GradeMax



Mark Scheme (Results)

Summer 2018

Pearson Edexcel
International Advanced Subsidiary Level
In Decision Mathematics D1 (WDM01)
Paper 01

GradeMax

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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.

PEARSON EDEXCEL IAL MATHEMATICS

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.

- 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
- o.e. – 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
- $\lfloor$ 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.

6. If a candidate makes more than one attempt at any question:
   - If all but one attempt is crossed out, mark the attempt which is NOT crossed out.
   - If either all attempts are crossed out or none are crossed out, mark all the attempts and score the highest single attempt.

7. Ignore wrong working or incorrect statements following a correct answer.

Question Number	Scheme	Marks
1. (a)	The list is not in alphabetical order	B1 **(1)**
(b)	e.g. Quick sort (**see notes for alternatives**) K N V D [H] L E S J D [E] [H] K N V [L] S J D [E] [H] K [J] [L] N [V] S D [E] [H] [J] K [L] N [S] [V] D [E] [H] [J] K [L] N [S] [V] (Sort Complete +) **named correctly**	M1 A1 A1ft A1 **(4)**
(c)	Pivot 1 $= \left\lceil \frac{1+9}{2} \right\rceil = 5$ Kerry reject 1 – 5 Pivot 2 $= \left\lceil \frac{6+9}{2} \right\rceil = 8$ Sylvester reject 8 – 9 Pivot 3 $= \left\lceil \frac{6+7}{2} \right\rceil = 7$ Nikki reject 7 Pivot 4 = 6 Leslie – name found	M1 A1 A1 **(3)**
(d)	e.g. $\log_2 727 = 9.505...$ so 10 or maximum number of items in each pass e.g. 727, 363, 181, 90, 45, 22, 11, 5, 2, 1 so 10 iterations	M1 A1 **(2)**
		10 marks

Notes for Question 1

a1B1: CAO – but give bod if phonetically close – must explicitly mention that the list is not in alphabetical order (just stating that the list is not in order is B0, but give B1 bod for 'the list is not in A - Z order')

b1M1: Quick sort, pivot, p, chosen (must be choosing middle left or right – **choosing first/last item as pivot is M0**) and first pass gives <p, p, >p. So after the first pass the list should read (values less than the pivot), pivot, (values greater than the pivot) **or** >p, p, <p. **If only choosing one pivot per iteration M1 only**
b1A1: First pass correct **and** next pivot(s) chosen correctly for second pass (but second pass does not need to be correct)
b2A1: Second and third passes correct (follow through from their first pass and choice of pivots) – they do not need to be choosing a pivot for the fourth pass
b3A1: CSO (correct solution only – all previous marks in this part **must** have been awarded) including 'sort complete' statement if required – this could be shown by the final list being re-written or 'sorted' statement or each item being used as a pivot + **algorithm correctly named**
c1M1: Choosing middle right pivot (choosing middle left is M0) + discarding/retaining half the list. So the 5th value (Kerry) found as a pivot and attempting to reject the first 5 values or retaining the final 4 values – **in (c) mark their pivot values only (allow restart from an incorrect sorted list in (c) if correct (or implied) in (d)) – if K is not their first pivot then M0 – any indication of using an incorrect list (e.g. the original unsorted list) is M0**
c1Al: First and second passes correct i.e. 5 found and either using 6th to 9th in 2nd pass or discarding 1st to 5th (so therefore no 'sticky' pivots in the first two passes — sticky is when the pivot is retained in the next pass) then 8 found and either using 6th and 7th in 3rd pass or discarding 8th and 9th
c2A1: CSO - search complete + 'found' (accept 'found', 'located', 'stop', etc. but not just, for example, the name Leslie; must be convinced that Leslie has been located and is not a pivot or a name in a sublist with only one value)

Question Number	Scheme	Marks

Part (d): Candidates who consider the maximum number of values at the start of each iteration:

- **M1** for at least 727, 363, 181, 90, … or embedded in a calculation e.g. [727+1] / 2 = 364, [363 + 1] / 2 = 182, [181 + 1] / 2 = 91, [90 + 1] / 2 = …
- **M1 A1** 727, 363, 181, 90, 45, 22, 11, 5, 2, 1 so 10 iterations

