Name:	Class: Sec _____	Index No.: _____

4E/5NA MERIDIAN SECONDARY SCHOOL PRELIMINARY EXAMINATION 2020

MATHEMATICS **Paper 1**

4048/01 31 August 2020

SECONDARY 4 EXPRESS / 5 NORMAL (ACADEMIC) **2 hours**

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
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.

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

Marks deducted for	
3 s.f. / 1 d.p.	
Inaccuracy	
Missing Geometrical Reason	
Total Deducted (Maximum 2)	

For Examiner's Use	
Score	

This question paper consists of **22** printed pages, including this page.

Setter: Mr Geoffrey Cheang

[Turn over

Mathematical Formulae

Compound Interest

$$\text{Total amount} = P(1+\frac{r}{100})^n$$

Mensuration

$$\text{Curved surface area of a cone} = \pi rl$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

$$\text{Volume of a cone} = \frac{1}{3}\pi r^2 h$$

$$\text{Volume of a sphere} = \frac{4}{3}\pi r^3$$

$$\text{Area of triangle } ABC = \frac{1}{2}ab\sin C$$

$$\text{Arc length} = r\theta, \text{ where } \theta \text{ is in radians}$$

$$\text{Sector area} = \frac{1}{2}r^2\theta, \text{ where } \theta \text{ is in radians}$$

Trigonometry

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc\cos A$$

Statistics

$$\text{Mean} = \frac{\Sigma fx}{\Sigma f}$$

$$\text{Standard Deviation} = \sqrt{\frac{\Sigma fx^2}{\Sigma f} - \left(\frac{\Sigma fx}{\Sigma f}\right)^2}$$

Answer **all** the questions.

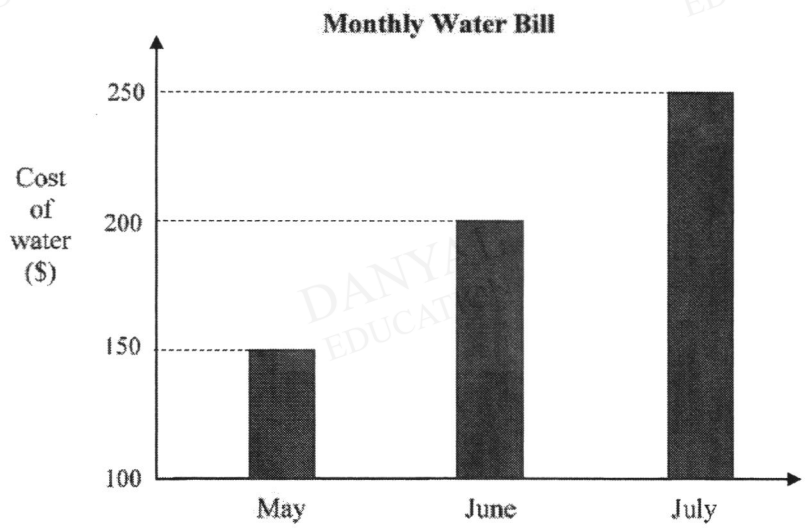
1 Calculate $\dfrac{11.27^{\frac{1}{4}}}{30.67-(5.23)^2}$.

Write your answer correct to 4 significant figures.

Answer ..... [1]

---

2 Kiegen draws this graph to show his monthly water bill for each of the last three months.



State one aspect of the graph that may be misleading and explain how this may lead to a misinterpretation of the graph.

.....

.....

..... [1]

---

3 Given that $7^{2x+1} \times \frac{1}{49} = 1$, find x.

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

---

4 **(a)** Express 3024 as a product of its prime factors.

Answer ..... [1]

(b) Hence, find the smallest positive integer m such that $\frac{3024}{m}$ is a cube number.

Answer ..... [1]

---

5 Employees of a company are offered a salary increase based on one of the schemes:

Scheme A: An increase of 12% of their present salary.

Scheme B: An increase of \$90 plus 10% of their present salary.

Gwendolyn finds that both schemes will give her the same salary increase. Given that Gwendolyn's present salary is \$$x$, form an equation in terms of x and hence find her present salary.

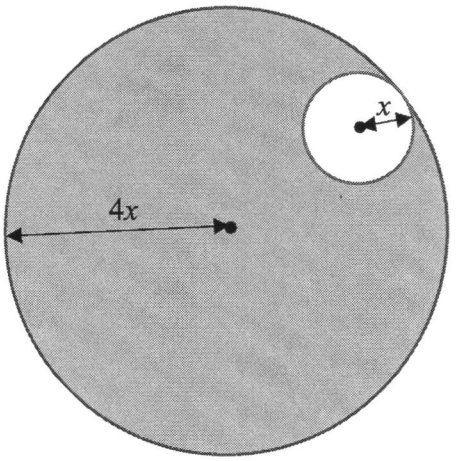
Answer \$..... [2]

---

6 Express $\frac{x}{2x-1}-\frac{3}{x+1}$ as a single fraction in its simplest form.

Answer ..... [2]

7



The diagram shows two circles with radii x and $4x$.
A point is chosen, at random, inside the larger circle.
Find, in its simplest fractional form, the probability that this point is in the shaded area.

Answer ..... [2]

8 x is directly proportional to y^2.
y is decreased by 40%.
Find the percentage decrease in x.

Answer ..... [2]

9 Solve the equation $2x^2 - 11x = 21$.

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

---

10 **(a)** Solve the inequalities $-3 < \frac{1}{2}x - 5 \leq \frac{2}{3}$.

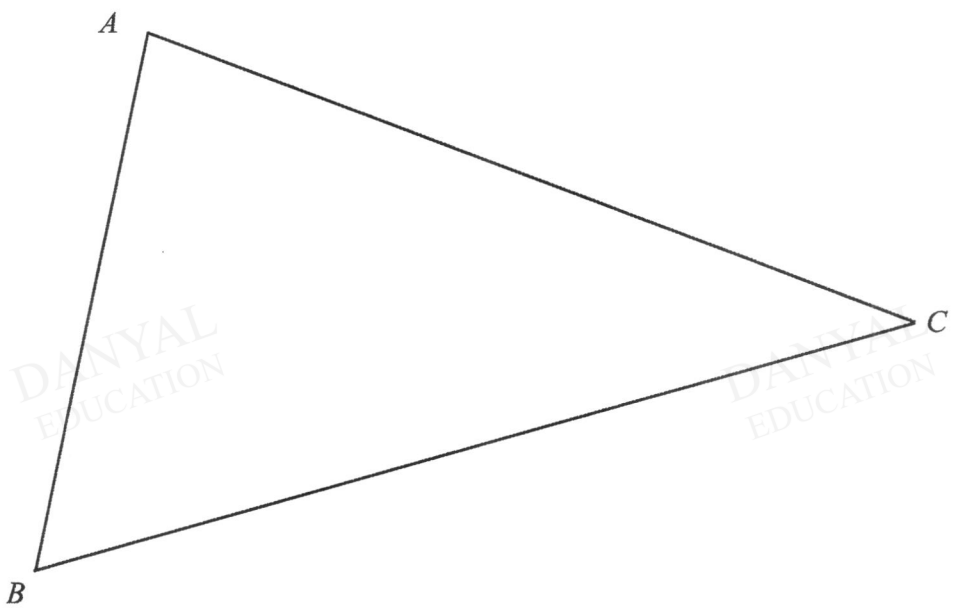
Answer ..... [2]

(b) Write down all the prime numbers which satisfy $-3 < \frac{1}{2}x - 5 \leq \frac{2}{3}$.

