Statistics

<table>
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<tr>
<th>Year</th>
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<th>HA</th>
<th>SA</th>
<th>LA</th>
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Multiple-choice questions

<table>
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<tr>
<th>Question</th>
<th>1</th>
<th>2</th>
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<td>D</td>
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<td>C</td>
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Characteristics of good responses

Knowledge and procedures (KP)

The majority of candidates demonstrated sound understanding or better of the syllabus subject matter across the full range of contexts. In good responses, candidates generally provided:

- clear justification and working to support their solutions or conclusions reached
- substantial use of diagrams and attempts to show significant intermediate calculation steps. This was particularly evident in the following topics: Linking two and three dimensions and Managing money in Paper One; and in Paper Two, Maps and compasses — Navigation and Introduction to data and its presentation
- significant attempts to reach a conclusion, with many candidates recognising the importance of supporting conclusions with reasoned mathematical argument.
Modelling and problem solving (MP)
Many responses demonstrated significant attempts to explore the strengths and limitations of proposals and/or conclusions reached in those scenarios involving mathematical modelling. This was particularly evident in the following topics: Managing money and Introduction to data and its presentation in Paper One and also in Maps and compasses — Navigation in Paper Two.

Communication and justification (CJ)
Many candidates appreciated the need to justify and validate their solutions. This was clearly evident in those successful responses which exhibited a developed argument and some exploration of the strengths and limitations of models.

Common weaknesses

Knowledge and procedures (KP)
Common weaknesses included:

- working accurately with instruments — showing the essential detail and calculations of chart work in Maps and compasses — Navigation; working with scale and units of measure in Linking two and three dimensions; and drawing accurate box plots in Introduction to data and its presentation
- transferring information — correct currency conversions and working algebraically in Managing money
- magnetic bearings — insufficient detail in calculation stages hindered the successful transfer of information in the chart work of Maps and compasses — Navigation
- difficulty in correctly identifying the critical path and then making an informed judgment using derived information.

Modelling and problem solving (MP)
To achieve success in this criterion, candidates must:

- explore the strengths and limitations of models
- make use of clearly labelled, neatly drawn diagrams to support their arguments and conclusions reached. These diagrams are a significant part of a candidate’s justification of an argument, even if only of an exploratory nature.

Communication and justification (CJ)
To achieve success in this criterion, candidates must:

- effectively build supporting arguments to show clarity and depth of thinking. This should be done across a range of subject matter
- give more attention to the requirements of this criterion when developing solutions to problems.
Sample solutions

The following solutions are not necessarily prescriptive model responses and are not necessarily the only way of solving a problem. Other approaches and problem-solving strategies may be just as acceptable.

Paper One Part B

Question

(a) i) discounted price = retail price - discount

\[ = 500 - 150 \]

\[ = 350 \]

\[ \therefore \text{the discounted price is $350} \]

ii) discount \% = \frac{\text{discount}}{\text{retail price}} \times 100

\[ = \frac{150}{350} \times 100 \]

\[ = 30 \]

\[ \therefore \text{the discount is 30\% of the retail price} \]

b) The bank will buy USD $0.90 for AUD $1

USD $1400 is worth AUD $1400 ÷ 0.90

Sandy will receive AUD $1555.56

Now she has the equivalent of 4000 × 1555.56 = AUD $5555.56

The bank will sell 0.65 euros for AUD $1

AUD $5555.56 is worth €0.65 × 5555.56

Sandy will receive €3611.11

\[ \therefore \text{Sandy has €3611.11 to travel in Europe} \]
c) Commission: \[ 7250 + 0.035 \times (480 \times 120 - 480 \times 100) \]
\[ = 7250 + 0.035 \times 2880 \]
\[ = 7250 + 100.80 \]
\[ = 8250.80 \]
Charles received $8250.80 in commission.

ii.) Total pay = retainer + commission
\[ = 650 + 8250.80 \]
\[ = 8900.80 \]
Charles' total pay was $8900.80.