Candidates who consider maximum number of values at the end of each iteration:

- **M1** for at least 363, 181, 90, …
- **M1 A1** 363, 181, 90, 45, 22, 11, 5, 2, 1 so 10 iterations (so 9 iterations is A0)

Other numerical arguments
(The maximum number of iterations is the least integer value of n such that)

- **M1** $2^n > 727$ then **either** taking logs of both sides and attempt to solve for n (accept $2^n = 727$) **or** stating $n = 9.5058$ ... (answer given correct to 1 decimal place)
- **M1 A1** the above with $n = 10$ (no errors if calculation seen) (allow recovery from equals)
- **M1 only** for those candidates who state $2^n > 727$ and then state $n = 10$ with no working unless 2^9 also considered
- **M1** $\log_2 727 = ...$
- **M1 A1** ... = 9.505 ... (answer given correctly to 1 dp) and hence 10
- $\frac{727}{2^n}$ considered with $n = 10$ is **M1** showing explicitly that $n = 10$ is the first value that gives a value less than 1 gets **A1** (it is not sufficient to just say that $\frac{727}{2^{10}}$ is less than 1 either $\frac{727}{1024}$ or 0.7099… (correct to 1 decimal place) must be seen)
- Candidates who say that halving 727 ten times gives a value less than 1 (or equal to 1) **M1 only**. Accept = 1 as when candidates talk about halving/dividing by 2 it is not always clear if they mean half the list or half the numbers in the list. However if the candidate explicitly shows that halving 727 ten times gives a value less than 1 which must be given either exactly or correct to 1 decimal place (0.70996…) then **A1**
- An answer of 10 with no working **M0**

Question Number	Scheme	Marks

Addition solutions for (b)

Quick sort middle left:

K N V D [H] L E S J	Pivot H	M1
[D] E [H] K N [V] L S J	Pivots D and V	A1
[D] E [H] K N [L] S J [V]	Pivots (E) and L	
[D] E [H] [K] J [L] [N] S [V]	Pivots K and N	A1ft
[D] E [H] J [K] [L] [N] S [V]	Sort complete + named correctly	A1 (cso)

Bubble sort left to right:

K N V D H L E S J		
K N D H L E S J V	V at the end, consistent direction	M1
K D H L E N J S V	1st and 2nd passes	A1
D H K E L J N S V		
D H E K J L N S V	3rd and 4th passes	A1ft
D E H J K L N S V	Sort complete + named corretly	A1 (cso)

b1M1: Bubble sort. Consistent direction, end number (greatest/least) in place. Do check these carefully as some candidates show the result of each comparison and swap in the first pass
b1A1: First and second passes correct – so end two numbers in place
b2A1ft: Third and fourth passes correct following through from the candidate's second pass
b3A1: CSO (correct solution only) – including either a 'sort complete' statement **or** final list rewritten/sixth pass + **named correctly**

Bubble sort right to left:

K N V D H L E S J		
D K N V E H L J S	D in place, consistent direction	M1
D E K N V H J L S	1st and 2nd passes correct	A1
D E H K N V J L S		
D E H J K N V L S	3rd and 4th passes	A1ft
D E H J K L N V S		
D E H J K L N S V	Sort complete + named correctly	A1 (cso)

Sorting into reverse alphabetical order is acceptable for full marks

Question Number	Scheme	Marks
2. (a)(i)	A path from an unmatched vertex in one set to an unmatched vertex in the other set which alternately uses arcs not in/in the matching.	B2,1,0
(a)(ii)	A matching where every member of set X is paired with a single member of set Y and vice-versa.	B2,1,0 **(4)**
(b)	Alternating path: F – 3 = A – 5 = B – 6 = D – 2 = E – 1 Change status: F = 3 – A = 5 – B = 6 – D = 2 – E = 1 Improved matching: A = 5, B = 6, (C =), D = 2, E = 1, F = 3 **SEE SPECIAL CASES BELOW FOR THOSE STARTING AT C OR FOR THOSE CONSIDERING F TO 4**	M1 A1 A1 **(3)**
(c)	e.g. F can only do task 3 so therefore A has to do task 5 as A can only do 5 and 3 and so therefore C has no task to do as C can only do task 5	B1 **(1)**
(d)	Alternating path: C – 1 = E – 2 = D – 6 = B – 4 Change status: C = 1 – E = 2 – D = 6 – B = 4 Complete matching: A = 5, B = 4, C = 1, D = 6, E = 2, F = 3	M1 A1 A1 **(3)**
		11 marks