Answer ..... [1]

---

11 The diagram shows a triangle ABC.



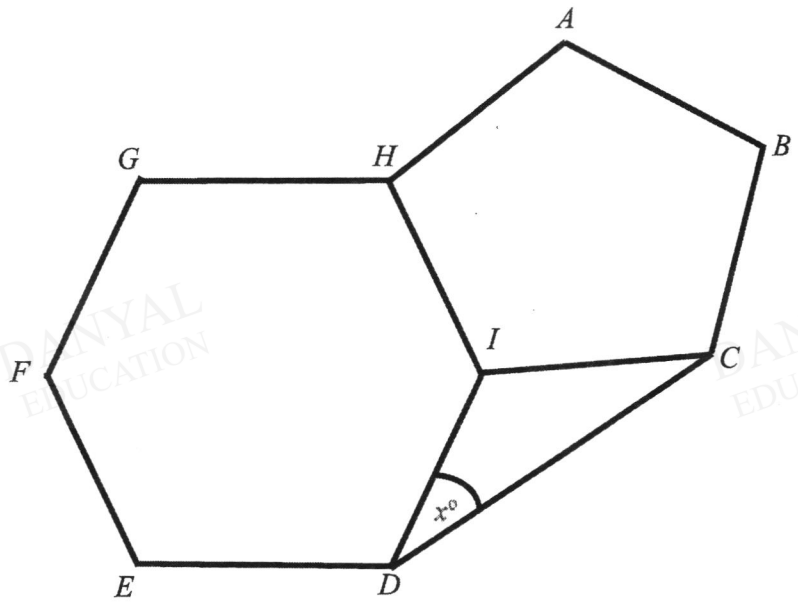
(a) On the diagram, construct

(i) the bisector of angle ABC, [1]

(ii) the perpendicular bisector of BC, [1]

(b) Mark clearly a possible point which is inside the triangle, equidistant from B and C, and is nearer to AB than BC. Label this point X. [1]

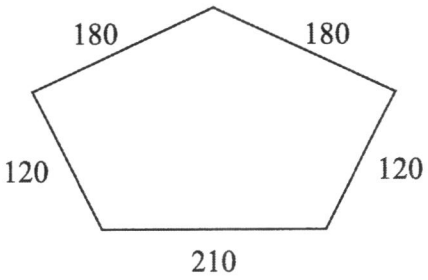
12 The diagram shows a regular pentagon *ABCIH*, a regular hexagon *DEFGHI* and a triangle *CDI*.



Find x.
Give a reason for each statement you make.

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

13



The diagram shows a pond in the shape of a pentagon.
The measurements given are in metres and the diagram is not drawn to scale.

Lamp posts are to be constructed around the perimeter of the pond with the following requirements:

- The lamp posts are to be equally spaced from each other.
- One lamp post must be constructed at each vertex of the pentagon.
- Minimum number of lamp posts are to be constructed to save cost.

Find

(a) the distance between any two lamp posts.

Answer .....m [1]

(b) the number of lamp posts to be constructed.

Answer ..... lamp posts [2]

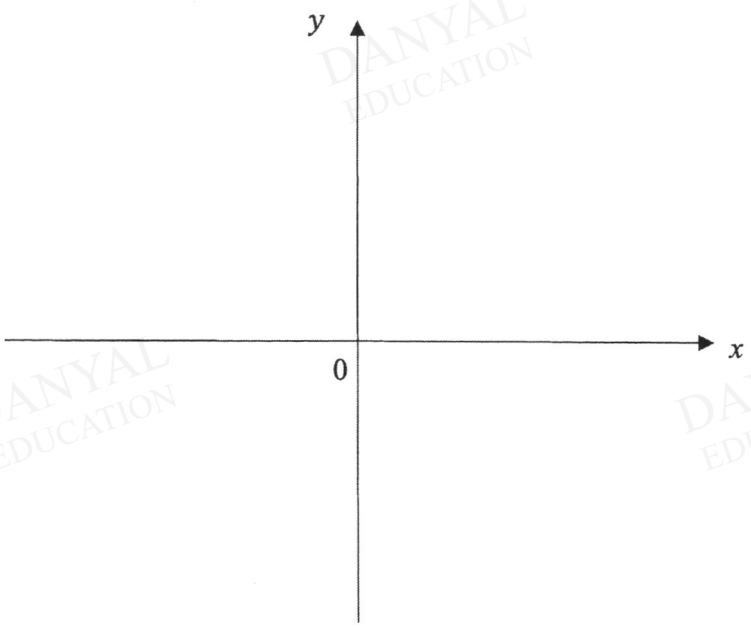
14 The ratio of the breadth to the length of a rectangle is 1 : 2. If the breadth is reduced by 50% and the length is increased by 25%, calculate the new area as a percentage of the original area of the rectangle.

Answer .....% [3]

---

15 **(a)** Sketch the graph of $y=(x-3)(x+2)$ on the axis below.

Indicate clearly the coordinates of the points where the graph crosses the axes and the minimum point on the curve.



[2]

(b) Write down the equation of the line of symmetry of the graph.

Answer ..... [1]

---

16 The matrices below show the results of 14 games played by two floorball teams and the points awarded.

$$\begin{array}{c} \\ \text{Courage} \\ \text{Diligence} \end{array} \begin{array}{c} \begin{array}{ccc} \text{Won} & \text{Drawn} & \text{Lost} \end{array} \\ \begin{pmatrix} 7 & 4 & 3 \\ 6 & 5 & 3 \end{pmatrix} \end{array} \qquad \begin{array}{c} \text{Points} \\ \begin{array}{l} \text{Won} \\ \text{Drawn} \\ \text{Lost} \end{array} \begin{pmatrix} 3 \\ 1 \\ 0 \end{pmatrix} \end{array}$$

(a) Find $\begin{pmatrix} 7 & 4 & 3 \\ 6 & 5 & 3 \end{pmatrix}\begin{pmatrix} 3 \\ 1 \\ 0 \end{pmatrix}$.

Answer ..... [2]

(b) Explain what your answer to **(a)** represents.

.....

.....

..... [1]

---

17 **(a)** Factorise $5x^2 - 20y^2$ completely.

Answer ..... [2]

(b) Factorise completely $6ap + 9aq - 6bq - 4bp$.

Answer ..... [2]

---

18 A map is drawn to a scale of 1 : 2 500 000.

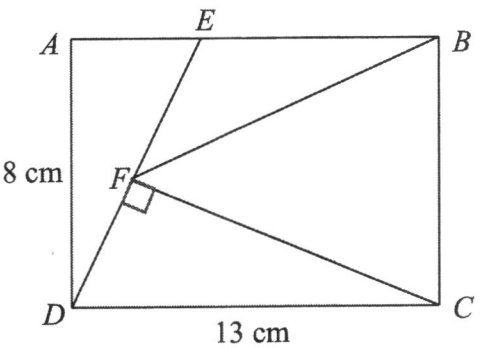
(a) The length of the longest highway on the map is 16.8 cm.
Find the actual distance, in kilometres, of this highway.

Answer ..... km [1]

(b) A country has an actual area of 102 020 km^2.
Find the area, in square centimetres, of that country on the map.

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

19



In the diagram, $ABCD$ is a rectangle, DFE is a straight line and E lies on AB.
FC is perpendicular to DE at F.
$DE = DC = 13$ cm and $FC = AD = 8$ cm.

(a) Show that triangle DAE and triangle CFD are congruent.
Give a reason for each statement you make.

Answer

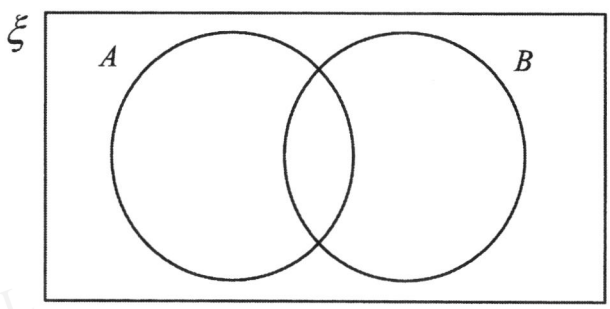
[2]

(b) Find the area of $BCFE$.

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

20 **(a)** On the Venn Diagram shown in the answer space, shade the set $(A \cap B')'$.

Answer



[1]

(b) ξ = {students in a school}
A = {male students}
B = {students who wear spectacles}
C = {students who walk to school}

Express male students who do not wear spectacles and walk to school in set notation.

Answer ..... [1]

(c) $\xi = \{x : x \text{ is an integer and } 12 < x \leq 21\}$
$P = \{x : x \text{ is a prime number}\}$
$Q = \{x : x \text{ is divisible by } 7\}$

Find

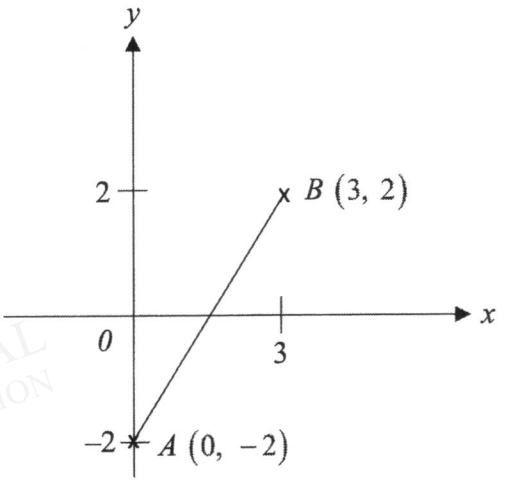
(i) $P \cup Q$,

Answer ..... [1]

(ii) P'.