d) \[ E = \frac{(1 + r)^n - 1}{n} \]
\[ 0.1 = \frac{(1 + r)^5 - 1}{5} \]
\[ 0.5 = (1 + r)^5 - 1 \]
\[ 1.5 = (1 + r)^5 \]
\[ \sqrt[5]{1.5} = 1 + r \]
\[ 1.0844 = 1 + r \]
\[ 0.0844 = r \]

Therefore the equivalent flat rate of interest is 8.44% p.a.
Question 2

(i) 
\[274000 \text{ cm} = 100 = 2740 \text{ m} \]
\[2740 \text{ m} = 1000 = 2.74 \text{ km} \]

(ii) 
\[1 \text{ m}^2 = 10000 \text{ cm}^2 \]
\[1.5 \text{ m}^2 = 1.5 \times 10000 = 15000 \text{ cm}^2 \]

(iii) 
\[\tan \theta = \frac{h}{A} \]
\[\tan 65^\circ = \frac{80}{x} \]
\[x = \frac{80}{\tan 65^\circ} \approx 37.3 \text{ m} \]

\[\therefore \text{ it is } 37.3 \text{ m from point A to point B} \]

(iv) 
\[\tan \theta = \frac{y}{x} \]
\[\tan 67^\circ = \frac{y}{37.3} \]
\[y = 37.3 \times \tan 67^\circ \approx 87.87 \text{ m} \]
\[x = \frac{y}{80} \approx 87.87 - 80 \approx 7.87 \text{ m} \]

\[\therefore \text{ the height of the flagpole is } 7.87 \text{ m} \]
Question \(2\)

(i) \[
\sqrt[3]{\frac{1}{\pi}} = \frac{1}{\pi} x 2 \times 2
\]

\[
= \pi \times 3.75 \times 2
\]

\[
= 88.36
\]

\[
\approx 88
\]

\[
\therefore \text{the volume of the tank is approximately} \ 88 \text{ m}^3
\]

(ii) \[1 \text{ m}^3 = 1000 \text{ L}\]

\[
\therefore 88 \text{ m}^3 = 88000 \text{ L}
\]

Number of hours = \[
\frac{\text{Number of L \div \text{L per hour}}}{1000}
\]

= \[
\frac{88000}{5000}
\]

= 17.6 hours

= 17 hours 36 min

\[
\therefore \text{the sprinkles can be used for} \ 17\text{h}36\text{min}
\]

\[
\text{(or 17 whole hours)}
\]
Question 3

g) 

Dining

Living

6.5cm

Length: \(6.5\text{cm} \times 150 = 975\text{cm} = 9.75\text{m}\)

Width: \(2\text{cm} \times 150 = 300\text{cm} = 3\text{m}\)

Area \(= L \times W\)

\[= 9.75 \times 3\]

\[= 29.25 \text{m}^2\]

Cost = \text{number of } \text{m}^2 \times \text{cost per } \text{m}^2

\[= 29.25 \times 9.6\]

\[= 280.8\]

\[\therefore \text{it will cost } \$280.8 \text{ to completely replace the tiles.}\]

b) 5m: \(500\text{cm} \div 250 = 2\text{cm}\)

6m: \(600\text{cm} \div 250 = 2.4\text{cm}\)

40m: \(4000\text{cm} \div 250 = 16\text{cm}\)

60m: \(6000\text{cm} \div 250 = 24\text{cm}\)
Question 3

b) (continued)
Question 3

b) (continued)

Width of lane of 1:150 plan is 8.5cm

\[ 8.5 \times 150 = 1275 \text{ cm} \]

Scaled back to 1:250: \[ 1275 \div 250 = 5.1 \text{ cm} \]

c) The back boundary is 40m long. To fit the fence contain a 3m wide gate.

So a 37m fence is to be built.

Rails: $2.45/m \times 3.7m \times 3 \text{ rails} = $271.95$

Palings: 75mm wide \times 25mm gap = 100mm effective width.

