NESA No.									

Class: 12MTS21_____

CHERRYBROOK TECHNOLOGY HIGH SCHOOL

2021

YEAR 12

AP4

MATHEMATICS STANDARD 2

Time allowed – 2 hours and 30 minutes plus 10 minutes reading time

General Instructions

- Attempt all questions
- Write your NESA number and class on the question paper
- Write using black pen
- NESA approved calculators may be used
- The NESA reference sheet has been provided
- For questions in Section II, show relevant mathematical reasoning and/or calculations

Total marks: 100

Section I – 15 marks (pages 3 – 8)

- Attempt Questions 1 – 15
- Allow about 25 minutes for this section

Section II – 85 marks (pages 9 – 44 in 3 booklets)

- Attempt Questions 16 – 38
- Allow about 2 hours and 5 minutes for this section

Section I

15 marks
Attempt Questions 1 – 15
Allow about 25 minutes for this section

Use the multiple-choice answer sheet for Questions 1 – 15.

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1. Which of the following values of x satisfies the equation $\frac{2x}{3} - 9 = -5$?

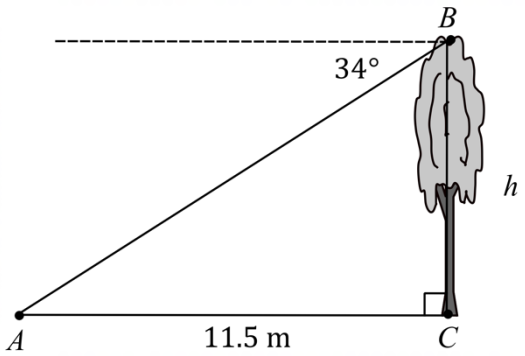
(A) $x = 5$

(B) $x = -5$

(C) $x = 6$

(D) $x = -6$

2. The angle of depression from the top of a tree (*B*) is 34˚ and the horizontal distance on the ground from *A* to *C* is 11.5 metres.



Not to scale

Which of these expressions would correctly give the height (*h*) of the tree above the ground?

(A) $11.5 \times \tan 34°$

(B) $\frac{11.5}{\tan 34°}$

(C) $11.5 \times \tan 56°$

(D) $\frac{11.5}{\sin 34°}$

3. Hector's height is measured as 1.88 metres, correct to two decimal places.

Between what two measurements would his actual height lie?

(A) Between 1.87 metres and 1.89 m

(B) Between 1.875 metres and 1.885 m

(C) Between 1.875 metres and 1.895 m

(D) Between 1.879 metres and 1.881 m

4. Express 0.004182 in standard form with two significant figures.

(A) 4.18×10^{-2}

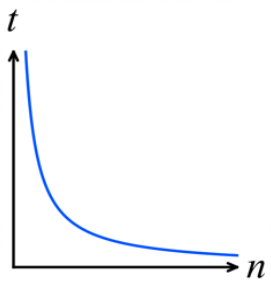
(B) 4.2×10^{-2}

(C) 4.18×10^{-3}

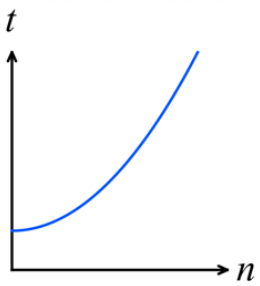
(D) 4.2×10^{-3}

5. ***t*** varies inversely with ***n***. Which graph represents this relationship?

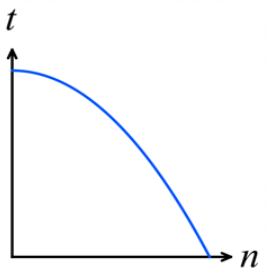
(A)



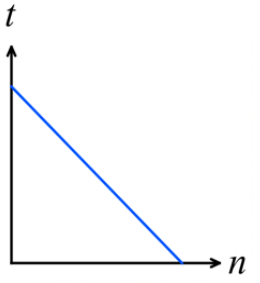
(B)



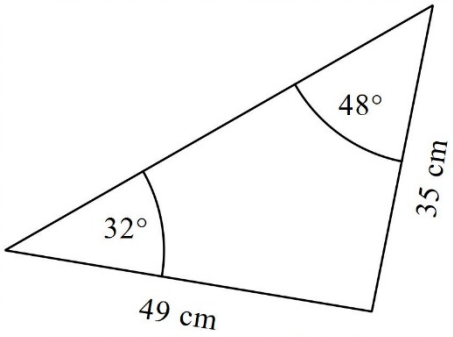
(C)



(D)



6. What is the area of the triangle shown below?



NOT TO SCALE

(A) 227 cm^2

(B) 319 cm^2

(C) 844 cm^2

(D) 1 275 cm^2

7. Omar owns a biased coin that comes up heads $\frac{3}{5}$ of the time.

If Omar flips the coin twice, what is the probability that he gets tails twice in a row?

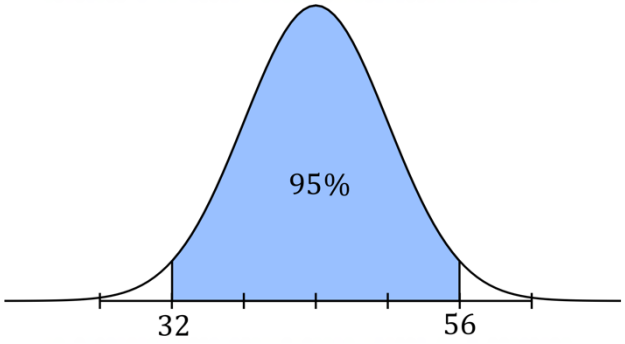
(A) $\frac{4}{25}$

(B) $\frac{2}{5}$

(C) $\frac{9}{25}$

(D) $\frac{3}{25}$

8.



Which of the following summaries is true for the normal distribution graph shown above?

(A) $\mu = 32, \sigma = 24$

(B) $\mu = 44, \sigma = 6$

(C) $\mu = 56, \sigma = 12$

(D) $\mu = 95, \sigma = 24$

9. Which of the following overall percentage increase is equivalent to a percentage increase of 9% followed by another increase of 4%?

