

3

- 1 (a) (i) Solve the simultaneous linear inequalities  $\frac{x-2}{3} < \frac{2x+1}{5} \leq 3$ .

$\frac{x-2}{3} < \frac{2x+1}{5}$	or	$\frac{2x+1}{5} \leq 3$	
$5x-10 < 6x+3$		$2x+1 \leq 15$	
$x > -13$		$x \leq 7$	[M1. M1]
Hence $-13 < x \leq 7$			[A1]

Answer .....  $-13 < x \leq 7$  [3]

- (ii) Hence, state the smallest integer that satisfy the inequality.

Answer ..... -12 [B1] [1]

- (b) Solve the fractional equation  $\frac{x-9}{2} = 2 + \frac{17}{x+2}$ .

$\frac{x-9}{2} = 2 + \frac{17}{x+2}$	
$\frac{x-9}{2} = \frac{2(x+2)+17}{x+2}$	
$(x-9)(x+2) = 2(2x+21)$	[M1 for non-fractional equation]
$x^2 - 7x - 18 = 4x + 42$	
$x^2 - 11x - 60 = 0$	[M1]
$(x-15)(x+4) = 0$	[M1]
$x = 15$ or $x = -4$	[A1]

Answer .....  $x = 15$  or  $x = -4$  [4]

[Turn over

(c) Given  $L = \frac{1}{3}m(n+p^2)$ .

(i) Evaluate  $L$  when  $m = 4$ ,  $n = -2$  and  $p = \frac{1}{2}$ .

$$\begin{aligned} L &= \frac{1}{3}(4)\left[-2 + \left(\frac{1}{2}\right)^2\right] \\ &= \frac{4}{3}\left(-\frac{7}{4}\right) \\ &= -\frac{7}{3} \end{aligned}$$

$-2\frac{1}{3}$ , or  $-\frac{7}{3}$  [B1]  
Answer  $L = \dots\dots\dots$  [1]

(ii) Express  $p$  as the subject of the formula.

$L = \frac{1}{3}m(n+p^2)$	
$p^2 = \frac{3L}{m} - n$	[M1]
$p = \pm \sqrt{\frac{3L}{m} - n}$	[A1]

$$\begin{aligned} L &= \frac{1}{3}m(n+p^2) \\ 3L &= m(n+p^2) \\ n+p^2 &= \frac{3L}{m} \\ p^2 &= \frac{3L}{m} - n \\ p &= \pm \sqrt{\frac{3L}{m} - n} \end{aligned}$$

Answer  $p = \dots\dots\dots \pm \sqrt{\frac{3L}{m} - n}$  [2]

(d) Solve  $2^{3-6x} = 32^{3-x}$ .

$2^{3-6x} = 32^{3-x}$	
$2^{3-6x} = 2^{15-5x}$	[M1]
$3-6x = 15-5x$	
$x = -12$	[A1]

Answer  $x = \dots\dots\dots -12$  [2]