3.7m = 3700mm (length of fence)

\[ 3700 \div 100 = 37 \text{ palings required} \]

\[ 37 \times 1.90 = 70.3 \text{ for palings} \]

Total cost = cost of rails + cost of palings

\[ = 271.95 + 70.3 = 972.25 \]
d) Obviously, multiple answers are acceptable. Here is one:

1. Frame – I intend using two of the 5m lengths and cutting each into a 3m and a 1.5m length, making two “top” and two “side”. 

2. Bracing – I will firstly consider the shortest possible brace (using the largest possible angle). 

\[ \sin 53^\circ = \frac{1.5}{x} \]

\[ x = \frac{1.5}{\sin 53^\circ} = 1.88 \text{m} \]

I would probably use the 2m length.

But aesthetically, the gate would look a bit odd with bracing like this: \[ \square \]

It would look better if it went from corner to corner like this: \[ \square \]

I will check the angle to make sure it isn’t too small and if feasible, check the length.
Question 3

\[ \tan \theta = \frac{3}{1.5} \]

\[ \theta = \tan^{-1}\left(\frac{3}{1.5}\right) \]

\[ \approx 63.43^\circ \]

The brace cannot go from corner to corner, as this angle is not within acceptable limits.

Consider the following possible design.

As each "side" of the gate forms a 1.5m x 1.5m square, angle \( \theta \) must be 45° (within acceptable limits).

To determine the length of each brace:

\[ a^2 + b^2 = c^2 \]

\[ 1.5^2 + 1.5^2 = c^2 \]

\[ 2.25 + 2.25 = c^2 \]

\[ 4.5 = c^2 \]

\[ c = \sqrt{4.5} \]

\[ c = 2.12 \]

A 3m 1.5m (0.5m waste)
B 3m 1.5m (0.5m waste)
C 2.12m 2.12m (0.76m waste)
D 1.5m (0.5m waste)
There are two braces for increased strength.
2. The symmetry of the design makes it aesthetically pleasing.

Limitations
1. There was wastage of wood.
   (but only little - 2.26m out of 17m)
2. There are holes big enough for people and animals to crawl through.
Question 4a

Time taken to perform a study task

Time... (minutes)
ii) This statement is not reasonable...

The "no music" group not only had a lower minimum and maximum than the "music" group, every other summary statistic was lower as well.

Whilst the range of the "no music" group is (slightly) higher (17 vs. 16), its smaller interquartile range indicates that the scores are more consistent.

Significantly, the maximum score of the "no music" group (30) is significantly lower than even the 75% of the "music" group.

This indicates that over 25% of the group, listening to music took longer than the slowest of the group, which was not listening to music...
Question 4b

i) Total number of workers = 80 + 60 + 100 + 45 + 40 + 35
   = 360

<table>
<thead>
<tr>
<th></th>
<th>&lt; 30</th>
<th>≥ 30</th>
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</thead>
<tbody>
<tr>
<td>Administrative</td>
<td>60 x 80 / 360 = 13.3 ≈ 13</td>
<td>60 x 45 / 360 = 7.5 ≈ 7</td>
</tr>
<tr>
<td>Technical</td>
<td>60 x 160 / 360 = 27.8 ≈ 30</td>
<td>60 x 40 / 360 = 6.7 ≈ 7</td>
</tr>
<tr>
<td>Labour &amp; Support</td>
<td>60 x 100 / 360 = 16.7 ≈ 17</td>
<td>60 x 35 / 360 = 5.8 ≈ 6</td>
</tr>
</tbody>
</table>

13 + 10 + 17 + 7 + 7 + 6 = 60 (required sample size)

ii) In order to select the survey respondents,
    allocate numbers to the members of each
    group (e.g. 1 to 80 for Administrative staff
    less than 30 years of age, 1 to 60 for
    Technical staff less than 30 years of age, etc).
    Use a random number generator to generate
    the appropriate number of random numbers
    for each group (as detailed in the table
    above). Distribute surveys to these staff
    members.
Question 5

(i) (a) Option 1: Total repayments = $5995
    Interest = $2

Option 2: Total repayments = 1250 + 24 x 2.65
    Interest = 7610

Option 3: Total repayments = 5995 + 1.8 x 3.3
    = $9018.33
    Interest = 9018.33 - 5995
    = $3023.33

(ii) Obviously, Option 1 is financially superior as the interest is required to be paid in full with $1615 and $3023.33 with other options. However, Option 1 requires a large up-front payment (almost $3000) and another $200 payment only 6 months later.

