

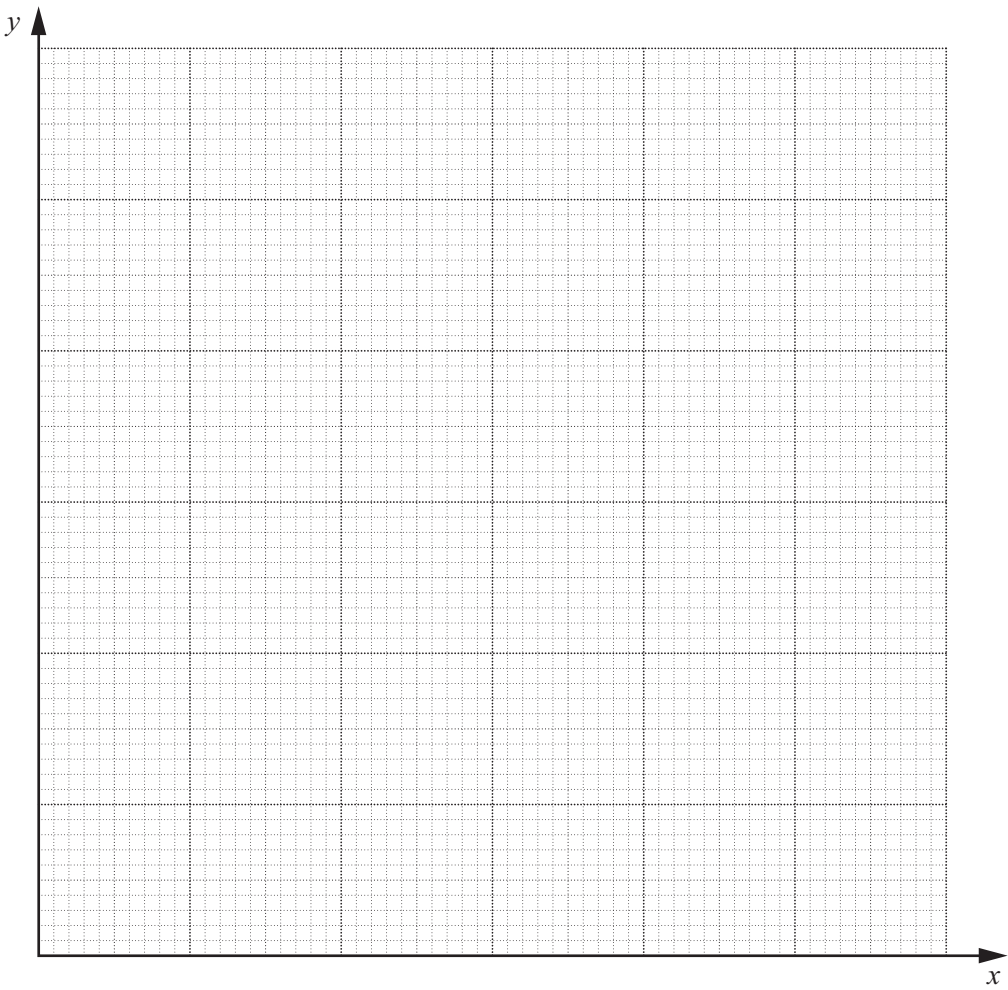
SPECIMEN

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Section A (24 marks)

<p>1 (i)</p>	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; text-align: center; vertical-align: middle;"> <p>5 ●</p> <p>4 ●</p> <p>3 ●</p> <p>2 ●</p> <p>1 ●</p> <p>0 ●</p> </td> <td style="width: 50%; text-align: center; vertical-align: middle;"> <p>● 5</p> <p>● 4</p> <p>● 3</p> <p>● 2</p> <p>● 1</p> <p>● 0</p> </td> </tr> <tr> <td style="text-align: center; vertical-align: middle;"> <p>number of pairs of shoes</p> </td> <td style="text-align: center; vertical-align: middle;"> <p>number of people</p> </td> </tr> </table>	<p>5 ●</p> <p>4 ●</p> <p>3 ●</p> <p>2 ●</p> <p>1 ●</p> <p>0 ●</p>	<p>● 5</p> <p>● 4</p> <p>● 3</p> <p>● 2</p> <p>● 1</p> <p>● 0</p>	<p>number of pairs of shoes</p>	<p>number of people</p>						
<p>5 ●</p> <p>4 ●</p> <p>3 ●</p> <p>2 ●</p> <p>1 ●</p> <p>0 ●</p>	<p>● 5</p> <p>● 4</p> <p>● 3</p> <p>● 2</p> <p>● 1</p> <p>● 0</p>										
<p>number of pairs of shoes</p>	<p>number of people</p>										
<p>1 (ii)</p>	<table border="1" style="width: 100%; height: 100%;"> <tr><td style="height: 20px;"></td></tr> <tr><td style="height: 20px;"></td></tr> <tr><td style="height: 20px;"></td></tr> </table>										
<p>1 (iii)</p>	<table border="1" style="width: 100%; height: 100%;"> <tr><td style="height: 20px;"></td></tr> <tr><td style="height: 20px;"></td></tr> <tr><td style="height: 20px;"></td></tr> </table>										
<p>1 (iv)</p>	<table border="1" style="width: 100%; height: 100%;"> <tr><td style="height: 20px;"></td></tr> <tr><td style="height: 20px;"></td></tr> <tr><td style="height: 20px;"></td></tr> <tr><td style="height: 20px;"></td></tr> </table>										
<p>1 (v)</p>	<table border="1" style="width: 100%; height: 100%;"> <tr><td style="height: 20px;"></td></tr> <tr><td style="height: 20px;"></td></tr> <tr><td style="height: 20px;"></td></tr> <tr><td style="height: 20px;"></td></tr> <tr><td style="height: 20px;"></td></tr> <tr><td style="height: 20px;"></td></tr> <tr><td style="height: 20px;"></td></tr> <tr><td style="height: 20px;"></td></tr> <tr><td style="height: 20px;"></td></tr> <tr><td style="height: 20px;"></td></tr> </table>										

