardboard that measure 15 cm by 20 cm.
The mass of 1 square meter of the cardboard is 180 grams.



She cuts a square from each corner of the piece of cardboard and then folds the cardboard to make an open box.

By changing the size of the square she cuts out, Karen can change the volume of the box.

(a) Find the mass of the box made if Karen cuts a square of 1.5 cm from each corner.

Answer ..... g [2]

(b) Given that Karen cuts a square of side x cm from each corner of the cardboard to form a box with a volume, $V = x(15-2x)(20-2x)$, explain why the value of x must be less than 7.5 cm.

Answer

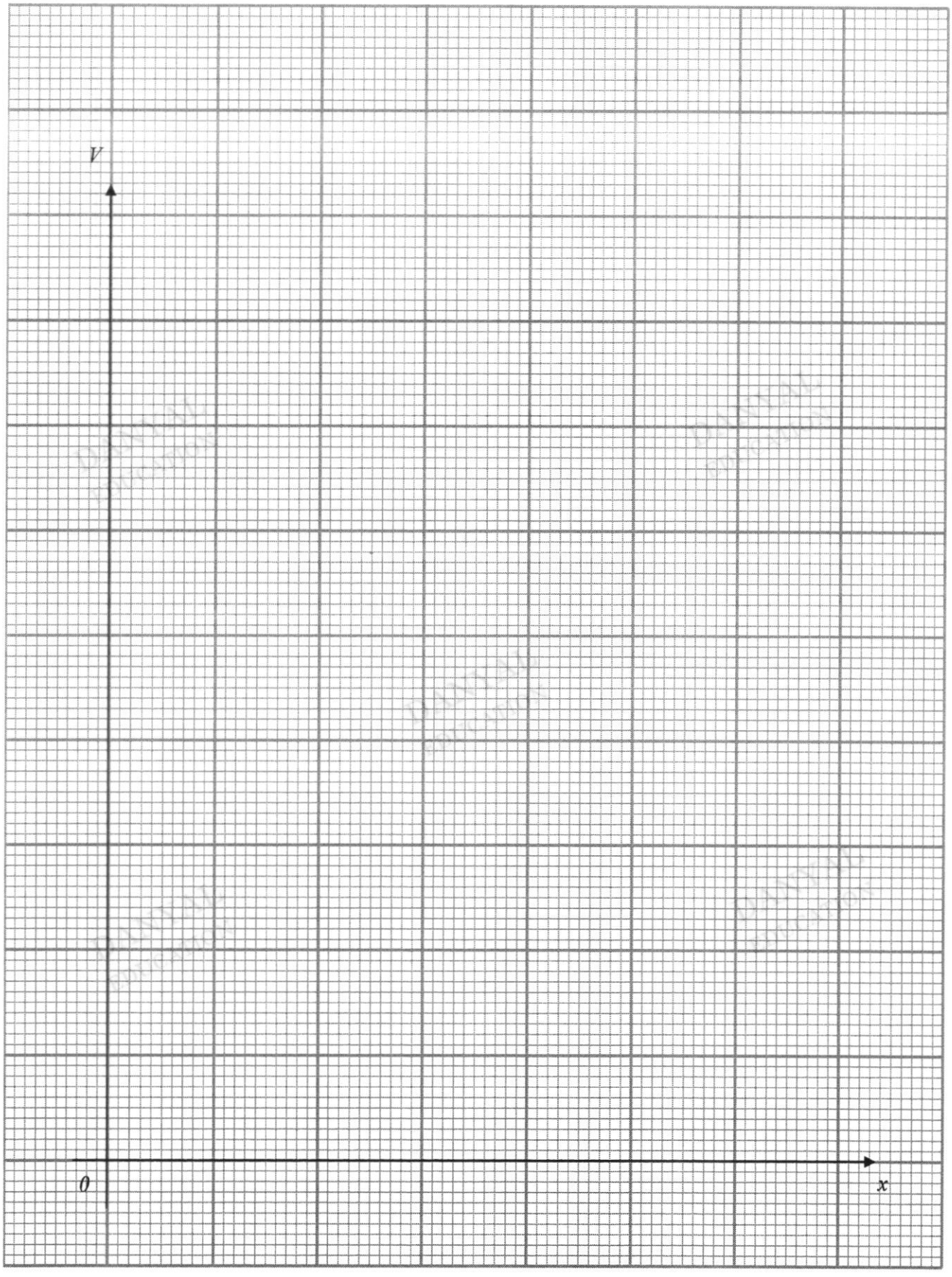
[1]

(c) Karen wants to make a box with a volume of at least 320 cm^3 while ensuring that the mass of the box is as small as possible.