Essentially, the entire cost must be paid within 6 months. If Clarissa can come up with the money within the tight time frame, this would be the best option.

Option 3 is not recommended for a number of reasons. Firstly, the deposit required is sizeable, and whilst it allows Clarissa longer to pay the loan off...
Question 5

(18 months) ... the interest rate must be very high. This is evidenced by the large amount of interest which accrues over the 18 months over $3000.

Option 2 is probably the best option, as it requires a smaller deposit ($1250), allows 24 months for repayments to be made, and charges only a moderate amount of interest ($1615).

b) i) Annual income = weekly income x 52

= 52.5 x 52

= 27300

ii) Jonathan’s annual income is $27,300.
Question 5

<table>
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<th>5</th>
<th>Expenses</th>
<th>Amount (annually)</th>
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<td></td>
<td>Board</td>
<td>78 x 52 = 3640</td>
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<tr>
<td></td>
<td>Car repayments</td>
<td>210 x 26 = 5460</td>
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<td></td>
<td>Car reg. + ins.</td>
<td>1040</td>
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<tr>
<td></td>
<td>Fuel</td>
<td>60 x 52 = 3120</td>
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<tr>
<td></td>
<td>Car maint. + serv.</td>
<td>780</td>
</tr>
<tr>
<td></td>
<td>Gym</td>
<td>70 x 26 = 1820</td>
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<tr>
<td></td>
<td>Entertainment</td>
<td>60 x 52 = 3120</td>
</tr>
<tr>
<td></td>
<td>Clothing</td>
<td>50 x 26 = 1300</td>
</tr>
<tr>
<td></td>
<td>Health insurance</td>
<td>18 x 20 = 1820</td>
</tr>
</tbody>
</table>

**Total:** 22100

(ii) Jonathan's after-tax expenditure is $22100.

(iii) $17,300 - 22100 = 5200

= $100 weekly saved.
Paper Two

Question 1

a) i) \[ 15500 - 3 \times 2500 = 8000 \]

\[ \text{the trade-in value of the van will be}$ 8000. \]

ii) \[ A = P \cdot (1 + r)^t \]

\[ = 29575 \cdot (1 + 0.029)^3 \]

\[ = 32223.36 \]

\[ \text{the van will cost}$ 32223.36 \text{ in 3 years.} \]

iii) \[ \text{Amount required} = \text{Cost of van} - \text{Value of trade-in} \]

\[ = 32223.36 - 8000 \]

\[ = 24223.36 \]

\[ \text{Jennifer will require an extra}$ 24223.36. \]

b) i) \[ \text{PAYG tax paid} = 875 \times 26 \]

\[ = 22750 \]

\[ \text{Gross income} = 3645 \times 26 \]

\[ = 94770 \]

\[ \text{Taxable income} = 94770 - 6425 \]

\[ = 88345 \]

\[ \text{Tax payable} = 18000 + 0.40 \times (88345 - 80000) \]

\[ = 18000 + 0.40 \times 8345 \]

\[ = 18000 + 3338 \]

\[ = 21338 \]

\[ \text{The tax payable is}$ 21338. \]
Question 1

b) ii) Medicare levy = 0.015 \times 88.345

= 1.325.18

Total tax payable = 21338 + 1.325.18

= 22663.18

Tax refund = 22750 - 22663.18

= 86.82

Tom receives a tax refund of $86.82.

