
Student Number

Barker College

2020 TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION

Mathematics Standard 2

Staff Involved:

- RAS
- BHC
- AYG
- JWH*
- DZP
- PDJ
- LZM

PM FRIDAY 14TH AUGUST

170 copies

General Instructions:

- Write your Student Number at the top of the page where indicated.
- Reading time - 10 minutes
- Working time - 2 hours and 30 minutes
- Write using black or blue pen
- NESA approved calculators may be used
- A Reference Sheet is provided separately
- For questions in Section II, show relevant mathematical reasoning and/or calculations

Total marks: 100

Section I - 15 marks (pages 2 - 6)
- Attempt Questions 1 - 15
- Allow about 25 minutes for this section

Section II - 85 marks (pages 7 - 29)
- Attempt Questions 16 - 39
- 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.
Choose the best response and fill in the corresponding response oval completely.

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1. Which one of the following will graph a hyperbola?

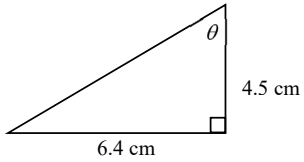
   A. $y = 4^x$

   B. $y = 2x^2$

   C. $y = 5x$

   D. $y = \frac{6}{x}$

2. Find the size of angle θ, correct to the nearest minute.



NOT TO SCALE

   A. $35^o\ 7'$

   B. $44^o\ 41'$

   C. $45^o\ 19'$

   D. $54^o\ 53'$

3. The Coordinated Universal Time (UTC) of Sydney is +10 hours and the UTC of New York is – 4 hours.

   When the time in New York is 3 pm, Tuesday, what is the time in Sydney?

   A. 5 am Wednesday

   B. 5 am Tuesday

   C. 1 am Wednesday

   D. 1 am Tuesday

4. A person's weight is measured as 82.42 kg.

What is the absolute error of this measurement?

A. 5 grams

B. 10 grams

C. 50 grams

D. 100 grams

5. A spacecraft is orbiting the Earth at a height of 80 km.
The radius of the Earth is given as 6 400 km.
How long, to the nearest minute, will it take a spacecraft travelling at 5 km/s to complete a single orbit of the Earth?

(use $C = 2\pi r$)

A. 2 hours 14 minutes

B. 2 hours 16 minutes

C. 8 hours 53 minutes

D. 9 hour 5 minutes

6. Which one of the following relationships would most likely show a negative correlation?

A. The population of a town and the number of schools in the town.

B. The hours spent training for a race and the time taken to complete the race.

C. The price per litre of petrol and the number of people travelling to work by train.

D. The number of pets per household and the number of computers per household.

7. On a school report, a student's achievements are graded A, B, C, D, E.
What type of data is this?

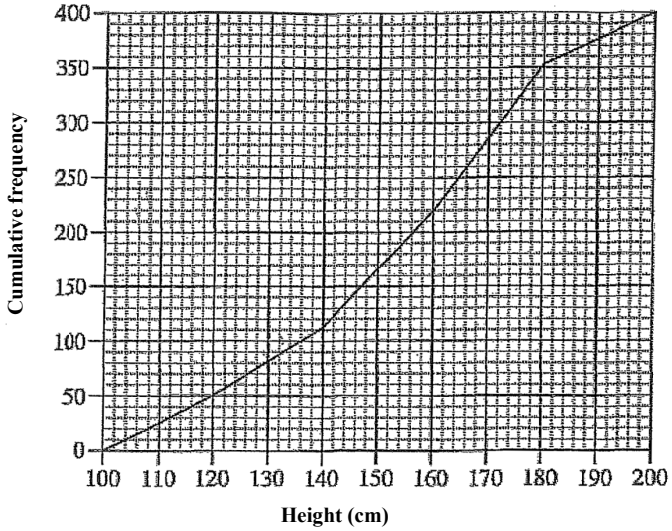
A. Categorical, nominal

B. Numerical, discrete

C. Categorical, ordinal

D. Numerical, continuous

8. The heights of students were measured. The measurements are shown in this cumulative frequency polygon (ogive).



Using this polygon, the interquartile range for this data set is:

A. 136 cm

B. 200 cm

C. 172 cm

D. 36 cm

9. Tahiti has a latitude of 18° South and a longitude of 150° West.
Taipei (Taiwan) is 43° North and 90° West of Tahiti.
The latitude and longitude of Taipei is

A. 61° North, 140° West

B. 25° North, 60° East

C. 25° North, 60° West

D. 25° North, 120° East

10. What amount must be invested now at 1.5% per annum, compounded quarterly, so that in five years' time it will have grown to \$82 000? Answer to the nearest dollar.