Answer ..... [1]

21 Point A has coordinates $(0, -2)$. Point B has coordinates $(3, 2)$.



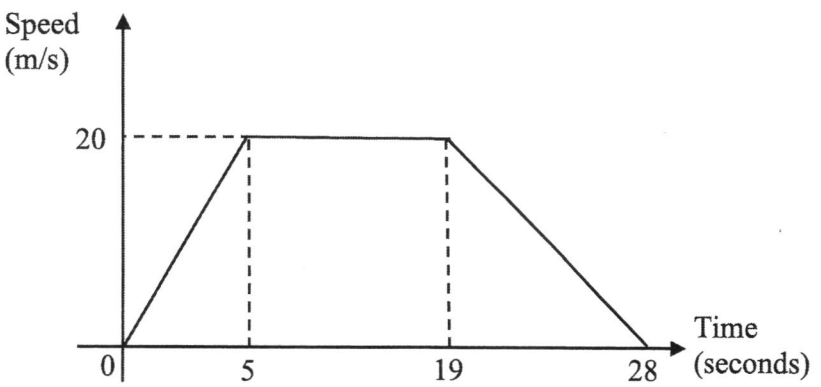
(a) Find the equation of the line AB.

Answer ..... [2]

(b) Calculate the length of the line segment AB.

Answer .....units [2]

22



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

(a) How long was the car travelling at zero acceleration?

Answer ..... s [1]

(b) Find the speed of the car at 4 seconds.

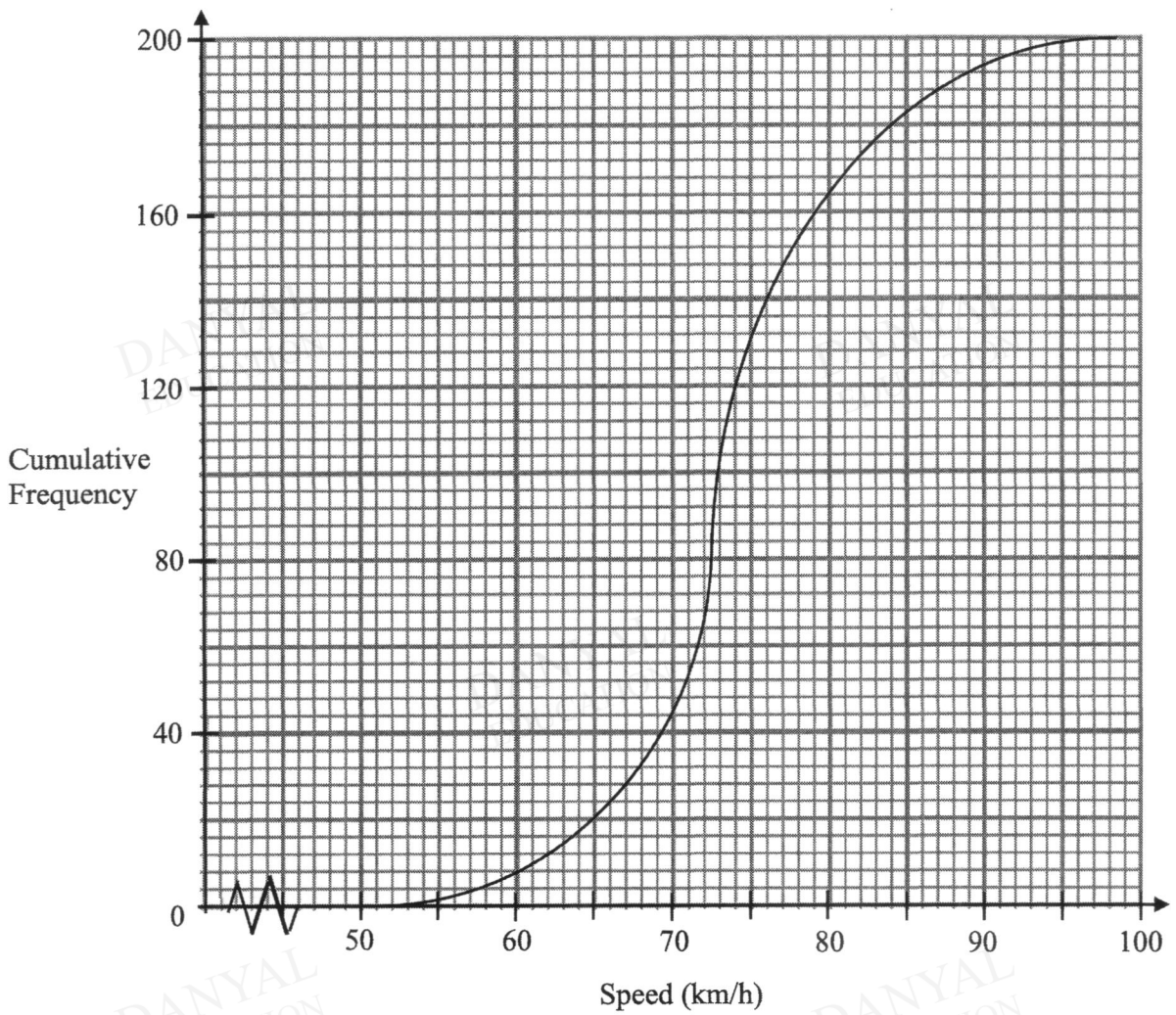
Answer ..... m/s [2]

(c) The speed limit of the road at which the car was travelling was **70 km/h**.
Show, with working, whether the car exceeded the speed limit.

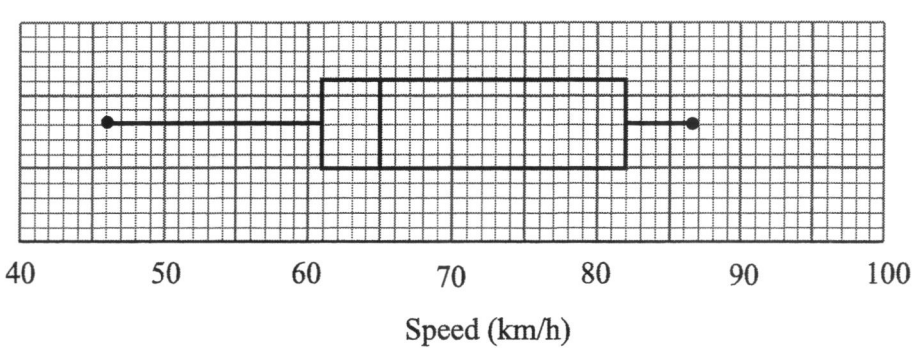
Answer

[2]

23 The cumulative frequency graph shows the distribution of the speed of 200 cars on a particular morning.



This box-and-whisker plot represents the distribution of the speed of another 200 cars on the same day in the evening.



(a) Use the two diagrams to complete this table for the speed of cars in the morning and evening.

Time	Lower Quartile	Median	Upper Quartile	Interquartile Range
Morning	70.5			
Evening		65	82	21

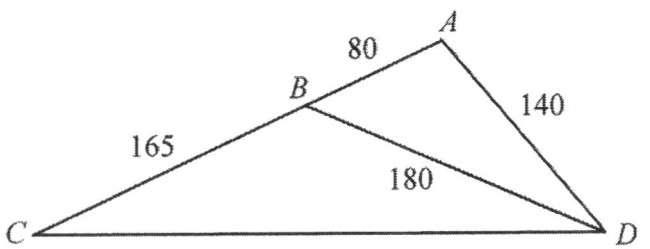
[2]

(b) The speed limit on this road is 80 km/h.
Below are two statements comparing the speeds in the morning and evening.
For each one, write whether you agree or disagree, giving a reason for your answer.

Statement 1: The cars are traveling at a more consistent speed in the evening than in the morning.
Agree/Disagree:
Reason:
Statement 2: There is a higher chance that a car can be issued with a fine for speeding in the morning than in the evening.
Agree/Disagree:
Reason:

[3]

24 ABD is a triangle where $AB = 80$ cm, $AD = 140$ cm, and $BD = 180$ cm.
AB is produced to C and $BC = 165$ cm.



(a) Show that triangle ACD is similar to triangle ADB.
Answer

[2]

(b) Calculate the length CD.

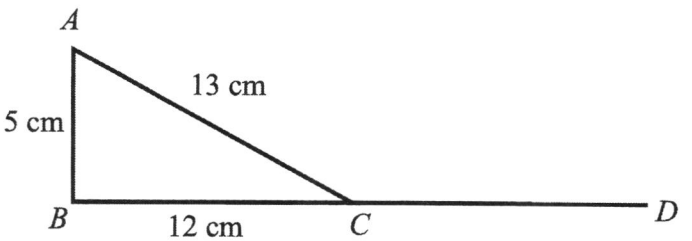
Answer .....cm [1]

(c) Calculate angle BAD.

