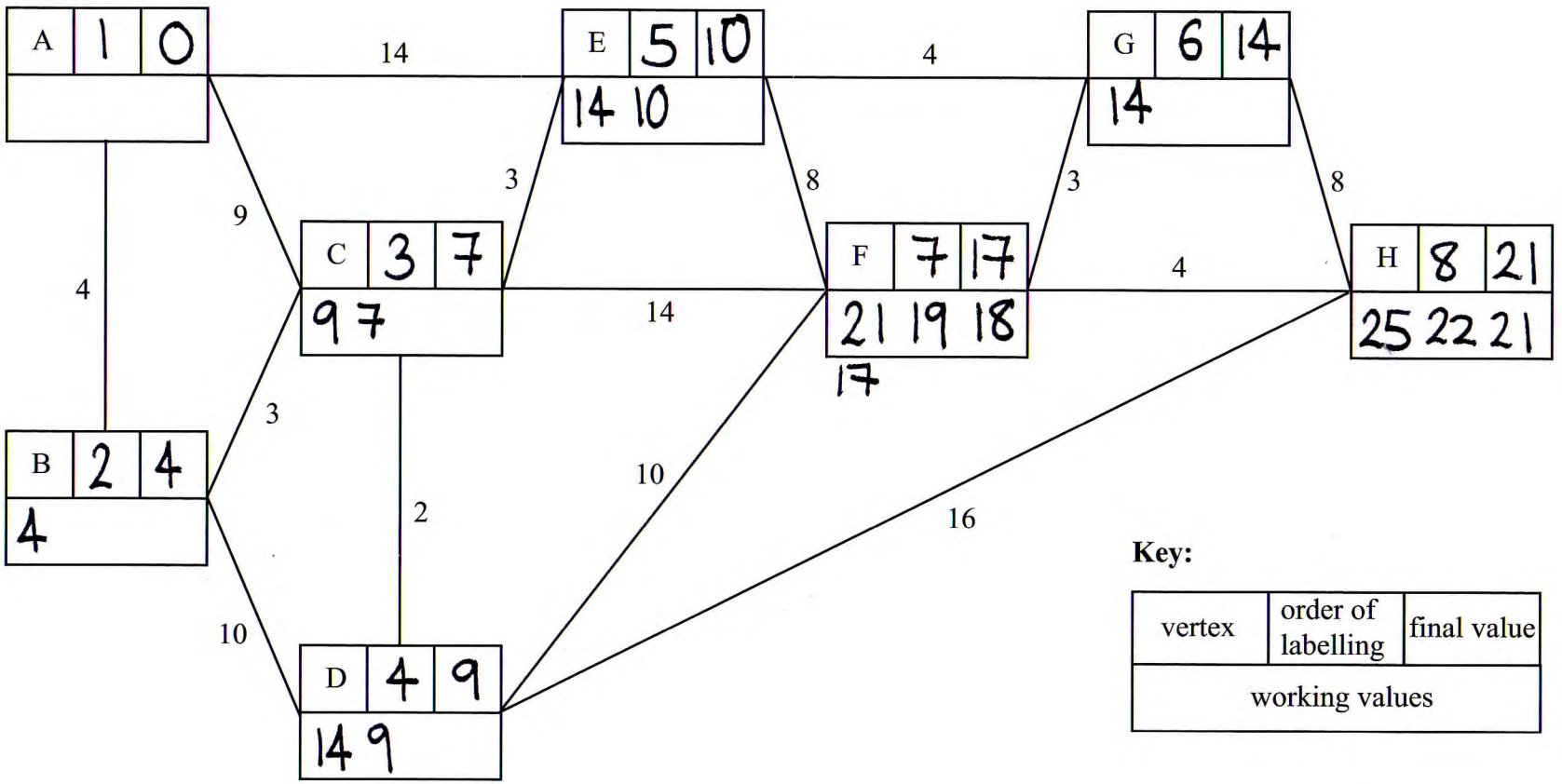
**1.** (a)




**Key:**

| vertex | order of labelling | final value |
|---|---|---|
| working values | | |

