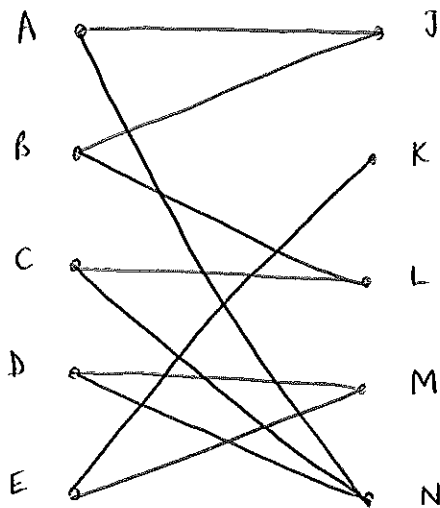


Jan '08

1a)



b)

D - M ≠ E - K

AN

BJ

CL

DM

EK

2. See sheet

3a)

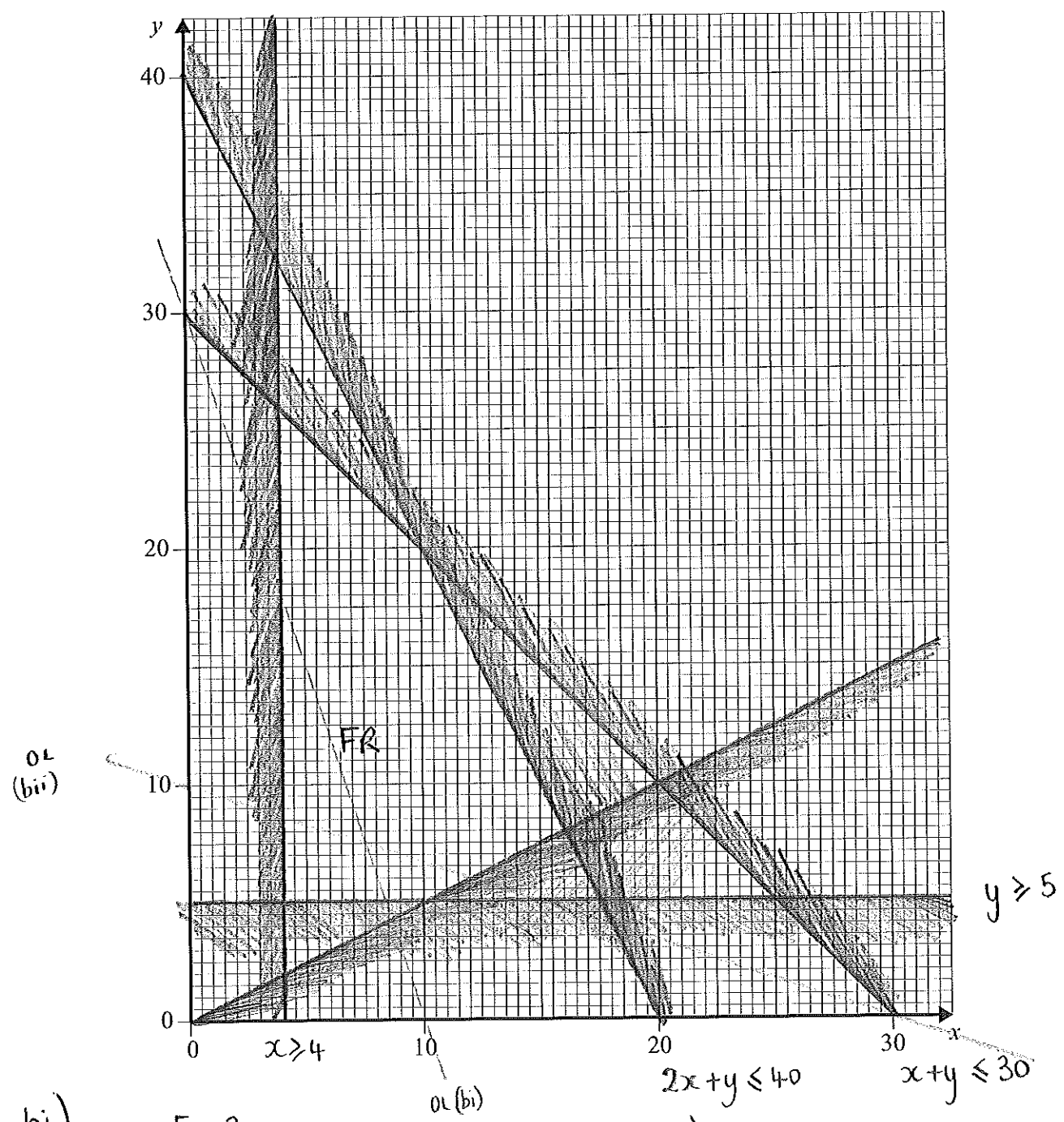
DF	1.2
IH	1.8
BC	2.1
AJ	2.2
EF	2.4
HG	2.6
FG	2.7
AB	2.8
IJ	2.9
<hr/>	
	20.7

b)