2 (i)



2 (ii)

3 (i)

x	1	2	3
Probability($X = x$)	$\frac{1}{2}$	$\frac{1}{6}$	$\frac{1}{3}$

3 (ii)

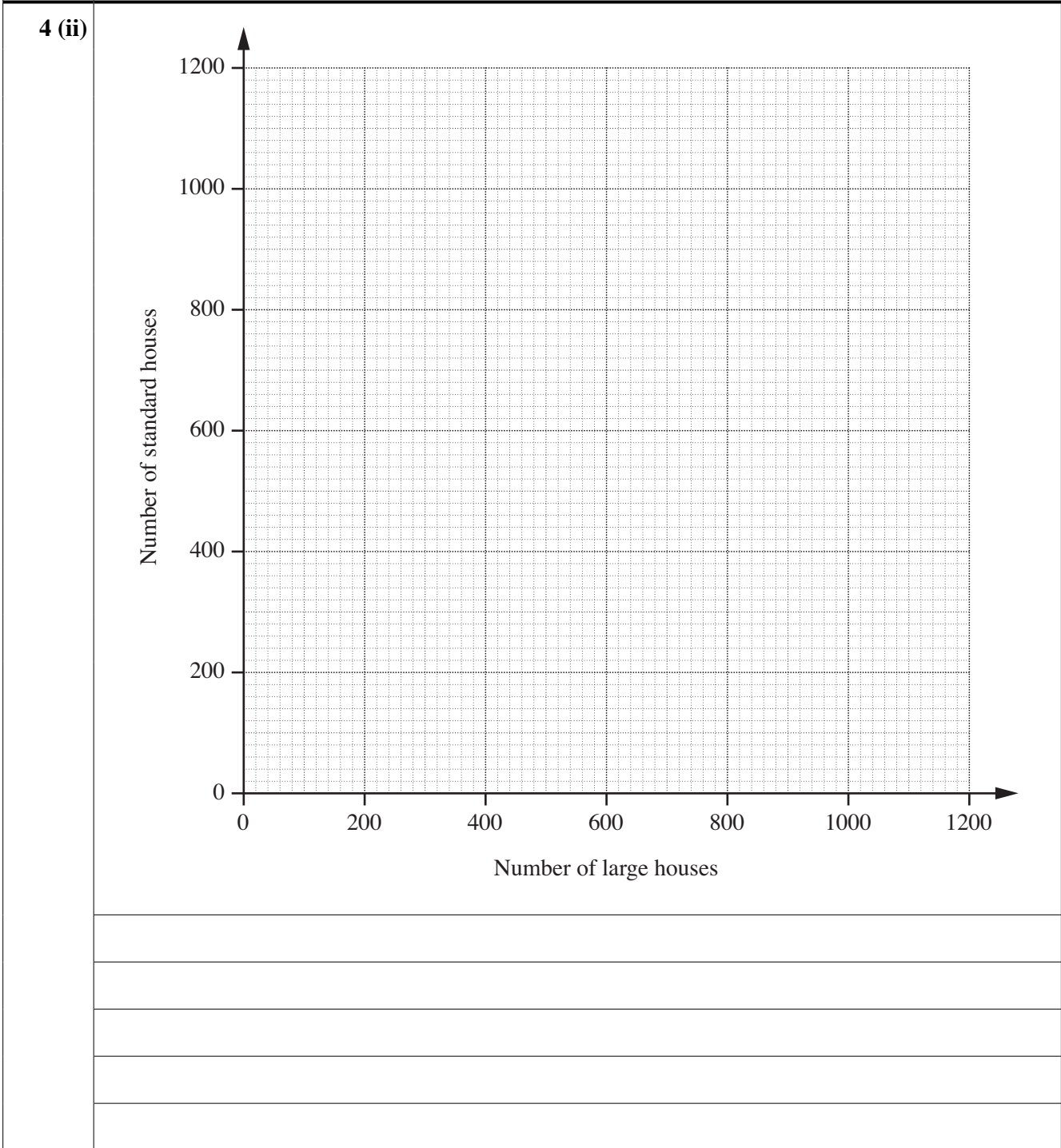
y	1	2	3
Probability($Y = y$)	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{4}$