(A) 13%

(B) 1.3%

(C) 3.36%

(D) 13.36%

10. Make *A* the subject of the equation $P = \frac{A^2+T}{2}$, given that *A* is a positive quantity

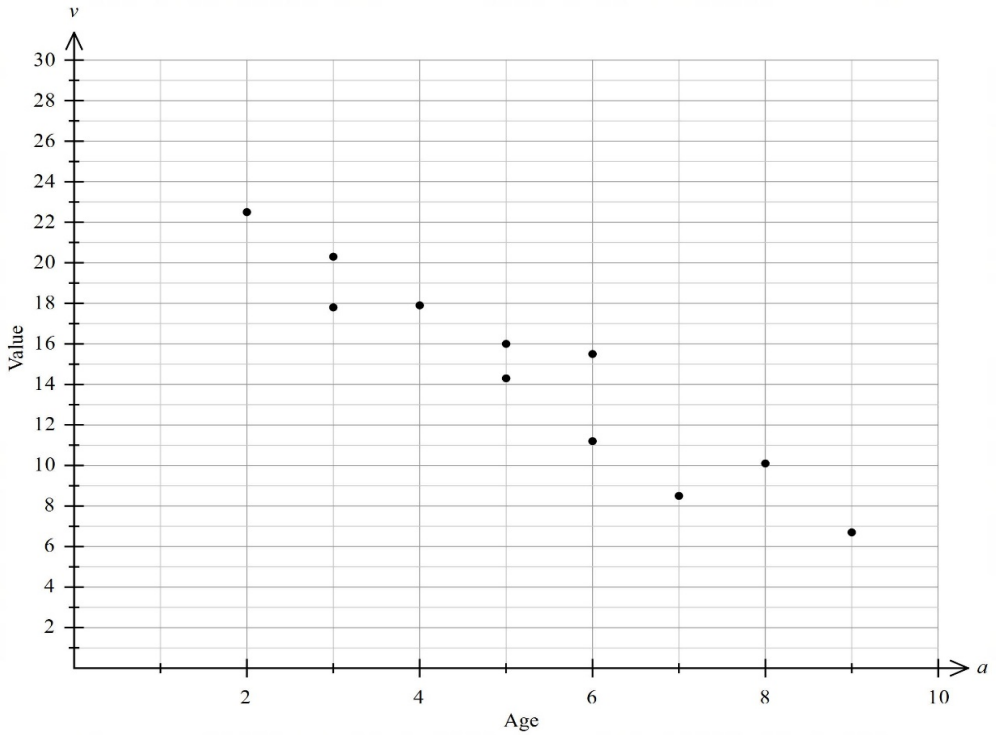
(A) $A = \mathrm{T} - \sqrt{2P}$

(B) $A = \sqrt{2P - 2T}$

(C) $A = \sqrt{T - 2P}$

(D) $A = \sqrt{2P - T}$

11. A scatterplot comparing the variables a and v is shown below.



Which equation could describe the least-squares regression line?

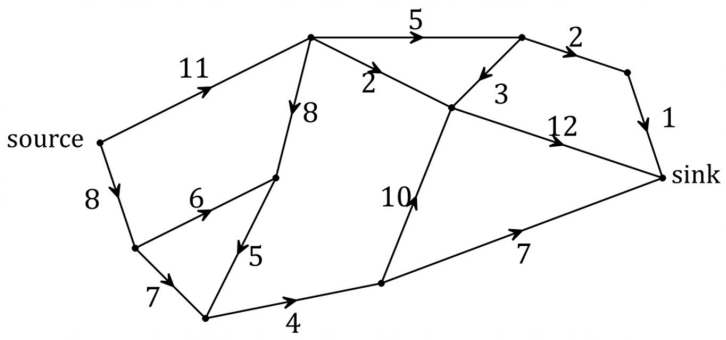
(A) $v = -2.2a + 6$

(B) $v = -2.2a + 26$

(C) $v = 2.2a + 6$

(D) $v = 2.2a + 26$

12.



What is the maximum flow in the above network diagram?

(A) 9

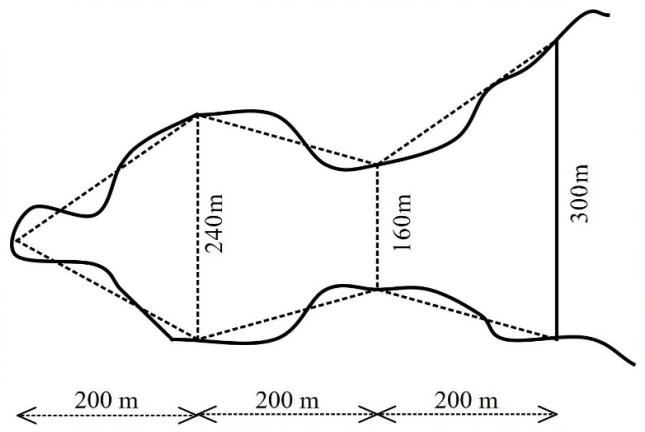
(B) 10

(C) 19

(D) 20

13. To estimate the area of a headland, the measurements below were taken.

Use three applications of the trapezoidal rule to make an estimate.



(A) 104 000 m^2

(B) 106 000 m^2

(C) 110 000 m^2

(D) 140 000 m^2

14. The relative frequency of the five vowels in English words are shown below.

A or a: 8.5% E or e: 11.2% I or i: 7.5% O or o: 7.2% U or u: 3.6%

A page of English text has 40 lines with an average of 16 words per line, with each word having an average of 5.6 letters.

How many vowels would you expect on this page?

