



Mark Scheme (Results)

Summer 2026

Pearson Edexcel International Advanced Level in
Decision Mathematics D1

WDM11/01A

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

General Instructions for Marking

1. The total number of marks for the paper is 75.
2. The Edexcel Mathematics mark schemes use the following types of marks:
 - **M** marks: Method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
 - **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
 - **B** marks are unconditional accuracy marks (independent of M marks) Marks should not be subdivided.

3. Abbreviations

These are some of the traditional marking abbreviations that will appear in the mark schemes and can be used if you are using the annotation facility on ePEN:

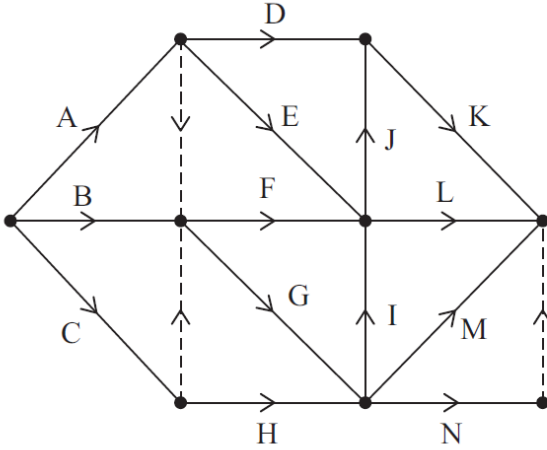
- bod – benefit of doubt
- ft – follow through
 - the symbol $\surd$ will be used for correct ft
- cao – correct answer only
- cso – correct solution only. There must be no errors in this part of the question to obtain this mark
- isw – ignore subsequent working
- awrt – answers which round to
- SC – special case
- oe – or equivalent (and appropriate)
- d... or dep – dependent
- indep – independent
- dp – decimal places
- sf – significant figures
- * – The answer is printed on the paper or ag- answer given

- $\square$ or d... – The second mark is dependent on gaining the first mark
4. All A marks are 'correct answer only' (cao), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but manifestly absurd answers should never be awarded A marks.
 5. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected. If you are using the annotation facility on ePEN, indicate this action by 'MR' in the body of the script.
 6. If a candidate makes more than one attempt at any question:
 - a) If all but one attempt is crossed out, mark the attempt which is NOT crossed out.
 - b) If either all attempts are crossed out or none are crossed out, mark all the attempts and score the highest single attempt.

Ignore wrong working or incorrect statements following a correct answer.

Question Number	Scheme	Marks
1.(a)	e.g. Left to right 18 13 21 17 23 14 20 15 16 19	M1
	13 18 17 21 14 20 15 16 19 23	A1
	13 17 18 14 20 15 16 19 21 23	A1
	13 17 14 18 15 16 19 20 21 23	A1
	13 14 17 15 16 18 19 20 21 23	
	13 14 15 16 17 18 19 20 21 23	
	13 14 15 16 17 18 19 20 21 23	(3)
	e.g. right to left 18 13 21 17 23 14 20 15 16 19	
	13 18 14 21 17 23 15 20 16 19	
	13 14 18 15 21 17 23 16 20 19	
	13 14 15 18 16 21 17 23 19 20	
	13 14 15 16 18 17 21 19 23 20	
	13 14 15 16 17 18 19 21 20 23	
	13 14 15 16 17 18 19 20 21 23	
	13 14 15 16 17 18 19 20 21 23	
(b) (i)	BD, AB, reject AD, AC, BE, reject CD, reject DE, DF (reject EF, reject CF)	M1 A1 A1
(ii)	80 (metres)	B1 (4)
		7 marks
	Notes for Question 1	
a1M1	Bubble sort working consistently L to R or R to L first two passes completed with two largest values in place (L to R) or two smallest values in place (R to L) (Note Quick sort is M0) (If sorting into descending order M1 only even if reversed) (condone one error either transcription or order for this mark but must have both largest or smallest in place)	
a1A1	First four passes correct (accept shrinking list)	
a2A1	CSO (must include 6 th unchanged pass L to R or 7 th unchanged pass R to L or list rewritten after 5 th /6 th pass – do not accept sort completed without the unchanged pass) (if shrinking list they must write out the final list in full)	
bi1M1	Kruskal not Prim, BD and AB selected and AD rejected (in that order) (Accept a full list of arcs in order followed by a list of the correct five arcs for M1 A1 A0) (Accept correct list of numerical values in place of arcs for M1 only)	
bi1A1	All five arcs selected in the correct order with no additional	

