

**EDEXCEL DECISION MATHEMATICS D1 (6689) – JUNE 2004 PROVISIONAL MARK SCHEME**

Question Number	Scheme	Marks
1. (a)		
		B1 B1 (2)
(b)	<p>For example:</p> <p>(i) <math>P - 2 = L - 4</math>      c.s. <math>P = 2 - L - 4</math></p> <p>(ii) <math>S - 2 = L - 1a = A - 3</math>      c.s. <math>S = 2 - L = 1a - A = 3</math></p> <p>giving</p> <p><math>A - 1, G - 1, L - 4, N - 5, P - 2</math></p> <p><math>A - 3, G - 1, L - 1, N - 5, S - 2</math></p>	M1 A1 A1 (3)
(c)	Sam must do 2 and Nicola must do 5, leaving Philip without a task.	B2, 1, 0 (2) <b>(7 marks)</b>

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2. (a)	<pre> graph LR     S[0] -- 18 --&gt; B[18]     S -- 22 --&gt; A[22]     S -- 17 --&gt; C[17]     A -- 3 --&gt; D[26, 25]     B -- 8 --&gt; D     B -- 3 --&gt; E[23, 21]     C -- 6 --&gt; E     C -- 15 --&gt; H[32, 28]     D -- 2 --&gt; G[27, 27]     D -- 8 --&gt; T[37, 39, 45]     E -- 6 --&gt; G     E -- 7 --&gt; H     G -- 10 --&gt; T     H -- 11 --&gt; T     F["F (9/10) (37)"] --- 37   </pre>	M1 A1 A1 ft
	Time = 37 minutes	A1 ft (4)
(b)	Either $S - A - D - G - T$ or $S - B - E - G - T$	A1 ft
	Not unique, e.g. gives other path	A1 ft (2)
(c)	$S - C - E - G - T$ 39 minutes	M1 A1 (2) <b>(8 marks)</b>

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3. (a)	Idea of travelling along each <i>arc</i> at least once and seeking to do so in a minimum total. <i>Practical</i> meaning of arcs/numbers.	B1 (1)
(b)	$AB + DF = 32 + 9 = 41$	M1 A1
	$AD + BF = 25 + 15 = 41$	
	$AF + BD = 18 + 24 = 42$	A1
	Repeat either $AE + EB$ and $DF$ or $AD$ and $BF$	A1 ft (4)
(c)	Not unique, e.g. gives other solution	A1 ft
(d)	$258 + 41 = 299$	B1 (2)
(e)	$DF$ is the shortest so start/finish at $A/B$	M1 A1 (2)
		<b>(9 marks)</b>

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4. (a)	The list is not in <i>alphabetical</i> order	B1 (1)
(b)	Use of Bubble Sort or Quick Sort  For example:  <b>Bubble sort</b> $\begin{array}{cccccccccc} G & N & M & Y & L & B & C & E & S & P \\ B & G & N & M & Y & L & C & E & P & S \end{array}$ 1st pass $\begin{array}{cccccccccc} B & C & G & N & M & Y & L & E & P & S \end{array}$ 2nd pass $\begin{array}{cccccccccc} B & C & E & G & N & M & Y & L & P & S \end{array}$ 3rd pass $\begin{array}{cccccccccc} B & C & E & G & L & N & M & Y & P & S \end{array}$ 4th pass $\begin{array}{cccccccccc} B & C & E & G & L & M & N & P & Y & S \end{array}$ 5th pass $\begin{array}{cccccccccc} B & C & E & G & L & M & N & P & S & Y \end{array}$ 6th pass No more changes	M1
		A1
(c)	<b>Quick sort</b> $\begin{array}{cccccccccc} G & N & M & Y & L & \textcircled{B} & C & E & S & P \\ \boxed{B} & G & N & M & Y & \textcircled{L} & C & E & S & P \end{array}$ 1st pass $\begin{array}{cccccccccc} \boxed{B} & G & \textcircled{C} & E & \boxed{L} & N & M & \textcircled{Y} & S & P \end{array}$ 2nd pass $\begin{array}{cccccccccc} \boxed{B} & C & \textcircled{G} & \textcircled{E} & \boxed{L} & N & M & \textcircled{S} & P & Y \end{array}$ 3rd pass $\begin{array}{cccccccccc} \boxed{B} & C & \textcircled{E} & G & \boxed{L} & N & \textcircled{M} & P & S & Y \end{array}$ 4th pass $\begin{array}{cccccccccc} \boxed{B} & C & \textcircled{E} & \textcircled{G} & \boxed{L} & M & N & \textcircled{P} & S & Y \end{array}$ 5th pass $\begin{array}{cccccccccc} \boxed{B} & C & \textcircled{E} & \textcircled{G} & \boxed{L} & M & N & \boxed{P} & S & Y \end{array}$ 6th pass No sublists > 2 and no more changes	A1 (4)
	1      2      3      4      5      6      7      8      9      10 $B \quad C \quad E \quad G \quad L \quad M \quad N \quad P \quad S \quad Y$ $\frac{[10+1]}{2} = 6 \quad \text{Manchester} \quad \text{discard first half of list and pivot}$ $\frac{[7+10]}{2} = 9 \quad \text{Southampton} \quad \text{discard last half of list and pivot}$ $\frac{[7+8]}{2} = 8 \quad \text{Plymouth} \quad \text{discard last half of list and pivot}$ Final term 7 Newcastle, therefore word found at 7	M1 A1
		A1
		A1 (4) <b>(9 marks)</b>