Notes for Question 2

ai1B1: unmatched to unmatched (vertices do not need to be explicitly mentioned for this mark but B0 if arcs or sets implied)
ai2B1: **(**alternate) **arcs** not in/in (not vertices/nodes) – **must** mention arcs/edges (not lines) and an understanding of what 'alternating' means in this context
aii3B1: **'**Pairing' or 'one to one' (or 1-1) **only** (no equivalents for this mark)
aii4B1: **all** elements from one **set** with all elements of the other ('all' (oe) and **set** (no equivalent) must be mentioned at least once)

b1M1: An alternating path (e.g. letter 1st set – number 2nd set – letter 1st set – …) from F to 1 or vice-versa
b1A1: CAO – a correct path including change status **either** stated (only accept 'change (of) status' **or** 'c.s' but not, e.g.'change state') **or** shown (all symbols e.g. (…– … = … – …) interchanged (… = …. – … = …)) Chosen path clear
b2A1: CAO (improved matching) must follow from the correct stated path. Accept either stated **or** on a clear diagram (with five arcs **only**). **Please check the top of the second page as many candidates will draw either the improved or complete matching on the nodes provided there**

c1B1: CAO – one completely correct statement – do not accept a general statement (specific nodes must be referred to). We need to see (e.g. for the example given in the main scheme) that the candidates have considered the fact that 'F can only do 3', 'A can only do 5 and 3' and 'C can only do 5'. Give bod if all 3 workers and 2 tasks are encorporated in a single use of the word 'only'

d1M1: An alternating path from C to 4 (or vice-versa)
d1A1: CAO – a correct path including change status stated **or** shown. Chosen path clear
d2A1: CAO (complete matching) must follow from two correct stated paths (so **both** previous M marks must have been awarded). Accept on a clear diagram (with six arcs **only**)

Question Number	Scheme	Marks

Special Cases for (b) and (d)

Alternating path from F to 4

M1 for an alternating path from F to 4 (or vice-versa)
A1 for the correct alternating path (F – 3 = A – 5 = B – 4) **and** change of status (stated or shown)
A1 for the correct improved matching of A = 5, B = 4, D = 6, E = 2, F = 3 from the correct stated path

In (d) the alternating path is simply C – 1 and therefore no marks in (d) – so an alternating path from F to 4 can score a maximum of three marks (of the six available) in (b) and (d)

Alternating path from either C to 4 or C to 1

Candidates who find in (b) an alternating path from either C to 4 **or** C to 1 can score in (b)

M1 for an alternating path from either C to 4 **or** C to 1
A1 for either C – 5 = B – 4 **or** C – 5 = B – 6 = D – 2 = E – 1 together with the change of status (either stated or shown)
A0

In (d)

M1 for F – 3 = A – 5 = C – 1 (following either their path from C to 4 or their path C to 1)
A0
A0

So both Special Cases can score a maximum of three marks (of the six available in (b) and (d))

Question Number	Scheme	Marks
3. (a)	7	B1 **(1)**
(b)	By definition a path cannot contain a vertex more than once, and as G contains only 8 vertices, a path on G cannot contain 10 vertices	B1 B1 **(2)**
(c)	11	B1 **(1)**
(d)	Prim's starting at C: CE, CD, CH; EJ, BC; AB, EF	M1 A1 A1 **(3)**
(e)	Weight of MST = 177	B1 **(1)**
		8 marks

Notes for Question 3

a1B1: CAO (7) – choice of answers scores B0

b1B1: a path cannot contain a vertex more than once (oe) – must explicitly state the fact that a vertex cannot appear more than once
b2B1: the number of vertices in the 'path' > the number of vertices in G (oe) – as a minimum compares 8 with 10 or states 'vertices in path is greater than the number of vertices in G' or '8 is the maximum (number of vertices in a path on G)' – not dependent on previous B mark, B0 for statements such as '10 is too many' without referencing the 8