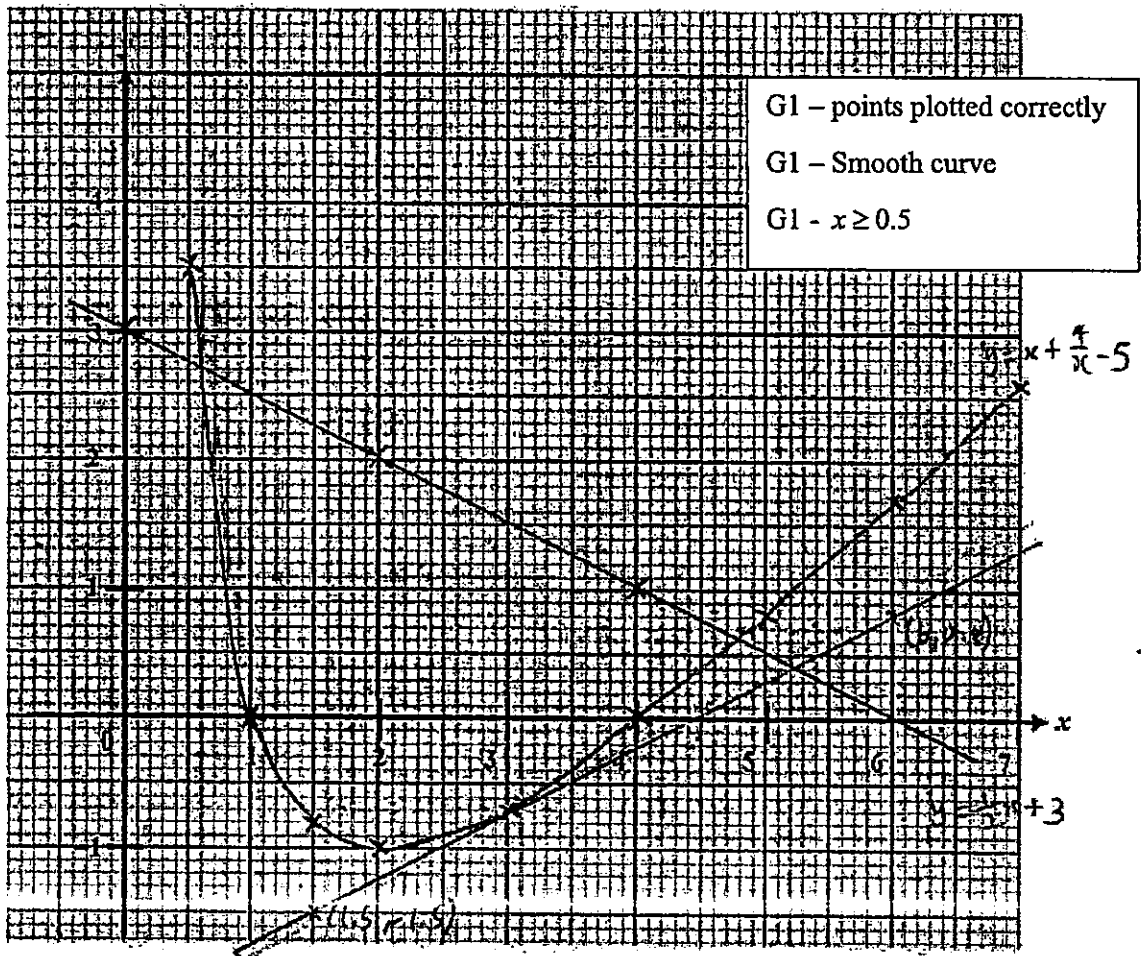
- 2 (a) Complete the table of values for  $y = x + \frac{4}{x} - 5$ .

Give your answer to 1 decimal place.

x	0.5	1	1.5	2	3	4	5	6	7
y	3.5	0	-0.8	-1	-0.7	0	0.8	1.7 [B1]	2.6

[1]

- (b) On the grid, draw the graph of  $y = x + \frac{4}{x} - 5$  for  $0.5 \leq x \leq 7$ .



[3]

- (c) Use your graph to find the solutions of the equation  $x + \frac{4}{x} - 6 = 0$  in the range  $0.5 \leq x \leq 7$ .

$$\begin{array}{l} x + \frac{4}{x} - 6 = 0 \\ x + \frac{4}{x} - 5 = 1 \\ y = 1 \quad [\text{B1}] \end{array}$$

0.8 (accept 0.7, 0.75, 0.85, 0.9) or  
5.2 (accept 5.1, 5.15, 5.25, 5.3) [B1]

Answer  $x = \dots\dots\dots$  or  $\dots\dots\dots$  [2]

- (d) By drawing a tangent, find the gradient of the curve at  $(3, -0.7)$ .