Question Number	Scheme	Marks
5. (a)	$x = 9, y = 16$	B1 B1 (2)
(b)	Initial flow = 53 – either finds a flow-augmenting route or demonstrates not enough saturated arcs for a minimum cut	B1 B1 (2)
(c)	<p>e.g. IDA – 9          IFDA – 24          max flow – 64</p>	M1 A1 (2)
(d)		M1 A1 (2)
(e)	Max flow – min cut Finds a cut $GC, AF, DF, DJ, EI, EH$ value 64 Note: must not use supersource or supersink arcs. <p style="text-align: right;">(13 marks)</p>	M1 A1 (2)

Question Number	Scheme	Marks
6. (a)	Maximise $P = 30x + 40y$ (or $P = 0.3x + 0.4y$ ) subject to $x + y \geq 200$ $x + y \leq 500$ $x \geq \frac{20}{100}(x + y) \Rightarrow 4x \geq y$ $x \leq \frac{40}{100}(x + y) \Rightarrow 3x \geq 2y$	B1 B1 B1 M1 A1 A1 (6)
(b)	<p>The graph shows the feasible region for a linear programming problem. The x-axis and y-axis both range from 0 to 500. Four solid lines are plotted: <math>y = 4x</math> (passing through (0,0) and (125, 500)), <math>2y = 3x</math> (passing through (0,0) and (250, 500)), <math>x + y = 200</math> (passing through (0,200) and (200,0)), and <math>x + y = 500</math> (passing through (0,500) and (500,0)). The feasible region is the quadrilateral formed by the origin (0,0), the point (200, 0) on the x-axis, the point (125, 500) on the line <math>y = 4x</math>, and the point (0, 200) on the line <math>x + y = 200</math>. This region is shaded with diagonal lines. A dashed line, labeled 'Profit line', passes through the feasible region, starting from the y-intercept (0, 150) and ending at the x-intercept (350, 0).</p>	B1 ft $(x + y = 200,$ $x + y = 500)$ B1 ft $(y = 4x)$ B1 ft $(2y = 3x)$ B1 ft $(\text{shading})$ B1 $(\text{labels})$
	(NB: Graph looks OK onscreen at 75% magnification but may print out misaligned)	

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<b>6.</b> (c) <i>(cont.)</i>	Point testing or profit line Intersection of $y = 4x$ and $x + y = 500$ (100, 400) Profit = £190 (units must be clear)	A1 A1 A1 (3) <b>(11 marks)</b>

Question Number	Scheme	Marks
7. (a)	E.g. It shows dependence but is not an activity; $G$ depends on $A$ and $C$ only but $H$ and $I$ depend on $A$ , $C$ and $D$ .	B1 (1)
(b)	<p>Activity details from the diagram:</p> <ul style="list-style-type: none"> <li><math>A(9)</math>: Starts at 0, ends at 9.</li> <li><math>C(8)</math>: Starts at 3, ends at 11.</li> <li><math>G(5)</math>: Starts at 11, ends at 16.</li> <li><math>H(5)</math>: Starts at 11, ends at 17.</li> <li><math>I(1)</math>: Starts at 12, ends at 13.</li> <li><math>J(5)</math>: Starts at 12, ends at 17.</li> <li><math>K(7)</math>: Starts at 16, ends at 23.</li> <li><math>L(8)</math>: Starts at 17, ends at 25.</li> <li><math>M(5)</math>: Starts at 23, ends at 28.</li> <li><math>B(3)</math>: Starts at 0, ends at 3.</li> <li><math>D(7)</math>: Starts at 3, ends at 10.</li> <li><math>E(4)</math>: Starts at 7, ends at 11.</li> <li><math>F(5)</math>: Starts at 12, ends at 17.</li> </ul>	M1 A1 M1 A1
(c)	$B \xrightarrow{C - I} \xrightarrow{E - F} J - L \quad \text{so } B, C, E, F, I, J, L$	A1 (5)
(d)	$A: 11 - 0 - 9 = 2$ $D: 11 - 3 - 7 = 1$ $G: 18 - 11 - 5 = 2 *$ $H: 17 - 11 - 5 = 1$ $K: 25 - 16 - 7 = 2 *$	M1 A1 (non *) A1 (*) (3)
(e)	<p>Activity details from the Gantt chart:</p> <ul style="list-style-type: none"> <li><math>A</math>: Duration 2, starts at 0, ends at 2.</li> <li><math>B</math>: Duration 2, starts at 0, ends at 2.</li> <li><math>C</math>: Duration 8, starts at 2, ends at 10.</li> <li><math>D</math>: Duration 5, starts at 2, ends at 7.</li> <li><math>E</math>: Duration 4, starts at 7, ends at 11.</li> <li><math>F</math>: Duration 5, starts at 11, ends at 16.</li> <li><math>G</math>: Duration 5, starts at 16, ends at 21.</li> <li><math>H</math>: Duration 5, starts at 16, ends at 21.</li> <li><math>I</math>: Duration 1, starts at 11, ends at 12.</li> <li><math>J</math>: Duration 5, starts at 12, ends at 17.</li> <li><math>K</math>: Duration 7, starts at 21, ends at 28.</li> </ul>	M1 A1 A1 A1 (4)
(f)	<p>Gantt chart at time 8: <math>C, F, A</math> and <math>D</math>, must be happening  <math>\therefore 4</math> workers needed</p>	M1 A1 (2) <b>(15 marks)</b>