Question Number	Scheme	Marks
bi2A1	CSO – all arcs selected and rejections made in correct order (rejecting EF and CF not required, but if seen they must be in this order)	
biiB1	CAO (Do not ISW if 2 x 80 seen)	

Question Number	Scheme	Marks
2.(a)	 e.g.	M1 A1 (ABCDEH) A1 (FGIJ) A1 (KLMN) A1 (5)
(b)	Activities A, B, C, G, H, I, J and K are critical	B2,1 (2)
		7 marks

	Notes for Question 2	
	Condone lack of, or incorrect, numbered events throughout. 'Dealt with correctly' means that the activity starts from the correct event but need not necessarily finish at the correct event, e.g. 'F dealt with correctly' requires the correct precedences for this activity, i.e. B labelled correctly and leading into the starting node, a dummy from the end of A and the end of C into the node and F starting from that node but do not consider the end event. Activity on node is M0	
	If an arc is not labelled, for example, if the arc for activity E is not labelled (but the arc is present) then this will lose the first A mark and the final (CSO) A mark – they can still earn the second A mark on the bod. If two or more arcs are not labelled then mark according to the scheme. Assume that a solid line is an activity which has not been labelled rather than a dummy (even if in the correct place for where a dummy should be). Ignore incorrect or lack of arrows on the activities for the first four marks only	
a1M1	Nine activities (labelled on arc), one start and at least two dummies placed	
a1A1	Activities A, B, C, 1 st two dummies (including correct arrow), D, E and H dealt with correctly	
a2A1	Activities F, G, I and J dealt with correctly	
a3A1	Activities K, L, M and N dealt with correctly	
a4A1	CSO – all arrows correctly placed for each activity with one finish and exactly three dummies (so uniqueness dummy for M/N required)	
	Please check all arcs carefully for arrows – if there are no arrows on any dummies then M1 only. Note that additional (but unnecessary) 'correct' dummies that still maintain precedence for the network should only be penalised with the final A mark if earned. Note that this diagram is not unique	
b1B1	At least one of A, B, C and one of G, H and all of I, J, K and no non-critical activities	
b2B1	CAO – all 8 activities and no non-critical activities	

Question Number	Scheme	Marks
3.(a)	Totals in bins are 47, 50, 49 so $n \geq 50$ or considers bin 2 $n \geq 15 + 24 + 11 \Rightarrow n \geq 50$ 13 placed in bin 3 instead of bin 2 so $n < 15 + 24 + 13 \Rightarrow n < 52$ n can be 50 or 51	B1 M1 A1 (3)
(b)	Either considers $n = 51$ 28 20 24 16 11 15 13 12 7 or considers $n = 50$ 28 20 24 16 7 15 13 12 11 If considering $n = 50$ shows that $24 + 16 + 11 = 51$ concludes that $n = 50$	M1 A1 (2)
		5 marks
	Notes for Question 3	
a1B1	Considers the total in each bin and states $n \geq 50$ which may be implied by sight of the three totals and then a statement that e.g. $n = 50$ or 51 or considers bin 2 and states $n \geq 50$	
a1M1	Considers the placement of 13 and deduces that this does not fit in bin 2 and therefore states a correct upper bound for n (accept statements e.g. 13 is not in bin 2 so $n < 52$ or $15 + 24 + 13 = 52$ so $n < 52$ or $15 + 24 + 13 = 52$ so $n = 50$ or 51) (Note: a statement of $n < 52$ with no working is M0)	
a1A1	CAO – accept inequalities $50 \leq n < 52$ o.e. (must have scored both B and M mark)	
b1M1	Either considers $n = 51$ and shows only 3 bins required or considers $n = 50$ and shows 4 bins required (bin packing must be correct – if both shown at least one must be correct)	
b1A1	If considering $n = 51$ sight of the correct bin packing plus conclusion that $n = 50$ is sufficient	