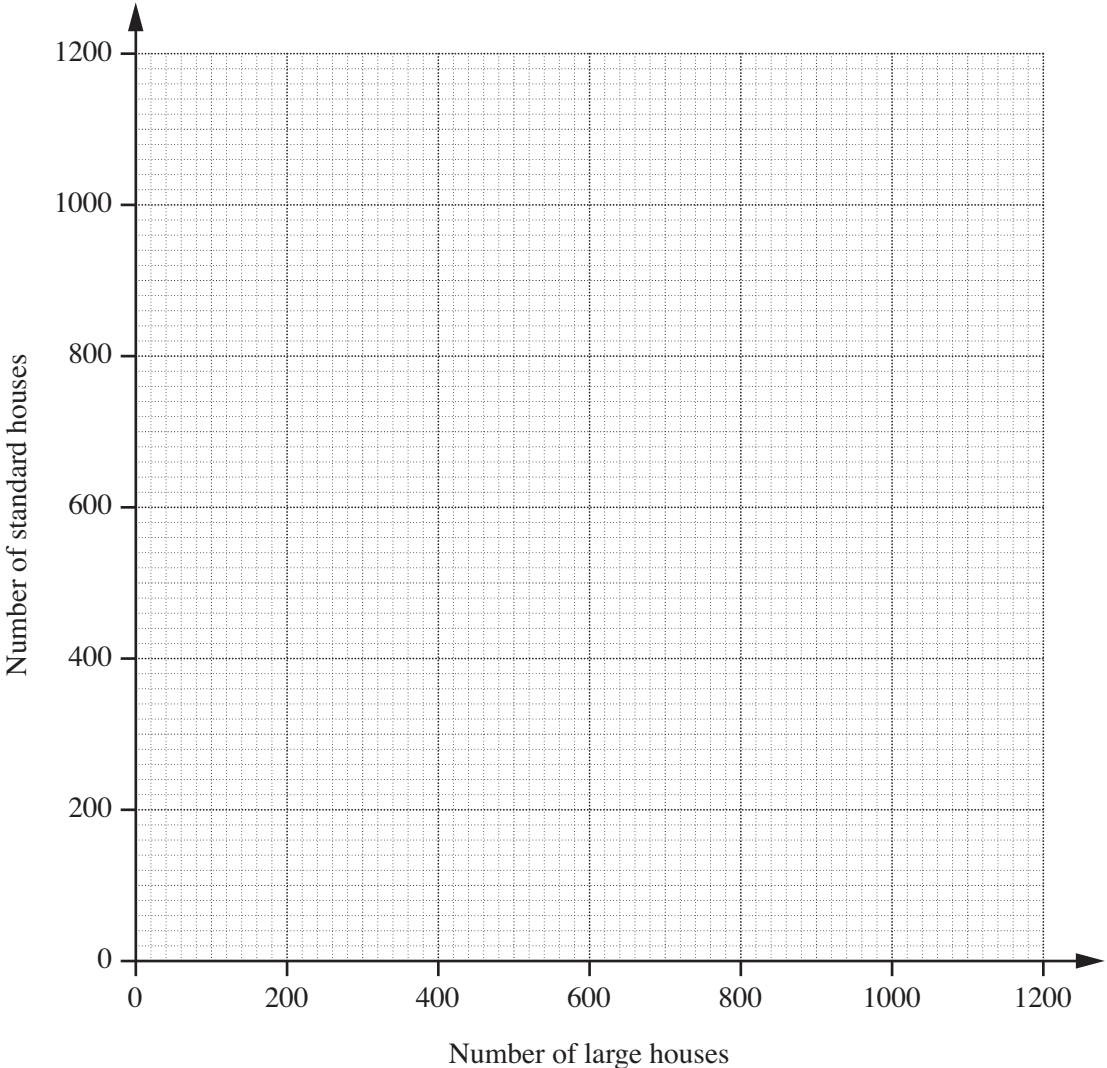
3 (iii)	

PLEASE DO NOT WRITE ON THIS SPACE

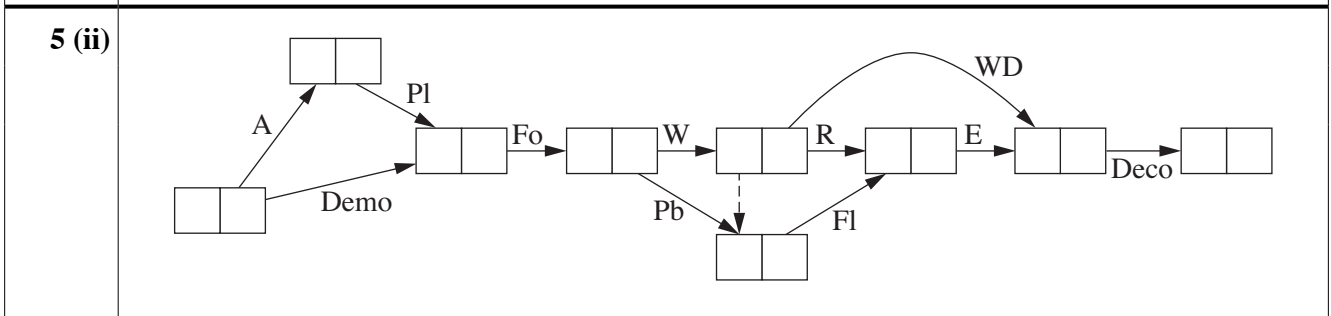
Section B (48 marks)