Shortest distance A to H: 21 miles

Leave blank

**Question 1 continued**

(b) ABCEGFH

(c) HFGEC length 14

**(Total 8 marks)**

**Q1**

Leave blank

Leave blank

**2.**

23 29 11 34 10 14 35 17

a) $23+29+11+34+10+14+35+17 = 173$

$\frac{173}{50} = 3.46$ ∴ lower bound = 4 discs

b)

| Bin1 | Bin2 | Bin3 | Bin4 | Bin5 |
|---|---|---|---|---|
| 23 | 29 | 34 | 35 | 17 |
| 11 | 14 | | | |
| 10 | | | | |

c) 29 23 34 11 14 35 17 (10)

29 34 23 14 35 17 (11) (10)

34 29 23 35 17 (14) (11) (10)

34 29 35 23 (17) (14) (11) (10)

34 35 29 (23) (17) (14) (11) (10)

~~35~~ ~~34~~ (29) (23) (17) (14) (11) (10)

On next pass No swaps so stop.

d)

| Bin1 | Bin2 | Bin3 | Bin4 |
|---|---|---|---|
| ~~35~~ | ~~34~~ | 29 | 23 |
| 14 | 11 | 17 | 10 |

Leave blank

**3.**

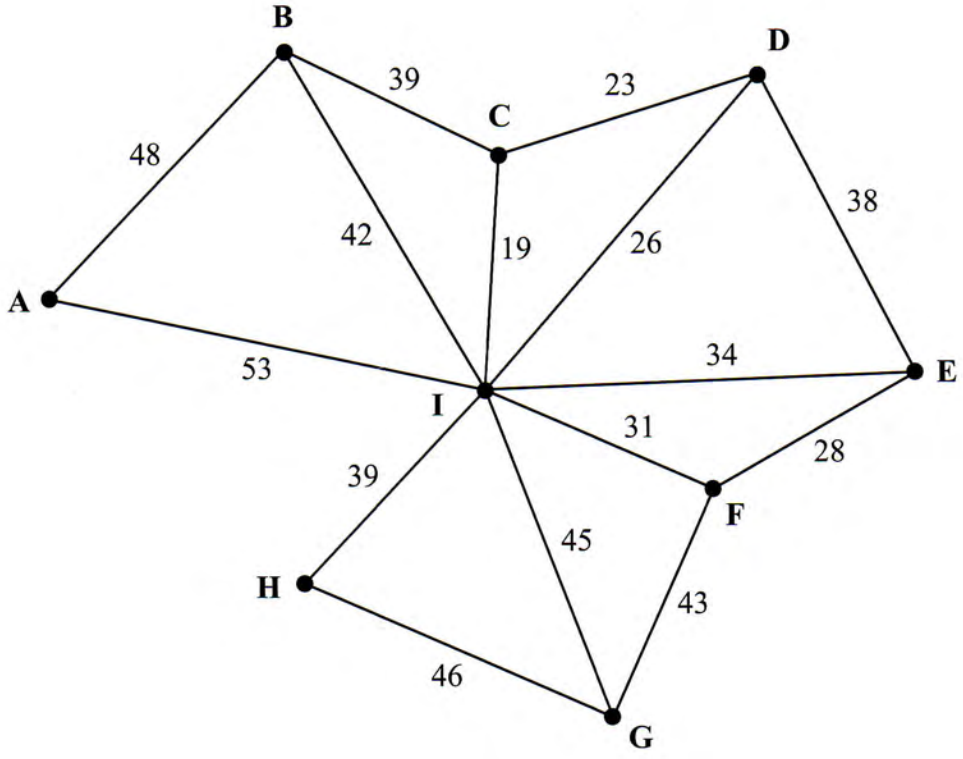



**Figure 2**

(a) CI, CD, DIrej, EF, FI, DErej, $\binom{BC}{HI}$, BIrej, FG, IGrej, HGrej, AB stop

Leave blank

**Question 3 continued**

(b) AB, BC, CI, CD, IF, FE, IH, FG

(c)