c) i) SI = PRT

= 5000 \times 0.062 \times 2

= 620

Tom and Claire will earn $620 in simple interest.

ii) A = \text{P} (1 + \text{i})^n

5620 = \text{P}(1 + \frac{0.062}{2})^4

\frac{5620}{(1 + \frac{0.062}{2})^4} = \text{P}

\text{P} = 4973.95

Tom and Claire would need to invest $4973.95.
Question 2

a) i. \( \bar{x} = \frac{\sum x}{n} \)

\[= \frac{13 + 15 + 16 + 23 + 24 + 30 + 30 + 30 + 30}{9} \]

\[= 23 \]

Median: 18, 18, 18, 23, 23, 30, 30, 30, 30

The mean is 23 and the median is 23.

ii) The mean will be drastically reduced.

\[\bar{x} = \frac{(13 + 15 + 16 + 23 + 24 + 23 + 23 + 30 + 30)}{8} \]

\[= 22.375 \]

The median, however, will be unaltered.

Median: 18, 18, 18, 23, 23, 23, 23, 30, 30

b) i. 50 - 60 kg = 5 students

60 - 70 kg = 3 more students

So, 8 would weigh less than 70 kg.

\( \frac{8}{100} \) of 100, there will be 40 students < 70 kg.

ii) Q₁ = score 5 = 55 kg

Q₃ = score 15 = 85 kg

\( IQR = Q₃ - Q₁ = 30 \) kg

iii) 12 kg weigh < 80 kg, 8 kg weigh > 80 kg.

So, the probability is \( \frac{8}{20} = 40\% \).
Question 2

...c)i)... The conclusion reached is questionable, for...

...many reasons:

1. The statement is based on a very small sample of cars. (b)

2. The stopping distance of a car is affected by many factors. To be a fair test, all 6 of the sample vehicles should have, at the very least, been of the same make and model. It is unknown whether or not this is the case.

3. Stopping distance is largely influenced by the condition of the tyres and brake pads. Were all 6 cars in similar condition with respect to these variables?

4. Testing at 50 km/h whilst technically modelling conditions in an urban environment does not give an accurate picture of the way many drivers drive.

The representative claims that “as the car gets older, its stopping distance increases.” Yet the 2nd longest stopping distance was recorded by the 2nd youngest car. Also, the oldest car had a stopping distance only 1m greater than a car which was less than half its age.

In summary, this is an unreliable conclusion. More extensive and rigorous testing is required.
Question 3

a) i) \[ \tan \theta = \frac{9}{x} \]

ii) \[ \tan 75^\circ = \frac{x}{9} \]

\[ x = 9 \cdot \tan 75^\circ = 33.59 \text{ km} \]

b) \[ \text{The pink lady is } 345^\circ \text{ W} / 225^\circ \text{T} \]
Question 3b

An additional chart for Question 3b (if required) is on page 26.

This chart is not to be used for navigation purposes.
ii) On the chart, the boat is 8.3 cm from Point Flinders.

- Transferring this distance to the latitude scale, the boat has travelled 1°01', or 61'.
- Since 1' = 1 nm, the boat is 61 nm from Point Flinders.
Question 3c

An additional chart for Question 3c (if required) is on page 27.

This chart is not to be used for navigation purposes.
Mean deviation = 9°05'.E

Increasing 06' annually for 21 years
06' x 21 = 126' = 2°06'

... Mean deviation is now 11°11'.E

"Deviation, east, magnetic, least..."
"Deviation, west, magnetic, best..."

... a bearing of 135°M = 135° + 11°11' = 146°11' T

105°M = 116°11' T
055°M = 066°11' T

Position at 9:45am = 40°00'S, 148°54'E
Position at 1pm = 40°38'S, 148°55'E

Distance between these points is 10.1cm on the map

... transferring this distance to the latitude scale,
the distance is 38', which is 38nm (1' = 1nm).