Answer ..... [3]

25 **(a)** ABC is a triangle and B, C and D forms a straight line.

$AB = 5$ cm, $BC = 12$ cm and $AC = 13$ cm.



(i) Show that ABC is a right-angled triangle.

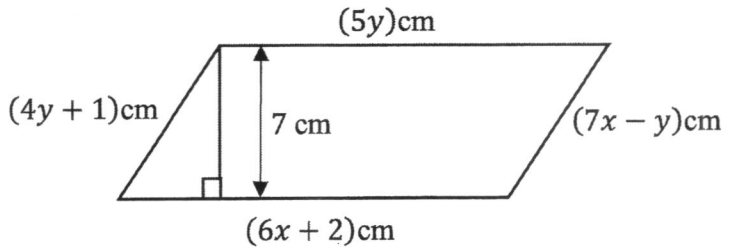
Answer

[2]

(ii) Find $\sin \angle ACD$.

Answer ..... [1]

(b)



The diagram shows a parallelogram.

(i) Form two different equations involving x and y.

Answer ..... [1]

..... [1]

(ii) Find the values of x and y by solving the equations in **(b)(i)** simultaneously.

Answer x =..... [1]

y =..... [1]

END OF PAPER 1

Name:	Class: Sec _____	Index No.: _____

4E/5NA

MERIDIAN SECONDARY SCHOOL PRELIMINARY EXAMINATION 2020

MATHEMATICS **Paper 2**

4048/02

1 September 2020

SECONDARY 4 EXPRESS / 5 NORMAL (ACADEMIC) **2 hours 30 minutes**

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

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For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is **100**.

Marks deducted for	
3 s.f. / 1 d.p.	
Inaccuracy	
Missing Geometrical Reason	
Total Deducted (Maximum 2)	

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$$\text{Area of triangle } ABC = \frac{1}{2}ab\sin C$$

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Statistics

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$$\text{Standard Deviation} = \sqrt{\frac{\Sigma fx^2}{\Sigma f} - \left(\frac{\Sigma fx}{\Sigma f}\right)^2}$$

1 **(a)** Express $x^2 - 4x - 1$ in the form $(x+a)^2 + b$.

Answer ..... [2]

(b) $m = \sqrt[3]{\frac{y}{a} - b^2}$

(i) Evaluate m when $a = 2$, $b = -3$ and $y = 7$.

Answer m = ... [1]

(ii) Express y in terms of a, b and m.

Answer ..... [2]

(c) Solve $\frac{5}{x+3} - \frac{2}{x-2} = 4$.

Answer x = ... or ..... [4]

(d) It is given that $\frac{5x}{2y+x} = \frac{4}{7}$.

Find the value of $\frac{x}{y}$.

Answer ..... [2]

2 **(a)** Genevieve invests \$58 000 in a 5-year savings plan with an interest rate of 3% per annum compounded every 6 months.
Calculate the total interest she will receive at the end of 5 years.

Answer \$..... [3]

(b) In January 2020, Singapore's estimated total retail sales were valued at \$4.1 billion.
(1 billion = 1×10^9)

(i) Calculate the estimated total retail sales for January 2019 given that there was a decrease of 2.4% in January 2020.

Answer \$..... [2]

(ii) Online retail sales in January 2020 was valued at \$0.24 billion.

(a) Write \$0.24 billion in standard form.

Answer \$..... [1]

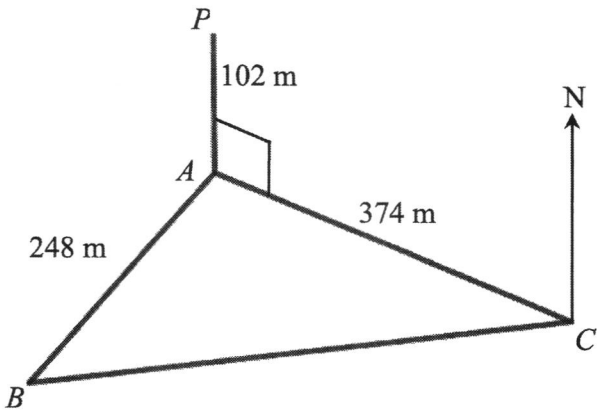
(b) Calculate the online retail sales as a percentage of total retail sales in January 2020.

Answer ..... % [1]

(c) Liyana went to Europe for a holiday and bought a bag for 945 Euros. She then sold the bag to her friend at a profit of 12%.
The rate of exchange between Singapore dollars (SGD) and Euro (€) was SGD 1 = 0.63€.
Calculate the price she sold the bag to her friend in Singapore dollars (SGD).

Answer SGD..... [3]

3



The diagram shows an airport control tower AP of vertical height 102 m.
A, B and C are points on level ground where the bearing of B from C is $267.8°$, the bearing of A from C is $293°$, $AB = 248$ m and $AC = 374$ m.

(a) Show that angle $ACB = 25.2°$.

Answer

[1]

(b) Calculate angle ABC.

Answer ..... [2]

(c) Find the area of triangle ABC.

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

(d) A ground handling staff, M, walks in a straight line from B to C.

(i) Show that the shortest distance of M from A is 159.24 m correct to 5 significant figures.

Answer

[2]

(ii) Hence, find the greatest angle of elevation of P from M.

Answer ..... [2]

4 The first four terms in a sequence of numbers are given below.

$$T_1 = 6+(1-2)^2-2=5$$

$$T_2 = 6+(2-2)^2-4=2$$

$$T_3 = 6+(3-2)^2-6=1$$

$$T_4 = 6+(4-2)^2-8=2$$

(a) Find T_6.

Answer ..... [1]

(b) Show that the n^{th} term of the sequence, T_n, is given by $n^2-6n+10$.

Answer

[2]

(c) T_k and T_{3k} are terms in the sequence.

It is given that $\frac{T_{3k}}{T_k}=17$.

Show that this equation simplifies to

$$2k^2-21k+40=0.$$

Answer

[3]

(d) Solve $2k^2 - 21k + 40 = 0$.

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

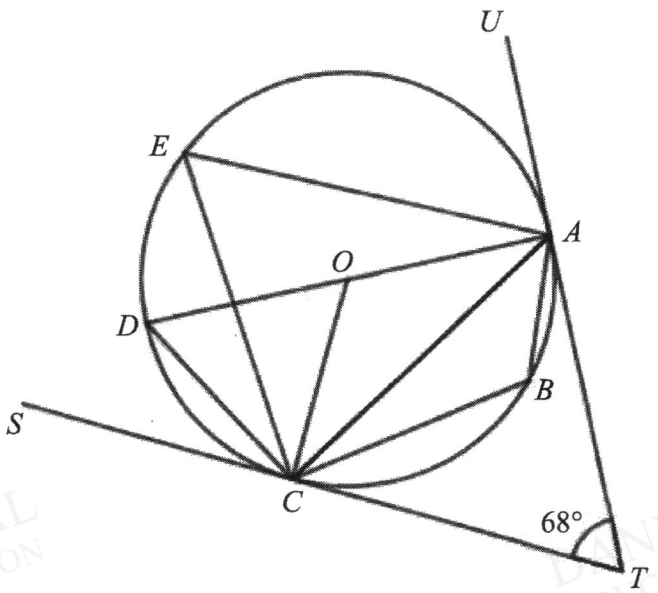
(e) Explain why one of the solutions in part **(d)** must be rejected as the position of T_k in the sequence.

Answer .....

.....

..... [1]

5



A, B, C, D and E are points on the circle, centre O.
AD is the diameter of the circle.
TCS and TAU are tangents to the circle.
Angle $ATC = 68°$.

(a) Find, giving reasons for each answer,

(i) angle CAT,

Answer ..... [1]

(ii) angle AOC,

Answer ..... [1]

(iii) angle AEC,

Answer ..... [1]

(iv) angle ABC,

Answer ..... [1]

(v) angle DCS,

Answer ..... [2]

(vi) the radius of the circle given that $AT = 10$ cm.

Answer ..... cm [2]

(b) Can A, O, C and T be points lying on another circle?
Justify your answer.