A. \$41 466

B. \$81 939

C. \$83 549

D. \$76 086

11. During COVID-19 the number of people (n) who can attend a concert **varies inversely** with the amount of space allowed per person (s).
If $4m^2$ of space is allowed per person, the concert hall can hold 12 450 people.
What is the value of the constant of variation (k)?

A. 3112.5

B. 49 800

C. 12 454

D. 0.00032

12. My 250 watt computer runs for 8 hours each day, five days each week.
Electricity is charged at \$0.15/kWh.
What is the cost of running my computer for 6 weeks?

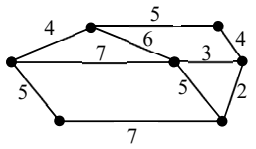
A. \$9

B. \$15

C. \$21

D. \$30

13. This network represents a system of roads with distances given in kilometres.



NOT TO SCALE

What is the length of the minimum spanning tree?

A. 10 km

B. 23 km

C. 24 km

D. 28 km

14. The three sides of a triangle are in the ratio 3:5:7.
The shortest side of the triangle is 4.86 cm.
What is the perimeter of the triangle?

A. 15·0 cm

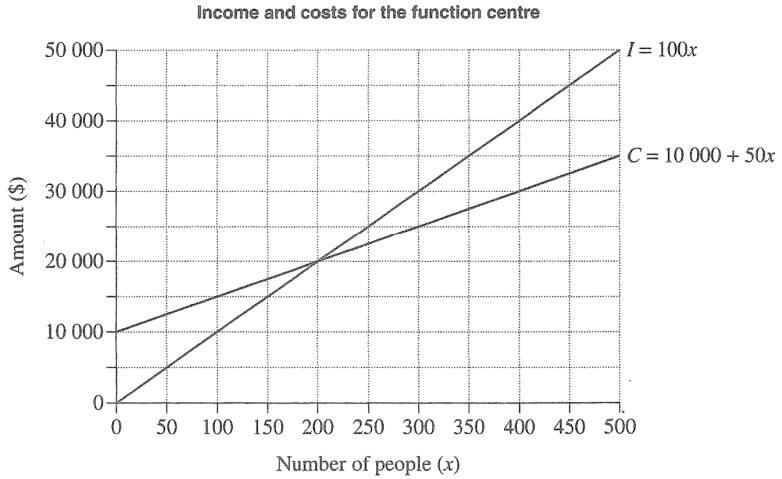
B. 17·0 cm

C. 24·3 cm

D. 58·0 cm

15. A function centre hosts events for up to 500 people. The cost C, in dollars, for the centre to host an event, where x people attend is given by $C = 10\,000 + 50x$.

The centre charges \$100 per person. Its income I, in dollars, is given by $I = 100x$.
The graph of each equation is shown below.



How much greater is the profit of the function centre when 400 people attend an event, than its profit when 300 people attend?

A. \$5 000

B. \$10 000

C. \$30 000

D. \$40 000

End of Section I

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Mathematics Standard 2

Section II Answer Booklet

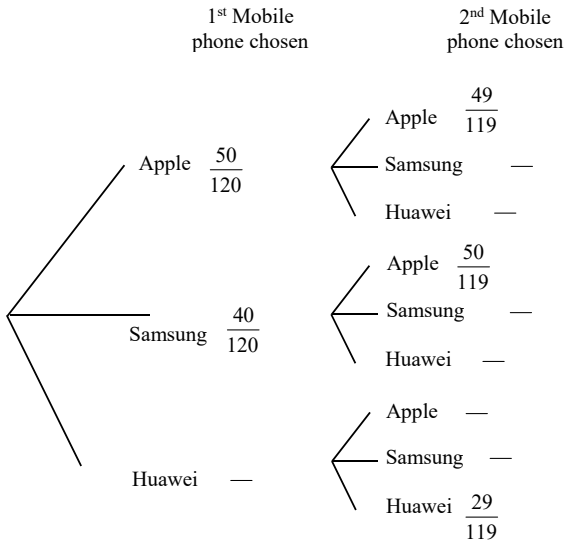
85 marks
Attempt Questions 16 - 39
Allow about 2 hours and 5 minutes for this section

Instructions:

- Write your Student Number at the top of the page where indicated.
- 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/or calculations.