4 (i)	



4 (iii)	
4 (iv)	
4 (ii) SPARE COPY OF GRAPH PAPER	

5 (i)	Activity	Immediate predecessor(s)
	A	
	Pl	
	Demo	
	Fo	
	W	
	Pb	
	R	
	Fl	
	E	
	WD	
	Deco	



5 (iii)

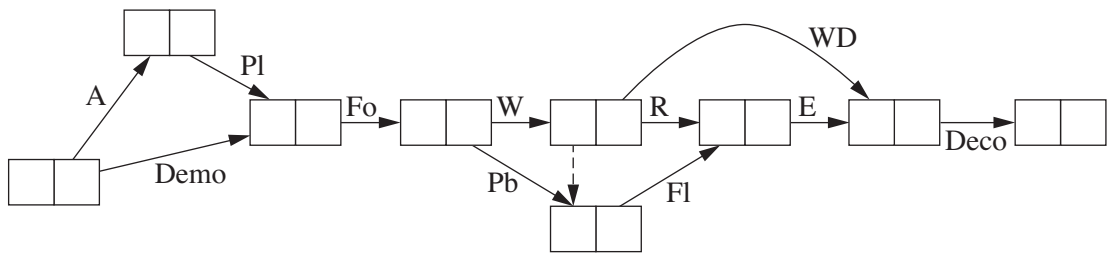
task:	A	Pl	Demo	Fo	W	Pb	R	Fl	E	WD	Deco
float:											

5 (iv)

5 (v)

5 (vi)

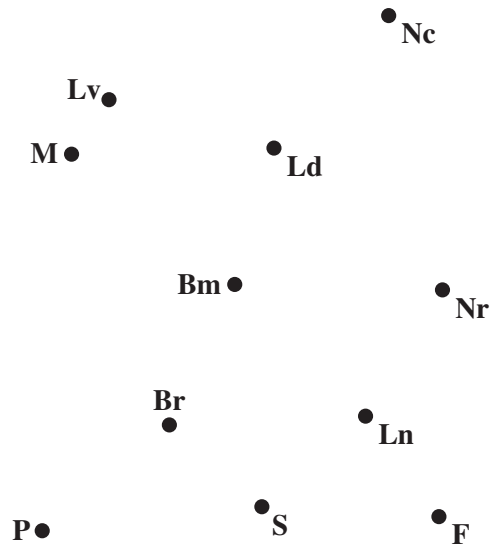
5 (ii) SPARE COPY OF ACTIVITY NETWORK



6 (i)

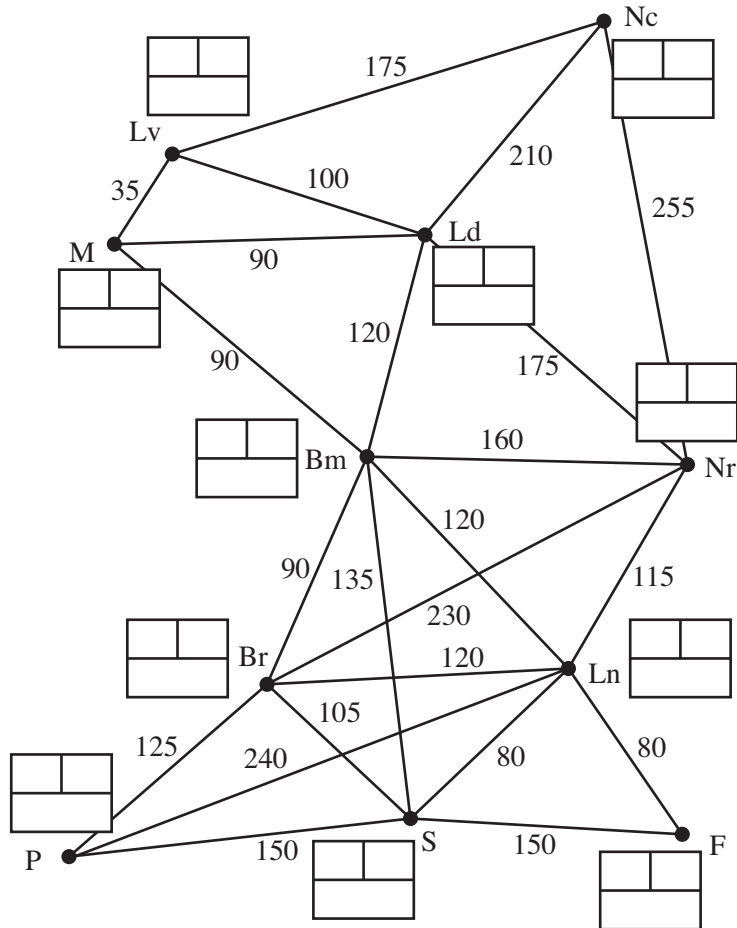
	P	S	F	Ln	Br	Nr	Bm	Ld	Nc	Lv	M
P	-	150	-	240	125	-	-	-	-	-	-
S	150	-	150	80	105	-	135	-	-	-	-
F	-	150	-	80	-	-	-	-	-	-	-
Ln	240	80	80	-	120	115	120	-	-	-	-
Br	125	105	-	120	-	230	90	-	-	-	-
Nr	-	-	-	115	230	-	160	175	255	-	-
Bm	-	135	-	120	90	160	-	120	-	-	90
Ld	-	-	-	-	-	175	120	-	210	100	90
Nc	-	-	-	-	-	255	-	210	-	175	-
Lv	-	-	-	-	-	-	-	100	175	-	35
M	-	-	-	-	-	-	90	90	-	35	-