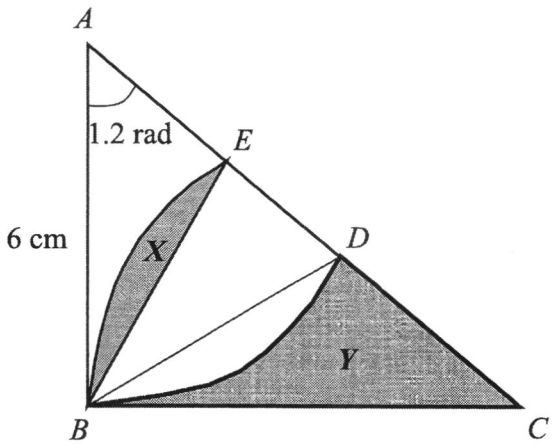
Answer .....

.....

.....

..... [1]

6



ABC is a right-angled triangle.
ABD is a sector of a circle of radius 6 cm with centre *A*.
CBE is a sector of another circle with centre *C*.
Angle *BAC* = 1.2 radians.

Find

(a) the length of arc *BD*,

Answer ..... cm [1]

(b) the length of *BC*,

Answer ..... cm [1]

(c) the perimeter of the shaded region *Y*,

Answer ..... cm [2]

(d) the area of the shaded region X,

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

(e) the area of the shaded region Y.

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

7 The variables x and y are connected by the equation $y = 2x - 7 + \frac{8}{x}$.

Some corresponding values of x and y are given in the table below.

x	1	1.5	2	2.5	3	3.5	4	5	6
y	3	1.3	1	p	1.7	2.3	3	4.6	6.3

(a) Find the value of p.

Answer p = ... [1]

(b) On the grid given, draw the graph of $y = 2x - 7 + \frac{8}{x}$ for $1 \leq x \leq 6$. [2]

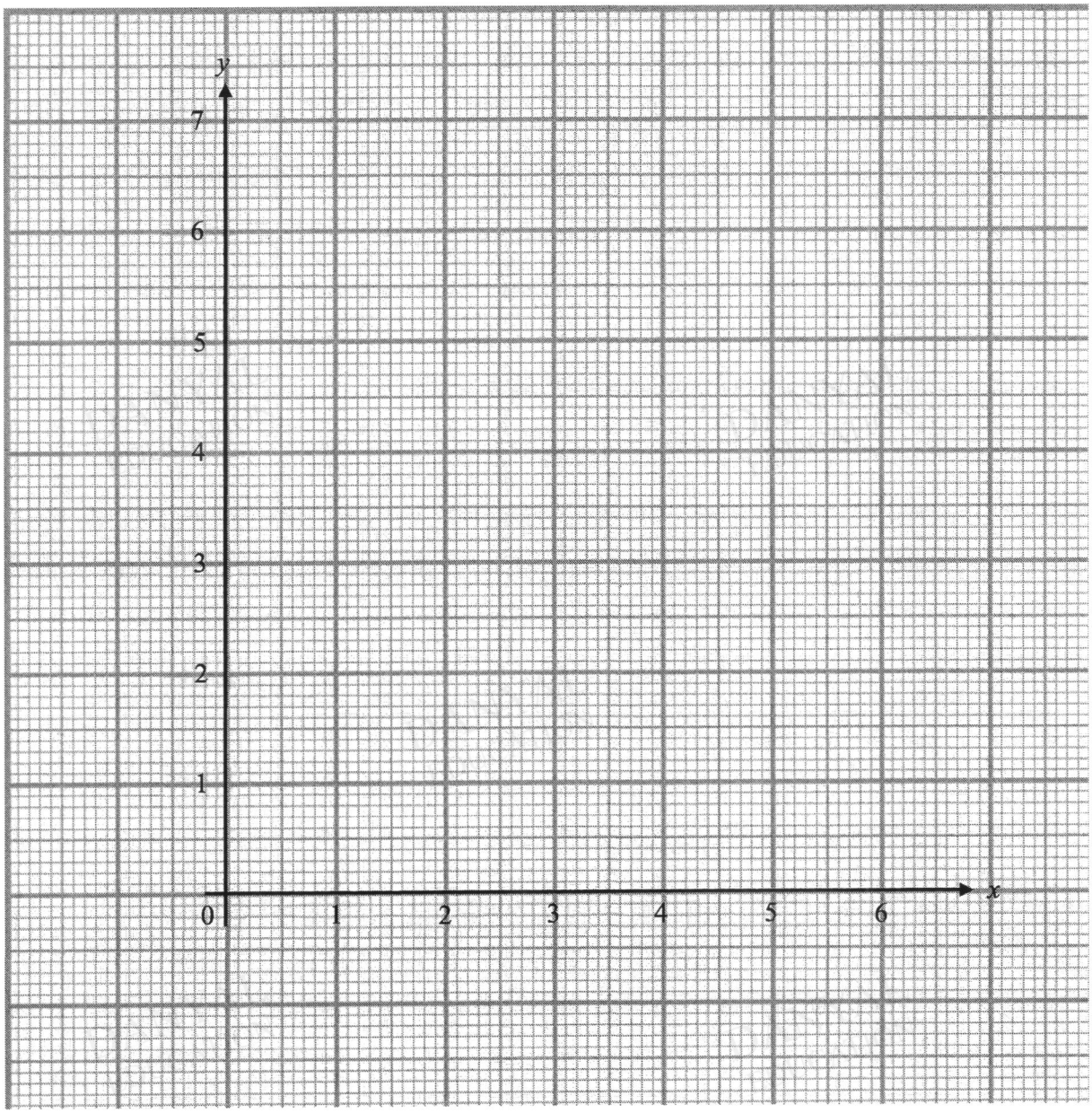
(c) Use your graph to find the solution of $2x - 7 + \frac{8}{x} = 5$.

Answer x = ... [1]

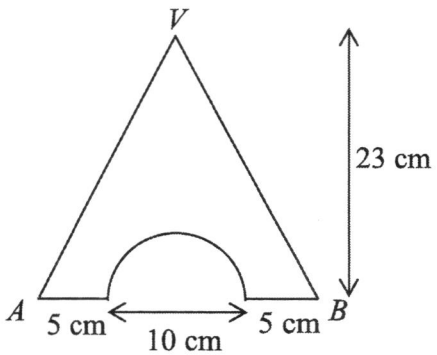
(d) By drawing a tangent, find the gradient of the curve at the point (3, 1.7). [2]

(e) By drawing a suitable line, find the solution(s) of the equation $\frac{8}{x} = 12 - 3x$.

Answer x = ... [3]


y
7
6
5
4
3
2
1
0
1
2
3
4
5
6
x

8



A solid is made up of a cone of base diameter 20 cm and height 23 cm, with a solid hemisphere of diameter 10 cm removed from it.
The diagram shows the cross-section of the solid.

(a) Calculate the volume of the solid.

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

(b) Calculate the length of VA.

Answer ..... cm [1]

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

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

(d) The solid is melt down to form small solid cylinders of radius 1.2 cm and height 2.5 cm.
Calculate the maximum number of small solid cylinders that can be made.

Answer ..... [3]

9 **(a)** The waiting times, in minutes, of 50 clients from two bank branches are given as follows:

Branch *A*

Time (t mins)	$10 < t \leq 12$	$12 < t \leq 14$	$14 < t \leq 16$	$16 < t \leq 18$	$18 < t \leq 20$
Number of clients	5	23	8	10	4

Branch *B*

Mean = 10.2 mins	Standard deviation = 1.48 mins

(i) For Branch *A*, calculate an estimate of

(a) the mean,

Answer ..... [1]

(b) the standard deviation.

Answer ..... [2]

(ii) Explain why the mean calculated in **(i)(a)** is an estimated value.

Answer .....

.....

..... [1]

(iii) Based on the information above, which branch will you choose?
Justify your decision with reasons.

Answer .....

.....

..... [2]

(b) A box of cupcakes contains 5 chocolate, 4 vanilla and 3 raspberry cupcakes.
Anthony takes a cupcake, at random, from the box. Brenda then takes another cupcake, at random, from the box.

(i) Draw a tree diagram to show the probabilities of the possible outcomes.

Answer

[2]

(ii) Find, as a fraction in its simplest form, the probability that

(a) Anthony and Brenda both choose a vanilla cupcake,

Answer ..... [1]

(b) Brenda chooses a raspberry cupcake.

Answer ..... [2]

10 Megan would like to buy an air conditioner for her home.

(a) She recorded how long she would use the air conditioner in the following table.

Monday and Friday	6 hours each day
Tuesday to Thursday	7 hours 15 minutes each day
Saturday and Sunday	9 hours each day

Find the mean length of time that she would use the air conditioner each day.

Answer ..... hours [1]

Megan is deciding between two models of air conditioner.
The table below shows information that she needs, including the annual electricity consumption of the two models.