Question 16 (7 marks)

Before the start of an examination, students are required to place their mobile phone in a box at the front of the examination hall.
It was noted that of the 120 mobile phones in the box, 40 were Samsung, 50 were Apple and 30 were Huawei.
The probability tree shows the probability of randomly drawing two particular phones from the box.



(i) Complete the probability tree. **2**

(ii) Calculate the probability that both mobile phones drawn are Samsungs. **2**

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Student Number

Question 16 (continued)

(iii) Calculate the probability that the first mobile phone drawn is either an Apple or a Huawei. **1**

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(iv) Calculate the probability that neither of the mobile phones drawn are Huaweis. **2**

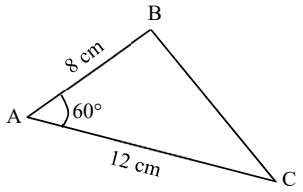
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Question 17 (3 marks)



NOT TO SCALE

Use the cosine rule to calculate the length of BC, correct to 2 decimal places. **3**

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Question 18 (3 marks)

Richard owns 16 000 shares with a market value of $6·45 per share.
The total dividend received for these shares is $7 800.
Calculate the percentage dividend yield, **correct to two significant figures.** **3**

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Question 19 (2 marks)

At the local football ground, the ratio of sausage rolls to beef pies sold was 3:5.
The ratio of beef pies to hot chips sold was 1:8.
If 240 hot chips were sold, how many sausage rolls were sold? **2**

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Question 20 (2 marks)

Solve the equation $\frac{x+4}{3}=\frac{3x}{2}+1$, leaving your answer as a fraction. **2**

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Question 21 (5 marks)

Six students sat both a Science and Humanities exam.
Their results are shown in the table below.

							Mean	*Standard Deviation*
Science (x)	70	65	80	62	72	90	73.2	9.4
Humanities (y)	50	60	41	58	50	45	50.7	6.7

The correlation coefficient (r) for this data set is approximately $-0{\cdot}8$.

(i) Verify the value of the correlation coefficient, using your calculator, and give your value correct to THREE decimal places. **1**

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(ii) Identify the direction and the strength of the linear association between the Science and Humanities results. **1**

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(iii) By applying the appropriate formulae given below and the given information in the table, determine the equation of the least-squares line of best fit, using $r = -0.8$ and values of both m and c correct to two decimal places. **3**

$$m = r \times \frac{\sigma_y}{\sigma_x} = r \times \frac{\text{population standard deviation of } y \text{ scores}}{\text{population standard deviation of } x \text{ scores}}$$

$$c = \bar{y} - m\bar{x} = \text{mean of } y\text{-scores} - m \times \text{mean of } x\text{-scores}$$

$$r = \text{correlation co-efficient}$$

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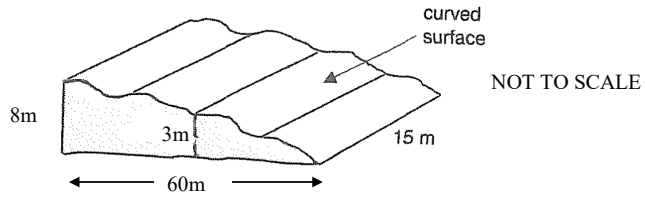
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Question 22 (3 marks)

The cross-section of part of a BMX track is shown below.



NOT TO SCALE

(i) Use two applications of the trapezoidal rule to calculate the approximate area of the cross-section (front face). **2**

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(ii) Compacted sand was used to build the track. The sand cost $\$120\ per\ m^3$. Calculate the cost of building the track. **1**

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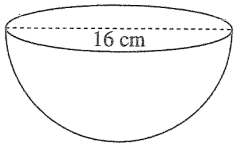
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Student Number

Question 23 (2 marks)

A cereal bowl is in the shape of a hemisphere with a diameter of 16 cm.



NOT TO SCALE

What is the exterior surface area of the cereal bowl, correct to the nearest square centimetre? **2**

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Question 24 (3 marks)

A commercial I.T. system was purchased for $36 000.
Each year the value of the I.T. system is depreciated by the same percentage.

The table show the value of the I.T. system, based on the declining-balance method of depreciation, for the first three years.

End of Year	*Value*
1	$32 580
2	$29 484.90
3	$26 683.83

(i) What is the annual percentage decrease? **1**

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(ii) What is the amount of depreciation after 8 years? **2**

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Question 25 (4 marks)

A table of future value interest factors for an annuity of $1 is shown.