$$\text{Gradient} = \frac{-1.5 - 0.8}{1.5 - 6}$$

B1 for tangent drawn at correct point

$$= 0.511 \text{ (3sf)} \quad [\text{B1}]$$

(accept 0.43 to 0.62)

Answer  $\dots\dots\dots$  [2]

- (e) (i) On the same grid, draw the graph of  $y = -\frac{1}{2}x + 3$ .  $\begin{array}{c|c|c|c} x & 0 & 1 & 6 \\ \hline y & 3 & 2\frac{1}{2} & 0 \end{array}$  [1]  
B1 for line drawn correctly

- (ii) Show that the points of intersection of the line and the curve gives the solutions of the equation  $3x^2 - 16x + 8 = 0$ .

$$\begin{array}{l} x + \frac{4}{x} - 5 = -\frac{1}{2}x + 3 \\ \frac{3}{2}x + \frac{4}{x} - 8 = 0 \\ \frac{3x^2 + 8 - 16x}{2x} = 0 \quad [\text{M1 for correct LCM}] \\ 3x^2 - 16x + 8 = 0 \text{ (shown)} \quad [\text{A1}] \end{array}$$

[2]

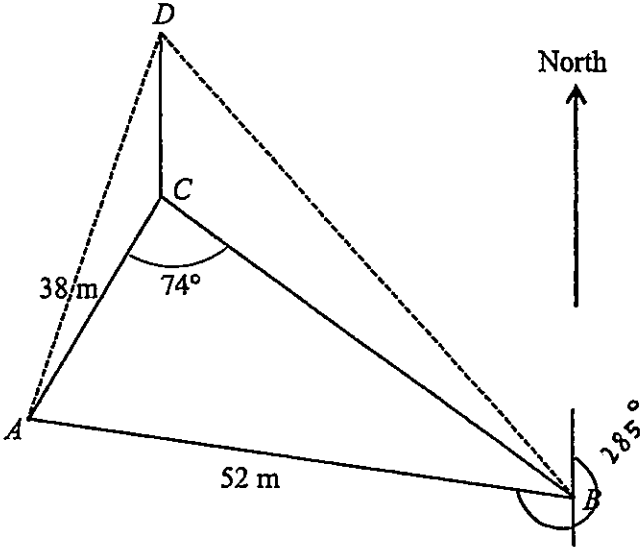
- (iii) Use your graph to solve the equation  $3x^2 - 16x + 8 = 0$ .

0.6 (accept 0.5, 0.55, 0.65, 0.7) or

4.8 (accept 4.7, 4.75, 4.85, 4.9) [B1]

Answer  $x = \dots\dots\dots$  or  $\dots\dots\dots$  [1]

3



In the diagram,  $A, B$  and  $C$  are three points on a level school field.  
 It is given that  $AC = 38$  m,  $AB = 52$  m and angle  $ACB = 74^\circ$ .  
 The bearing of  $A$  from  $B$  is  $285^\circ$ .

(a) Calculate the angle  $ABC$ .

$\frac{\sin \angle ABC}{38} = \frac{\sin 74^\circ}{52}$	[M1]
$\angle ABC = 44.6247^\circ$	
$= 44.6^\circ$	[A1]

Answer .....° [2]

(b) Find the bearing of  $C$  from  $B$ .

$$\begin{aligned}
 &285^\circ + 44.6247^\circ \\
 &= 329.6247^\circ \\
 &= 329.6^\circ \text{ (1 d.p.)}
 \end{aligned}$$

Answer .....° [B1] [1]

- (c) Calculate the area of triangle  $ABC$ .

$$\begin{aligned}\angle CAB &= 180^\circ - 74^\circ - 44.6247^\circ \\ &= 61.375^\circ \\ \text{Area of } \triangle ABC &= \frac{1}{2}(38)(52)\sin 61.375^\circ \quad [\text{M1}] \\ &= 867.243 \\ &= 867 \text{ m}^2 \quad [\text{A1}]\end{aligned}$$