Residential Air Conditioners

	Model S (Standard)	**Model E** (Energy efficient)
Price of air conditioner	$962	$1 294
Electricity consumption in one year	1 390 kWh	847 kWh

Notes:
- Prices include GST
- Electricity consumption is computed based on 8 hours of use each day

(b) Based on her usage, Megan estimates that the electricity consumptions in 1 year will be 1284.5 kWh for Model S and 782.7 kWh for Model E.

Explain how she found these estimates.

Answer

[2]

Service Contracts

Frequency	Price per service before 7% GST
1 service every 2 months	$25
1 service every 3 months	$30
1 service every 4 months	$35

Offer: **30% discount on service contract** with purchase of Model S

(c) The total cost of an air conditioner includes its price, the cost of the electricity it consumes and the cost of servicing it.

Electricity costs 20.97 cents per kWh, including GST.
Megan would like the air conditioner to be serviced once every 3 months.

Based on her usage, which model will have a lower total cost after 5 years of use?
Justify your decision with calculations.
(You should assume that the costs of electricity and servicing remain the same.)

Answer

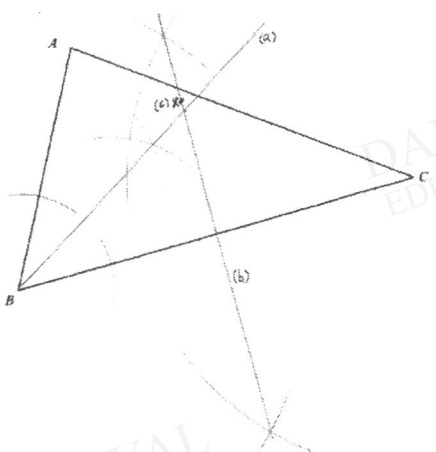
[7]

END OF PAPER 2

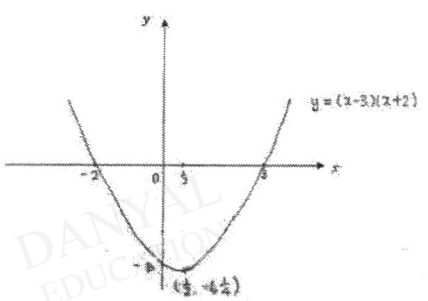
4E/5NA Mathematics Preliminary Examination Paper 1 (2020)
Marking Scheme

Qn. No.	Answer	Marking Point	Marks	Remarks
1	0.5524	B1	1	
2	The vertical axis did not start from zero giving an impression that the cost of water in June was twice of that in May but the actual data for June is 1.3 times of May.	B1	1	B0 if no explanation is seen in the answer.
3	$7^{2x+1}\times\frac{1}{49}=1$ $7^{2x+1}\times\frac{1}{7^2}=7^0$ $7^{2x-1}=7^0$ $\Rightarrow 2x-1=0$ $x=\frac{1}{2}$	M1 A1	2	M1 awarded if 7^0 and 7^2 is seen. Accept $x=0.5$.
4(a)	$2^4\times3^3\times7$	B1	2	
(b)	$m=14$	B1		
5	$1.12x=1.1x+90$ $x=\$4500$	B1 A1	2	Accept alternative equation: $0.12x=0.1x+90$
6	$=\frac{x(x+1)-3(2x-1)}{(2x-1)(x+1)}$ $=\frac{x^2+x-6x+3}{(2x-1)(x+1)}$ $=\frac{x^2-5x+3}{(2x-1)(x+1)}$	M1 A1	2	M1 awarded for combining into a single fraction
7	P(shaded area) $=\frac{\pi(4x)^2-\pi x^2}{\pi(4x)^2}$ $=\frac{15\pi x^2}{16\pi x^2}=\frac{15}{16}$	M1 A1	2	
8	$x=ky^2$ $x_N=k(0.6y)^2$ $=0.36ky^2$ % decr $=\frac{ky^2-0.36ky^2}{ky^2}\times100\%$ $=64\%$	 M1 A1	2	***Accept alternative methods***. Eg. Assume $k=1$ y x Original 1 1 New 0.6 0.36 % decr. $=\frac{1-0.36}{1}\times100\%$ $=64\%$

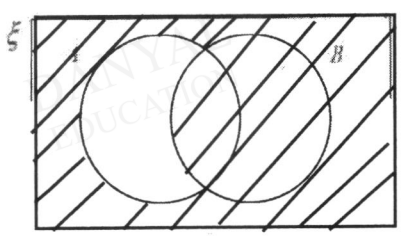
4E/5NA Mathematics Preliminary Examination Paper 1 (2020)
Marking Scheme

Qn. No.	Answer	Marking Point	Marks	Remarks
9	$2x^2-11x-21=0$ $(2x+3)(x-7)=0$ $x=-1\frac{1}{2}$ or $x=7$	M1 B1, B1	3	M1 for correct factorisation. Award M0 if $(x+1.5)(x-7)=0$ is seen.
10(a)	$-3<\frac{1}{2}x-5$ or $\frac{1}{2}x-5\le\frac{2}{3}$ $x>4$ or $x\le11\frac{1}{3}$ $4<x\le11\frac{1}{3}$	 M1 A1	3	Alternative method: $2<\frac{1}{2}x\le5\frac{2}{3}$ M1 $4<x\le11\frac{1}{3}$ A1
(b)	5, 7, 11	B1		
11			3	For construction of angle bisector and perpendicular bisector, construction lines must be seen. B1: bisector of angle ABC B1: perpendicular bisector of AB B1: marking point X in the correct region.
12	$\angle CIH=\frac{(5-2)\times180^\circ}{5}$ $=108^\circ$ $\angle DIH=\frac{(6-2)\times180^\circ}{6}$ $=120^\circ$ $\angle CID=360^\circ-108^\circ-120^\circ$ (Angles at a pt.) $=132^\circ$ $x=\frac{180-132}{2}$ (base $\angle$, isos Δ) $=24$	 M1 M1 A1	3	M1 awarded for finding either $\angle CIH$ or $\angle DIH$ correctly. M1 awarded for finding $\angle CID$. Penalise 1 mark for absence of geometric reason.

4E/5NA Mathematics Preliminary Examination Paper 1 (2020)
Marking Scheme

Qn. No.	Answer	Marking Point	Marks	Remarks
13(a)	$120 = 2^3 \times 3 \times 5$ $180 = 2^2 \times 3^2 \times 5$ $210 = 2 \times 3 \times 5 \times 7$ HCF $= 2 \times 3 \times 5$ $= 30$	 A1	3	
(b)	No. of lamp post $= 2 \times \frac{180}{30} + 2 \times \frac{120}{30} + \frac{210}{30}$ $= 27$	M1, 0 A1		
14	Let x be the breadth. Then the length will be $2x$. Original Area $= 2x^2$ New Area $= (0.5x)(1.25(2x))$ $= 1.25x^2$ $\% = \frac{1.25x^2}{2x^2} \times 100\%$ $= 62.5\%$	 M1 M1 A1	3	
15(a)			3	B1: correct x-intercepts, y-intercept B1: correct turning point and shape.
(b)	$x = \frac{1}{2}$	B1		
16(a)	$\begin{pmatrix} 25 \\ 23 \end{pmatrix}$	M1, A1	3	
(b)	The elements in the matrix represents the total points obtained by the teams respectively. Courage obtained 25 points while Diligence obtained 23 points.	B1		

4E/5NA Mathematics Preliminary Examination Paper 1 (2020)
Marking Scheme

Qn. No.	Answer	Marking Point	Marks	Remarks
17(a)	$=5(x^2-4y^2)$ $=5(x+2y)(x-2y)$	B1 B1	4	
(b)	$=3a(2p+3q)-2b(3q+2p)$ $=(3a-2b)(2p+3q)$	M1 A1		
18(a)	1 cm rep. 25 km 16.8 cm → $16.8\times25=420$ km	A1	3	
(b)	1 cm^2 → 625 km^2 Area on map $=\dfrac{102020}{625}$ $=163.232$ cm^2	M1 A1		Award A0 if answer given is rounded to163 cm^2. The answer is an exact value.
19(a)	$\angle DAE=\angle CFD=90°$ (given) $DE=CD=13$ cm (given) $AD=FC=8$ cm (given) $\therefore\ \Delta DAE\equiv\Delta CFD$ (RHS)	B2, 1, 0	4	
(b)	$AE^2=13^2-8^2=105$ $AE=\sqrt{105}$ Area of $BCFE$ $=8\times13-2\left(\dfrac{1}{2}\times\sqrt{105}\times8\right)$ $=22.0243\ldots$ ≈ 22.0 cm^2 (3 s.f.)	M1 A1		M1 for area of triangle.
20(a)		B1	4	
(b)	$A\cap B'\cap C$	B1		
(c)(i)	{13, 14, 17, 19, 21}	A1		
(c)(ii)	{14, 15, 16, 18, 20, 21}	B1, 0		
21(a)	$m=\dfrac{2-(-2)}{3-0}$ $=\dfrac{4}{3}$	M1	4	

