

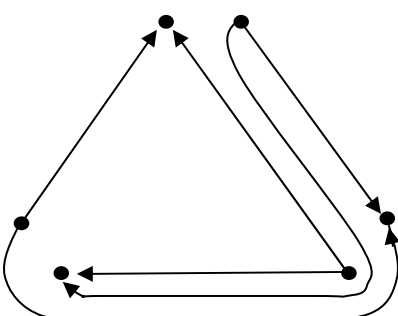
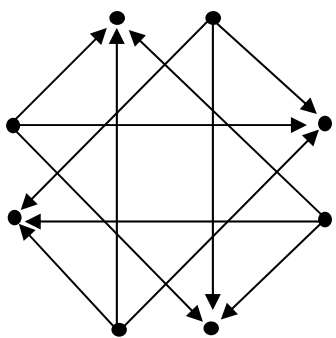
1.

<p>(i)</p> <p>AB 12 AB          AC 13 AC          AD 29 ABD          AE 35 ABDE          AF 22 ACF</p> <p>(ii) 5</p>	<p>M1 Dijkstra          A1 working values          B1 order of labelling          B1 labels</p> <p>B1 AB and AC          B1 AD and AF          B1 AE</p> <p>B1</p>
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2.

<p>(i)</p> $\begin{array}{r} \cancel{3} \quad \quad \quad \cancel{8} \\ \cancel{6} \quad \quad \quad \cancel{4} \\ \cancel{12} \quad \quad \quad \cancel{2} \\ 24 \quad \quad \quad 1 \\ \hline 24 \end{array}$ <p>(ii)</p> $\begin{array}{r} \cancel{26} \quad \quad \quad \cancel{42} \\ 52 \quad \quad \quad 21 \\ \cancel{104} \quad \quad \quad \cancel{10} \\ 208 \quad \quad \quad 5 \\ \cancel{416} \quad \quad \quad \cancel{2} \\ 832 \quad \quad \quad 1 \\ \hline 1092 \end{array}$ <p>(iii) multiplication</p>	<p>M1 doubling and halving          M1 deleting and summing          A1 cao</p> <p>M1 doubling and halving          M1 deleting          DM summing          A1 cao</p> <p>B1</p>
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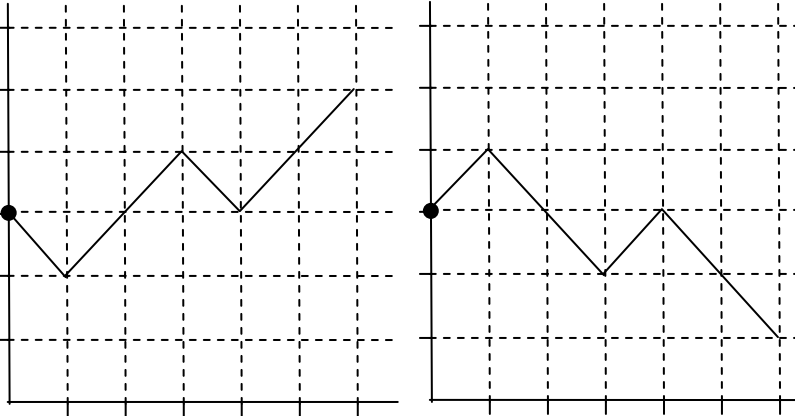
3.

<p>(i)</p> 	<p>B1 B1 B1</p>
<p>(ii)</p> 	<p>B1 12 arcs B1 connectivity B1 3 out of each in vertex B1 3 into each out vertex</p>
<p>(iii) The graphs represent traffic flows within the junctions. They do not take account of flows approaching or leaving the junctions. (Graphs are not planar if these flows are added, so traffic flows have to cross.)</p>	<p>B1</p>

4.