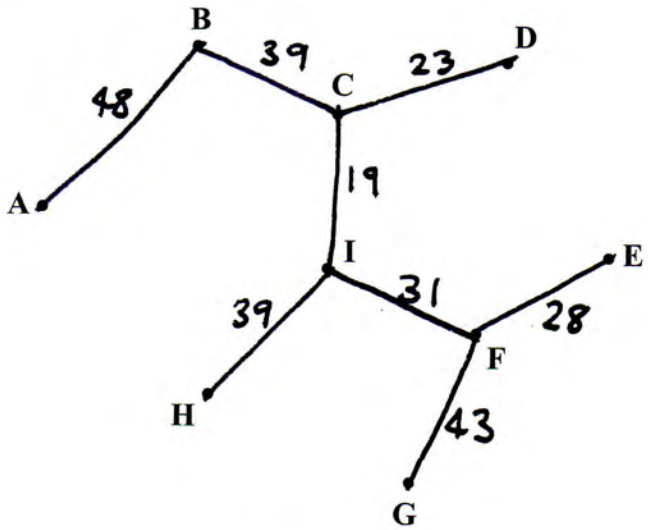



**Diagram 1**

Weight of minimum spanning tree: 270

(d) Use Kruskal's algorithm. Start by adding DI and HG and the proceed with Krustal's as normal.

**Q3**

**(Total 10 marks)**

Leave blank

**4.**

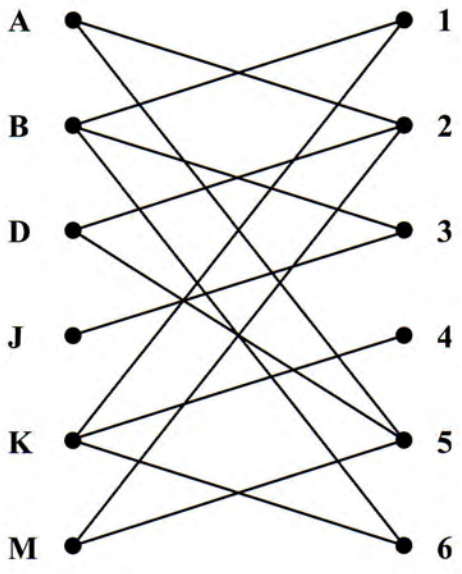



**Figure 3**

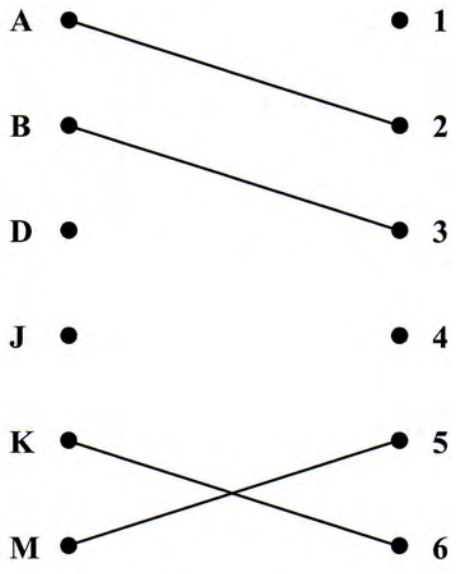



**Figure 4**

a) Bipartite Graph

b) $J-3=B-6=k-4$

c.s

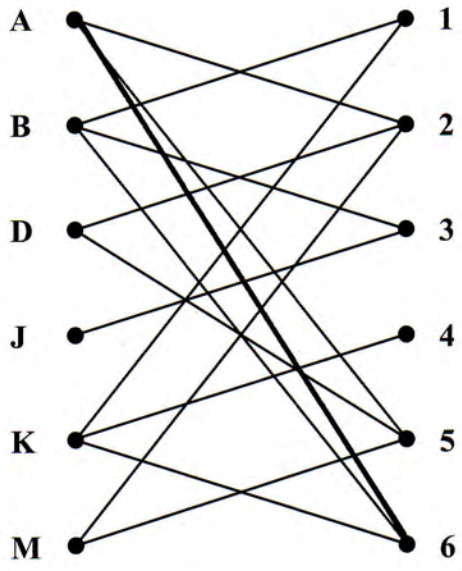
$J=3\ -B=6\ -k=4$

improved matching: A=2
B=6
D
J=3
K=4
M=5

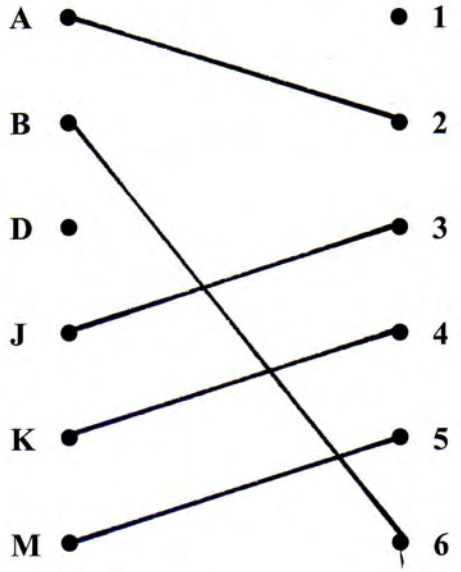
* There are a number of different solutions to this question *