	If just considering $n = 50$ must also show that $n = 51$ uses 3 bins when using the algorithm e.g. by stating that 11 fits in bin 2 and 7 in bin 3 Concludes that $n = 50$ (there must not be any incorrect statements or working seen)	
--	--	--

Question Number	Scheme	Marks
4.(a)	Use Dijkstra to find the shortest route from A to C and from A to I and add these together	B2,1 (2)
(b)		M1 A1 (ABFJ) A1 (DEG) A1ft (CHI)
	Quickest route is IHGJBABDEC	A1
	Length of quickest route is $90 + 66 = 156$ (minutes)	A1ft (6)
		8 Marks

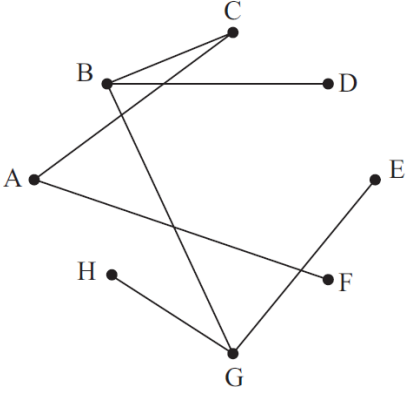
	Notes for Question 4
a1B1	A general idea of finding the route from A to C and from A to I (accept if stated as I to A or C to A)
a2B1	A complete explanation which uses Dijkstra's algorithm throughout, with both sections starting at A, including combining the two sections of the route
	In (b) it is important that all values at each node are checked very carefully – the order of the working values must be correct for the corresponding A mark to be awarded e.g. at G the working values must be 63 57 in that order (so 57 63 is incorrect) It is also important that the order of labelling is checked carefully. The order of labelling must be a strictly increasing sequence – so 1, 2, 3, 3, 4, ... will be penalised once (see notes below) but 1, 2, 3, 5, 6, ... is fine. Errors in the final values and working values are penalised before errors in the order of labelling If the order of labelling and final values have been swapped penalise with the loss of the first A mark earned.
b1M1	A larger value replaced by a smaller value at least twice in the working values at either C, D, E, G, H, I or J
b1A1	All values at A, B, F and J correct and the working values in the correct order
b2A1	All values at D, E and G correct and the working values in the correct order
b3A1ft	All values in C, H and I correct and the working values in the correct order. Follow through on the values at C and I only. The working values at C must follow from the final values at B, D and E and the working values at I must follow from the final values at J, G and H.
b4A1	CAO – do not accept the route in reverse
b5A1ft	Their "156" – this must be the sum of their final values at I and C (Accept if the route and distance have been written on the wrong lines)

	Special Case – starting from I max 3 marks	
(b)		M1 A1 (IHGJF) A1 (BAEDC) AO
	Mark unavailable	AO
	Mark unavailable	AO (6)
	Notes for Special Case	
b1M1	A larger value replaced by a smaller value at least twice in the working values at either G, J, A or C	
b1A1	All values at I, H, G, J and F correct and the working values in the correct order	
b2A1	All values at B, A, E, D and C correct and the working values in the correct order	
b3A0	Mark unavailable	
b4A0	Mark unavailable	
b5A0	Mark unavailable	

Question Number	Scheme	Marks
5.(a)	Semi-Eulerian as there are exactly two nodes with odd degree	B1 (1)
(b)(i)	Repeat D(CGJ)K length 23 Total $338 + 23 = 361$ (km)	M1 A1
(b)(ii)	DC, CG, GJ and JK	A1 (3)
(c)(i)	A(BC)D + K(LM)N = 44 A(BCGJ)K + D(CGJI)N = 69 A(FM)N + D(CGJ)K = 55 Total $338 + 44 = 382$ (km)	M1 A1 A1 A1ft
(c)(ii)	AB, BC, CD, KL, LM and MN	A1 (5)
		9 marks
	Notes for Question 5	
a1B1	CAO – must state reason (as a minimum must see the words in bold and should imply exactly/only two) (accept equivalent wording) (accept reasons e.g. all vertices apart from D and K are even) (must use correct technical language so nodes or vertices but not points) (Any reference to specific vertices must be to the correct vertices only, D K)	
bi1M1	Calculates shortest path for DK	
bi1A1	CAO (361 implies both marks)	
bii1A1	CAO – must be arcs so do not accept DCGJK	
ci1M1	Three pairings of the correct four nodes (A, D, K and N) including totals	
ci1A1	Two rows correct including pairings and totals	
ci2A1	All three rows correct including pairings and totals	
ci3A1ft	$338 +$ their shortest from a choice of 3 totals	
cii1A1	CAO – must be arcs so do not accept ABCD KLMN	