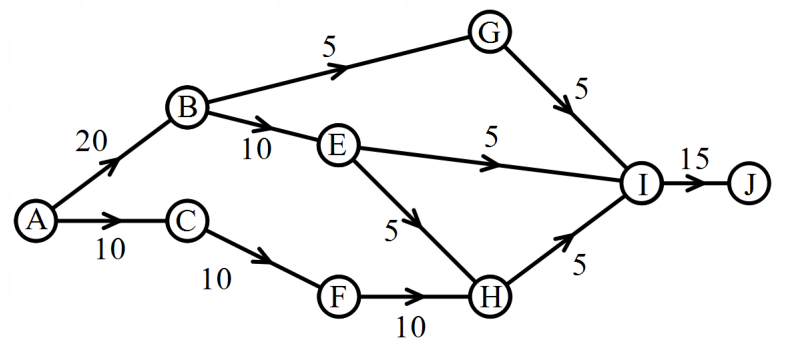
(A) 243

(B) 401

(C) 640

(D) 1 362

15. The flow diagram below represents the capacity of pipes carrying coolant through a factory.



The flow capacity of the coolant system is not maximised.
Which additional pipe(s) would increase the flow capacity to maximum?

(A) A pipe from A to E with a capacity of 5, and a pipe from E to I with a capacity of 10

(B) A pipe from B to H with a capacity of 5, and a pipe from H to J with a capacity of 15

(C) A pipe from H to J with a capacity of 10

(D) A pipe from B to I with a capacity of 5 and a second pipe from I to J with a capacity of 15

End of Section I

NESA No.									

Class: 12MTS21_____

CHERRYBROOK TECHNOLOGY HIGH SCHOOL
AP4 2021

MATHEMATICS STANDARD 2
Section II Answer Booklet 1

Section II

85 marks
Attempt Questions 16—37
Allow about 2 hours and 5 minutes for this section

Booklet 1—Attempt Questions 16—24 (28 marks)
Booklet 2—Attempt Questions 25—31 (28 marks)
Booklet 3—Attempt Questions 31—37 (29 marks)

Instructions

- Write your NESA number at the top of this page.
- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
- Your responses should include relevant mathematical reasoning and/orcalculations.
- Extra writing space is provided at the back of each booklet. If you use this space, clearly indicate which question you are answering.

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Question 16 (2 marks) **Marks**

After completing a numeracy test (%), Hazel achieved a *z*-score of –1.

(a) How does Hazel's result compare with those of her peers? Explain your answer in terms of the mean and standard deviation. **1**

(b) If the mean test mark was 81 and the standard deviation was 3, calculate Hazel's actual mark. **1**

Question 17 (2 marks)

In the region of a tropical forest, 96 rare birds were captured, tagged and released. Five months later, 72 birds were recaptured from the same region and it was found that 18 of these birds had previously been tagged. Use the 'capture-recapture' method to give an estimate of the number of rare birds in this region of the forest. **2**

Please turn over for Question 18

Question 18 (4 marks) **Marks**

Jo delivered catalogues as a job during her summer holidays.

She was paid a rate of $20 per 1000 catalogues.

On an average day she delivered 4 catalogues to each residence along 45 city blocks.

Each block had on average 40 residences to receive catalogues.

(a) What would she have been paid for a week where she worked on 3 days? **2**

(b) It took her on average 12 minutes to cover each block. What hourly rate of pay would be equivalent to her piecework pay rate? **2**

Question 19 (2 marks)

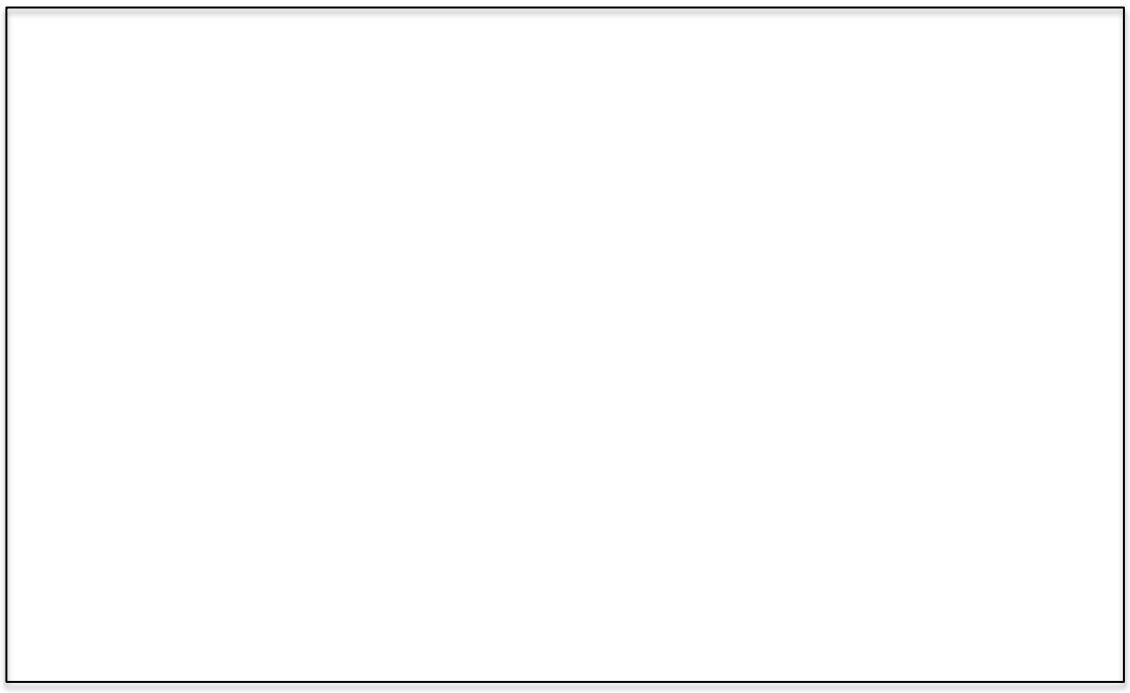
Sydney is at the coordinates 34°S, 151°E, and Tokyo is at the coordinates 36°N, 140°E. What is the time difference, to the nearest minute, between Sydney and Tokyo? **2**

Question 20 (2 marks) **Marks**

Ada is a Year 12 student who is mapping her social network. Ada's friends are Bernhard, Charles, and David. Ada also knows that **2**

- Bernhard is friends with David and Emmy,
- Charles is friends with David,
- David is friends with Emmy and Fermat, and
- Emmy is friends with Fermat.