By drawing on the next page, the graph of $V = x(15-2x)(20-2x)$ for $0 \le x \le 6$ using a scale of 2 cm to 1 unit on the horizontal axis and 2 cm to 50 units on the vertical axis, find the mass of the box that she will be making.

Answer ..... g [8]

[Turn over



END OF PAPER

Bedok View Secondary School
Mathematics Department — Marking Scheme

Year	2022	Level & Stream	Sec 3E/3N (Express)
Type of Exam	EYE	Subject	E Math Paper 1

No.			Working	Remarks
1	(a)	(i)	5.1219 (5 digits) **[B1]**	
		(ii)	5.1 (2 s.f.) **[B1]**	
	(b)		$-\frac{13}{24}, -0.3, \sqrt[5]{0.0045}, 0.089^{\frac{4}{9}}$ **[B2]**	Deduct [B1] for any one error in the order

[Total : 4m]

2	(a)	$(3a+1)^2-(3a-1)^2$ $=9a^2+6a+1-(9a^2-6a+1)$ **[M1]** $=12a$ **[A1]**	Correct expansion of both terms. P error if did not put in bracket which led to wrong answer but give M1.
	(b)	$2aq+4p-8a-pq$ $=2a(q-4)+p(4-q)$ **[M1]** $=2a(q-4)-p(q-4)$ $=(2a-p)(q-4)$ **[A1]**	Factorisation using grouping

[Total : 4m]

3	Hire purchase price $= (0.25 \times 480) + 24(22.50)$ $= \$660$ **[M1]** Percentage increase $= \frac{660-480}{480} \times 100$ **[M1]** $= 37.5\%$ **[A1]**	

[Total: 3m]

Bedok View Secondary School
Mathematics Department

Marking Scheme

4	$4x + 3y = 8$ ------ (1) $3x - 4y = 5$ ------ (2) (1) × 3; $12x + 9y = 24$ ------ (3) (2) × 4; $12x - 16y = 20$ ------ (4) } **[M1]** (3) − (4); $25y = 4$ $y = \frac{4}{25}$ **[A1]** Sub $y = \frac{4}{25}$ into (2); $3x - 4\left(\frac{4}{25}\right) = 5$ $3x = 5\frac{16}{25}$ $x = 1\frac{22}{25}$ **[A1]**	Accept sub. method Accept $x = 1.88$ & $y = 0.16$

[Total : 3m]

5	(a)	$7\left[4x^4y^2 \times \sqrt[3]{x^6}\right]\left(3x^3y\right)^2$ $= 7\left[4x^4y^2 \times x^2\right] - (3)^2(x^3)^2(y)^2$ [M1 changing $\sqrt[3]{x^6}$] $= 28x^6y^2 - 9x^6y^2$ [M1 simplifying $\left(3x^3y\right)^2$] $= 19x^6y^2$ **[A1]**	
	(b)	$9 \times 27^{\frac{2}{3}} = \frac{h}{81^m}$ $3^2 \times 3^{3\left(\frac{2}{3}\right)} = 3^{-4m}$ **[M1]** $3^4 = 3^{-4m}$ $-4m = 4$ $m = -1$ **[A1]**	Express all numbers as a base of 3 Accept $81 = 81^{-m}$ **[M1]** $m = -1$ **[A1]**