Answer ..... m<sup>2</sup> [2]

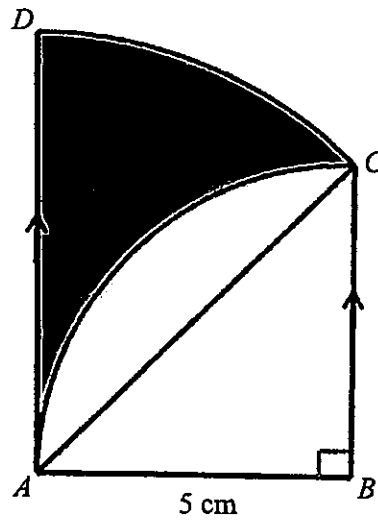
- (d) A vertical metal beam was mounted on  $C$ , with its top at  $D$ . The angle of elevation of the top of the beam from  $A$  is  $25^\circ$ .  
A man was walking along  $AB$ . Find the maximum angle of elevation of the top of the beam from the man along  $AB$ .

$$\begin{aligned}\tan 25^\circ &= \frac{CD}{38} \\ CD &= 17.71969 \text{ m} \quad [\text{M1}] \\ \text{Let } E &\text{ be the point on } AB \text{ where the maximum angle of elevation occurs.} \\ \frac{1}{2} \times 52 \times CE &= 867.243 \quad [\text{M1}] \\ CE &= 33.3555 \text{ m} \quad [\text{A1}] \\ \tan \angle CED &= \frac{17.71969}{33.3555} \quad [\text{M1}] \\ \angle CED &= 28.0^\circ \quad [\text{A1}]\end{aligned}$$

Hence, maximum angle of elevations is  $28.0^\circ$ .

occurs at the point closest to C

Answer ..... ° [5]



In the diagram, triangle  $ABC$  is a right-angled triangle.  $AC$  is an arc of a circle with centre  $B$  and  $CD$  is an arc of another circle with centre  $A$ . It is given that  $AB = 5$  cm and  $AD$  is parallel to  $BC$ .

- (a) Show that angle  $CAD$  is  $\frac{\pi}{4}$  radians.

*Answer:*

$$\angle BCA = \angle DAC \text{ (alternate angles, } AD \parallel BC)$$

$$= \frac{\pi - \frac{\pi}{2}}{2} \quad [\text{B1}]$$

$$= \frac{\pi}{4} \text{ radians (shown)}$$

[1]

(b) Find the perimeter of the shaded region.

$$\begin{aligned}
 AD = AC &= \sqrt{5^2 + 5^2} \\
 &= \sqrt{50} \\
 &= 7.07107 \text{ cm} && \text{[M1]} \\
 \text{Arc } AC &= \frac{5\pi}{2} = 7.85398 \text{ cm} \\
 \text{Arc } CD &= \sqrt{50} \times \frac{\pi}{4} = 5.5536 \text{ cm} \\
 \text{Perimeter of shaded part} &= \sqrt{50} + \sqrt{50} \times \frac{\pi}{4} + \frac{5\pi}{2} && \text{[M1]} \\
 &= 20.5 \text{ cm (3sf)} && \text{[A1]}
 \end{aligned}$$

Answer ..... cm [3]

(c) Find the area of the shaded region.

$$\begin{aligned}
 \text{Area of segment } AC &= \frac{1}{2} \times 5^2 \times \frac{\pi}{2} - \frac{1}{2} \times 5 \times 5 \\
 &= \frac{25}{4} \pi - \frac{25}{2} = 7.13495 \text{ cm}^2 && \text{[M1]} \\
 & \text{[M1 for area either area of sector } BAC \text{ or area of sector } ACD] \\
 \text{Area of shaded region} &= \frac{1}{2} \times (\sqrt{50})^2 \times \frac{\pi}{4} - \left( \frac{25}{4} \pi - \frac{25}{2} \right) && \text{[M1]} \\
 &= 12 \frac{1}{2} \text{ cm}^2 \text{ or } 12.5 \text{ cm}^2 && \text{[A1]}
 \end{aligned}$$

Answer ..... cm<sup>2</sup> [4]



5 Clinton and Harry took part in a city race where they each ran 21 km.

(a) Clinton ran at an average speed of  $x$  km/h.