	Notes for Question 6	
a1M1	All top boxes complete, values generally increasing in the direction of the arrows ('left to right'), condone one rogue. For a rogue in the top boxes if values do not increase in the direction of the arrows, then if one value is ignored and then the values do increase in the direction of the arrows then this is considered to be only one rogue value (with a similar definition for bottom boxes but in reverse)	
a1A1	CAO (top boxes)	
a2M1	All bottom boxes complete, values generally decreasing in the opposite direction of the arrows ('right to left'), condone one rogue. Condone missing 0 and/or their 38 (at the end event) for the M mark only	
a2A1	CAO (bottom boxes)	
b1B1	CAO	
c1M1	$(136 \pm 13) \div 38 (=3.58)$ or awrt 3.6 seen (If their final time is not 38 award for $(136 \pm 13) \div \text{their "38"}$)	
c1A1	CAO with no incorrect working seen – note an answer of 4 with no working is M0	
d1B1ft	Their "Late End Time L" – "Early Start Time L" – 3 (must see all three values)	
e1M1	Not a cascade (Gantt) chart. 5 'workers' used at most and at least 10 activities placed. End time must be the same as their end time from the diagram in (a)	
e1A1	4 or 5 workers. All 16 activities present (just once). Condone at most three errors. An activity can give rise to at most three errors; one on duration, one on time interval and only one on IPA	
e2A1	4 workers. All 16 activities present (just once). Condone one error either precedence or time interval or activity length; An activity can give rise to at most three errors; one on duration, one on time interval and only one on IPA	
e3A1	4 workers. All 16 activities present (just once). No errors.	
	For (e) the following may be useful in checking their schedule	

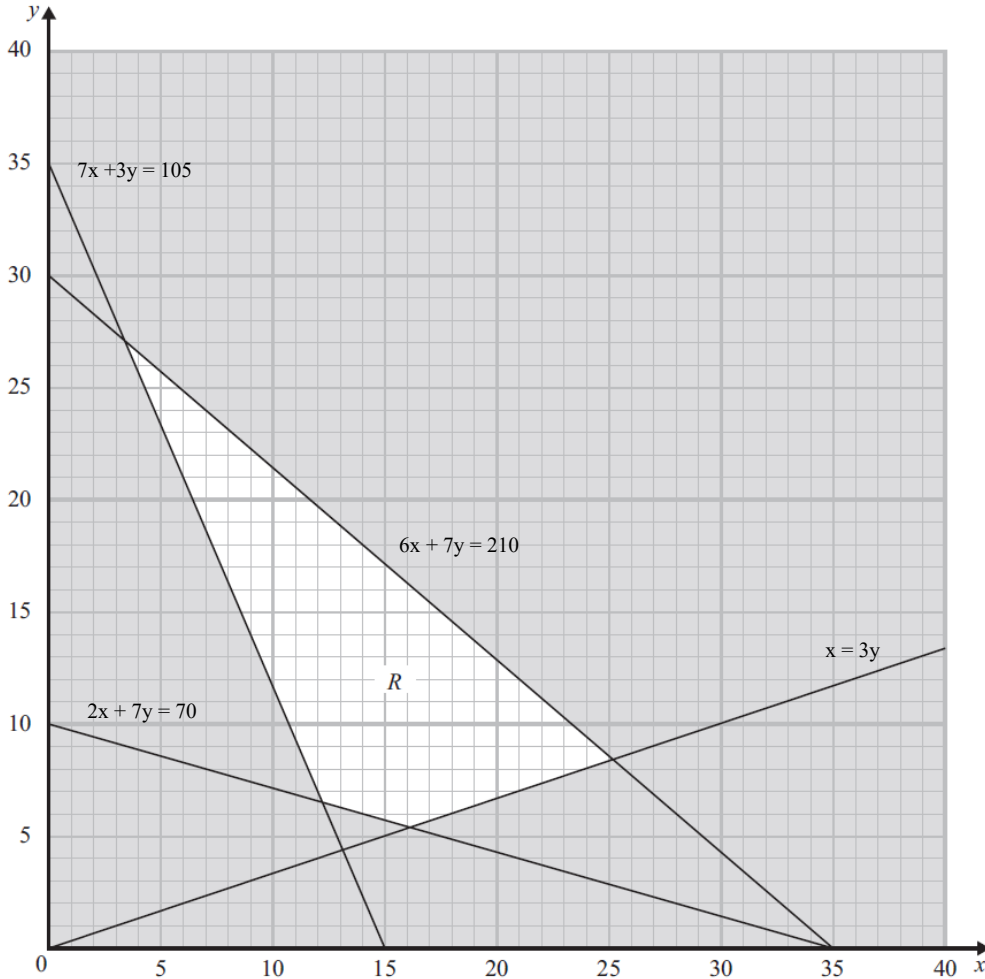
Activity	Duration	Time interval	IPA
A	8	0 - 10	-
B	6	0 - 14	-
C	9	0 - 11	-
D	11	0 - 11	-
E	13	8 - 29	A
F	9	8 - 19	A
G	5	8 - 19	A, B
H	8	11 - 19	C, D
I	6	11 - 19	D
J	13	11 - 30	D
K	7	19 - 29	F, G, H, I
L	3	19 - 28	F, G, H, I
M	11	19 - 30	F, G, H, I
N	9	26 - 38	E, K, L
P	10	22 - 38	L
Q	8	30 - 38	J, M