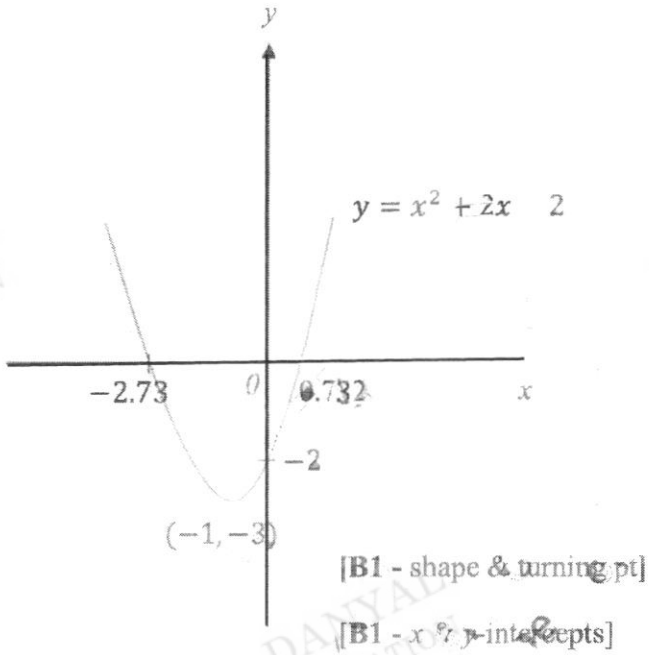
[Total : 5m]

6	length of 105 oxygen atoms $=105(60\times10^{-12})(2)$ **[M1]** $=0.000\ 000\ 0126$ $=1.26\times10^{-8}$ m **[A1]**	

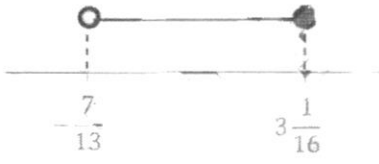
[Total : 2m]

7	Bank *A*: Simple Interest $=\frac{20000\times3\times5}{100}=3000$ **[M1]** Total amount $= 20000 + 3000 = \$23000$ **[M1]** Bank *B*: $A = 20000(1+\frac{\frac{2.4}{4}}{100})^{20}$ **[M1]** $= \$22541.85$ **[M1]** Sarah should put her money in Bank *A* because the total amount will be greater in this bank. **[A1-for correct bank & reason]**	Accept comparison of interest Bank *A*: S.I= 3000 **[M1]** Bank *B*: As stated on the left **[M1, M1]** Interest = 22541.85 − 20000 =2541.85 **[M1] FT** FT A1 if conclusion & reason is correct based on incorrect value above

[Total : 5m]

8	(a)	$x^2 + 2x - 2 = x^2 + 2x + \left(\frac{2}{2}\right)^2 - 1 - (\frac{2}{2})^2$ **[M1]** $= (x+1)^2 - 3$ **[A1]**	
	(b)	 **[B1** - shape & turning pt**]** **[B1** - x & y-intercepts**]**	Minus P if graph is not labelled
	(c)	$x = -1$ **[B1]**	No B1 if x is not stated

[Total : 5m]

9	(a)	$\frac{x-15}{6} < \frac{7x-4}{3}$ $\quad$ $\frac{7x-4}{3} \leq 15-3x$ $\frac{6(x-15)}{6} < \frac{6(7x-4)}{3}$ $\quad$ $\frac{3(7x-4)}{3} \leq 3(15-3x)$ $x-15 < 14x-8$ $\quad$ $7x-4 \leq 45-9x$ $-13x < 7$ $\quad$ $16x \leq 49$ $x > -\frac{7}{13}$ **[M1]** $\quad$ $x \leq 3\frac{1}{16}$ **[M1]** $-\frac{7}{13} < x \leq 3\frac{1}{16}$ **[A1]**  **[A1-closed & open dot & nos indicated]**	Accept double arrows with shading. If no shading of overlapping region, no A1.
	(b)	3 **[B**	

[Total : 5m]

10	(a)	2 | 756 2 | 378 3 | 189 3 | 63 3 | 21 7 | 7 1 $756 = 2^2 \times 3^3 \times 7$ **[B1]**	
	(b)	$k = 2 \times 7^2 = 98$ **[B1]**	

[Total : 2m]