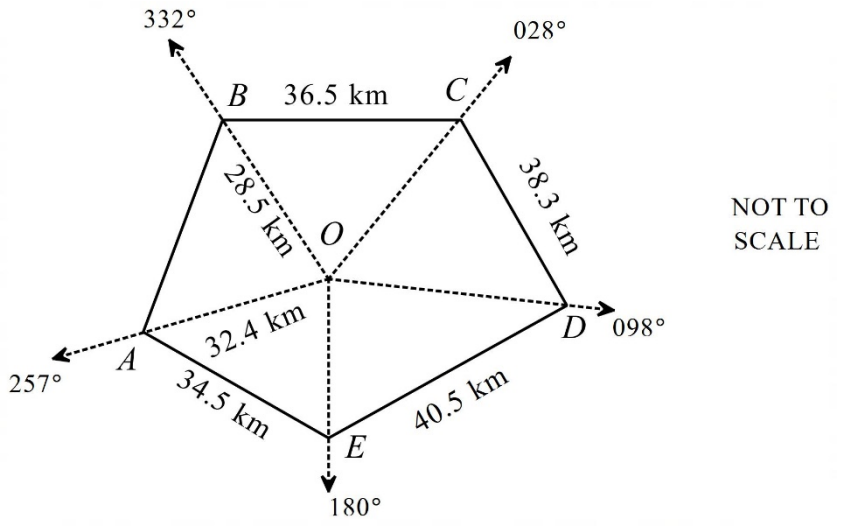
Draw a network diagram to represent Ada's social network. You may use each person's first initial to represent them in the network (e.g. "A" for Ada).



Please turn over for Question 21

Question 21 (4 marks) **Marks**

Julie completed a radial survey of a paddock with five straight boundaries, using *O* as a centre.



Calculate the perimeter of the paddock. **4**

Question 22 (3 marks) **Marks**

A formula is shown below: $M = 8v - \frac{3v}{2} + 20$

(a) Find the value of *M* when $v = 2$. **1**

(b) Find the value of *v* which gives $M = 72$. **2**

Question 23 (4 marks)

Alex weighs 75 kg. When participating in a marathon, Alex's body typically uses 12 kJ per 1 kg of his body mass for an hour of running. He completed his last marathon in four and a half hours.

(a) How many kilojoules of energy did his body use in completing the marathon? **1**

(b) The body is only about 25% efficient in converting food to usable energy. If a kilogram of pasta contains 3000 kJ of energy, how many kilograms of pasta would Alex need to consume to give him the energy to complete the marathon. **3**

Question 24 (5 marks) **Marks**

A section of a floor plan is shown below. The scale of the drawing is 1:125.



(a) What are the actual dimensions of Bedroom 1? **2**
Give your answer correct to two decimal places.

(b) A tradesman is employed to pain the ceiling of Bedroom 1. He paints at a constant rate of 12m^2 per hour and is paid at a rate of \$62 per hour to the nearest whole number of hours. **3**

If the owner has saved \$350 to pay for the painting of the ceiling, will he have sufficient funds to cover the labour cost if two coats of paint are required?

End of Booklet 1.
Start Booklet 2.

Section II Extra writing space

If you use this space, clearly indicate which question you are answering.

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NESA No.									

Class: 12MTS21_____

CHERRYBROOK TECHNOLOGY HIGH SCHOOL
AP4 2021

MATHEMATICS STANDARD 2
Section II Answer Booklet 2

Section II

Booklet 2—Attempt Questions 25—31 (28 marks)

Instructions

- Write your NESA number at the top of this page.
- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
- Your responses should include relevant mathematical reasoning and/orcalculations.
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Question 25 (3 marks) **Marks**

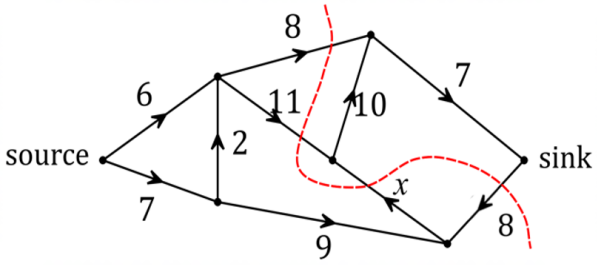
On a flight to Europe, Jackie spends 7 hours and 46 minutes on a flight from Melbourne to Singapore, 2 hours and 10 minutes at the airport in Singapore, and then 11 hours and 20 minutes on a flight to Geneva, Switzerland. **3**

What time does she arrives in Geneva (UTC +2) if she left Melbourne (UTC +10) on Thursday at 9:00 am?

Question 26 (2 marks)

For the network diagram shown opposite, the capacity of the cut is 30. **2**

What is the value of x?



