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Mark Scheme (Results)

Summer 2012

GCE Decision D1
(6689) Paper 1

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Summer 2012
6689 Decision Maths 1
Mark Scheme

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.

EDEXCEL GCE 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 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)
- dep – dependent
- indep – independent
- dp decimal places
- sf significant figures
- * The answer is printed on the paper
- ⌐ 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.

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Question 1 (c) Misread
Usual rule, remove the last 2 A marks awarded in (c) if list not reversed.

Note: if final list is reversed in (c), award full credit

20	33	19	24	31	22	27	18	25	M1
20	19	24	31	22	27	18	25	33	
19	20	24	22	27	18	25	31	33	A1
19	20	22	24	18	25	27	31	33	
19	20	22	18	24	25	27	31	33	A1ft
19	20	18	22	24	25	27	31	33	
19	18	20	22	24	25	27	31	33	
18	19	20	22	24	25	27	31	33	
List in order									A1 CSO

20	33	19	24	31	22	27	18	25	M1
18	20	33	19	24	31	22	27	25	
18	19	20	33	22	24	31	25	27	A1
18	19	20	22	33	24	25	31	27	
18	19	20	22	24	33	25	27	31	A1ft
18	19	20	22	24	25	33	27	31	
18	19	20	22	24	25	27	33	31	
18	19	20	22	24	25	27	31	33	
List in order									A1 CSO

Summer 2012
6689 Decision Mathematics D1
Mark Scheme

Question Number	Scheme	Marks
1.(a)	$\frac{219}{50} = 4.38$ so lower bound is 5 bins	M1 A1 **(2)**
(b)	Bin 1: 20 19 Bin 2: 33 Bin 3: 24 22 Bin 4: 31 18 Bin 5: 27 Bin 6: 25	M1 1A1 2A1 **(3)**
(c)	e.g (left to right) 20 33 19 24 31 22 27 18 25 33 20 24 31 22 27 19 25 18 33 24 31 22 27 20 25 19 18 33 31 24 27 22 25 20 19 18 33 31 27 24 25 22 20 19 18 33 31 27 25 24 22 20 19 18 List in order	M1 1A1 2A1ft 3A1 CSO **(4)**
(d)	Bin 1: 33 Bin 2: 31 19 Bin 3: 27 22 Bin 4: 25 24 Bin 5: 20 18	M1 1A1 2A1 **(3)** **Total 12**

Notes for question 1

a1M1 219 (186-252) /50
a1A1 CAO correct calc seen or awrt 4.4 + 5
b1M1 First four terms placed correctly in bins 1, 2 and 3. (Condone cumulative totals here only.)
b1A1 First seven terms placed correctly.
b2A1 CAO
c1M1 Bubble sort. Consistent direction throughout sort, end number (greatest/least) in place.
c1A1 first and second passes correct – so end two numbers in place
c2A1ft 3rd and 4th passes correct – so end four numbers in place.
c3A1 CSO; including 'sorted'**or** final list rewritten in (c) **or** 'final pass' o.e. A **clear statement** in (c).
d1M1 **Must be using 'sorted' list** in decreasing order . First five terms correct.
d1A1 First seven terms correct.
d2A1 CAO

SC for 1(d) If '**sorted'** list is wrong from (c) then award M1 only in (d) for their first seven terms correctly placed.

Alt for (c) right to left

20 33 19 24 31 22 27 18 25	
33 20 31 19 24 27 22 25 18	M1
33 31 20 27 19 24 25 22 18	1A1
33 31 27 20 25 19 24 22 18	
33 31 27 25 20 24 19 22 18	2A1ft
33 31 27 25 24 20 22 19 18	
33 31 27 25 24 22 20 19 18	
List in order	3A1 CSO

<table>
<tr>
<td>2.(a)

(b)</td>
<td>Either (i) G – 3 = C – 2 = F – 1 = D – 4
or (ii) G – 5 = E – 4
or (iii) G – 5 = E – 1 = D – 4
Change status
Either (i) G = 3 – C = 2 – F = 1 – D = 4
or (ii) G = 5 – E = 4
or (iii) G = 5 – E = 1– D = 4
Giving matchings:
<table>
<tr><td></td><td>C</td><td>D</td><td>E</td><td>F</td><td>G</td></tr>
<tr><td>(i)</td><td>2</td><td>4</td><td>5</td><td>1</td><td>3</td></tr>
<tr><td>(ii)</td><td>3</td><td>1</td><td>4</td><td>2</td><td>5</td></tr>
<tr><td>(iii)</td><td>3</td><td>4</td><td>1</td><td>2</td><td>5</td></tr>
</table>
Gives another solution</td>
<td>M1 1A1