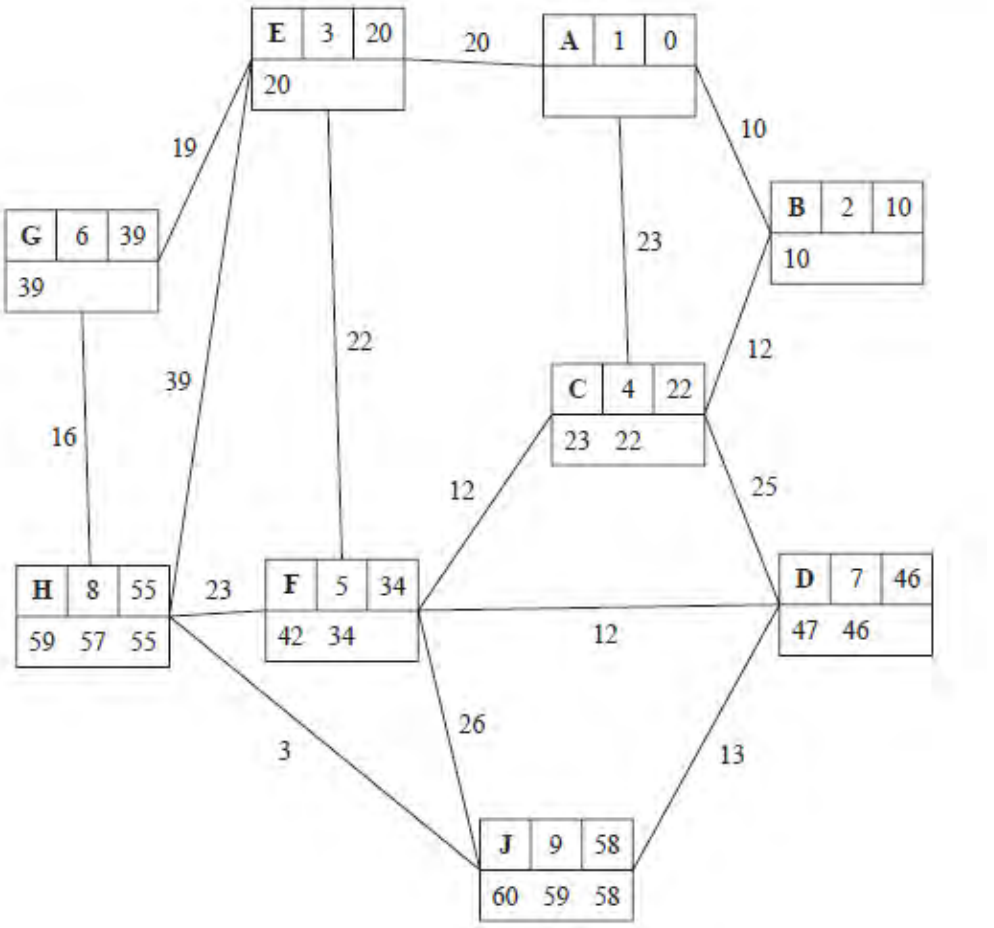
In (b) those who state the general case correctly (so score B1) and then go on to give a correct mention of this specific case will most likely score the second B mark too e.g. 'G contains 8 vertices but in a path no vertex can appear more than once' scores B1B1

c1B1: CAO (11) – choice of answers scores B0

d1M1: First three arcs correctly chosen in order (CE, CD, CH) or first four nodes correctly chosen in order (C, E, D, H). **If any explicit rejections seen at any point then M1 (max) only**. Candidates may apply Prim's in matrix form so the order of the nodes may be seen across the top of a table – accept {-, -, 1, 3, 2, -, 4, -} for the M mark. Allow CD for DC etc. throughout (d)
d1A1: First five arcs correctly chosen in order (CE, CD, CH, EJ, BC) **or** all eight nodes correctly chosen in order (C, E, D, H, J, B, A, F). Candidates may apply Prim's in matrix form so the order of the nodes may be seen across the top of a table – accept {7, 6, 1, 3, 2, 8, 4, 5} – do not condone any missing numbers e.g. the number 8 must be above F
d2A1: CSO (correct solution only) – all arcs correctly stated and chosen in the correct order. Candidates must be considering arcs for this final 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)