4E/5NA Mathematics Preliminary Examination Paper 1 (2020)
Marking Scheme

Qn. No.	Answer	Marking Point	Marks	Remarks
	$y=-2$ is the y-intercept. $y=\frac{4}{3}x-2$	 A1		
(b)	$AB=\sqrt{(3-0)^2+(2-(-2))^2}$ $=5$ units	M1 A1		
22(a)	14	B1		
(b)	$\frac{v}{20}=\frac{4}{5}$ $v=16$	M1 A1		
(c)	$20\text{ m/s}=\frac{\frac{20}{1000}\text{ km}}{\frac{1}{3600}\text{ h}}$ $=72$ km/h Hence, the car exceeded the speed limit between 5 and 19 s when travelling at maximum speed.	M1 B1	5	***Alternative solution:*** $70\text{ km/h}=\frac{70000}{3600}\text{ m/s}$ $=19\frac{4}{9}\text{ m/s}$ $\therefore$ exceeded between 5 and 19 s since the car's maximum speed is 20 m/s.
23(a)	Morning: 73; 77.5; 7 Evening: 61	B2, 1, 0		
(b)	Statement 1 Disagree. IQR in the morning was smaller than the IQR in the evening suggesting that the speed of the cars were more consistent in the morning. Statement 2 Disagree. The Upper Quartile for the morning was 77.5 km/h suggesting that less than 25% of cars were over the speed limit. In the evening it was 82 km/h, suggesting that more than 25% of cars were over the speed limit.	B1 B1 B1	5	***Alternative solution:*** $\text{Morning}=\frac{200-164}{200}\times 100\%$ $=18\%$ $\therefore$ 18% exceeded the speed limit. Award B2.
24(a)	$\frac{AC}{AD}=\frac{245}{140}=\frac{7}{4}$	B2, 1, 0	6	Deduct 1 mark if no reason is seen.

4E/5NA Mathematics Preliminary Examination Paper 1 (2020)
Marking Scheme

Qn. No.	Answer	Marking Point	Marks	Remarks
	$\frac{AD}{AB}=\frac{140}{80}=\frac{7}{4}$ $\angle CAD=\angle DAB$ (common $\angle$) $\therefore \Delta ACD$ is similar to ΔADB. (SAS Similarity)			
(b)	$\frac{CD}{180}=\frac{140}{80}$ $CD=315$	A1		
(c)	$\cos\angle BAD=\frac{80^2+140^2-180^2}{2(80)(140)}=-\frac{2}{7}$ $\angle BAD \approx 106.6°$ (1 d.p.)	M2 A1		
25(a)(i)	$AB^2+BC^2=5^2+12^2$ $=169=13^2$ $=AC^2$ By the converse of Pythagoras' Theorem, triangle ABC is a right-angled triangle with $\angle ABC=90°$.	M1 B1	7	Award M0 B0 if students start with using Pythagoras' Theorem.
(a)(ii)	$\frac{5}{13}$	B1		
(b)(i)	$5y=6x+2$ $4y+1=7x-y$ $5y=7x-1$	B1 B1		B1 awarded for unsimplified expression.
(b)(ii)	$7x-1=6x+2$ $x=3$ $5y=7(3)-1=20$ $y=4$	A1 A1		
			80	

4E/5NA Preliminary Examination Paper 2 (2020)
Marking Scheme

Qn. No.	Answer	Marking Point	Marks	Remarks
1(a)	x^2-4x-1 $=(x-2)^2-(-2)^2-1$ $=(x-2)^2-5$	M1 A1		
(b)(i)	$m=-1.7651...$ $\Rightarrow -1.77$ (3 s.f.)	A1		
(b)(ii)	$m^3=\frac{y}{a}-b^2$ $m^3+b^2=\frac{y}{a}$ $\therefore\ y=a(m^3+b^2)$	M1 A1		M1 awarded for cubing both sides of the equation. Also accept $y=am^3+ab^2$.
(c)	$\frac{5(x-2)-2(x+3)}{(x+3)(x-2)}=4$ $3x-16=4x^2+4x-24$ $\Rightarrow 4x^2+x-8=0$ $x=\frac{-1\pm\sqrt{1^2-4(4)(-8)}}{2(4)}$ $=\frac{-1\pm\sqrt{129}}{8}$ $x=-1.5447...$ or $x=1.29472...$ $\Rightarrow -1.54$ (3 s.f.) or $\Rightarrow 1.29$ (3 s.f.)	M1 M1 M1 A1	11	
(d)	$35x=8y+4x$ $31x=8y$ $\frac{x}{y}=\frac{8}{31}$	M1 A1		
2(a)	$A=58000\left(1+\frac{1.5}{100}\right)^{10}$ $=58000(1.015)^{10}$ $I=58000(1.015)^{10}-58000$ $=9311.367...$ $\Rightarrow$ \$9311.37 (2 d.p.)	M1 M1 A1	10	
(b)(i)	$97.6\% \rightarrow 4.1$ billion $100\% \rightarrow \frac{100}{97.6}\times 4.1$ billion $=4.2008...$ billion $\Rightarrow 4.20$ billion (3 s.f.)	M1 A1		Accept 4.20×10^9.

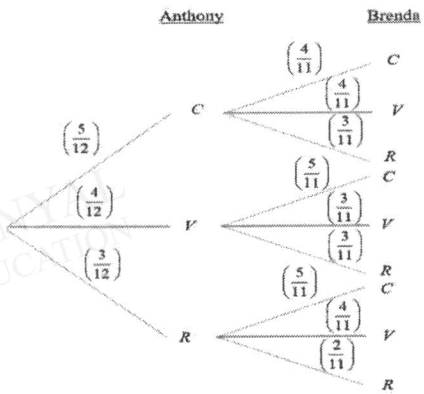
4E/5NA Preliminary Examination Paper 2 (2020)
Marking Scheme

Qn. No.	Answer	Marking Point	Marks	Remarks
(b)(ii)(a)	2.4×10^{8}	B1		
(b)(ii)(b)	$\frac{0.24}{4.1}\times100\%=5.8536...$ $\square$ 5.85% (3 s.f.)	M1 A1		
(c)	Selling price $=112\%\times945€$ $=1058.4€$ $=\frac{1058.4}{0.63}$ $=SGD1680$	M1 M1 A1		
3(a)	$\angle ACB=293°-267.8°$ $=25.2°$ (shown)	 A1		
(b)	$\frac{\sin\angle ABC}{374}=\frac{\sin25.2°}{248}$ $\sin\angle ABC=\frac{374\sin25.2°}{248}$ $\angle ABC=39.948...°$ $=39.9°$ (1 d.p.)	M1 A1		
(c)	$\angle BAC=180°-39.9°-25.2°$ ($\angle$ sum of Δ) $=114.9°$ Area of $\Delta ABC=\frac{1}{2}(248)(374)\sin114.9°$ $=42065.073...$ $\square$ 42100 m^2 (3 s.f.)	M1 M1 A1	10	
(d)(i)	$\sin25.2°=\frac{d}{374}$ $\Rightarrow d=374\sin25.2°$ $=159.2414...$ 159.24 m (5 s.f.)	M1 A1		If students use $\angle ABC$, they will have to use 39.948° and they will obtain 159.2388 $\square$ 159.24 (5 s.f.)
(d)(ii)	Let θ be the greatest angle of elevation. $\tan\theta=\frac{102}{159.2414}$ $\theta=32.6410...$ 32.6° (1 d.p.)	 M1 A1		
4(a)	$T_6=6+(6-2)^2-12=10$	B1		
(b)	$T_n=6+(n-2)^2-2n$ $=6+n^2-4n+4-2n$ $=n^2-6n+10$ (shown)	M1 A1	10	