2A1

3A1 (4)

M1 1A1 2A1 (3)

Total 7</td>
</tr>
</table>

Notes for question 2

<u>Mark the candidates best attempt as part (a)</u>

a1M1 Path from G to 4 - or vice versa
a1A1 CAO chosen path clear.
a2A1 Change status step clear stated or shown. [Only accept 'change status'; 'c.s.'; sight of the connectives being swapped]
a3A1 CAO must ft from stated path, diagram ok
b1M1: A second path from G to 4 (or vice versa)
b1A1: CAO including change status (stated or shown), chosen path clear.
b2A1: CAO must ft from stated paths, diagram ok.

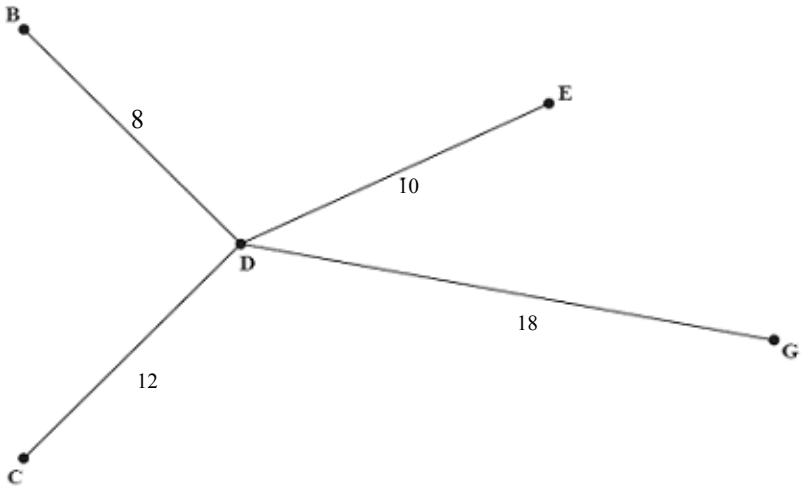
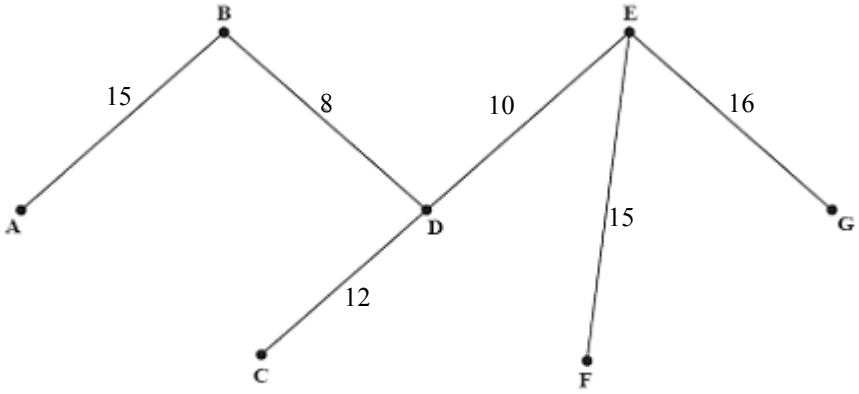
Notes for question 3

a1B1 All four arcs CAO (+ see below)
a2B1 All four weights CAO.

Additional notes for (a)

- If B0 B0 but three arcs and their weights correct then give B1 B0.
- If extra arcs and weights remove second B mark (so B1 B0 max)
- If just one of DB or DE or DC missing, mark remainder of question as a misread.
- If two or more arcs are missing send to review.
- If DF used instead of DG, ignore references to this in (b)