Misread: Starting at a node other than C scores M1 only in (d) – must have the first three arcs (or four nodes) correct (and in the correct order). The most common misread is those that start at A so for M1 only – accept AB, BC, CE or A, B, C, E

e1B1: CAO (177)

Question Number	Scheme	Marks
4. (a)		M1 A1 (BECF) A1 (GD) A1ft (HJ)
	Shortest time: 58 (mins) Quickest route: A – E – G – H – J	A1ft A1 **(6)**
(b)	Route D to H via A: D – F – C – B – A – E – G – H Length: 101 (mins)	B1 B1ft **(2)**
(c)	A(BCF)D + F(D)J = 46 + 25 = 71 A(EGH)J + DF = 58 + 12 = 70 A(BC)F + DJ = 34 + 13 = 47* Arcs AB, BC, CF and DJ will be traversed twice	M1 A1 A1 A1 A1 **(5)**
(d)	Route: GHEFHJDJFCFDCBCABAEG Length: 275 + 47 = 322 (mins)	B1 B1ft **(2)**
(e)	Start at D, finish at J (or vice-versa) **or** start at C, finish at J (or vice-versa) Length: 275 – 12 – 10 + 12 = 265 (mins)	M1 A1 B1 **(3)**
		18 marks

Notes for Question 4

In (a) 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 J the working values must be 60 59 58 in that order (so 60 58 59 is incorrect)
It is also important that the order of labelling is checked carefully. Also 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

Question Number	Scheme	Marks

a1M1: A larger value replaced by a smaller value at least once in the working values at either C or F or D or H or J
a1A1: All values in B, E, C and F correct and the working values in the correct order at C (including order of labelling)
a2A1: All values G and D correct and the working values in the correct order. Penalise order of labelling only once per question (G and D must be labelled in that order and G must be labelled after B, E, C and F)
a3A1ft: All values in H and J correct on the follow through and the working values in the correct order. Penalise order of labelling only once per question. To follow through H check that the working value at H follows from the candidate's final values from nodes E, F and G (with the order of these values determined by the candidates order of labelling of E, F and G) and that the final value, and order of labelling, follows through correctly. Repeat this process for J (which will have working values from F, D and H with the order of these values determined by the candidates order of labelling of F, D and H)
a4A1ft: Follow through on their final value at J **only** (condone lack of units)
a5A1: CAO – correct route (A to J **or** J to A)

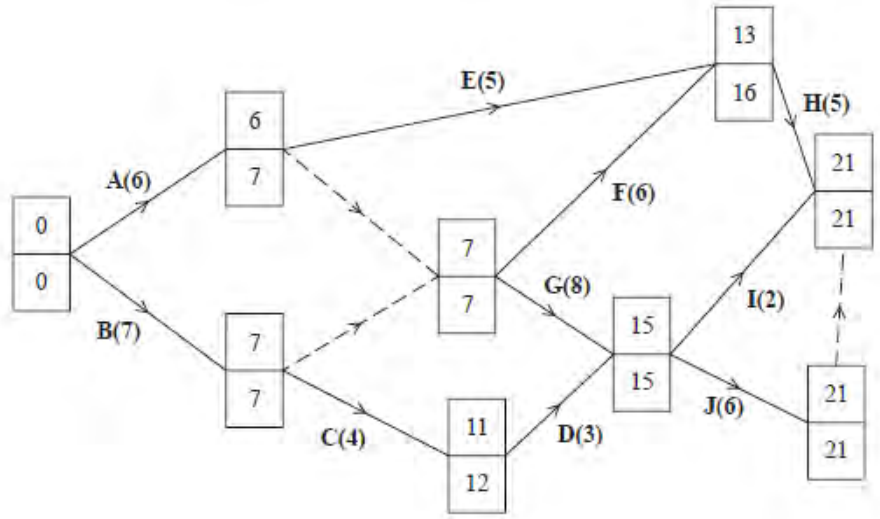
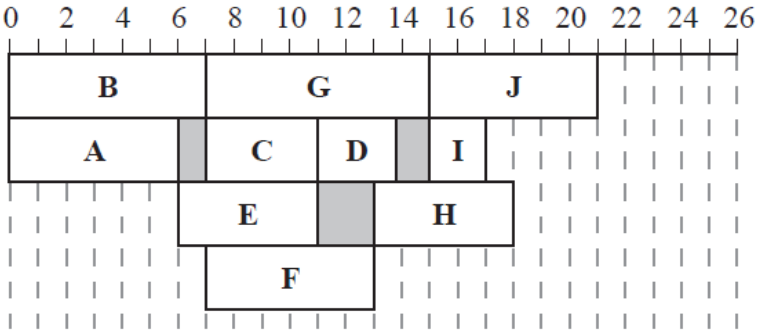
b1B1: CAO – correct route from D to H via A
b2B1ft: Follow through on their final value at D + their final value at H