Qn. No.	Answer	Marking Point	Marks	Remarks
(c)	$\frac{(3k)^2-6(3k)+10}{k^2-6k+10}=17$ $9k^2-18k+10=17k^2-102k+170$ $\Rightarrow 8k^2-84k+160=0$ $2k^2-21k+40=0$ (shown)	M2 A1		M1 for numerator M1 for denominator
(d)	$(2k-5)(k-8)=0$ $k=2.5$ or $k=8$	M1 A1, A1		
(e)	k has to be a whole number. Since $k=2.5$ is not a whole number, it will have to be rejected.	B1		
5(a)(i)	$\angle CAT=\frac{180°-68°}{2}$ (tangents from ext. pt.) $=56°$	A1	9	
(a)(ii)	$\angle OAT=\angle OCT=90°$ (tan $\perp$ rad) $\angle AOC=180°-2\times 90°-68°$ ($\angle$ sum of quad) $=112°$	A1		
(a)(iii)	$\angle AEC=\frac{112°}{2}$ ($\angle$ at ctr. = 2$\angle$ at circumference) $=56°$	A1		
(a)(iv)	$\angle ABC=180°-56°$ ($\angle$s in opp. segment) $=124°$	A1		Allow ft. $180°-$ their $\angle AEC$
(a)(v)	$\angle DCA=90°$ ($\angle$ in semicircle) $\angle ACT=\angle CAT$ (isos. Δ) $\angle DCS=180°-90°-56°$ (adj. $\angle$s on str. line) $=34°$	M1 A1		Allow ft. $180°-90°-$ their $\angle AEC$
(a)(vi)	$\angle OAT=90°$ (tangent $\perp$ radius) $\angle ATO=34°$ $\tan 34°=\frac{OA}{10}$ $\Rightarrow OA=10\tan 34°$ $=6.74508\ldots$ ≈ 6.75 cm	M1 A1		
(b)	$\angle AOC+\angle ATC=112°+68°$ $=180°$ ($\angle$s in opp. segment) $\therefore$ the points A, O, C and T are points lying on another circle.	B1		*Alternative Solution:* $\angle OAT=\angle OCT=90°$ rt. angle in semicircle
6(a)	arc $BD=6(1.2)$ $=7.2$ cm	A1	10	
(b)	$\tan 1.2=\frac{BC}{6}$			

Qn. No.	Answer	Marking Point	Marks	Remarks
	$\Rightarrow BC = 6\tan 1.2$ $= 15.4329\ldots$ $\square$ 15.4 cm (3 s.f.)	A1		
(c)	$\cos 1.2 = \frac{6}{AC}$ $\Rightarrow AC = \frac{6}{\cos 1.2} = 16.5582\ldots$ $P = 7.2 + 15.4329\ldots + \left(\frac{6}{\cos 1.2} - 6\right)$ $= 33.1911\ldots$ $\square$ 33.2 cm (3 s.f.)	M1 A1		
(d)	area of X $= \frac{1}{2}(15.4329)^2\left(\frac{\pi}{2} - 1.2\right) - \frac{1}{2}(15.4329)^2 \sin\left(\frac{\pi}{2} - 1.2\right)$ $= 1.0049\ldots$ $\square$ 1.00 cm^2 (3 s.f.)	M2 A1		M1 for area of sector CBE. M1 for area of triangle CBE.
(e)	area of Y $= \frac{1}{2}(6)(15.4329) - \frac{1}{2}(6)^2(1.2)$ $= 24.6987\ldots$ $\square$ 24.7 cm^2 (3 s.f.)	M2 A1		M1 for area of triangle ABC. M1 for area of sector ABD.
7(a)	$p = 1.2$	A1		
(b)	(see attached)			P1 for correct plotting of points. C1 for smoothness of curve.
(c)	Draw the line $y = 5$. $x = 5.2\ (\pm 0.05)$	B1		
(d)	$m = \frac{4.4 - 0.6}{5.5 - 2}$ $= 1.0857\ldots$ 1.09 (3 s.f.)	M1 A1	9	Actual gradient $= 1.11$ Accept: $0.967 \le m \le 1.26$
(e)	$\frac{8}{x} = 12 - 3x$ $2x - 7 + \frac{8}{x} = (12 - 3x) + 2x - 7$ Draw $y = -x + 5$. $x = 3.15\ (\pm 0.05)$	M1 M1 B1		B1 awarded if line passes thru (1,4) and (5,0).
8(a)	$V = \frac{1}{3}\pi(10)^2(23) - \frac{1}{2} \times \frac{4}{3}\pi(5)^3$	M1	10	Award M1 for either for volume of cone or hemisphere.

Qn. No.	Answer	Marking Point	Marks	Remarks
	$= \frac{2300}{3}\pi - 83\frac{1}{3}\pi$ $= 683\frac{1}{3}\pi$ $= 2146.7549...$ $\therefore 2150\,\text{cm}^3$ (3 s.f.)	A1		
(b)	$VA^2 = 23^2 + 10^2$ $= 629$ $VA = \sqrt{629}$ $= 25.0798...$ $\therefore 25.1$ cm (3 s.f.)	A1		
(c)	$TSA = \pi(10)\sqrt{629} + \pi(10^2 - 5^2) + \frac{1}{2} \times 4\pi(5)^2$ $= 10\sqrt{629}\pi + 75\pi + 50\pi$ $= 1180.6065...$ $\therefore 1180\,\text{cm}^2$ (3 s.f.)	M3 A1		M1 each awarded for CSA of cone, area of annulus and CSA of hemisphere.
(d)	No. of cylinders $= \frac{683\frac{1}{3}\pi}{\pi(1.2)^2(2.5)}$ $= 189.8148...$ ≈ 189 (rounded down)	M2 A1		M1 each awarded for volume of material and volume of cylinder.
9(a)(i)(a)	Mean $= \frac{5(11) + 23(13) + 8(15) + 10(17) + 4(19)}{50}$ $= \frac{720}{50}$ $= 14.4$ min	B1	11	
(i)(b)	$\Sigma ft^2 = 5(11)^2 + 23(13)^2 + 8(15)^2 + 10(17)^2 + 4(19)^2$ $= 10626$ SD $= \sqrt{\frac{10626}{50} - (14.4)^2}$ $= \sqrt{5.16}$ $= 2.2715...$ $\therefore 2.27$ min (3 s.f.)	M1 A1		
(ii)	The data is grouped into intervals. Thus it is not possible to know the exact waiting time of people in a class interval. The mid-value is used, thus the mean calculated will be an estimate.	B1		*Alternative solution:* We do not know the actual waiting times and have estimated them using the mid-values in the calculation of the mean.

Qn. No.	Answer	Marking Point	Marks	Remarks
(iii)	$\text{mean}_B < \text{mean}_A$. On average, the waiting time in Branch be is less than that of Branch *A*. $SD_B < SD_A$. This suggest that the waiting times in Branch *B* is more consistent. Thus, I will choose Branch *B*.	B1 B1		
(b)(i)		B2, 1, 0		
(ii)(a)	$P(V,V) = \frac{4}{12} \times \frac{3}{11}$ $= \frac{1}{11}$	A1		
(ii)(b)	$P(\text{Brenda choose R}) = P(C,R) + P(V,R) + P(R,R)$ $= \left(\frac{5}{12} \times \frac{3}{11}\right) + \left(\frac{4}{12} \times \frac{3}{11}\right) + \left(\frac{3}{12} \times \frac{2}{11}\right)$ $= \frac{1}{4}$	M1, 0 A1		
10(a)	$\text{mean} = \frac{6 \times 2 + 7\frac{1}{4} \times 3 + 9 \times 2}{7}$ $= 7\frac{11}{28}$ $= 7.39285...$ 7.39 h (3 s.f.)	A1	10	
(b)	Model S: $8 \text{ h} \rightarrow 1390 \text{ kWh}$ $7\frac{11}{28} \text{ h} \rightarrow \frac{7\frac{11}{28}}{8} \times 1390 = 1284.5098...$ 1284.5 kWh (1 d.p.) (shown) Model E:	A1		

Qn. No.	Answer	Marking Point	Marks	Remarks
	$8\text{ h} \rightarrow 847\text{ kWh}$ $7\frac{11}{28}\text{ h} \rightarrow \frac{7\frac{11}{28}}{8} \times 847 = 782.7187...$ $\therefore$ 782.7 kWh (1 d.p.) (shown)	A1		
(c)	Model S: Total Cost $= 962 + 5[1284.5 \times 0.2097 + 0.7 \times 4 \times 30 \times 1.07]$ $= 2758.19825...$ $\therefore$ \$2758.20 (2 d.p.) Model E: Total Cost $= 1294 + 5[782.7 \times 0.2097 + 4 \times 30 \times 1.07]$ $= 2756.66095...$ $\therefore$ \$2756.66 (2 d.p.) Based on her usage, Model E will have a lower cost of \$1.54 after 5 years of use.	M2, 1, 0 M1 M2, 1, 0 M1 B1		
			100	

Q7