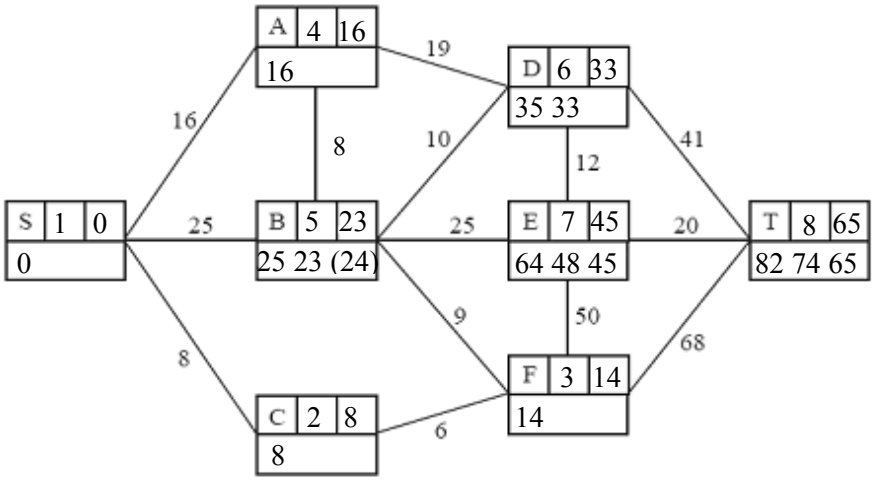
b1M1 First three arcs correctly chosen and **at least one rejection seen at some point.** (Kruskal not Prim.)
b1A1 First five arcs selected correctly; BD, DE, CD, then (in either order) EF, AB
b2A1 CAO including necessary rejections.
c1B1 CAO condone missing weights.
d1B1 CAO

Question Number	Scheme	Marks
3(a)		1B1 2B1 **(2)**
(b)	BD(8), DE(10), CD(12), reject BE(13), {EF(15), AB(15)}, {EG(16), reject CF(16)} reject remainder of arcs.	M1 1A1 2A1 **(3)**
(c)		B1
(d)	Weight of tree = 76 (km)	**(1)** B1 **(1)** **Total 7 marks**

Question Number	Scheme	Marks
4(a)	The valency of a vertex is the number of edges incident to it.	B2,1,0 **(2)**
(b)	DE + HI = 131 + 75 = 206 DH + EI = 146 + 137 = 283 DI + EH = 143 + 62 = 205* Arcs EH, DF and FI will be traversed twice.	M1 1A1 2A1 3A1 4A1ft **(5)**
(c)	Route length = 1436 + 205 = 1641(m)	B1ft **(1)**
(d)	Since HI is removed only D and E are odd, So only the route between DE need to be repeated Route length = 1436 – 75 (for HI) + 131 = 1492(m)	M1 A1 **(2)**
(e)	Route should start and finish at D and E. E.g DCFDAEBGEFKIFHJGHE (18 vertices)	M1, A1 **(2)**
		12 marks