c1M1: Three distinct pairings of A, D, F and J
c1A1: **Any** row correct including pairing **and** total
c2A1: **Any** two rows correct including pairings **and** totals
c3A1: **All** three rows correct including pairings **and** totals
c4A1: CAO correct edges clearly stated and not just in their working as AB, BC, CF and DJ. Do not accept AF or AF via B and C

d1B1: Any correct route (the route may be given in terms of either vertices (GHE…) or arcs (GH, HE,…) – checks: starts and finishes at G, 20 vertices (repeats AB, BC, CF and DJ, and nodes appearing A(2), B(2), C(3), D(2), E(2), F(3), G(2), H(2), J(2))
d2B1: 275 + their smallest repeat out of a choice of at least **two** totals seen in (c) – dependent on the M mark in (c) – this mark can be awarded if answered in (c)

e1M1: Any consideration/mention of all the odd nodes (C, D, F, J) **or** consideration/mention of arcs CF and DF (and no others) having least weight **or** listing one correct starting and finishing point (**must be clearly chosen**)
e1A1: Both combinations of starting and finishing points correct (D and J + C and J) and no others
e1B1: CAO (265)

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<table>
<tr><th>Question Number</th><th>Scheme</th><th>Marks</th></tr>
<tr><td>5. (a)</td><td>
<table>
<tr><th>Activity</th><th>Immediately preceding activities</th><th>Activity</th><th>Immediately preceding activities</th></tr>
<tr><td>A</td><td>-</td><td>F</td><td>A, B</td></tr>
<tr><td>B</td><td>-</td><td>G</td><td>A, B</td></tr>
<tr><td>C</td><td>B</td><td>H</td><td>E, F</td></tr>
<tr><td>D</td><td>C</td><td>I</td><td>D, G</td></tr>
<tr><td>E</td><td>A</td><td>J</td><td>D, G</td></tr>
</table>
</td><td>B2, 1, 0 (2)</td></tr>
<tr><td>(b)</td><td>
</td><td>M1
A1
A1 (3)</td></tr>
<tr><td>(c)</td><td>Minimum project completion time is 21 (hours)
Critical activities: B, G, J</td><td>B1ft
B1 (2)</td></tr>
<tr><td>(d)</td><td>E could be delayed by 16 – 5 – 6 = 5 (hours)</td><td>B1 (1)</td></tr>
<tr><td>(e)</td><td>Lower bound = $\frac{52}{21} = 2.476...$ so 3 workers required</td><td>B1 (1)</td></tr>
<tr><td>(f)</td><td>e.g.

</td><td>M1
A1
A1 (3)</td></tr>
<tr><td>(g)</td><td>Activities A, E and H are now critical
The minimum project completion time is now 22 (hours)</td><td>B1
B1 (2)</td></tr>
<tr><td></td><td></td><td>14 marks</td></tr>
</table>

Question Number	Scheme	Marks

Notes for Question 5

a1B1: **Any** 7 of the 10 rows correct (allow A and B blank)
a2B1: CAO (allow A and B blank)

b1M1: All top boxes and all bottom boxes completed. Values generally increasing left to right (for top boxes) and values generally decreasing from right to left (for bottom boxes). Condone missing 0 or 21 for M only (in bottom boxes). Condone one rogue value in top boxes and one rogue value in bottom boxes. 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)

b1A1: CAO (top boxes)
b2A1: CAO (bottom boxes)

c1B1: Follow through candidate's value provided that the M mark was earned in (b)
c2B1: CAO on critical activities (B, G, J)