Min connector



6 (ii)

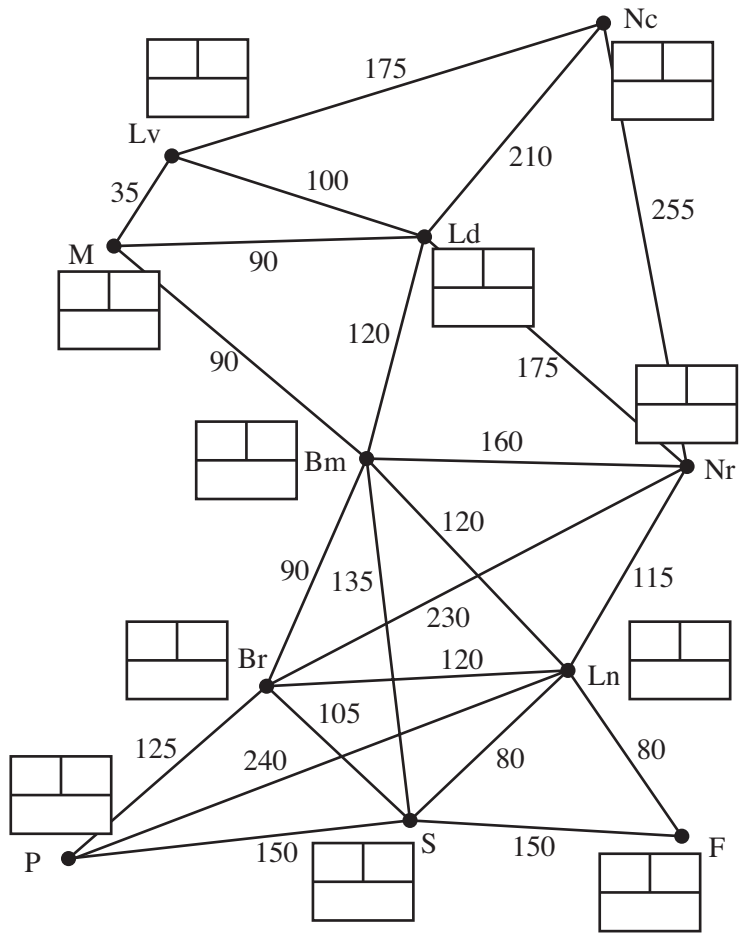
6 (iii)



THERE IS A SPARE COPY OF THIS NETWORK ON PAGE 12.

6 (iv)

6 (iii) SPARE COPY OF NETWORK



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SPECIMEN

Advanced Subsidiary GCE
QUANTITATIVE METHODS (MEI)
G246 Decision Mathematics 1 (D1)

Specimen Mark Scheme

The maximum mark for this paper is 72.

GENERIC MARKING INSTRUCTIONS

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the scoris 50% and 100% (traditional 40% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone or the scoris messaging system, or by email.
5. Work crossed out:
 - a. where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks
 - b. if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.
7. There is a NR (No Response) option. Award NR (No Response):
 - if there is nothing written at all in the answer space
 - OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')
 - OR if there is a mark (e.g. a dash, a question mark) which is not an attempt at the question.Note: Award 0 marks - for an attempt that earns no credit (including copying out the question).
8. The scoris **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.** If you have any questions or comments for your Team Leader, use the phone, the scoris messaging system, or email.
9. Assistant Examiners will send a brief report on the performance of candidates to your Team Leader (Supervisor) by the end of the marking period. The Assistant Examiner's Report Form (AERF) can be found on the RM Cambridge Assessment Support Portal (and for traditional marking it is in the *Instructions for Examiners*). Your report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. Annotations and abbreviations

Annotation in scoris	Meaning
✓ and ✖	
BOD	Benefit of doubt
FT	Follow through
ISW	Ignore subsequent working
M0, M1	Method mark awarded 0, 1
A0, A1	Accuracy mark awarded 0, 1
B0, B1	Independent mark awarded 0, 1
SC	Special case
^	Omission sign
MR	Misread
Highlighting	
Other abbreviations in mark scheme	Meaning
E1	Mark for explaining
U1	Mark for correct units
G1	Mark for a correct feature on a graph
M1 dep*	Method mark dependent on a previous mark, indicated by *
cao	Correct answer only
oe	Or equivalent
rot	Rounded or truncated
soi	Seen or implied
www	Without wrong working

SUBJECT-SPECIFIC MARKING INSTRUCTIONS

- A Annotations should be used whenever appropriate during your marking.