Notes for question 4

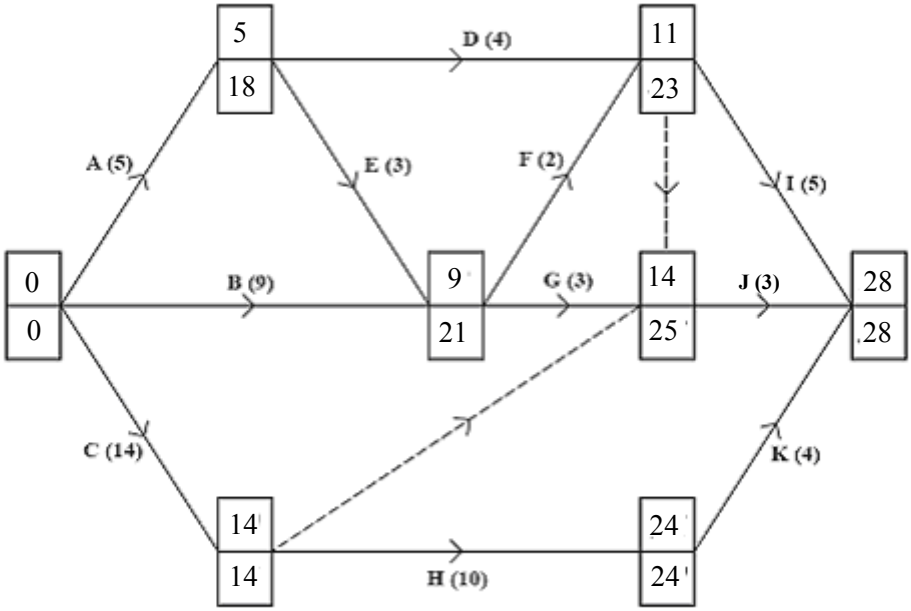
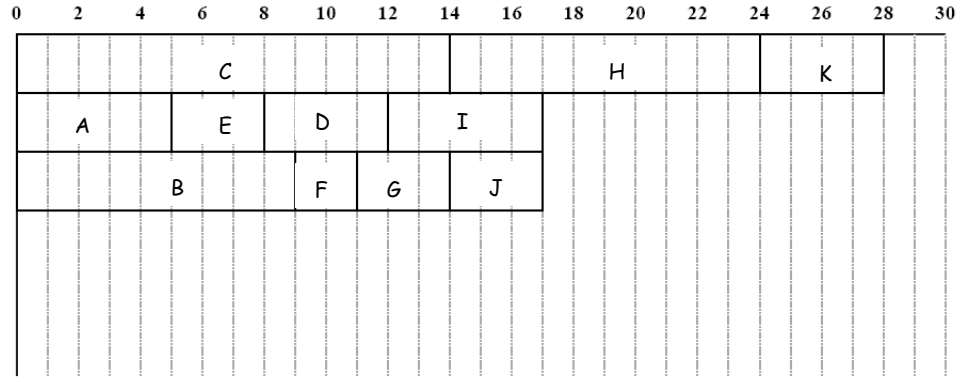
a1B1 Give bod but refers to arc/edge and to node/vertex
a2B1 A clear, correct statement. CAO.
b1M1 Three pairings of their four odd nodes
b1A1 One row correct including pairing and total
b2A1 Two rows correct including pairing and total
b3A1 Three rows correct including pairing and total
b4A1ft Their smallest repeated **arcs**, (accept DFI).
c1B1ft **Must have a choice of at least two pairs seen in part (b).** 1436 + their least from (a).
d1M1 Aim to include their DE(131) [ft from (b)] and remove HI(75) **or** 1436+131-75
d1A1 CAO 1492. Must see method though, NMS gets M0.
e1M1 D and E identified as start and finish nodes. We do not have to see a route here.
e1A1 CAO must see a route. 18 vertices; Each of A–K present; 3E's, 3F's, 2D's,2G's and 2H's.

Question Number	Scheme	Marks
5(a)		M1 A1(SCFA) A1ft (BD) A1(ET)
	SCFBDET ; length 65	1B1; 2B1ft **(6)**
(b)	E.g. 65 – 20 = 45 ET; 45 – 12 = 33 DE; 33 – 10 = 23 BD; 23 – 9 = 14 FB; 14 – 6 = 8 CF; 8 – 8 = 0 SC **Or** Work back from T, including arc XY if the weight of arc XY = the difference in the final values of X and Y.	B2ft, 1ft, 0 **(2)**
(c)	SCFBET; length 68	B1; B1 **(2)**
		Total 10

Notes for question 5

a1M1 Big replaced by smaller at least once at B or D or E or T.
a1A1 S, C, F and A boxes all correct, condone lack of 0 in A's working value
a2A1ft B and D ft correctly. Penalise order of labelling only once per question.
a3A1 E and T correct. Penalise order of labelling only once per question.
a1B1 Route CAO
a2B1ft their final value ft.
b1B1ft Attempting an explanation, at least 3 stages or one half of general explanation.
b2B1ft Correct explanation – all stages, both halves of explanation
c1B1 Route CAO.
c2B1 length CAO.

Amplification for (b)
General explanation:
1B1 for partial explanation e.g.'working backwards/traceback' or ref to arcs and final value differences
2B1 for working backwards **from T** + include an arc XY if weight of XY = final value of Y – final value of X.
Demonstration:
1B1 for three correct calculations for **their** network
2B1 for all calculations correct **and** linking arcs/nodes to those calculations. Arc lengths and final values visible.