Table of future value interest factors					
Period	*Interest rate per period*				
	1%	2%	3%	4%	5%
3	3.0301	3.0604	3.0909	3.1216	3.1525
4	4.0604	4.1216	4.1836	4.2465	4.3101
5	5.1010	5.2040	5.3091	5.4163	5.5256
6	6.1520	6.3081	6.4684	6.6330	6.8019

An annuity involves contributions of $18 000 per annum for 6 years.
The interest rate is 3% per annum, compounded annually.

(i) Calculate the future value of this annuity. **1**

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(ii) Calculate the interest earned on this annuity. **1**

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(iii) Using this table, find the payment per period (to the nearest cent), of an annuity whose future value is $142 000 at 2% p.a. compounded annually for 5 years. **1**

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(iv) Using this table, find the annual compound interest rate of an annuity whose future value is $10 446.96 when $1575 is invested at the end of each year for 6 years. **1**

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Student Number

Question 26 (3 marks)

The table shows the estimated number of kilojoules used per kilogram of body mass per 30 minutes in different activities.

Activity	*Energy used in 30 minutes*
Walking: 6 km/h	9.22 kJ/kg
Cycling: 20 km/h	18.43 kJ/kg
Swimming: 50 m/min	20.73 kJ/kg
Jogging: 10 km/h	21.19 kJ/kg
Running: 16 km/h	32.25 kJ/kg

(a) Georgia has a mass of 52 kg and swims at an average rate of 50m/min for 20 minutes. How much energy does she use, to the nearest kilojoule? **1**

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(b) Mark, who weighs 72 kg, has a drink which contains 1200 kJ. For how long, correct to the nearest minute, must Mark jog at 10 km/h to burn off the energy contained in the drink? **2**

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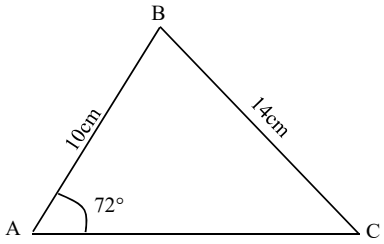
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Student Number

Question 27 (3 marks)

(i) Use the sine rule to calculate ∠ ACB to the nearest degree. **2**



NOT TO SCALE

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(ii) Calculate the area of △ ABC, correct to the nearest square centimetre. **1**

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Question 28 (3 marks)

Find the values of x and y which satisfy the following equations simultaneously. **3**

$y = 2x - 3$

$4y - x = 30$

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Question 29 (3 marks)

Jack bought a car advertised for $38 000.
He paid a $10 000 deposit and took out a flat-rate loan to repay the balance.
Simple interest was charged at a rate of 5% per annum on the amount borrowed.
He repaid the loan over 4 years, making equal monthly repayments.

Calculate the monthly repayment. **3**

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Question 30 (3 marks)

Rosie has arranged to take her four weeks holiday from work.
She will be paid her 'normal' four weeks pay and her 17.5% holiday loading during this holiday period.
She received $8 657.40 over the holiday period.

Calculate Rosie's annual pay. **3**

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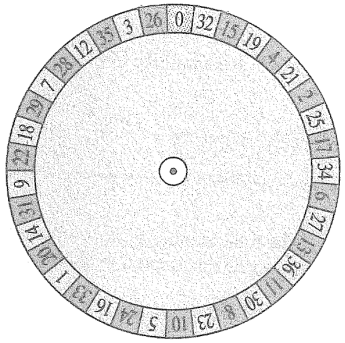
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Question 31 (2 marks)

A roulette wheel has the numbers 0, 1, 2, …., 36 where each of the numbers is equally likely to be spun.



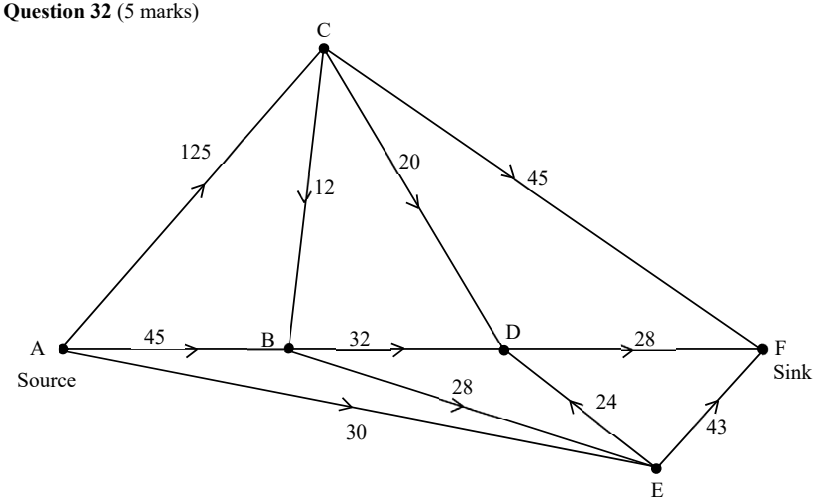
The wheel is to be spun 74 times. Calculate the expected frequency of spinning a single digit number. **2**