11	(a)	29, 35	
	(b)	$T_n = 6n - 1$ **[B2]**	$T_n = 5+(n-1)6$ **[B1]** only
	(c)	$6n - 1 = 119$ $6n = 120$ $n = 20$ } **[B2]** Yes, 119 is a term in the sequence because n is an integer value.	Accept expansion of terms to 20th term Conclusion must be indicated to be awarded B2, otherwise P error. No FT mark from (b)

[Total : 5m]

12	Misleading: Appears as if the number of students in 2022 does not change from that in 2017. **[B1]** Improvement: Vertical axis to start from 0.	Accept other reasonable answers

[Total : 2m]

13	Price of 1 gallon in Singapore (in S$) $= 2.87 \times 3.78$ $= 10.86295$ **[M1]** Price of 1 gallon in Los Angeles (in S$) $= 8.57 \times 1.39$ $= 11.9123$ **[M1]** Petrol is cheaper in Singapore. **[A1]**	Accept comparison based on US$

[Total : 3m]

14	(a)	Let the diameter of the smaller tumbler by d. $\frac{28}{20} = \frac{9.8}{d}$ **[M1]** $d = 7$ cm **[A1]**	
	(b)	Let the capacity of the large tumbler be V. $\frac{V}{350} = (\frac{28}{20})^3$ **[M1]** $V = 960.4$ ml (exact) **[A1]**	S error if answer corrected to 3 s.f.

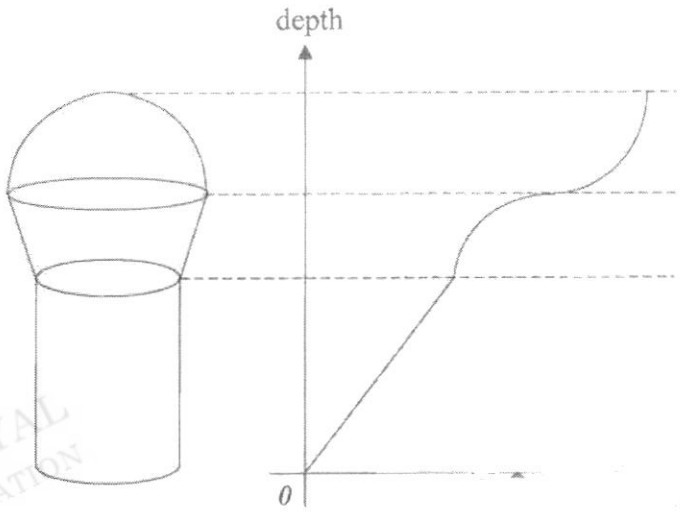
[Total : 4m]

15	$15x^2 + 8 = 22x$ $15x^2 - 22x + 8 = 0$ $(5x - 4)(3x - 2) = 0$ **[M1]** $x = \frac{4}{5}$ or $\frac{2}{3}$ **[A1-for both answers]**	

[Total : 2m]

16	(a)	$AC^2 = 5^2 + 12^2$ $AC = 13$ **[M1]** $\sin \angle ACB = \frac{5}{13}$ **[A1]**	
	(b)	$\cos \angle ACD = -\cos \angle ACB = -\frac{12}{13}$ **[B1]**	Accept -0.923 if found value of angle first (* this is not a recommended method)

[Total : 3m]

17			[**B1**-for each section correctly drawn]

[Total : 3m]

18	**(a)**	1: 50 000 1 cm : 0.5 km Length on map = $\frac{8}{0.5}$ = 16 cm **[B1]**	
	(b)	1 cm^2 : 0.25 km^2 **[M1]** Actual area = 0.25 × 14 = 3.5 km^2 **[A1]**	

[Total : 3m]

19	**(a)**	Refer to the diagram on the next page. [**B2**-all lengths and angles correctly drawn with vertices indicated accordingly]	[**B1**-if any one of the points is drawn wrongly]
	(b)	[**B1**-perpendicular bisector of AB] [**B1**-angle bisector of DAB] [**B1**-point M marked based on intersection between the two bisectors]	
	(c)	60 ($\pm$1) [**B1**]	No [**B1**] if (b) was wrong.