Question Number	Scheme	Marks
6(a)		B2, 1, 0 **(2)**
(b)		1M1 1A1 2M1 2A1 **(4)**
(c)	Total float on E = 21 – 5 – 3 = 13	M1 A1 **(2)**
(d)	$\frac{62}{28} = 2.21$ so lower bound is 3 workers	M1 A1 **(2)**
(e)	e.g. 	1M1 1A1 2A1 3A1 **(4)**
		Total 14

Act.	I.P.A.	Act.	I.P.A.	Act.	I.P.A
A	-	E	A	I	D F
B	-	F	B E	J	C D F G
C	-	G	B E	K	H
D	A	H	C		

Question 6

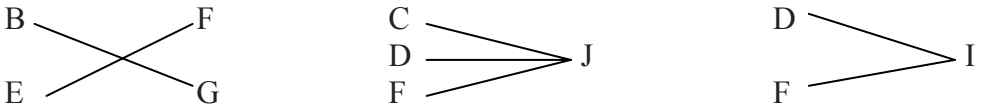
a1B1 Any 3 rows completed correctly
a1B2 All five rows completed correctly
b1M1 All top boxes complete, values generally increasing left to right, condone one rogue
b1A1 CAO
b2M1 All bottom boxes complete, values generally decreasing R to L, condone one rogue. Condone missing 0 or 28 for the M only.
b2A1 CAO
c1M1 Correct calculation seen all three numbers correct (ft). Float ≥ 0 .
c1A1 CAO
d1M1 Attempt to find lower bound. [52-72 / their finish time] accept awrt 2.2.
d1A1 CAO – correct calculation seen or awrt 2.2, then . [Beware 28/11 gives 3 also, so 3 with no working gets M0A0.]
e1M1 Not a cascade chart. 4 'workers' used at most. At least 7 activities. If in doubt send to review.
e1A1: CHKAB correct. C- 14; H – 10; K – 4; A – 5; B – 9. A and B completed by their late finish times. (A by time = 18 B by time = 21).

Now you need to check the last 6 activites – the last two marks are for D, E, F, G, I, J only

First check that they have only used three workers and that all 11 activities are present (just once).

Then check precedences: You have these on the mark scheme in (a).
Each row of the table in (a) could give rise to 1 error (only)
I'd suggest you check these ones first since they are most likely to generate errors.

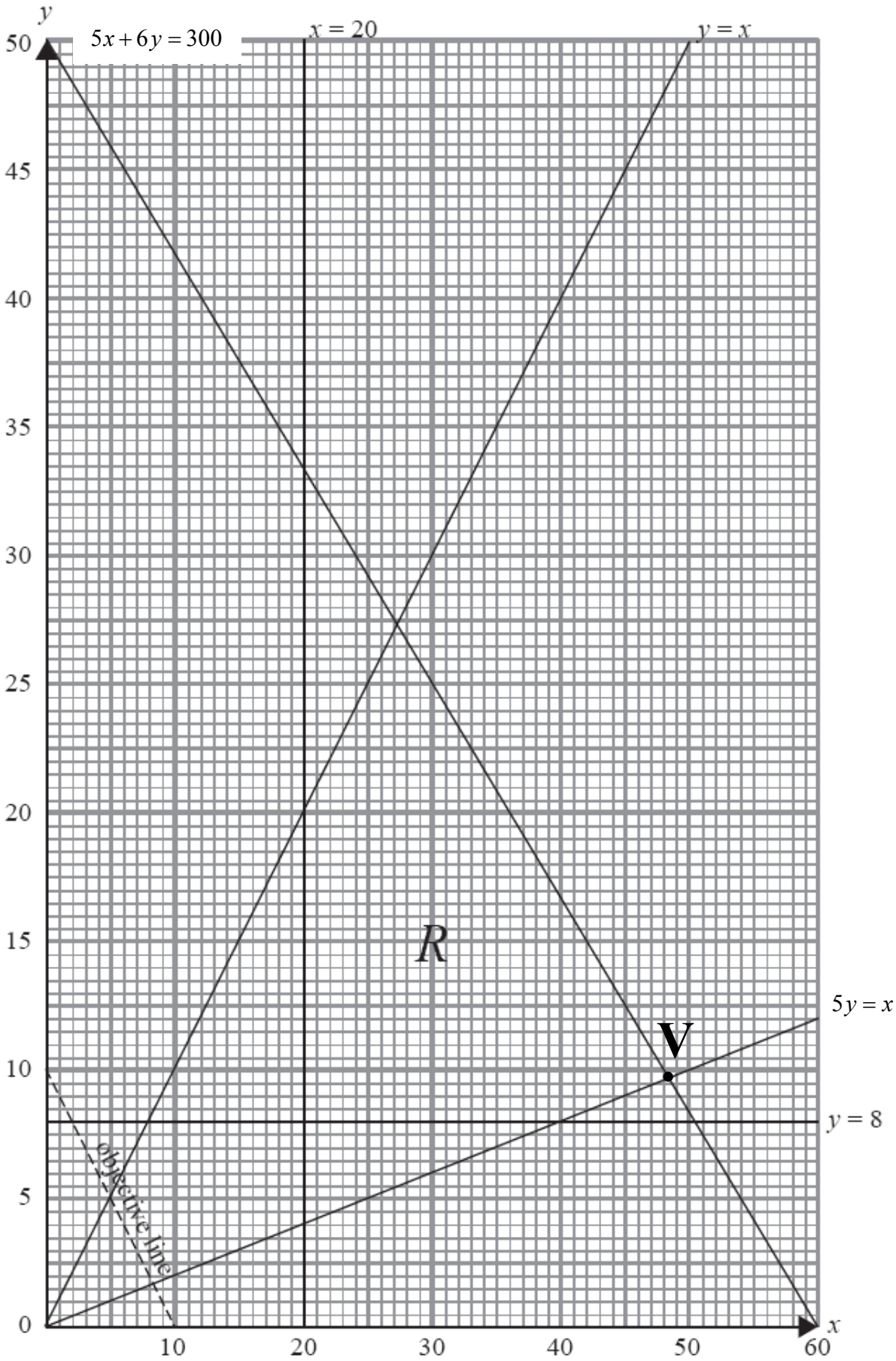
- F must not start until after B and E are complete.
- G must not start until after B and E are complete.
- J must not start until after C, D, F are complete.
- I must not start until after D and F are completed



