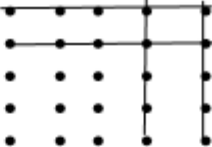
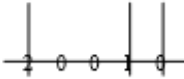


Decision 2 Allocation Answers

1(a)	Add extra row with all values the same	B1	1	Usually all equal to 26 and below the other rows																																																						
(b)	Reduce columns first	M1																																																								
	<table style="width: 100%; text-align: center; border-collapse: collapse;"> <tr><td>0</td><td>0</td><td>0</td><td>4</td><td>4</td></tr> <tr><td>6</td><td>2</td><td>2</td><td>5</td><td>5</td></tr> <tr><td>5</td><td>3</td><td>5</td><td>0</td><td>4</td></tr> <tr><td>4</td><td>2</td><td>3</td><td>2</td><td>0</td></tr> <tr><td>10</td><td>7</td><td>8</td><td>5</td><td>6</td></tr> </table>	0	0	0	4	4	6	2	2	5	5	5	3	5	0	4	4	2	3	2	0	10	7	8	5	6	A1		<table style="width: 100%; text-align: center; border-collapse: collapse;"> <tr><td>26</td><td>26</td><td>26</td><td>26</td><td>26</td></tr> <tr><td>16</td><td>19</td><td>18</td><td>25</td><td>24</td></tr> <tr><td>22</td><td>21</td><td>20</td><td>26</td><td>25</td></tr> <tr><td>21</td><td>22</td><td>23</td><td>21</td><td>24</td></tr> <tr><td>20</td><td>21</td><td>21</td><td>23</td><td>20</td></tr> <tr><td>26</td><td>26</td><td>26</td><td>26</td><td>26</td></tr> </table>	26	26	26	26	26	16	19	18	25	24	22	21	20	26	25	21	22	23	21	24	20	21	21	23	20	26	26	26	26
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	Covering zeros requires 4 lines so adjust with least entry remaining being 2	M1																																																								
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	Match $A-1; C=2; D-3; E-4$	B1																																																								
	Expected minimum time $16 + 20 + 21 + 20 = 77 \text{ min}$	B1	2																																																							
Total			9																																																							