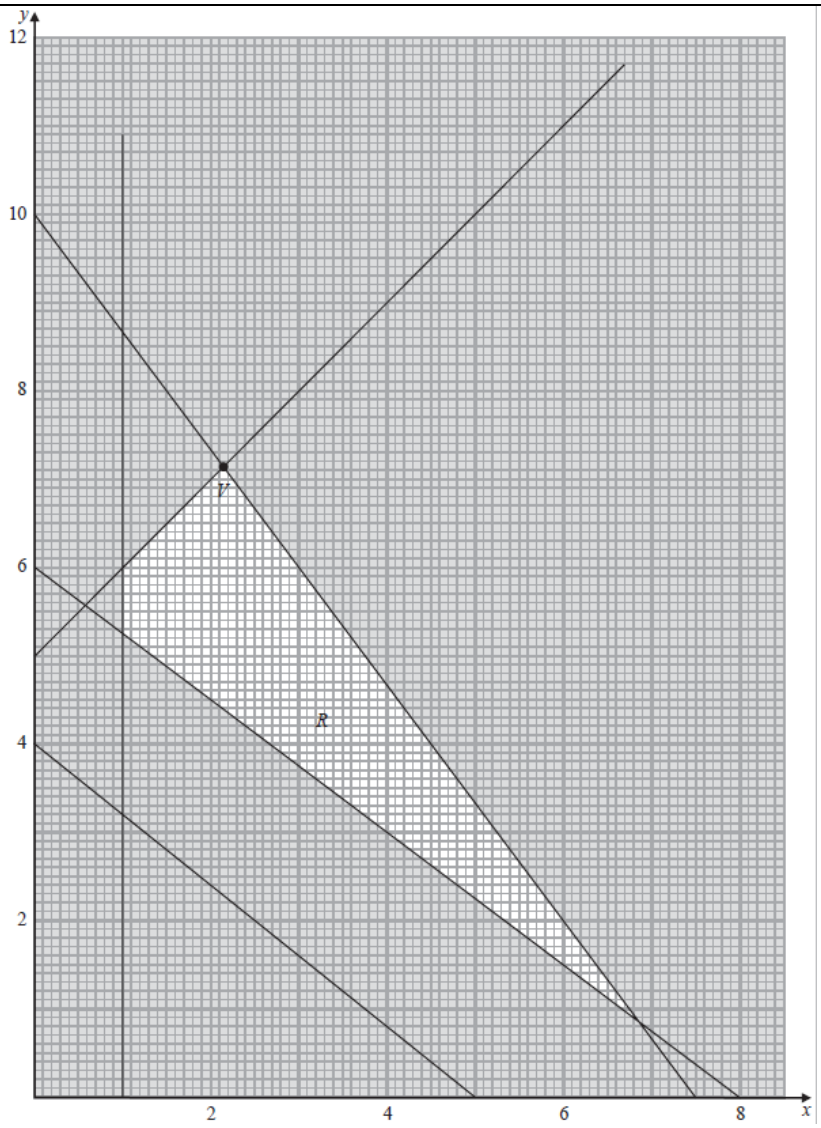
d1B1: Correct calculation with all three numbers present. An answer of 5 with no working scores B0

e1B1: **Correct calculation** seen then 3 – an answer of 3 with no working scores B0

f1M1: Not a cascade chart. 4 'workers' used at most and at least 9 unique activities placed
f1A1: 4 workers. All 10 activities present (just once). Condone at most two errors. An activity can give rise to at most three errors; one on duration, one on time interval and only one on IPA
f2A1: 4 workers. All 10 activities present (just once). No errors

Activity	Duration	Time interval	IPA
A	6	0 -7	-
B	7	0 - 7	-
C	4	7 – 12	B
D	3	11 – 15	C
E	5	6 – 16	A
F	6	7 – 16	A, B
G	8	7 – 15	A, B
H	5	13 – 21	E, F
I	2	15 – 21	D, G
J	6	15 – 21	D, G

g1B1: Correctly stating the activities that are now critical (A, E and H) – no extras
g2B1: Correctly stating new project completion time (22 – no units required)