You need to check the others too of course.
Finally you need to check the length of each activity.
Length 5 - A, I
Length 4 – D
Length 3 – E, G, J
Length 2 – F
Length 9 – B

e2A1: 3 workers. All 11 activities present (just once). Condone one error either precedence, or activity length, on activities D, E, F, G I, J.
e3A1: 3 workers. All 11 activities present (just once). No errors on activities D, E, F, G I, J.

Please use the pen or highlighter tool to indicate any errors to your team leader.
Usually we use a vertical line to indicate precedence errors, indicating the overlap,
and a horizontal line to indicate an activity of incorrect length.


y
50
45
40
35
30
25
20
15
10
5
0
10
20
30
40
50
60
x
5x + 6y = 300
x = 20
y = x
5y = x
y = 8
R
V
objective line

Question Number	Scheme	Marks
7 (a)	$y \leq x$	B1 **(1)**
(b)	$y \geq \frac{1}{6}(x+y)$ $6y \geq x+y$ $5y \geq x$	B2,1,0 **(2)**
(c)	$5x+6y \leq 300$	B1 **(1)**
(d)	Two lines and shading correctly added	B1 B1 **(2)**
(e)	R correctly labelled	B1 **(1)**
(f)	Objective line correctly drawn and labelled Optimal vertex labelled	M1 A1 A1 **(3)**
(g)	Buy 48 standard and 10 luxury cars, Expected profit £4640 per week	1B1 2B1, 3B1 **(3)** **13 marks**

Notes for question 7

a1B1 CAO

b1B1 Either of my first two lines. Must have three terms, two in y and one in x.

b2B1 CSO. (Answer given) must have $\geq$ throughout.

c1B1 CAO

In (d) If lines do not meet both axis then extend as necessary, but must extend beyond the feasible region. Use the line drawing tool to check.

d1B1 $5y = x$ drawn correctly, passes within a small square of (0,0) and (50, 10). Ignore shading.

d2B1 $5x + 6y = 300$ drawn correctly, passes within a small square of (0, 50), (30, 25) and (60, 0) Ignore shading.

e1B1 CAO – **but must have scored both marks in (d)**

f1M1 Drawing objective line with correct gradient, use line drawing tool to check if necessary. You can give BOD here if it is close. If their line is shorter than the length equivalent to that of line (0, 5) to (5, 0), please send to review.

f1A1 Correct objective line drawn (so no BOD) and their correct V labelled, or clearly indicated, or coordinates written to 1 dp.

f2A1 CSO, R correct, my V labelled or clearly indicated, or coordinates written to 1dp so awrt (9.7, 48.4).

g1B1 Finding vertex, in my R, with integer coordinates. Must be within 2 small squares of their V and must be maximising, so accept only; (48, 10), (47, 10), (46, 11), (27, 27), (28, 26).

g2B1 CAO (48, 10)

g3B1 CAO 4640

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