Write down an expression, in terms of  $x$ , for the time he took to complete the race.

$$\text{Answer } \dots\dots\dots \frac{21}{x} \text{ [B1]} \text{ h [1]}$$

(b) Harry ran at an average speed which was 3 km/h slower than Clinton's.

Write down an expression, in terms of  $x$ , the time he took to complete the race.

$$\text{Answer } \dots\dots\dots \frac{21}{x-3} \text{ [B1]} \text{ h [1]}$$

(c) The difference between their time was 18 minutes.

Write down an expression  $x$  to represent this information and show that it reduces

to  $x^2 - 3x - 210 = 0$ .

Answer:

$\frac{21}{x-3} - \frac{21}{x} = \frac{18}{60}$	[M1]
$\frac{21x - 21(x-3)}{x(x-3)} = \frac{3}{10}$	
$\frac{63}{x(x-3)} = \frac{3}{10}$	
$630 = 3x^2 - 9x$	
$3x^2 - 9x - 630 = 0$	[M1]
$x^2 - 3x - 210 = 0 \text{ (shown)}$	[A1]

[3]

- (d) Solve the equation  $x^2 - 3x - 210 = 0$ , giving your answers to 2 decimal places.

$$x = \frac{-(-3) \pm \sqrt{(-3)^2 - 4(1)(-210)}}{2(1)} \quad [\text{M1}]$$

$$= 16.07 \text{ or } -13.07 \text{ (2dp)} \quad [\text{A1, A1}]$$

Answer  $x = \dots\dots\dots$  or  $\dots\dots\dots$  [3]

- (e) Find the time that Harry took to complete the race, giving your answer in hours and minutes, correct to the nearest minutes.

$$\text{Time} = \frac{21}{16.07 - 3} \quad [\text{M1}]$$

$$= 1.6067 \text{ h}$$

$$= 1 \text{ h } 36 \text{ mins} \quad [\text{A1}]$$

Answer  $\dots\dots\dots$  h  $\dots\dots\dots$  min [2]

6 The employees of a company are offered a wage increase calculated according to one of the following schemes:

Scheme A: An increase of 5% of their present wages.

Scheme B: An increase of \$16 per week plus 3% of their present wages.

(a) Mr Tay earns \$480 per week. Which scheme should he choose?  
Support your answer with necessary working.

Scheme A: New wage =  $1.05 \times \$480 = \$504$   
 Scheme B: New wage =  $\$16 + 1.03 \times 480 = \$510.40$  [M1 for both new wages]  
 He should choose Scheme B because the new wage is more than Scheme A. [A1]

*Answer* Scheme ..... because.....  
 ..... [2]

(b) Mr Kannan finds that either scheme will give him the same wage increase. How much is he earning presently?

Let  $x$  be his present wage.  
 $1.05x = 16 + 1.03x$  [M1]  
 $0.02x = 16$   
 $x = 800$   
 His present wage is \$800. [A1]

*Answer* \$..... [2]

- (c) Benny divides his monthly income between food, transport and savings in the ratio 5 : 4 : 6 respectively.