20.7

Figure 1 (for use in Question 2)

Q2 a)



bi)

$$F = 3x + y$$

$$30 = 3x + y$$

(0, 30) (10, 0)

maximum at (16, 8)

$$F = 3(16) + 8 = 56$$

bii)

$$F = x + 3y$$

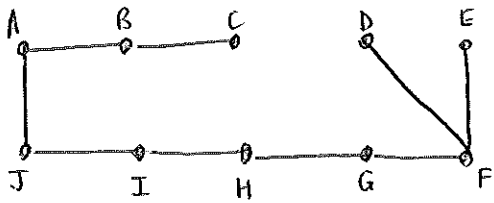
$$30 = x + 3y$$

(0, 10) (30, 0)

maximum at (4, 26)

$$F = 4 + 3(26) = 82$$

c)

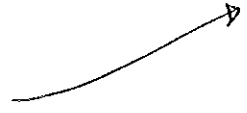


Prim's

- AJ
- AB
- BC
- IJ
- IH
- HG
- GF
- FD
- EF

d)

EF



4ai)

See sheet

ii)

A B E I K

b)

odd vertices A, D, H, K

AD	27	(ABD)
AH	20	(ACD)
AK	46	(ABEIK)
DH	40	(from Q)
DK DK	20	(DIK)
HK	30	(DJK)