Question Number	Scheme	Marks
6. (a)	$z = 15 + x - y$ substituting into constraints gives $-7x + 4(15 + x - y) \leq 36 \Rightarrow\ 3x + 4y \geq 24$ * $15 + x - y \geq 10\ \Rightarrow -x + y \leq 5$ * $P = 2x + 7y + 2(15 + x - y)\ \Rightarrow P = 4x + 5y\ (+30)$	M1 A1 B1 **(3)**
(b)		B1 B1 B1 B1 (R) **(4)**
(c)	Correct objective line V correctly labelled	B1 B1 **(2)**
(d)	$V\left(\frac{15}{7}, \frac{50}{7}\right)$ $P = \frac{520}{7}$	M1 A1 B1 **(3)**
(e)	$x = 2, y = 7, z = 10$ $P = 73$	B1 B1 **(2)**
		14 marks

Question Number	Scheme	Marks

Notes for Question 6

a1M1: Substitute $z = x + 15 - y$ correctly into both $-7x + 4z \leq 36$ and $z \geq 10$

a1A1: Both of the constraints correctly derived (note that these answers are given in the question) – no recovery from incorrect working and sufficient working must be shown (e.g. in the first constraint we must see at least one stage of working from substitution to given answer)

a1B1: CAO either $(P =) 4x + 5y + 30$ or $(P =) 4x + 5y$ only – isw after correct answer seen

In (b), lines must be long enough to define the correct feasible region and pass through one small square of the points stated:

$4x + 3y = 30$ must pass within one small square of its intersection with the axes – (0, 10) and (7.5, 0)

$3x + 4y = 24$ must pass within one small square of its intersection with the axes – (0, 6) and (8, 0)

$x = 1$ must pass within one small square of (1, 0) and (1, 7)

$-x + y = 5$ must pass within one small square of (0, 5) and if the line requires extending then (3, 8)

b1B1: Any two lines correctly drawn

b2B1: Any three lines correctly drawn

b3B1: All four lines correctly drawn

b4B1: Region, *R*, correctly labelled – not just implied by shading – dependent on scoring the first three marks in this part

c1B1: Drawing the correct objective line **on the grid** – if their line is shorter than the length equivalent to that of the line from (0, 1) to (1.25, 0) then B0. Line must be correct to within one small square if extended from axis to axis

c2B1: V labelled clearly on their graph – this mark is dependent on scoring at least B1B1B1B0 in (b) and the previous B mark in (c)

d1M1: **Must have scored at least B1B1B0B0 in (b) <u>and</u> candidates must have drawn an objective line (but note that it does not need to be correct but must have negative gradient)**. Must be solving one of the following two pairs of equations **only**: $-x + y = 5, 4x + 3y = 30$ **or** $4x + 3y = 30, 3x + 4y = 24$. Must be a correct method to solve simultaneous equations and must arrive at *x* = … and *y* =… but allow slips/errors. This mark can also be awarded for the **correct** exact coordinates stated with no working provided B1B1 B0B0 in (b) and an objective line drawn (if coordinates are incorrect we must see working for this mark)

d1A1: Correct exact coordinates of V correctly **derived** (**so if no working then M1 only for correct exact coordinates**) as either $\left(\frac{15}{7}, \frac{50}{7}\right)$ or $\left(2\frac{1}{7}, 7\frac{1}{7}\right)$. **Note that this mark is dependent on B1B1B1B0 scored in (b) <u>and</u> a correct objective line**

d1B1: CAO $\left(P = \frac{520}{7} \text{ or } 74\frac{2}{7}\right)$ **- note that this mark is dependent on B1B1B1B0 scored in (b) <u>and</u> a correct objective line**

e1B1: CAO $(x = 2, y = 7, z = 10)$ **- note that this mark is dependent on B1B1B1B0 scored in (b) <u>and</u> a correct objective line**

e2B1: CAO $(P = 73)$ **- note that this mark is dependent on B1B1B1B0 scored in (b) <u>and</u> a correct objective line**

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