- (i) He sets aside \$6000 as savings. Find his monthly income.

$$\begin{aligned} \text{New monthly income} &= \frac{6000}{6} \times 15 && \text{[M1]} \\ &= \$15000 && \text{[A1]} \end{aligned}$$

*Answer \$.....* [2]

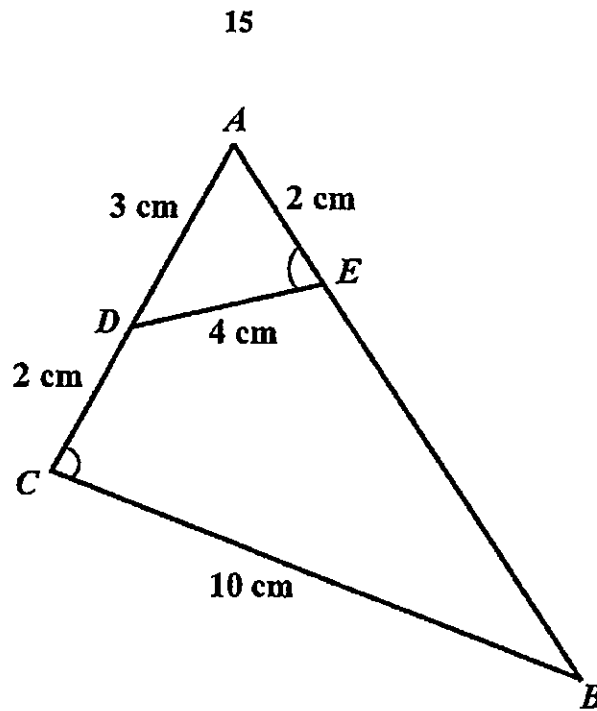
- (ii) He puts the \$6000 into an account paying compound interest of 3.8% per annum compounded half-yearly.

Calculate the interest he earns after 4 years, correct to the nearest cents.

$$\begin{aligned} \text{Amount} &= 6000 \left(1 + \frac{1.9}{100}\right)^8 && \text{[M1]} \\ &= \$6975.01 && \text{[M1]} \\ \text{Interest} &= \$975.01 \text{ (nearest cent)} && \text{[A1]} \end{aligned}$$

*Answer \$.....* [3]

7



In the diagram,  $ADC$  and  $AEB$  are straight lines. It is given that  $AD = 3$  cm,  $CD = 2$  cm,  $AE = 2$  cm,  $DE = 4$  cm,  $BC = 10$  cm and  $\angle AED = \angle ACB$ .

(a) Show that triangle  $ABC$  and triangle  $ADE$  are similar.

*Answer:*

$$\frac{AE}{AC} = \frac{2}{5}$$

$$\angle AED = \angle ACB \text{ (given)}$$

$$\frac{DE}{BC} = \frac{4}{10} = \frac{2}{5}$$

[M2 for 3 statements, M1 for 2 statements]

Hence, triangle  $ABC$  is similar to triangle  $ADE$  (SAS-similarity). [A1, no need to write SAS]

OR

$$\angle AED = \angle ACB \text{ (given)}$$

$$\angle EAD = \angle CAB \text{ (common angle)}$$

Hence, triangle  $ABC$  is similar to triangle  $ADE$  (AA-similarity).

[3]

- (b) Find the length
- $BE$
- .

$\frac{AB}{3} = \frac{5}{2}$	
$AB = 7.5 \text{ cm}$	[M1]
$BE = 7.5 - 2$	
$= 5.5 \text{ cm}$	[A1]

Answer ..... cm [2]

- (c) Given that the area of triangle
- $ADE$
- is
- $6 \text{ cm}^2$
- , find the area of triangle
- $ABC$
- .

$\frac{\text{Area of } \triangle ABC}{\text{Area of } \triangle ADE} = \left(\frac{5}{2}\right)^2$	[M1]
$\frac{\text{Area of } \triangle ABC}{6} = \frac{25}{4}$	
$\text{Area of } \triangle ABC = 37.5 \text{ cm}^2$	[A1]

Answer .....  $\text{cm}^2$  [2]

- (d) State the ratio of the area of triangle
- $ADE$
- to the area of quadrilateral
- $BCDE$
- .