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Question 32 (5 marks)



The network above represents the waterflow, in kilolitres per minute, in a series of pipes.

(i) What is the maximum flow through A-B-E-F? **1**

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(ii) What is the maximum flow of this network? **1**

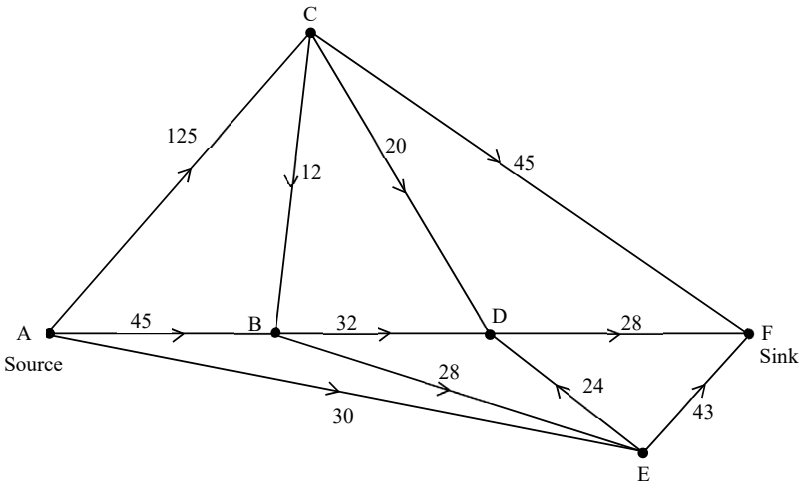
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Question 32 (continued)

(iii) By annotating the network diagram below or listing the relevant paths and their flows, show the flow along each edge in order to achieve the maximum flow. **2**



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(iv) The capacity of one pipe is to be increased to improve the maximum flow.
Which pipe should be chosen?
Justify your choice giving reasons. **1**

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Question 33 (5 marks)

The number of penguins living in an area is given by the formula

$$N = 850(0 \cdot 7)^t$$

where N = the number of penguins
t = the number of years since the start of 2010

(i) The formula above is an example of exponential growth. True or false? **1**

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(ii) How many penguins were living in the area at the start of 2010? **1**

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(iii) How many penguins were living in the area at the start of 2020? **1**

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(iv) Which was the first year when there were there less than 400 penguins living in the area? **2**
Show calculations to justify your answer.

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Question 34 (3 marks)

The weight, to the nearest kilogram, of seven people at the local gym is shown.

53, 80, 86, 88, 94, 98, 126

Identify all outliers in this data set, justifying your answers with calculations. **3**

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Question 35 (4 marks)

Dan is driving at 90 km/h. He sees a fallen tree ahead and applies the brakes.
His reaction time is 0.8 seconds.
His braking distance (D metres) is given by

$D = 0 \cdot 01v^2$, where v is speed in km/h.

Using the formula: stopping distance = reaction time distance + braking distance

calculate Dan's stopping distance, to the nearest metre. **4**

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Question 36 (5 marks)

Two basketball teams, Team A and Team B, each played 12 games. For each team, the number of points scored in each game was recorded in the table below.

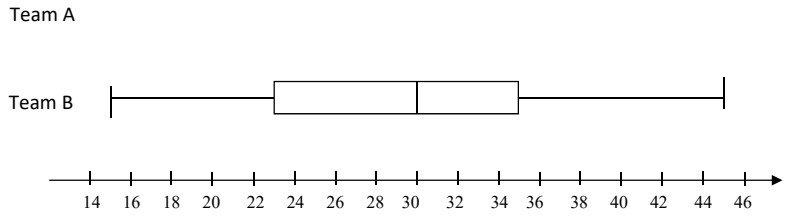
Team A	27	35	31	25	28	35	32	27	32	24	32	29
Team B	22	38	29	18	25	31	45	24	15	32	38	31

(i) Using your calculator or otherwise, analyse the data for Team A to complete the Team Analysis table below. **2**

	Team A	*Team B*
Lowest score		15
Lower quartile		23
Median		30
Upper quartile		35
Highest score		45

The data for Team B was used to create the box-plot shown below.