Please turn over for Question 27

Question 27 (4 marks) **Marks**

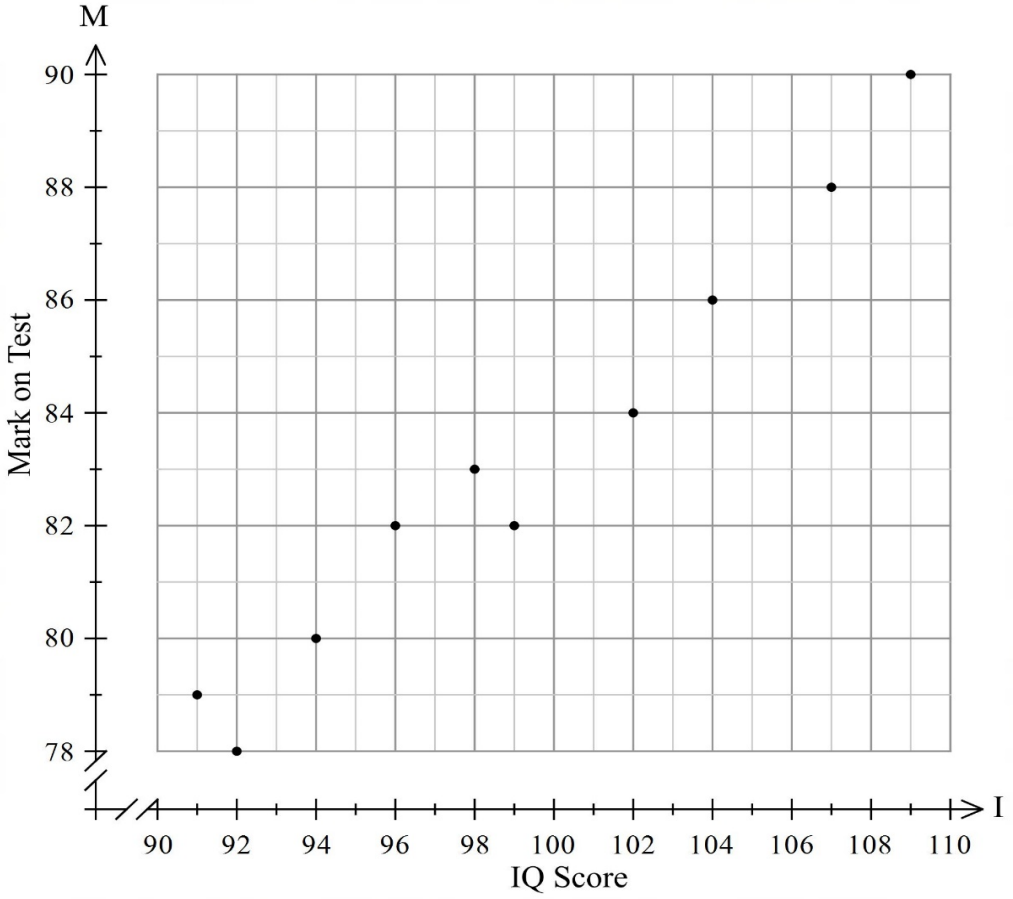
Pasta boxes are labelled with a net weight of 375 g. The business selling the pasta boxes fills the boxes to a net weight of 380 g, to avoid customer complaints. The weight of the pasta boxes follows a normal distribution with a mean weight of 380 g and a standard deviation of 2.5 g.

(a) What is the probability that a box selected randomly will contain less than 375 g of pasta? **2**

(b) The business sets a target of less than 16% of all boxes will contain more than 385 g of pasta. The business can change the mean weight of the boxes to meet this target. What is the mean weight required to meet the target if the standard deviation remains at 2.5? **2**

Question 28 (4 marks) **Marks**

The bivariate data in the scatterplot below compares the recorded IQ score of students with their mark on a class test out of 100.



(Note : Both axes are broken)

(a) Calculate Pearson's correlation coefficient for the data, correct to two decimal places. **1**

(b) Describe the direction and strength of the relationship between the IQ and the test marks. **1**

Question 28 continues on page 26

(c) The equation of the least-squares regression line is: **1**

$$M = 0.615I + b$$

where *b* is the intercept on the *M*-axis of the regression line.

Find the value of *b,* correct to 3 significant figures

(d) A student had a recorded IQ of 114. **1**

Calculate the predicted test mark of this student using the equation of the least-squares regression line. (Answer as a whole number.)

Question 29 (4 marks)

Aria has placed 50 pens in a bucket. There were 28 blue pens and the rest were red. Aria selected two pens at random from the bucket.

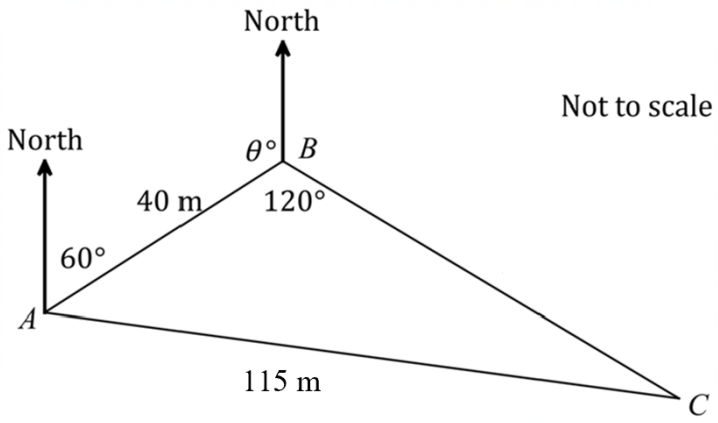
(a) Draw a probability tree diagram for selecting two pens at random **2**

(b) What is the probability of Aria selecting two pens which are the same colour? **2**

Question 16 – 29 are worth 45 marks in total

Question 30 (5 marks) **Marks**

The diagram below shows the plan for a triangular garden. Fence posts have been located at points *A*, *B* and *C*. *AB* is 40 m and *BC* is 90 m. The bearing of *B* from *A* is 060° and $\angle ABC$ is 120°