Answer .....  $4 : 21$  or  $\frac{4}{21}$  [B1] [1]

- 8 Home renovation costs in Singapore vary depending on a few factors such as the size and type of your home. The average renovation cost of a resale 4-room HDB is around \$67,000, while a resale 4-room condominium will cost around \$82,000. A resale home is one where the new owner is taking over the property from the previous owner.

Meanwhile, a new 4-room HDB will cost around \$44,000 to renovate, while a new 4-room condominium will cost around \$39,000.

- (a) Calculate the percentage difference between the average cost of renovating a resale 4-room HDB and a new 4-room HDB, using the new 4-room HDB renovation cost as the base.

$$\begin{aligned} \text{\% difference} &= \frac{67000 - 44000}{44000} \times 100\% \\ &= 52.3\% \text{ (3sf) [B1]} \end{aligned}$$

*Answer* ..... % [1]

- (b) The following are other factors that will affect the renovation cost.
- Hacking means tearing down walls, rebuilding walls, or touching up walls.
  - Flooring installation – either using ceramic tiles, laminate or marble
  - You can built-in wardrobes, kitchen cabinets, desks and other fixtures instead of buying from furniture shops. This is known as carpentry.
  - Decoration of walls – either painting or applying wallpaper.

The following table shows the breakdown of the cost of renovation based on a 3-room HDB.

<b>Flooring installation</b>	<b>Ceramic Tiles</b> \$2.50/square feet	<b>Laminate</b> \$4/square feet	<b>Marble</b> \$7.50/square feet
<b>Wall – Decoration</b>	<b>Paint</b> \$650	<b>Wallpaper</b> \$845	
<b>Wall – Hacking</b>	<b>HDB wall</b> \$500	<b>Condo wall</b> \$800	

<b>Carpentry (built-in items)</b>	<b>Cost per metre</b>
Bottom kitchen cabinet	\$345
Full height kitchen cabinet	\$885
Full height wardrobe (swing door)	\$755
Full height wardrobe (sliding door)	\$837
Study table with drawers	\$493
Study table without drawers	\$427
Display cabinet	\$886
Half height shoe cabinet	\$525
Full height shoe cabinet	\$804

- (i) Given that 1 square feet is approximately 0.0929 square metre, convert the cost of laminate flooring from the cost per square feet to the cost per square metre, correcting your answer to the nearest dollar.

$$\frac{\$4}{1 \text{ square feet}} = \frac{\$4}{0.0929 \text{ sqm}} \quad [\text{M1}]$$

$$= \$43 \text{ (nearest dollar)} \quad [\text{A1}]$$

Answer \$ ...../ square metre [2]



Ben and Jenny planned to get married and they bought a new 3-room HDB of size 70 square metre. They set aside a budget of \$12 000 for renovating their new home. The following is a list of things they would like to have.

Laminate flooring for the whole house
Painting for the wall
Hack the wall between master bedroom and guest room
5-metre full height wardrobe (sliding door)
5-metre full height kitchen cabinet
2-metre full height shoe cabinet

- (ii) Is their budget sufficient for their renovation plan? Support your answer with the necessary working.

*Answer:*

Cost of laminate flooring = $\$43 \times 70 \text{ sqm} = \$3010$	[Accept \$3014]	[C1]
Cost of painting = \$650		
Cost of hacking = \$500		
Cost of full height wardrobe (sliding door) = $\$837 \times 5 \text{ m} = \$4185$		[C1]
Cost of full height kitchen cabinet = $\$885 \times 5 \text{ m} = \$4425$		[C1]
Cost of full height shoe cabinet = $\$804 \times 2 \text{ m} = \$1608$		[C1]
Total cost of renovation = $\$3010 + \$650 + \$500 + \$4185 + \$4425 + \$1608$		
[C1 for adding 6 individual costs]		
$= \$14378$	[Accept \$14382]	[A1]
Since $\$14378 > \$12000$ , their budget is insufficient.		
[A1 for correct conclusion based on calculated total cost]		

[7]

**End of Paper**