$$AD + HK = 27 + 30 = 57$$

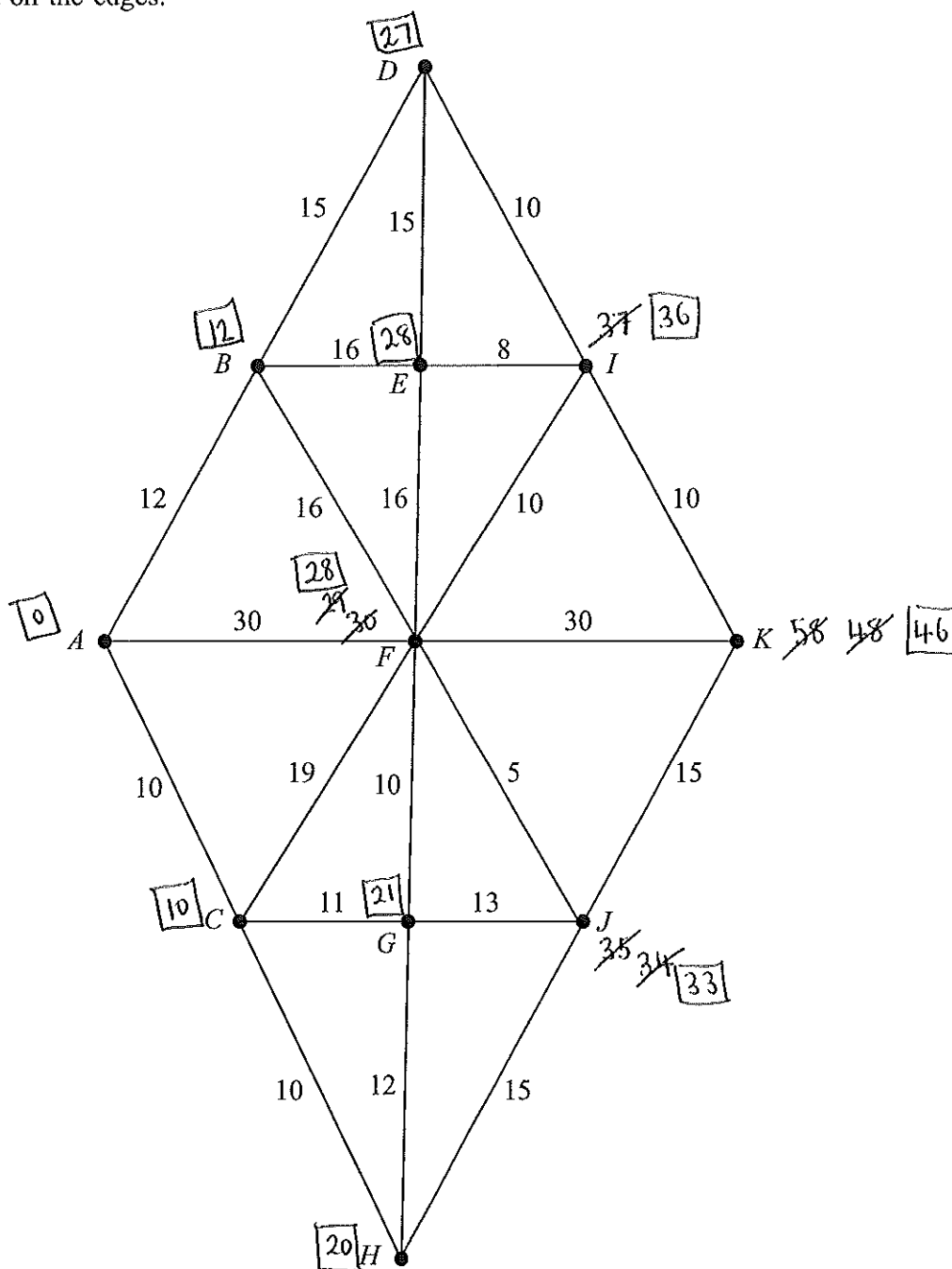
$$AH + DK = 20 + 20 = 40$$

$$AK + DH = 46 + 40 = 86$$

$$308 + 40 = 348 \text{ mins}$$

4 [Figure 2, printed on the insert, is provided for use in this question.]

The network shows 11 towns. The times, in minutes, to travel between pairs of towns are indicated on the edges.



The total of all of the times is 308 minutes.

- (a) (i) Use Dijkstra's algorithm on Figure 2 to find the minimum time to travel from A to K . (6 marks)
- (ii) State the corresponding route. (1 mark)
- (b) Find the length of an optimum Chinese postman route around the network, starting and finishing at A . (The minimum time to travel from D to H is 40 minutes.) (5 marks)

5ai) 40

ii) 40

b) The optimal solution must lie between 45 and 55
 $45 \leq T \leq 55$

ci)

	A	B	C	D
A	-	20	38	35
B	20	-	18	15
C	38	18	-	33
D	35	15	33	-

ii)

$$A \xrightarrow{20} B \xrightarrow{15} D \xrightarrow{33} C \xrightarrow{38} A = 106$$

iii)

A B D B C B A

6ai)

A	B	C	D	K	N	X	
1	-6	11	-6	1	0	1	0
				2	1	2	0
				3	2	3	0
					3		

ii)

A	B	C	D	K	N	X	
1	-10	29	-20	1	0	1	0
				2	1		6
				3		2	
				4		3	4
				5		4	0
					2		
						5	
							0
					3		

b) If line 90 wasn't there the algorithm would never end

7 The numbers 17, 3, 16 and 4 are to be sorted into ascending order.

The following four methods are to be compared: bubble sort, shuttle sort, Shell sort and quick sort (with the first number used as the pivot).

A student uses each of the four methods and produces the correct solutions below. Each solution shows the order of the numbers after each pass.

			Comparisons	Swaps			
Solution 1	17	3	16	4	Shuttle	1	1
	3	17	16	4			
	3	16	17	4			
	3	4	16	17			
Solution 2	17	3	16	4	Shell	2	1
	16	3	17	4			
	3	4	16	17			
Solution 3	17	3	16	4	Quick	3	3
	3	16	4	17			
	3	16	4	17			
	3	4	16	17			
Solution 4	17	3	16	4	Bubble	3	3
	3	16	4	17			
	3	4	16	17			
	3	4	16	17			

- (a) Write down which of the four solutions is the bubble sort, the shuttle sort, the Shell sort and the quick sort. (3 marks)
- (b) For each of the four solutions, write down the number of comparisons and swaps (exchanges) on the first pass. (8 marks)

Turn over for the next question

Turn over ►

- 8 Each day, a factory makes three types of hinge: basic, standard and luxury. The hinges produced need three different components: type A , type B and type C .

Basic hinges need 2 components of type A , 3 components of type B and 1 component of type C .

Standard hinges need 4 components of type A , 2 components of type B and 3 components of type C .

Luxury hinges need 3 components of type A , 4 components of type B and 5 components of type C .

Each day, there are 360 components of type A available, 270 of type B and 450 of type C .

Each day, the factory must use at least 720 components in total.

Each day, the factory must use at least 40% of the total components as type A .

Each day, the factory makes x basic hinges, y standard hinges and z luxury hinges.

In addition to $x \geq 0$, $y \geq 0$, $z \geq 0$, find five inequalities, each involving x , y and z , which must be satisfied. Simplify each inequality where possible. (8 marks)

END OF QUESTIONS

$$\text{Type A: } 2x + 4y + 3z \leq 360$$

$$\text{Type B: } 3x + 2y + 4z \leq 270$$

$$\text{Type C: } x + 3y + 5z \leq 450$$

$$\text{Total: } 6x + 9y + 12z \geq 720$$

$$\Rightarrow 2x + 3y + 4z \geq 240$$

$$2x + 4y + 3z \geq 0.4(6x + 9y + 12z) \Rightarrow 2x + 4y + 3z \geq 2.4x + 3.6y + 4.8z$$

$$0.4y \geq 0.4x + 1.8z$$

$$4y \geq 4x + 18z$$

$$2y \geq 2x + 9z$$