(a) What is the size of angle θ ? **1**

(b) What is the true bearing of point *A* from point *C*? **4**

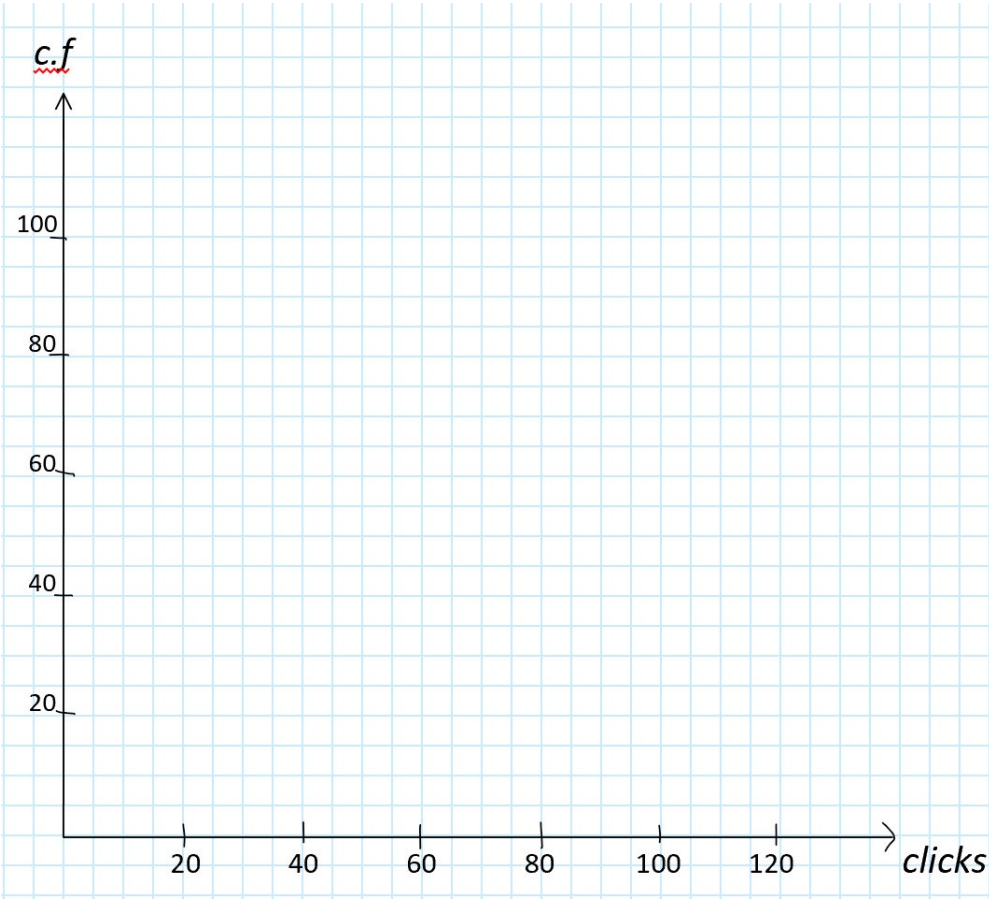
Please turn over for Question 31

Question 31 (6 marks) **Marks**

A data analytics company is programming a system to distinguish between humans and bots in an online video game. The company gathers data on 100 human players. The average number of mouse clicks per minute for these 100 players is shown in the frequency table below.

Clicks per minute	Frequency	Cumulative Frequency
0 - 19	4	
20 – 39	12	
40 - 59	22	
60 - 79	37	
80 - 99	20	
100 - 119	5	

(a) Complete the cumulative frequency histogram and draw the polygon. **2**



Question 31 continues on page 29

(b) Use the graph to find the interquartile range of the clicks per minute. Please show your working on the graph. **2**

(c) The company is considering flagging accounts whose number of clicks per minute qualifies as an outlier according to the data gathered. One account is measured as having 127 clicks per minute. What conclusion can be drawn when comparing this result to the collected data? **2**

End of Booklet 2.
Start Booklet 3.

Section II Extra writing space

If you use this space, clearly indicate which question you are answering.

Section II Extra writing space

If you use this space, clearly indicate which question you are answering.

NESA No.									

Class: 12MTS21_____

CHERRYBROOK TECHNOLOGY HIGH SCHOOL
AP4 2021

MATHEMATICS STANDARD 2
Section II Answer Booklet 3

Section II

Booklet 3—Attempt Questions 32—37 (29 marks)

Instructions

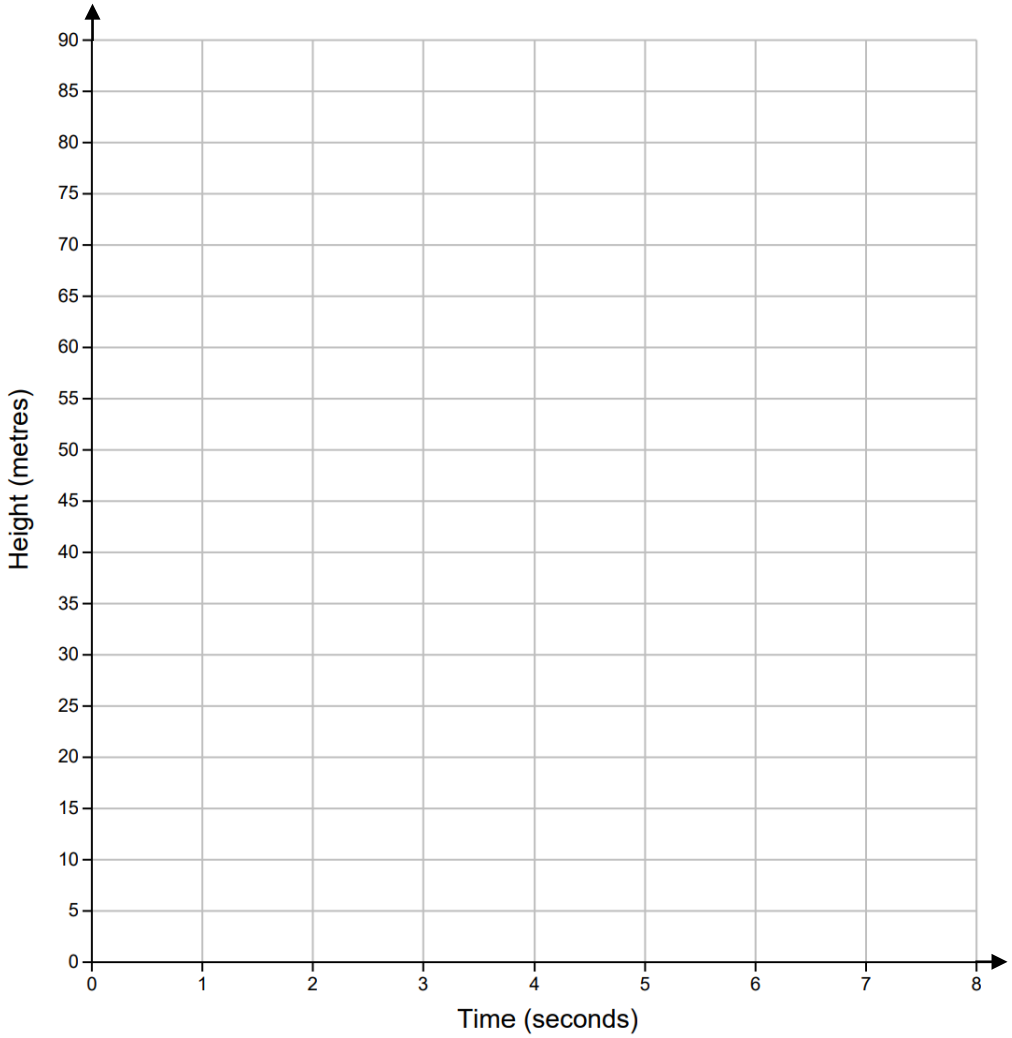
- Write your NESA number at the top of this page.
- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
- Your responses should include relevant mathematical reasoning and/orcalculations.
- Extra writing space is provided at the back of each booklet. If you use this space, clearly indicate which question you are answering.