The A, M and B annotations must be used on your standardisation scripts for responses that are not awarded either 0 or full marks. It is vital that you annotate standardisation scripts fully to show how the marks have been awarded.

For subsequent marking you must make it clear how you have arrived at the mark you have awarded.

- B An element of professional judgement is required in the marking of any written paper. Remember that the mark scheme is designed to assist in marking incorrect solutions. Correct *solutions* leading to correct answers are awarded full marks but work must not be judged on the answer alone, and answers that are given in the question, especially, must be validly obtained; key steps in the working must always be looked at and anything unfamiliar must be investigated thoroughly.

Correct but unfamiliar or unexpected methods are often signalled by a correct result following an *apparently* incorrect method. Such work must be carefully assessed. When a candidate adopts a method which does not correspond to the mark scheme, award marks according to the spirit of the basic scheme; if you are in any doubt whatsoever (especially if several marks or candidates are involved) you should contact your Team Leader.

- C The following types of marks are available.

M

A suitable method has been selected and *applied* in a manner which shows that the method is essentially understood. Method marks are not usually lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, e.g. by substituting the relevant quantities into the formula. In some cases the nature of the errors allowed for the award of an M mark may be specified.

A

Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated Method mark is earned (or implied). Therefore M0 A1 cannot ever be awarded.

B

Mark for a correct result or statement independent of Method marks.

E

A given result is to be established or a result has to be explained. This usually requires more working or explanation than the establishment of an unknown result.

Unless otherwise indicated, marks once gained cannot subsequently be lost, e.g. wrong working following a correct form of answer is ignored. Sometimes this is reinforced in the mark scheme by the abbreviation isw. However, this would not apply to a case where a candidate passes through the correct answer as part of a wrong argument.

D When a part of a question has two or more 'method' steps, the M marks are in principle independent unless the scheme specifically says otherwise; and similarly where there are several B marks allocated. (The notation 'dep *' is used to indicate that a particular mark is dependent on an earlier, asterisked, mark in the scheme.) Of course, in practice it may happen that when a candidate has once gone wrong in a part of a question, the work from there on is worthless so that no more marks can sensibly be given. On the other hand, when two or more steps are successfully run together by the candidate, the earlier marks are implied and full credit must be given.

E The abbreviation ft implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A and B marks are given for correct work only – differences in notation are of course permitted. A (accuracy) marks are not given for answers obtained from incorrect working. When A or B marks are awarded for work at an intermediate stage of a solution, there may be various alternatives that are equally acceptable. In such cases, exactly what is acceptable will be detailed in the mark scheme rationale. If this is not the case please consult your Team Leader.

Sometimes the answer to one part of a question is used in a later part of the same question. In this case, A marks will often be 'follow through'. In such cases you must ensure that you refer back to the answer of the previous part question even if this is not shown within the image zone. You may find it easier to mark follow-through questions candidate-by-candidate rather than question-by-question.

F Wrong or missing units in an answer should not lead to the loss of a mark unless the scheme specifically indicates otherwise. Candidates are expected to give numerical answers to an appropriate degree of accuracy, with 3 significant figures often being the norm. Small variations in the degree of accuracy to which an answer is given (e.g. 2 or 4 significant figures where 3 is expected) should not normally be penalised, while answers which are grossly over- or under-specified should normally result in the loss of a mark. The situation regarding any particular cases where the accuracy of the answer may be a marking issue should be detailed in the mark scheme rationale. If in doubt, contact your Team Leader.

G Rules for replaced work

If a candidate attempts a question more than once, and indicates which attempt he/she wishes to be marked, then examiners should do as the candidate requests.

If there are two or more attempts at a question which have not been crossed out, examiners should mark what appears to be the last (complete) attempt and ignore the others.

NB Follow these maths-specific instructions rather than those in the assessor handbook.

- H For a *genuine* misreading (of numbers or symbols) which is such that the object and the difficulty of the question remain unaltered, mark according to the scheme but following through from the candidate's data. A penalty is then applied; 1 mark is generally appropriate, though this may differ for some units. This is achieved by withholding one A mark in the question.

Note that a miscopy of the candidate's own working is not a misread but an accuracy error.

Question		Answer	Marks	Guidance	
1	(i)		B1 B1 B1 [3]	3 to 4 deleted 1 to 4 deleted 4 to 4 added	-1 for each arc in error
1	(ii)	14	B1 [1]		
1	(iii)	47	M1 A1 [2]	cao	Award method mark if answer correct, or if wrong but with a sum of products shown.
1	(iv)	(0, 0) and (1, 0)	B1 [1]		Award only if correct points are specified in some way.
1	(v)	Explanation should recognise that a line is a set of points – not appropriate in this context	B1 [1]		e.g. “Intermediate points have no meaning.” e.g. “Can’t have one and a half pairs of shoes.” (sic)