(ii) Using the same axis, construct a box-plot for the data for Team A. **1**



(iii) Compare the distribution of the number of goals scored by the two teams. **2**

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Student Number

Question 37 (3 marks)

The table shows the income tax rates for the 2019-2020 financial year.

Taxable income	*Tax payable on this income*
\$0 to \$18 200	Nil
\$18 201 to \$37 000	19c for each \$1 over \$18 200
\$37 001 to \$90 000	\$3 572 plus 32.5c for each \$1 over \$37 000
\$90 001 to \$180 000	\$20 797 plus 37c for each \$1 over \$90 000
\$180 001 and over	\$54 097 plus 45c for each \$1 over \$180 000

The Medicare levy is calculated as 2% of taxable income.
Mollie earns \$104 000 and has allowable tax deductions of \$1 500.
Calculate **the total tax payable** to the Australian Taxation Office. **3**

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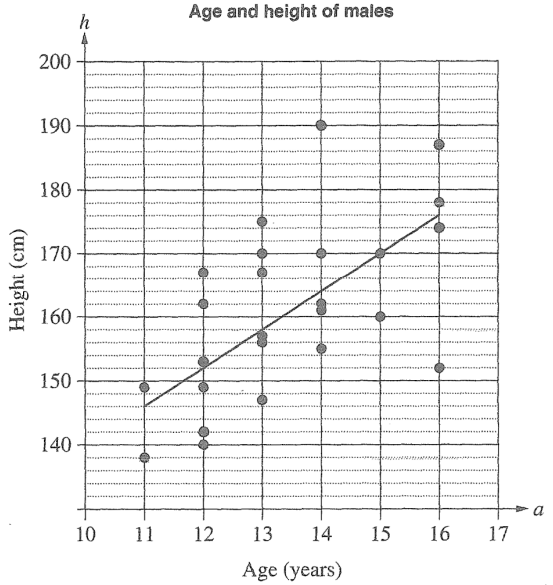
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Question 38 (4 marks)

Michael collected data on the age (a) and height in centimetres (h) of students aged 11 to 16 years. He created a scatterplot of the data and drew a line of best fit to model the relationship between age and height of these students.



(i) Determine the equation of the line of best fit, by determining the gradient and vertical intercept. **2**

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(ii) Explain the meaning of the gradient in the context of the data. **1**

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(iii) Why would this model not be useful for predicting the height of a 30 year old person? **1**

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Question 39 (5 marks)

A project requires activities A to F to be completed.
The activity chart shows the immediate prerequisite(s) and duration for each activity.

Activity	*Immediate prerequisite(s)*	*Duration in days*
A	-	3
B	-	4
C	A	2
D	B C	7
E	B	10
F	D E	5

(i) By drawing a network diagram, determine the minimum time for the project to be completed. **3**

Minimum time: …….

(ii) List the activities on the critical path. **1**

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(iii) Determine the float time of activity C. **1**

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2020 Y12 Standard 2 Trial Solutions

1. D

2. $\tan\theta = \frac{6.4}{4.5}$ $\theta = 54°53'$ D

3. Sydney is +14hrs of New York
   ∴ NY 3pm Tuesday +14 = Sam Wed A

4. A

5. Distance = $2\pi \times 6480$km
   Time = $2\pi \times 6480$km $/ 5$km/s
   = 8143sec $\div 60 \div 60$
   = 2hrs 15min 43sec B

6. B

7. C

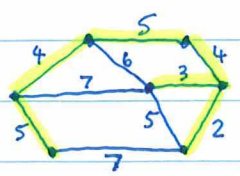
8. $IQR = Q_3 - Q_1 = 172 - 136 = 36$ D

9. 18°S + 43°N = 25°N ∴ D
   150°W + 90°W = 240°W ie 120°E

10. $\$82000 = P\left(1+\frac{1.5\%}{4}\right)^{5\times4}$
    $P = 82000 \Big/ \left(1+\frac{1.5\%}{4}\right)^{5\times4}$
    = \$76085.64 D