2(a)	Add extra row with all values equal	B1	1	Usually + 25 and below rest <table border="1" style="margin-left: 20px;"> <tr><td>18</td><td>15</td><td>19</td><td>20</td><td>17</td></tr> <tr><td>23</td><td>24</td><td>22</td><td>25</td><td>23</td></tr> <tr><td>20</td><td>16</td><td>18</td><td>22</td><td>19</td></tr> <tr><td>21</td><td>17</td><td>18</td><td>23</td><td>20</td></tr> <tr><td>25</td><td>25</td><td>25</td><td>25</td><td>25</td></tr> </table>	18	15	19	20	17	23	24	22	25	23	20	16	18	22	19	21	17	18	23	20	25	25	25	25	25																									
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(b)	Reduce columns first	M1		Do not award if full row of zeros added																																																		
	<table border="1" style="margin-left: 20px;"> <thead> <tr><th></th><th>P</th><th>Q</th><th>R</th><th>S</th><th>T</th></tr> </thead> <tbody> <tr><td>A</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td></tr> <tr><td>B</td><td>5</td><td>9</td><td>4</td><td>5</td><td>6</td></tr> <tr><td>C</td><td>2</td><td>1</td><td>0</td><td>2</td><td>2</td></tr> <tr><td>D</td><td>3</td><td>2</td><td>0</td><td>3</td><td>3</td></tr> <tr><td>(E)</td><td>7</td><td>10</td><td>7</td><td>5</td><td>8</td></tr> </tbody> </table>		P	Q	R	S	T	A	0	0	1	0	0	B	5	9	4	5	6	C	2	1	0	2	2	D	3	2	0	3	3	(E)	7	10	7	5	8	A1																
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(E)	7	10	7	5	8																																																	
	Reduce rows next	M1		These 2 marks available for those who reduce row first																																																		
	<table border="1" style="margin-left: 20px;"> <tbody> <tr><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td></tr> <tr><td>1</td><td>5</td><td>0</td><td>1</td><td>2</td></tr> <tr><td>2</td><td>1</td><td>0</td><td>2</td><td>2</td></tr> <tr><td>3</td><td>2</td><td>0</td><td>3</td><td>3</td></tr> <tr><td>2</td><td>5</td><td>2</td><td>0</td><td>3</td></tr> </tbody> </table>	0	0	1	0	0	1	5	0	1	2	2	1	0	2	2	3	2	0	3	3	2	5	2	0	3	A1✓		<table border="1" style="margin-left: 20px;"> <tbody> <tr><td>.</td><td>.</td><td>.</td><td>.</td><td>.</td></tr> <tr><td>.</td><td>.</td><td>.</td><td>.</td><td>.</td></tr> <tr><td>.</td><td>.</td><td>.</td><td>.</td><td>.</td></tr> <tr><td>.</td><td>.</td><td>.</td><td>.</td><td>.</td></tr> <tr><td>.</td><td>.</td><td>.</td><td>.</td><td>.</td></tr> </tbody> </table>
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	Covering zeros requires 3 lines so adjust with least entry remaining being 1	M1		SC if full row of zeros, award M1 for further stage of adjustment and A1 for final correct matrix ft one error only																																																		
	<table border="1" style="margin-left: 20px;"> <thead> <tr><th></th><th>P</th><th>Q</th><th>R</th><th>S</th><th>T</th></tr> </thead> <tbody> <tr><td>A</td><td>0</td><td>0</td><td>2</td><td>1</td><td>0</td></tr> <tr><td>R</td><td>0</td><td>4</td><td>0</td><td>1</td><td>1</td></tr> <tr><td>C</td><td>1</td><td>0</td><td>0</td><td>2</td><td>1</td></tr> <tr><td>D</td><td>2</td><td>1</td><td>0</td><td>3</td><td>2</td></tr> <tr><td>E</td><td>1</td><td>4</td><td>2</td><td>0</td><td>2</td></tr> </tbody> </table>		P	Q	R	S	T	A	0	0	2	1	0	R	0	4	0	1	1	C	1	0	0	2	1	D	2	1	0	3	2	E	1	4	2	0	2	A1✓																
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D	2	1	0	3	2																																																	
E	1	4	2	0	2																																																	
	Match: A-Tim; B-Phil; C-Quin; D-Ros	B1																																																				
	Min ^m Time = 17 + 23 + 16 + 18 = 74 secs	B1	8																																																			
	Total		9																																																			