[Total : 6m]

20	3 units ------ 15 13 units ----- $\frac{13}{3} \times 15$ **[M1]** $= \$65$ **[A1]**	

[Total : 2m]

21	Let the angle be x. $\sin x = 0.5859$ $x = 35.866, 144.134$ $x = 35.9°, 144.1°$ **[B1, B1]**	

[Total : 2m]

22	Total amount $= (18 \times 5) \times 1.1 \times 1.07$ **[M1]** $= \$105.93$ (exact value) **[A1]**	

[Total : 2m]

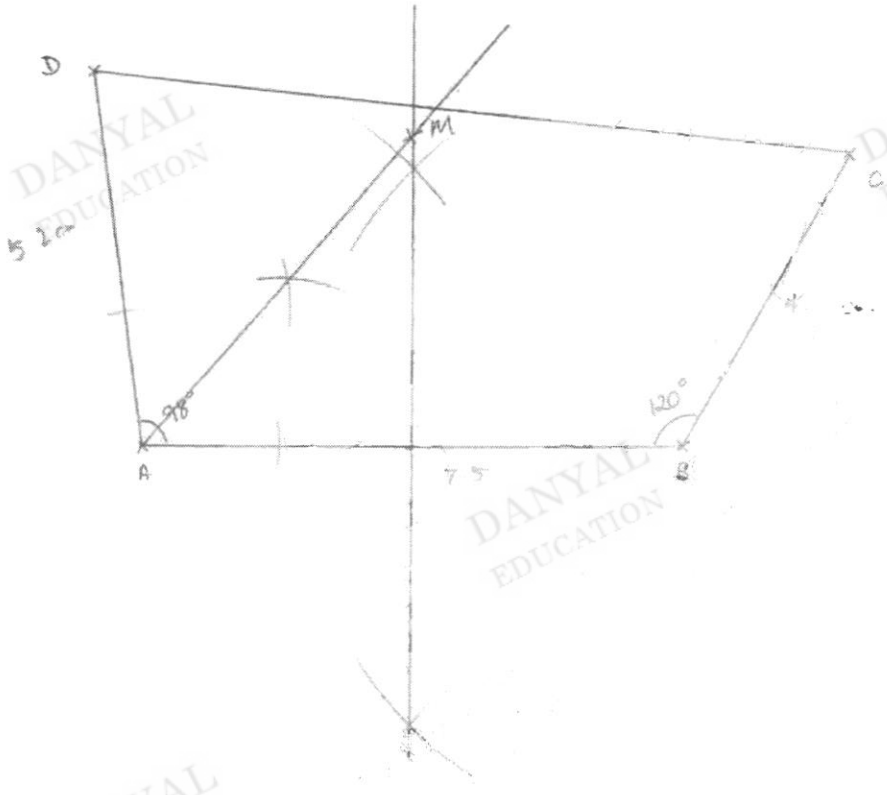
23	(a)	Portion that can be made based on quantity of carrots $= \frac{2900}{350}$ $= 8.2857$ **[M1]** Maximum number of people $= 8 \times 2 = 16$ **[A1]**	
	(b)	Quantity of vegetable stock needed for 8 portions $= 500 \times 8$ $= 4000$ ml **[M1]** Number of packets needed $= \frac{4000}{890}$ **[M1]** $= 4.494$ $= 5$ **[A1]**	FT marks based on value from (a)

[Total : 5m]

19 Tom wants to construct a scale drawing of quadrilateral $ABCD$ where $AB = 75\,\text{m}$, $BC = 46\,\text{m}$, $AD = 52\,\text{m}$, $\angle ABC = 120°$ and $\angle BAD = 98°$.

(a) Given that he uses a scale of 1 cm to represent 10 m, construct quadrilateral $ABCD$ in the space below.

Answer (a) and (b)



[2]

(b) The point M in quadrilateral $ABCD$ is such that it is equidistant from A and B and equidistant from AB and AD. By drawing appropriate bisectors, find and label point M. [3]

(c) Hence, find the actual distance from M to C.

Answer 60 ..... m [1]