11. $12450 = \frac{k}{4}$ $k = 49800$ B

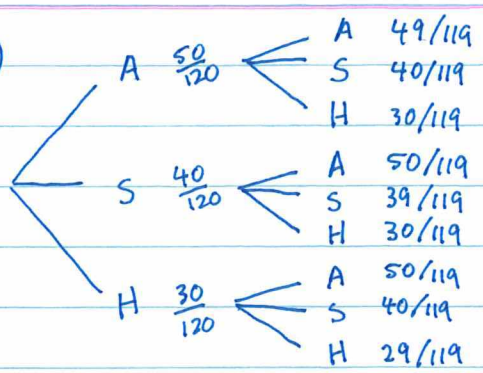
12. 250W × 8h × 5 × 6 = 60000Wh
    60kWh × \$0.15/kWh = \$9 A

13. 

    2+3+4+5+4+5
    = 23km B

14. 3:5:7 → 15parts
    4.86cm = 3parts
    15parts = 24.3cm C

15. profit 400 = \$10000
    profit 300 = \$5000 A

16. i) 

    ii) $P(SS) = \frac{40}{120} \times \frac{39}{119} = \frac{13}{119}$
    iii) $P(A \text{ or } H) = \frac{50}{120} + \frac{30}{120} = \frac{2}{3}$
    iv) Method 1: $P(\overline{HH}) = \frac{90}{120} \times \frac{89}{119} = \frac{267}{476}$
    Method 2: $P(\overline{HH}) = P(AA) + P(AS) + P(SA) + P(SS)$
    $= \frac{50}{120}\times\frac{49}{119} + \frac{50}{120}\times\frac{40}{119} + \frac{40}{120}\times\frac{50}{119} + \frac{40}{120}\times\frac{39}{119}$
    $= \frac{267}{476}$

17. $(BC)^2 = 8^2 + 12^2 - 2\times8\times12\times\cos60° = 112$
    $BC = \sqrt{112} = 10.583\ldots = 10.58$cm

18. $\%\text{ div yield} = \frac{\$7800}{16000 \times \$6.45} \times 100\% = 7.6\%$

19. beef pies = $240 \div 8 = 30$
    sausage rolls = $30 \div 5 \times 3 = 18$

20. Method 1: $2x+8 = 9x+6$
    $2 = 7x$ $\therefore x = \frac{2}{7}$
    Method 2: $\frac{2x+8}{6} = \frac{9x}{6} + \frac{6}{6}$
    $2x+8 = 9x+6$
    $2 = 7x$ $\therefore x = \frac{2}{7}$

21. i) $-0.83903\ldots = -0.839$
    ii) strong negative
    iii) $m = -0.8 \times \frac{6.7}{9.4} = -0.57$
    $c = 50.7 - -0.57 \times 73.2$
    $= 92.42$ $\therefore y = -0.57x + 92.42$

22. i) $A \approx \frac{30}{2}\times(8+3) + \frac{30}{2}\times(3+0) = 210m^2$
    ii) Volume = $210m^2 \times 15m = 3150m^3$
    cost = $3150m^3 \times \$120/m^3$
    = \$378000

23. $SA = \frac{1}{2} \times 4\pi \times 8^2 = 402 cm^2$

24. i) $\frac{36000 - 32580}{36000} \times 100\% = 9.5\%$

ii) $S = 36000(1 - 9.5\%)^8 = \$16199.11$

$\therefore$ Depreciation $= \$36000 - \$16199.11$

$= \$19800.89$

25. i) $FV = \$18000 \times 6.4684 = \$116431.20$

ii) Interest $= \$116431.20 - \$18000 \times 6$

$= \$8431.20$

iii) payment $= \$142000 \div 5.2040$

$= \$27286.70$

iv) $\$10446.96 = \$1575 \times$ interest factor

interest factor $= 6.63299...$

from table $6.6330 \rightarrow 4\%$ pa

26. a) Energy $= \frac{20.73 kJ}{kg} \times 52kg \times \frac{20 min}{30 min}$

$= 719 kJ$

b) $1200 kJ = 21.19 kJ/kg \times 72kg \times x$

$x = 0.7865$

time $= 0.7865 \times 30 mins = 24 mins$

27. i) $\frac{\sin \angle ACB}{10} = \frac{\sin 72^\circ}{14}$ $\angle ACB = \sin^{-1}\left(\frac{10 \sin 72}{14}\right) = 43^\circ$

ii) $A = \frac{1}{2} \times 10 \times 14 \times \sin 65^\circ = 63 cm^2$

as $\angle ABC = 180 - 72 - 43 = 65^\circ$

28. $y = 2x - 3$ (A)