2(a)	Hungarian algorithm minimises	E1																																																				
	15 - x gives measure of criteria NOT met which need minimising in order to maximise scores	E1	2	idea of high becoming low, etc.																																																		
(b)	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr><td>2</td><td>4</td><td>6</td><td>5</td><td>2</td></tr> <tr><td>0</td><td>3</td><td>3</td><td>4</td><td>3</td></tr> <tr><td>3</td><td>5</td><td>7</td><td>1</td><td>1</td></tr> <tr><td>4</td><td>3</td><td>2</td><td>1</td><td>5</td></tr> <tr><td>3</td><td>1</td><td>1</td><td>2</td><td>1</td></tr> <tr><td>0</td><td>2</td><td>4</td><td>3</td><td>0</td></tr> <tr><td>0</td><td>3</td><td>3</td><td>4</td><td>3</td></tr> <tr><td>2</td><td>4</td><td>6</td><td>0</td><td>0</td></tr> <tr><td>3</td><td>2</td><td>1</td><td>0</td><td>4</td></tr> <tr><td>2</td><td>0</td><td>0</td><td>1</td><td>0</td></tr> </table>	2	4	6	5	2	0	3	3	4	3	3	5	7	1	1	4	3	2	1	5	3	1	1	2	1	0	2	4	3	0	0	3	3	4	3	2	4	6	0	0	3	2	1	0	4	2	0	0	1	0	B1		array giving 15 - x
2	4	6	5	2																																																		
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3	2	1	0	4																																																		
2	0	0	1	0																																																		
	Zeros can be covered with only 4 lines so adjustment needed	E1		 augmented array																																																		
	Reduction by subtracting 1 from each uncovered element and adding 1 to each element at intersection of two lines	M1		<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr><td>0</td><td>1</td><td>3</td><td>3</td><td>△</td></tr> <tr><td>△</td><td>2</td><td>2</td><td>4</td><td>3</td></tr> <tr><td>2</td><td>3</td><td>5</td><td>△</td><td>0</td></tr> <tr><td>3</td><td>1</td><td>△</td><td>0</td><td>4</td></tr> <tr><td>3</td><td>△</td><td>0</td><td>2</td><td>1</td></tr> </table>	0	1	3	3	△	△	2	2	4	3	2	3	5	△	0	3	1	△	0	4	3	△	0	2	1																									
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2	3	5	△	0																																																		
3	1	△	0	4																																																		
3	△	0	2	1																																																		
	Matching on particular zeros	M1																																																				
	Alex ↔ (5) Don ↔ (3)																																																					
	Bill ↔ (1) Ed ↔ (2)																																																					
	Cath ↔ (4)	A1	8	Award last 2 marks in whichever way benefits candidate most																																																		
	If adjustment not done correctly and matching made, award B1 for 3 correct and B1 for rest correct																																																					
(c)	Deleting row 2 and column 4 either in final matrix or reworking Final solution:	M1		<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr><td>0</td><td>1</td><td>3</td><td>3</td><td>0</td></tr> <tr><td>0</td><td>2</td><td>2</td><td>3</td><td>3</td></tr> <tr><td>2</td><td>3</td><td>5</td><td>0</td><td>0</td></tr> <tr><td>3</td><td>1</td><td>0</td><td>0</td><td>4</td></tr> <tr><td>3</td><td>0</td><td>0</td><td>2</td><td>1</td></tr> </table>	0	1	3	3	0	0	2	2	3	3	2	3	5	0	0	3	1	0	0	4	3	0	0	2	1																									
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3	1	0	0	4																																																		
3	0	0	2	1																																																		
	A ↔ (1) C ↔ (5)	A1																																																				
	D ↔ (3) E ↔ (2)	A1	3																																																			
	If no method award B2 if matching is all correct																																																					
Total			13																																																			

2(a)	10	11	8	12	5			
	11	5	11	6	7			
	12	8	7	11	4			
	10	9	14	10	6			
	9	9	7	8	9			
	<hr/>							
	5	6	3	7	0			
	6	0	6	1	2			
	8	4	3	7	0	M1		Row reduction up to 2 slips
	4	3	8	4	0	A1		Correct
2	2	0	1	2				
<hr/>								
	Printed answer					A1	3	Columns AG
(b)	3	6	3	6	0			
	4	0	6	0	2			
	6	4	3	6	0	B1		Covering zeros with 3 lines
	2	3	8	3	0			
	0	2	0	0	2			
	<hr/>							
	1	4	1	4	0	M1		Subtract 2 from uncovered and add 2 to double covered
	4	0	6	0	4			
	4	2	1	4	0	A1		Table correct
	0	1	6	1	0			
0	2	0	0	4				
<hr/>								
	Can now be covered with 4 lines, so reduce again					M1		Subtract 1 from uncovered; Add 1 to double covered
	1	3	0	3	0			
	5	0	6	0	5			
	4	1	0	3	0	or	3	1
	0	0	5	0	0		0	1
	1	2	0	0	5		0	2
						A1	5	
(c)	Matching A-4, B-2, D-5					B1		
	And either C-1, E-3					B1		
	or C-3, E-1					B1	3	
(d)	$(10 + 5 + 8) + (8 + 4) = £35$					B1	1	
	Total						12	