Question Number	Scheme	Marks
7.(a)(i)	DB, BG, BC, CA, AF, {GE, GH either order}	M1 A1
(a)(ii)	277 (miles)	A1 (3)
(b)		B1 (1)
(c)	"277" x 2 = 554 (miles)	B1ft (1)
(d)	Replace BC CAAAF with BF $554 - 41 - 38 - 39 + 46 = 482$ (miles)	M1 A1 (2)

(e)	ACBGEDHFA 342 (miles) ACBGHEDFA 337 (miles)	M1 A1 A1 (3)
(f)	$277 - 42 + (42 + 43)$ 320 (miles)	M1 A1 (2)
(g)	$321 \leq L \leq 337$	dB1ft (1)
		13 marks

	Notes for Question 7	
ai1M1	Prim's – first three arcs correctly chosen in order (DB, BG, BC, ...) or first four nodes {D, B, G, C, ...} correctly chosen in order. If any explicit rejections seen at some point then M1 (max) only. Order of nodes may be seen at the top of a matrix/table {-, 2, 4, 1, -, -, 3, -}. Starting at any other node can score M1 only for first three arcs chosen correctly (If starting at A first 3 arcs AC AF BC)	
ai1A1	CSO – all arcs correctly stated and chosen in the correct order (with no additional arcs). They must be considering arcs for this mark (do not accept a list of nodes or numbers across the top of the matrix unless the correct list of arcs (in the correct order) is also seen)	
aii2A1	CAO (must be stated in (a))	
b1B1	CAO	
c1B1ft	Their “277” x 2	
d1M1	Attempts to use BF as shortcut (accept correct calculation or arcs listed)	
d1A1	CAO value and arcs must be stated	
e1M1	Nearest neighbour starting at A with first five nodes correct (A – C – B – G – E – or A – C – B – G – H) Accept arcs so AC, CB, BG, GE or GH	
e1A1	One route correct including return to A (may be stated as arcs) and its value correct	
e2A1	Both routes correct including return to A (may be stated as arcs) and both values correct	

f1M1	(weight of their MST from (a) or 277 only) – 42 + 42(HG) + 43(HB) (oe so may not see the –42 + 42). A correct answer of 320 with no working can imply this (and the next) mark. If (a) is incorrect and H is only connected by HG, a value of their “277” from (a) plus 43 scores M1 (Note new calculation to find RMST 235 + 42 + 43 = 320 may be seen) (If using a new calculation for the RMST award for the correct arcs DB, BG, BC, CA, AF, EG seen or a value of 235 plus the two shortest from H)	
f1A1	CAO	
g1dB1ft	Dependent on both M marks in (e) and (f). Follow through their smallest upper bound and their greatest lower bound. Do not accept strict inequalities. Accept interval notation [321, 337]	