Question		Answer	Marks		Guidance
2	(i)	$X = \min(25, 8.5) = 8.5$ or equivalent $Y = \min(5, 42.5) = 5$ oe $X^* = (85-10)/10 = 7.5$ oe $Y^* = (25-8.5)/5 = 3.3$ oe 	B1 B1 B1 B1 B1 B1 B1 [7]	cao cao cao cao allow ft cao cao	OK if only seen once or more on graph OK if only seen once or more on graph OK if only seen on graph OK if only seen on graph sensibly scaled for their X and Y e.g. disallow if either of the lines in the question could intersect both axes. lines – can extend to beyond segment condone minor errors in plotting (e.g. 8.5 plotted at 9)
2	(ii)	Avoids tiny feasible regions	B1 [1]		need comment on size of region
3	(i)	e.g. $1, 2, 3 \rightarrow 1$ $4 \rightarrow 2$ $5, 6 \rightarrow 3$	M1 A1 A1 [3]		function with domain {1,2,3,4,5,6} and range {1,2,3}(special cases are possible – if correct!) proportions 3:2:1 all OK
3	(ii)	e.g. $1, 2 \rightarrow 1$ $3 \rightarrow 2$ $4 \rightarrow 3$ (5, 6 → reject and throw again)	M1 A1 A1 [3]	reject some reject two rest	(Special cases are possible – if correct! e.g. allow throwing die twice and allocating correct proportions of 36)
3	(iii)	non uniform allows 100	B1 B1 [2]		‘101 values’ OK no credit for, e.g. ‘3 is not a two-digit number’

Question		Answer	Marks	Guidance	
4	(i)	e.g. $x = \text{number of large houses}$ $y = \text{number of standard houses}$ land: $200x + 120y \leq 120000$ oe cash: $60x + 50y \leq 42400$ oe market: $x \leq 0.5y$ oe	M1A1 B1 B1 B1 [5]		M1 for variables for large and for standard A1 for 'number' use 'isw' for incorrect simplifications -1 once only for any '<'
4	(ii)		B1 B1 B1 B1 [4]	line 1, allow ft line 2, allow ft line 3, allow ft feasible region	for instance, if $x \leq 2y$ in part (i), then allow correct graph of $x \leq 0.5$ or ft graph of $x \leq 2y$ plotting tolerance on axis intersection points – within correct small square must consider 3 lines ft if region includes y-axis interval from origin upwards allow any clear indication of feasible region ignore any indication(s) of boundary lines included or excluded
4	(iii)	intersection of $y = 2x$ and $6x + 5y = 4240$, (265, 530) 2650	M1 A1 [2]	correct point, cao	identification only – coordinates not required here their $4x + 3y$ from (260–280, 520–540)
4	(iv)	their $60x + 50y \leq 45000$ or line from their (0, 900) to (750, 0)	B1	ft	can be implied from final M1 working

Question		Answer	Marks	Guidance																									
		Best point is at the intersection of the land constraint and the new cash constraint, and not on $y=2x$ (214, 643) 2785	M1 A1 M1 A1 [5]	comparison of two (or more) points Correct point, cao	not just ringing points their identified best point is not on $y = 2x$ or an axis identification, coordinates not required here bedrooms – their $4x + 3y$ from (200–220, 620–660)																								
5	(i)	<table border="1" data-bbox="434 568 945 1040"> <thead> <tr> <th>Activity</th> <th>Immediate predecessors</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>–</td> </tr> <tr> <td>Pl</td> <td>A</td> </tr> <tr> <td>Demo</td> <td>–</td> </tr> <tr> <td>Fo</td> <td>Pl; Demo</td> </tr> <tr> <td>W</td> <td>Fo</td> </tr> <tr> <td>Pb</td> <td>Fo</td> </tr> <tr> <td>R</td> <td>W</td> </tr> <tr> <td>Fl</td> <td>Pb; W</td> </tr> <tr> <td>E</td> <td>R; Fl</td> </tr> <tr> <td>WD</td> <td>W</td> </tr> <tr> <td>Deco</td> <td>WD; E</td> </tr> </tbody> </table>	Activity	Immediate predecessors	A	–	Pl	A	Demo	–	Fo	Pl; Demo	W	Fo	Pb	Fo	R	W	Fl	Pb; W	E	R; Fl	WD	W	Deco	WD; E	M1 A1 [2]	Fl correct rest	
Activity	Immediate predecessors																												
A	–																												
Pl	A																												
Demo	–																												
Fo	Pl; Demo																												
W	Fo																												
Pb	Fo																												
R	W																												
Fl	Pb; W																												
E	R; Fl																												
WD	W																												
Deco	WD; E																												