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Question 32 (5 marks) **Marks**

From the top of a tower, which is 60 metres high, Isaac throws a stone upward and allows it to fall under gravity. The height of the stone is modelled by the equation, $h = 20t - 5t^2 + 60$, where *h* is the height (in metres) of the stone above ground level and *t* is the time in seconds since the stone was thrown.

(a) On the grid below, draw the graph of this model and label it as *Stone*. **2**



Question 32 continues on page 36

Question 32 continued

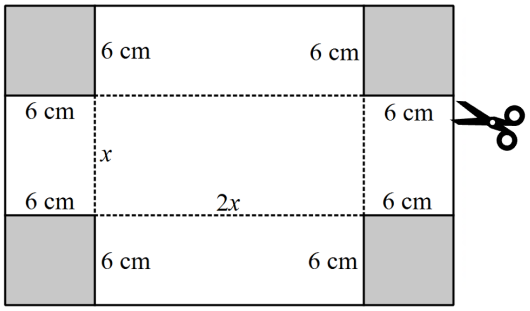
(b) At the same time as the stone is thrown, Jay releases a toy glider from the top of the tower. The glider drifts down, losing height at a constant rate of 5 metres each second. Draw the graph modelling the height of the glider on the grid on the previous page and determine the equation which describes the model. Label the graph *Glider*. **2**

(c) Determine the height of the glider when the stone reaches the ground. **1**

Question 33 (4 marks) **Marks**

An open-top box is to be made from a flat piece of cardboard. To do so, squares of side length 6 cm are cut from each corner, as shown in the diagram below, and each flap is folded up to form the box. The longer side of the box is twice the length of the shorter side.

NOT TO SCALE



(a) If the volume of the box is 972 cubic centimetres, find the value of x. **2**

(b) What were the original dimensions of the flat piece of cardboard before it was cut? **2**

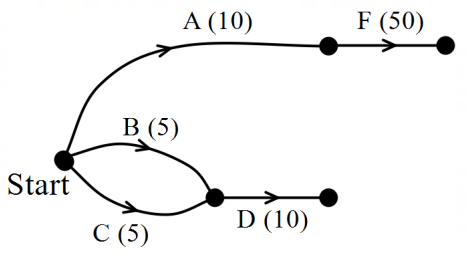
Please turn over for Question 34

Question 34 (8 marks) **Marks**

Augustin is following a recipe for a cake. A summary of the steps in the recipe is as follows:

- A: Preheat oven (10 minutes)
- B: Mix dry ingredients (5 minutes)
- C: Mix wet ingredients (5 minutes)
- D: When B and C are done, mix dry and wet ingredients (10 minutes)
- E: When D is done, pour batter into pan (2 minutes)
- F: When A and E are done, put pan into oven and bake (50 minutes)
- G: When F is done, prepare frosting (10 minutes)
- H: When F is done, place cake in fridge to cool (30 minutes)
- I: When G is done, prepare decorations (5 minutes)
- J: When H and I are done, frost cake and serve (10 minutes)

(a) Complete the network diagram below representing the durations and interdependencies of the steps in the recipe by adding activities E, G, H, I, and J, and find the minimum completion time of the recipe. **4**



Minimum completion time: _____

(b) What is the latest time after starting the recipe that the oven needs to begin preheating? **2**

_____

_____

_____

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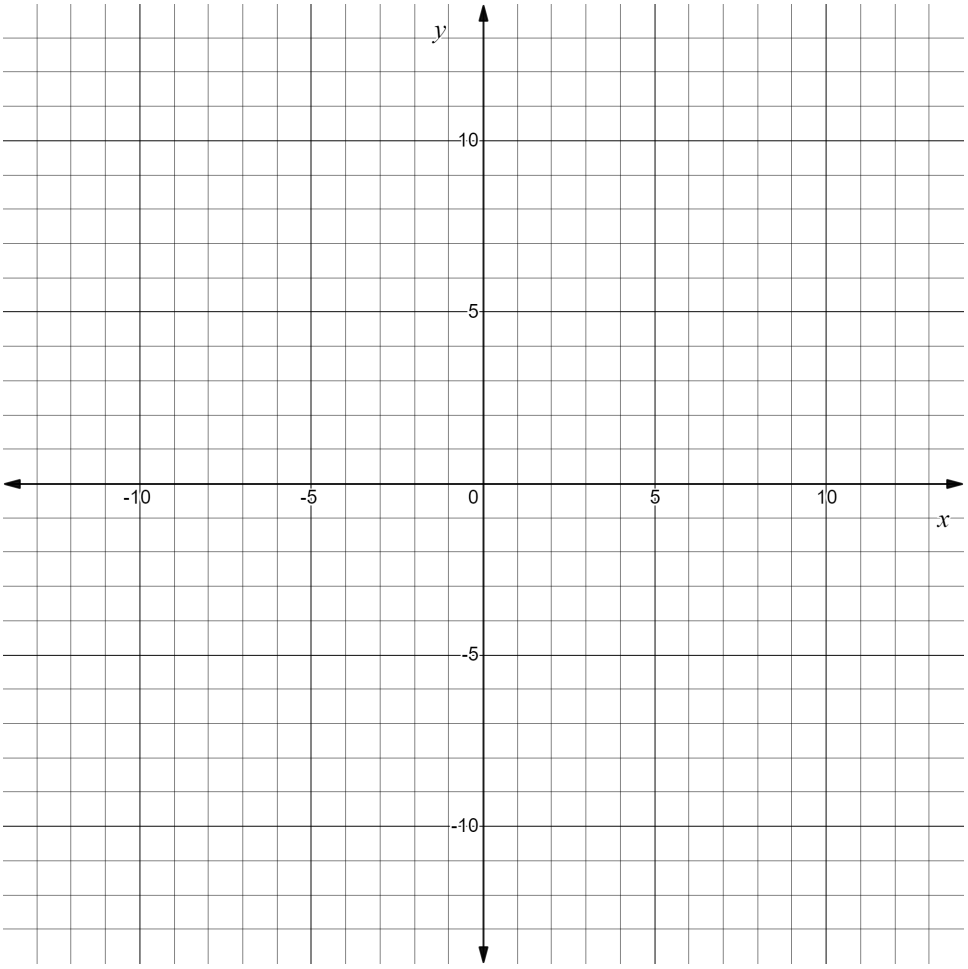
Question 34 continues on page 39