$4y - x = 30$ (B)

sub (A) into (B)

$4(2x - 3) - x = 30$

$8x - 12 - x = 30$

$7x = 42$ $\therefore \boxed{x = 6}$

sub $x = 6$ into (A)

$y = 2 \times (6) - 3$

$\boxed{y = 9}$

29. $I = \$28000 \times 5\% \times 4 = \$5600$

mthly payment $= \frac{28000 + 5600}{4 \times 12}$

$= \$700$ per mth

30. $\$8657.40 = 117.5\% \times 4$ wks pay

4 wks pay $= \$7368$

annual pay $= \frac{7368}{4} \times 52 = \$95784$

31. $\frac{10}{37} \times 74 = 20$

32. i) 28 kL/min

ii) $45 + 28 + 43 = 116 kL/min$

iii) Multiple ways 116kL/min can flow

One answer: A - C - F 45

A - B - D - F 28

A - B - E - F 13

A - E - F 30

iv) CF, DF or EF are on the min cut line

CF is best $\rightarrow$ can increase flow by 80kL/min

33. i) False $\rightarrow$ exponential decay

ii) $N = 850(0.7)^0 = 850$

iii) $N = 850(0.7)^{10} = 24$

iv) when $t = 2$ $N = 416.5$ $\therefore$ during 2012

when $t = 3$ $N = 291.6$

34. $Q_1 = 80$ $Q_3 = 98$ $IQR = 18$

$LL = 80 - 1.5 \times 18 = 53$ $\therefore$ no low outliers

$UL = 98 + 1.5 \times 18 = 125$ $\therefore$ 126 is an outlier

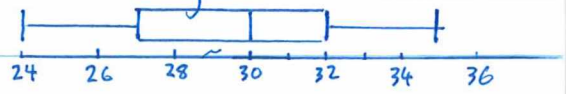
35. reaction distance $= 0.8 sec \times (90 \div 3.6) m/s = 20 m$

braking distance $= 0.01 \times 90^2 = 81 m$

stopping distance $= 20 + 81 = 101 m$

36. i) 5 number summary: 24 27 30 32 35

ii)



iii) The range of A(11) is smaller than B(30)

The IQR of A(5) is smaller than B(12)

The medians for both teams are equal(30)

Both distributions are relatively symmetrical

37. taxable income $= 104000 - 1500 = \$102500$

income tax $= \$20797 + 0.37 \times (102500 - 90000) = \$25422$

medicare $= 2\% \times 102500 = \$2050$

total $= 2050 + 25422 = \$27472$

38. i) $m = \frac{\text{rise}}{\text{run}} = \frac{176-146}{16-11} = 6$

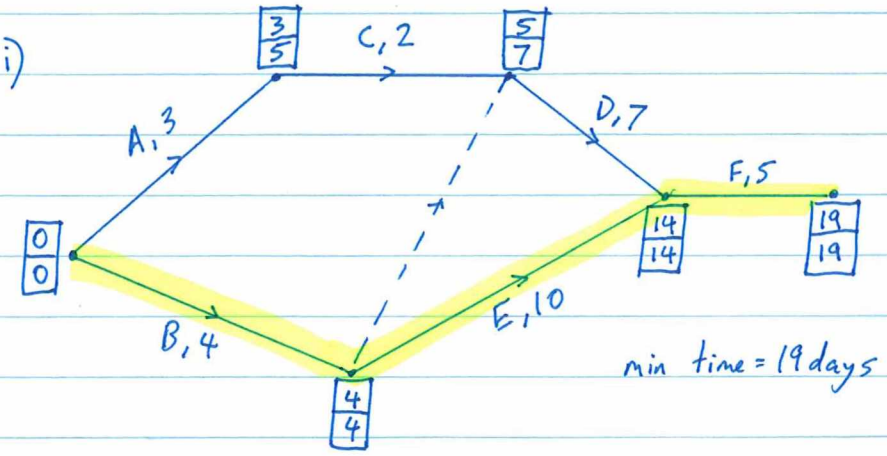
y-intercept $= 146 - 11 \times 6 = 80$

$\therefore h = 6a + 80$

ii) growth → 6cm/yr growth of males

iii) 30 years old is outside the dataset and extrapolations are much less reliable

39. i)



min time = 19 days

ii) B - E - F

iii) float = 7 - 3 - 2 = 2 days