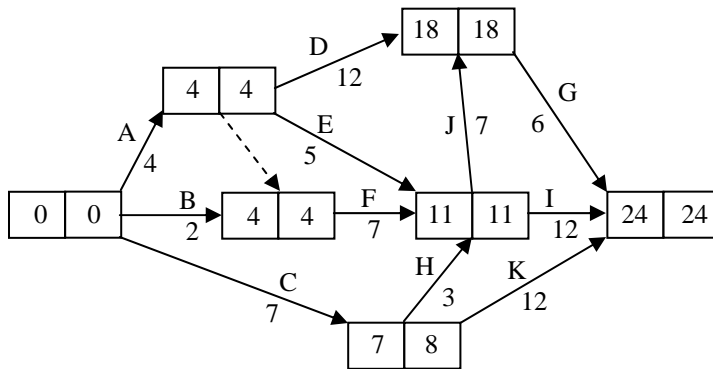
<p>(i) Each small tile has area <math>100 \text{ cm}^2</math> so <math>1000x</math>          Similarly <math>900y</math>          So <math>1000x + 900y \geq 400 \times 300 = 120000</math></p> <p>(ii) <math>y \leq 100</math>  <math>10x \leq 9y</math></p> <p>(iii) e.g. minimise <math>1.5x + 2y</math></p> <p>Integer solution required, so <math>x=60, y=67, \text{ cost} = 224</math></p> <p>(iv) wastage or design</p>	<p>M1 areas          A1 tile areas          A1</p> <p>B1          B1 B1</p> <p>B1</p> <p>B3 lines          B1 shading</p> <p>M1 solving          A1 <math>x = 59-61 \quad y = 66-68</math>          A1 220-228</p> <p>B2</p>
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5.

<p>(i) e.g. 0 to 4 → stagger left 5 to 9 → stagger right + accumulation</p> <p>(ii) probably one of:</p>  <p>(iii) repeat relative frequency</p> <p>(iv) e.g. 0 to 2 → stagger left 3 to 8 → stagger right 9 reject and redraw</p>	<p>M1 A1 B1</p> <p>M1 A1</p> <p>B1 B1</p> <p>M1 A1 A1</p> <p>reject some proportions efficient</p>																																																																								
<p>(v) e.g.</p> <table border="1"> <tr><td>run 1</td><td>R</td><td>L</td><td>R</td><td>L</td><td>L</td><td>R</td></tr> <tr><td>run 2</td><td>R</td><td></td><td>L</td><td></td><td>R</td><td>R</td><td>L</td><td>R</td></tr> <tr><td>run 3</td><td>R</td><td>R</td><td>L</td><td>L</td><td>L</td><td>L</td></tr> <tr><td>run 4</td><td>L</td><td>L</td><td>R</td><td>L</td><td>R</td><td>R</td></tr> <tr><td>run 5</td><td>R</td><td>R</td><td>R</td><td>*</td></tr> <tr><td>run 6</td><td>L</td><td>R</td><td>R</td><td></td><td>R</td><td></td><td>R</td><td>*</td></tr> <tr><td>run 7</td><td>R</td><td>R</td><td>L</td><td>R</td><td>R</td><td>*</td></tr> <tr><td>run 8</td><td>R</td><td>R</td><td>L</td><td>R</td><td>R</td><td>*</td></tr> <tr><td>run 9</td><td>R</td><td></td><td>R</td><td></td><td>R</td><td>*</td></tr> <tr><td>run 10</td><td>L</td><td>R</td><td>R</td><td>L</td><td>R</td><td>R</td></tr> </table> <p>Probability estimate = 0.5 (Theoretical = <math>0.7^3 + 5 \times 0.7^4 \times 0.3 = 0.70315</math>)</p>	run 1	R	L	R	L	L	R	run 2	R		L		R	R	L	R	run 3	R	R	L	L	L	L	run 4	L	L	R	L	R	R	run 5	R	R	R	*	run 6	L	R	R		R		R	*	run 7	R	R	L	R	R	*	run 8	R	R	L	R	R	*	run 9	R		R		R	*	run 10	L	R	R	L	R	R	<p>M1 A2</p> <p>(-1 each wrong row)</p> <p>B1</p> <p>falling in</p> <p>M1 A1</p> <p>probability</p>
run 1	R	L	R	L	L	R																																																																			
run 2	R		L		R	R	L	R																																																																	
run 3	R	R	L	L	L	L																																																																			
run 4	L	L	R	L	R	R																																																																			
run 5	R	R	R	*																																																																					
run 6	L	R	R		R		R	*																																																																	
run 7	R	R	L	R	R	*																																																																			
run 8	R	R	L	R	R	*																																																																			
run 9	R		R		R	*																																																																			
run 10	L	R	R	L	R	R																																																																			

6.

(i) & (ii)



Duration = 24 months

Critical : A; F; J; G

(iii) Crash F by 1 month and G by 1 month at a cost of £6m.

(iv) Crash G by 2 months at a cost of £8m.

M1 activity-on-arc  
 A1 D, E, H and K  
 A1 F  
 A1 I and J  
 A1 G

M1 forward pass  
 A1  
 M1 backward pass  
 A1

B1 cao

B1 cao

B1 F by 1 month  
 B1 G by 1 month  
 B1 £6m

M1 G only  
 A1 £8m