(c) Augustin realises as he is about to make the frosting that he forgot to buy an ingredient for the frosting. He takes some time to run to the store and back for the ingredient and starts preparing the frosting 20 minutes late. How will this delay affect the minimum completion time of the recipe? **2**

Question 35 (3 marks)

Using the number plane below find the simultaneous solution of

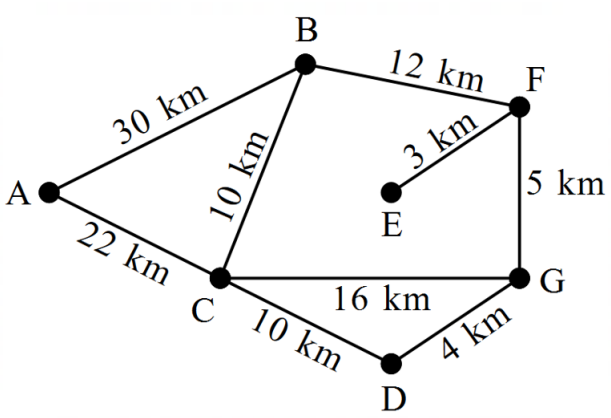
$y = 3x - 10$ and $x - y - 2 = 0$. **3**



Please turn over for Question 36

Question 36 (5 marks) **Marks**

The network diagram represents the distance between the rural towns shown.



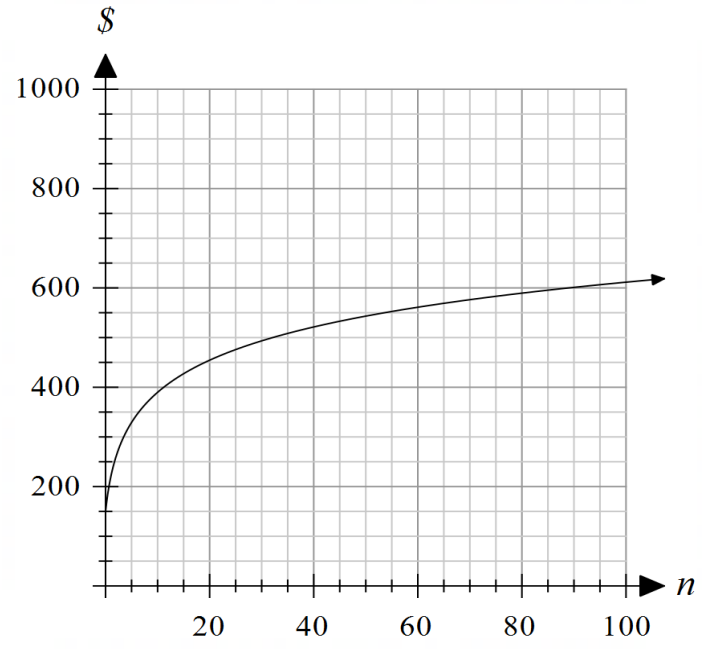
(a) Find the shortest path and shortest distance from Town A to Town E. **2**

(b) The towns are to be connected by new high-speed internet cables. **2**
Draw the minimum spanning tree that connects all towns to the network.

(c) If the cabling costs $25,000 per kilometre to install, what is the minimum cost to connect all towns to the network? **1**

Question 37 (4 marks) **Marks**

A gadget manufacturer finds that the cost to produce each gadget becomes cheaper the more gadgets they make. They model their manufacturing cost to make n gadgets and graph the model, shown below.



(a) The manufacturer knows their revenue from selling gadgets varies directly with the number of gadgets sold. When 40 gadgets are sold, their revenue is $400. Draw a graph representing the revenue on the plot above. **2**

(b) Approximately how many gadgets must the manufacturer sell to break even? **1**

(c) What is the profit if the manufacturer sells 90 gadgets? **1**

End of Paper

Section II Extra writing space

If you use this space, clearly indicate which question you are answering.

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If you use this space, clearly indicate which question you are answering.

Year 12 Mathematics Standard 2 Section I – Answer Sheet

NESA No. | | | | | | | | | |

Name: _____ **Class:** _____

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

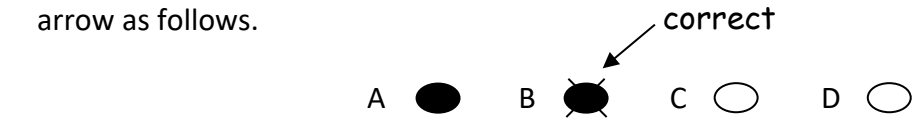
Sample: 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

A ○ B ● C ○ D ○

- If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A ● B ⊗ C ○ D ○

- If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word correct and drawing an arrow as follows.



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1. A ○ B ○ C ○ D ○
2. A ○ B ○ C ○ D ○
3. A ○ B ○ C ○ D ○
4. A ○ B ○ C ○ D ○
5. A ○ B ○ C ○ D ○
6. A ○ B ○ C ○ D ○
7. A ○ B ○ C ○ D ○
8. A ○ B ○ C ○ D ○
9. A ○ B ○ C ○ D ○
10. A ○ B ○ C ○ D ○
11. A ○ B ○ C ○ D ○
12. A ○ B ○ C ○ D ○
13. A ○ B ○ C ○ D ○
14. A ○ B ○ C ○ D ○
15. A ○ B ○ C ○ D ○