Speed = \frac{\text{distance}}{\text{time}}
= \frac{38\text{ nm}}{3.25 \text{ h}}
= 11.7 \text{ nm/h}
= 11.7 \text{ knots}

... the average speed of the trailer was 11.7 knots.
Question 4a

i) \[ 3 + 6 + 8 + 6 + 25 = 48 \text{ days} \]

ii) Critical path: \( A - C - E - G - L \)

iii) Critical path is now \( A - C - E - G - L \)

(assuming C to go to 4 days, and either of B or H to dry a day) or: \( A - B - H - E \) (requiring the same adjustments. In either case, L must go to 23 days.

Minimum completion time is now

\[ 3 + 4 + 8 + 6 + 23 = 46 \text{ days} \]

However, this involved an overall reduction of 5 days across the critical path:

\( 2 \text{ at } C \), \( 1 \text{ at } B \), \( H \) and \( 2 \text{ at } L \)

\[ 65000 \times 5 = 325000 \]

The minimum completion time is now

44 days, with an associated minimum additional cost of \( 325000 \).
Question 4b

i) Minimum spanning tree is highlighted above.

\[200 + 200 + 400 + 150 + 150 + 100 = 1000 \text{ m}\]

ii) \[4.5 \times 1000 = 45000\]

...it would cost $45000 to provide fibre optic cabling to each building.
**Question 4c (i)**

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<th>Arrivals</th>
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<th>People in queue</th>
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<td>A</td>
<td>—</td>
<td>0</td>
<td>—</td>
</tr>
<tr>
<td>1</td>
<td>A</td>
<td>B, C</td>
<td>2</td>
<td>B, C</td>
</tr>
<tr>
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<td>A</td>
<td>D</td>
<td>3</td>
<td>B, C, D</td>
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<tr>
<td>3</td>
<td>B</td>
<td>—</td>
<td>2</td>
<td>C, D</td>
</tr>
<tr>
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<td>B</td>
<td>E</td>
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<td>—</td>
<td>2</td>
<td>D, E</td>
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<td>F</td>
<td>3</td>
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<td>—</td>
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<tr>
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<td>C</td>
<td>G, H</td>
<td>5</td>
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<td>D</td>
<td>—</td>
<td>4</td>
<td>E, F, G, H</td>
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Question 4c (ii)

Waiting times at a self-service check-out

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</tbody>
</table>

Time (minutes)
Question 5a

15,000 $5 preference shares @ $5.25 each
10,000 $6 ordinary shares @ $6.20 each

Annual dividend Chingam = $4,800
Annual dividend Icon = $4,600.

\[
\text{Yield} = \frac{\text{dividend per share}}{\text{market price per share}} \times 100
\]

Chingam = \[
\frac{4,800}{15,000} \times 100 = 6.1\%
\]

Icon = \[
\frac{4,600}{16,000} \times 100 = 7.4\%
\]

Sell the preference shares.

15,000 x $5.25 = $78,750

Stamp duty = \[
\frac{78,750 \times 0.6}{100} = $472.50
\]

Brokerage = \[
0.03 \times 5,000 + 0.025 \times 20,000 + 0.02 \times 50,000 + 0.015 \times 37,500 + $20 = $1,726.25
\]

Total fees and charges = $2,198.75

Amount that Sally and Mark received is $76,551.25
Question 5

b) i) Amount borrowed = purchase price - deposit

= 430,000 - 50,000

= $380,000

20 years @ 6.5% p.a. = $7.46 / $1000 borrowed

7.46 x 380 = 2,834.80

i.e. the monthly loan repayment is $2,834.80

ii) Amount borrowed = purchase price - deposit

= 420,000 - 125,000

= $295,000

30 years @ 6.0% p.a. = $6.00 / $1000 borrowed

6.00 x 295 = 1,770

i.e. technically, yes, they can afford the
house, as repayments are $1,770/month and
they can afford $1,800/month. They should
think very carefully before signing the contract,
though, as they only have a "buffer zone"
of $30, and slight movements in interest
rates could easily push the level of
repayments beyond that which they can
afford.