Question Number	Scheme	Marks
8. (a)	$z = 100 - x - y$ $(P =) 5x + y + 10(100 - x - y)$ $(P =) 1000 - 5x - 9y$ Maximising $1000 - 5x - 9y$ is equivalent to minimising $5x + 9y$	M1 A1 A1 (3)
(b)		B1 B1 dB1 (3)
(c)	$2x + 7y = 70 \Rightarrow x = \frac{525}{43} \quad y = \frac{280}{43} \quad C = \frac{5145}{43} = 119\frac{28}{43} \quad 119.7$ $7x + 3y = 105 \quad (12.2, 6.5)$ $2x + 7y = 70 \Rightarrow x = \frac{210}{13} \quad y = \frac{70}{13} \quad C = \frac{1680}{13} = 129\frac{3}{13} \quad 129.2$ $x = 3y \quad (16.2, 5.4)$ $\text{Optimum point } x = 12\frac{9}{43} \quad y = 6\frac{22}{43}$	M1 A1 dM1 A1 (4)

(d)		$2x + 7y \geq 70$	$7x + 3y \geq 105$	$5x + 9y$	dM1
	(12, 7)	73 Y	105 Y	123	
	(13, 6)	68 N	109 Y	(119)	
	(13, 7)	75 Y	112 Y	128	
	$x = 12 \ y = 7 \ z = 81$ $P = 877$				
					14 marks

	Notes for Question 8	
a1M1	Rearranges given information and substitutes for z in the objective function	
a1A1	Correct simplified expression for objective function	
a2A1	Correct statement that maximising a negative expression is equivalent to minimising the positive expression (Note M1 A0 A1 is possible if an error with the constant is seen)	
b1B1	Draws any two lines correctly (lines should be solid not dashed) (lines must be long enough to fully define the feasible region) (lines must be within half small square of (35, 0) (0, 10), (15, 0) (0, 35), (35, 0) (0, 30) and (0, 0) (30, 10) (extended if necessary))	
b2B1	Draws all four lines correctly	
b3dB1	Feasible region identified by shading and labelled R – dependent on both previous B marks	
c1M1	Solves $2x + 7y = 70$ with $7x + 3y = 105$ and $3y = x$ to obtain two pairs of coordinates (note ignore any attempts to calculate the coordinates of the other two vertices) (may be using calculators so accept coordinates seen to 1 dp with no working (12.2, 6.5) (16.2, 5.4))	
c1A1	Correct exact coordinates for at least one vertex	
c2dM1	At least two sets of coordinates substituted into the objective function (dependent on previous M mark)	
c2A1	Correct values for the objective function at both vertices (exact or 1 dp) and exact optimum point stated – do not accept decimal approximation	
d1dM1	Tests integer solutions in both the correct inequalities close to the correct optimum point (only one needed if point is rejected) (at least two of (12, 7) (13, 6) and (13, 7)) (dependent on both M marks in (c)) (accept e.g. Y/N for each inequality without values explicitly stated)	
d1A1	Correct minimum point identified (12, 7) with no incorrect working seen in (d)	
d2A1	Correct values for x, y and z stated with no incorrect working seen in (d)	
d3A1	Correct value for P with no incorrect working seen in (d)	

	Special Case for (c) and (d) – Incorrect feasible region R in part (b) (which may either be choosing a region other than R from the correct graph or by drawing an incorrect line such as $y = 3x$ instead of $x = 3y$) Max M1 A0 M1 A0 M0 A0 A0 A0	
	Note these are method marks only and there is no requirement to check for accuracy other than sight of the correct equations being used in their calculations	
c1dM1	Solves at least two pairs of the correct equations to obtain two pairs of coordinates for the vertices of their feasible region (dependent on scoring at least one mark in (b))	
c1A1	Not available	
c2ddM1	Their coordinates substituted into the objective function (dependent on previous M mark)	
c2A1	Not available	
d1dM1	Not available	
d1A1	Not available	
d2A1	Not available	
d3A3	Not available	