Question		Answer	Marks	Guidance																								
5	(ii)	<p>Network diagram showing activities and their dependencies. Nodes contain ES, EF, LS, LF values. Arrows show dependencies with activity names and durations.</p>	<p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>[4]</p>	<p>at least one correct nontrivial join forward pass</p> <p>at least one correct nontrivial burst backward pass</p> <p>excluding start node</p>																								
5	(iii)	<p>critical activities: A; Pl; Fo; W; R; E; Deco</p> <p>project duration = 41 days</p> <table border="1"> <tr> <td>act</td> <td>A</td> <td>Pl</td> <td>Dm</td> <td>Fo</td> <td>W</td> <td>Pb</td> <td>R</td> <td>Fl</td> <td>E</td> <td>WD</td> <td>Dc</td> </tr> <tr> <td>float</td> <td>0</td> <td>0</td> <td>21</td> <td>0</td> <td>0</td> <td>2</td> <td>0</td> <td>1</td> <td>0</td> <td>4</td> <td>0</td> </tr> </table>	act	A	Pl	Dm	Fo	W	Pb	R	Fl	E	WD	Dc	float	0	0	21	0	0	2	0	1	0	4	0	<p>B1</p> <p>B1</p> <p>B1</p> <p>B1</p> <p>[4]</p>	<p>cao</p> <p>cao</p> <p>A,Pl,Dm,Fo,W rest</p> <p>cao – most zeros, dashes or empty spaces won't do</p>
act	A	Pl	Dm	Fo	W	Pb	R	Fl	E	WD	Dc																	
float	0	0	21	0	0	2	0	1	0	4	0																	
5	(iv)	<p>Fl has both W and Pb as immediate predecessors.</p> <p>R and WD have only W as immediate predecessor.</p>	<p>B1</p> <p>B1</p> <p>[2]</p>	<p>one of R/WD</p> <p>SC1 for a convincing but not specific answer, e.g. 'A dummy is needed to cater for both joint and separate precedences'.</p>																								

Question		Answer	Marks	Guidance
5	(v)		<p>M1</p> <p>A1</p> <p>A1</p> <p>[3]</p>	<p>C between W and R</p> <p>FI + dummy</p> <p>OK</p> <p>WD OK</p>
5	(vi)	<p>new duration = 42 days</p> <p>critical activities: A; PI; Fo; W; C; R; E; Deco</p>	<p>B1</p> <p>[1]</p>	<p>both needed</p>

Question		Answer											Marks	Guidance		
6	(i)		1	7	9	8	2	10	3	6	11	5	4	M1 tabular Prim A2 choosings A1 crossings B1 cao B1 cao [6]	125 in P column and 90 in Br column ringed, with both rows crossed all circles in correct place; -1 each error (watch for one error making two changes to a row) all rows crossed out except, possibly, Nc row. accept convincing transpose	
			P	S	F	Ln	Br	Nr	Bm	Ld	Nc	Lv	M			
		P	-	150	-	240	125	-	-	-	-	-	-			-
		S	150	-	150	80	105	-	135	-	-	-	-			-
		F	-	150	-	80	-	-	-	-	-	-	-			-
		Ln	240	80	80	-	120	115	120	-	-	-	-			-
		Br	125	105	-	120	-	230	90	-	-	-	-			-
		Nr	-	-	-	115	230	-	160	175	255	-	-			-
		Bm	-	135	-	120	90	160	-	120	-	-	-			90
		Ld	-	-	-	-	-	175	120	-	210	100	90			-
		Nc	-	-	-	-	-	255	-	210	-	175	-			-
		Lv	-	-	-	-	-	-	-	100	175	-	35			-
		M	-	-	-	-	-	-	90	90	-	-	35			-
<p style="text-align: right;">Length = 985 miles</p>																

Question		Answer	Marks	Guidance	
6	(ii)	<p>Advantage: shortest length of track</p> <p>Disadvantage: tree, no redundancy \equiv fragility (breakdown et al)</p> <p>Disadvantage: some journeys are not shortest paths</p>	<p>B1</p> <p>B1</p> <p>B1</p> <p>[3]</p>	cao	<p>allow cost minimisation</p> <p>could say 'no cycles'</p> <p>disallow comments relating to direct connectivity, or relating to more stops; 'longer journeys' or 'takes longer' allowed</p> <p>allow 'min connector arcs may be more expensive' oe</p> <p>don't allow two marks for the same point described differently. e.g. longer journeys/more time/more upkeep</p>

Question	Answer	Marks	Guidance
<p>6 (iii)</p>	<p>Route: P S Ln Nr Distance: 345 miles</p>	<p>M1 Dijkstra A1 working values B1 labels B1 order of labelling B1 cao B1 cao [6]</p>	<p>correct working values (no extras) at Ln and Nr, and working values only superseded at Ln and Nr (ignore Nc for this M) (need to check Nc here)</p>
<p>6 (iv)</p>	<p>Distance by min connector = 425 miles</p>	<p>B1 ft their mc [1]</p>	

Assessment Objectives (AO) Grid

Question	AO1	AO2	AO3	AO4	AO5	Total
1(i)			3			3
1(ii)				1		1
1(iii)				1	1	2
1(iv)				1		1
1(v)	1					1
2(i)	2	2	2		1	7
2(ii)			1			1
3(i)	3					3
3(ii)	1		2			3
3 (iii)				2		2
4(i)	2		3			5
4(ii)		4				4
4(iii)				1	1	2
4(iv)	1	1	2	1		5
5(i)	1	1				2
5(ii)	2	2				4
5(iii)			2	2		4
5(iv)				2		2
5(v)	1	2				3
5(vi)			1			1
6(i)	3	1	1	1		6
6(ii)			3			3
6(iii)		4	2			6
6(iv)					1	1
Totals	17	17	22	12	4	72

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Mark Scheme

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