Leave blank

**Question 4 continued**




initial match




c) $D-2=A-6=B-1$

c.s

$D=2-A=6-B=1$

complete match : $A=6$

$B=1$

$D=2$

$J=3$

$K=4$

$M=5$

Q4

**(Total 7 marks)**

Leave blank

5. a) Odd nodes A, D, F, I

| | | |
|---|---|---|
| AD = 4.5 | AF = 5.8 | AI = 5.9 |
| FI = 5.3 | DI = 3.9 | DF = 5.1 |
| 9.8 | 9.7 | 11.0 |

Repeat edges AE, EF and DG, GI

Possible route: ABDGIGDEIHFCAEFEA

b) traverse AE, EF, DG and GI twice

length = 31.6 + 9.7 = 41.3 km

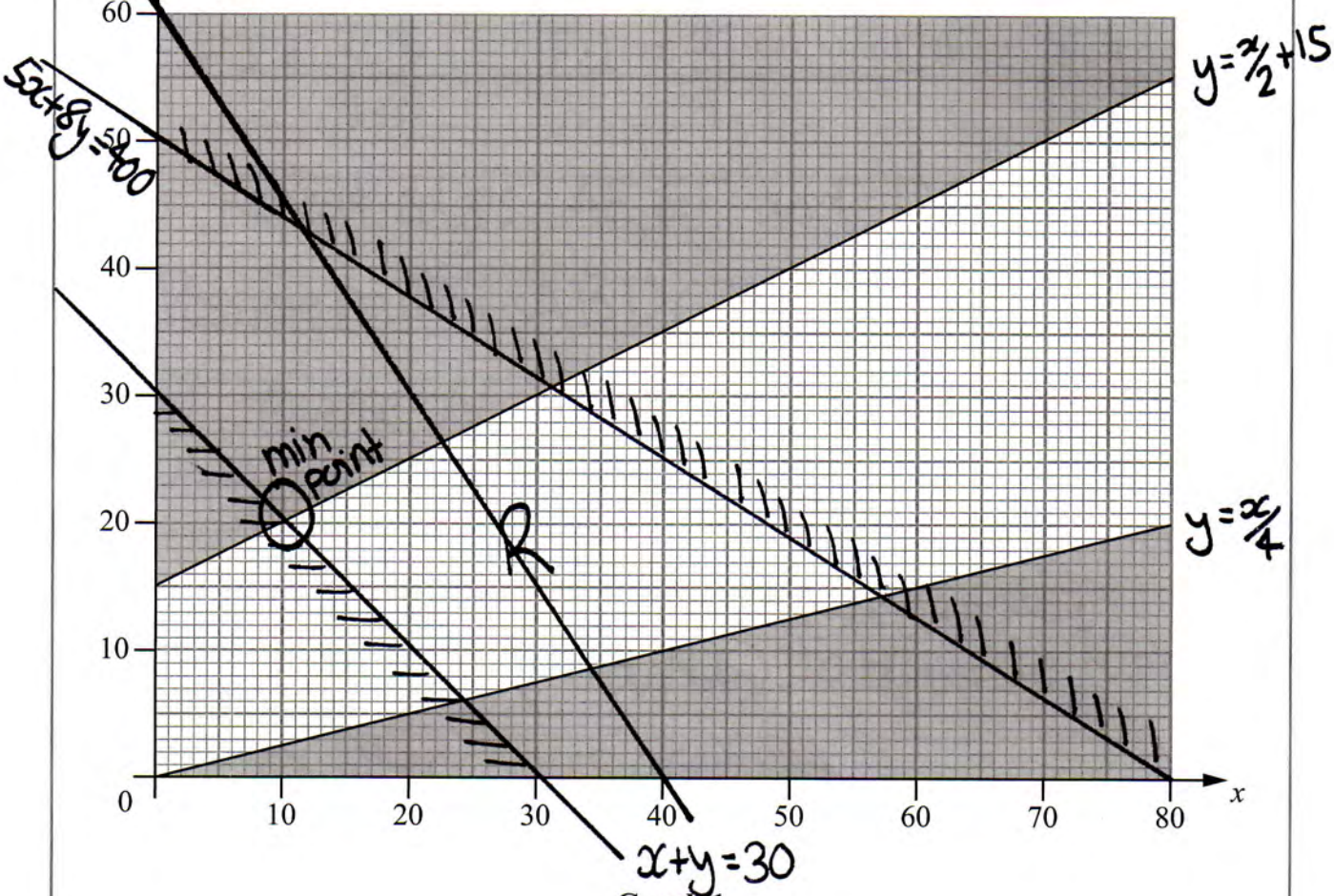
c) Start at D, finish at A as this leaves FI (FH, HI) to traverse twice length 5.3.
The other choices are:

finish at I (repeat AF = 5.8)
" " F (repeat AI = 5.9)

both longer than 5.3.

Leave blank

6. Profit line $15x+10y=600$




**Graph 1**

a) $y \leq \frac{x}{4}$ (since grad $= \frac{1}{4}$)

$y \geq \frac{x}{2}+15$ (since grad $= \frac{1}{2}$ intercept $= 15$)

c) min point at $(10,20)$

$\therefore$ Profit $= 15\times10+20\times10$

$= 150+200$

$= \underline{\underline{350}}$

Leave blank

7. (a)

| Activity | Immediately preceding activities |
|---|---|
| A | - |
| B | - |
| C | A |
| D | A |
| E | A |
| F | B, C |
| G | B, C |
| H | E, F |
| I | D, E, F |
| J | H, G |
| K | I, H, G |
| L | I, H, G |

**Precedence table**

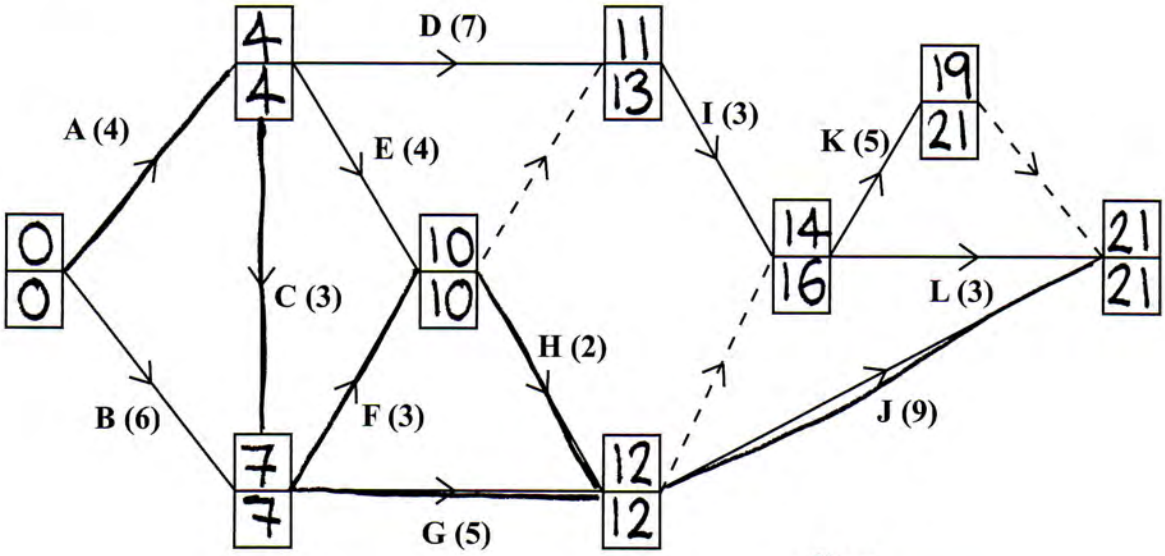
(b) I) To show dependence; K and L depend I, H and G while J depends on H and G only

II) For uniqueness; each activity must uniquely be expressed in terms of start and end events.

Leave blank

**Question 7 continued**

(c)




**Key:**

| Early event time |
|---|
| Late event time |

**Diagram 2**

(d) Critical Activities: A, C, (F, H, G), J

(e) 21 - 5 - 14 = 2

(f) sum of durations = 54

$\frac{54}{21} = 2.57\ldots$ ∴ lower bound = 3

Q7

**(Total 16 marks)**

**TOTAL FOR PAPER: 75 MARKS**

**END**