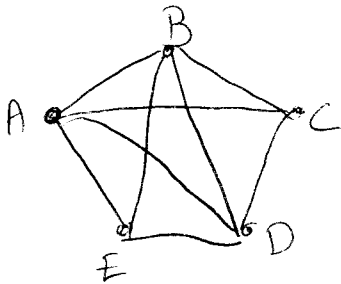# D1 Specimen Paper.

1. i.

Eulerian as all nodes even.
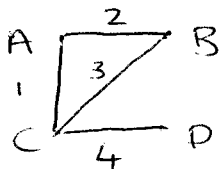
ii   Any path ie ACD.

iii   Any cycle   ABCDEA

2. i   Minimum arc is chosen first.
Next minimum is chosen next as 2 arcs can't make
a cycle.

ii

3. i
6	3	8	3	2
3	6	8	3	2
3	6	8	3	2
3	6	3	8	2
3	3	6	8	2
3	3	6	8	2
3	3	6	2	8
3	3	2	6	8
3	2	3	6	8
2	3	3	6	8

ii
Number of Operations $\propto$ no of items^2.

4. i
Step	A	B	C
1	6	13	0
2	6	13	6
3̸4	12	6	6
8̸2	12	6	6
3̸4	24	3	6
8̸2	24	3	30
3̸4	48	1	30
8̸2			78
6			78

ii
Step	A	B	C
1.	A	8.	0
2.4	2A	4	0
24	4A	2	0
24	8A	1	0
24			8A
6			8A

Output is A×B.

5.i Min Connector for diagram is
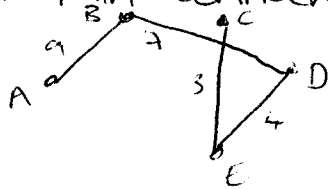
$3+4+7+9 = 23$.

Shortest way into and out of F is

$7 + 8 = 15$.

$15 + 23 = 38$.

ii Upper Bound is 47.
All vertices have to be gone into and out of so use highest Lower Bound ie A = 40 km.

iii $B \to C D E \to F$. Use tour improvement.

BC & DE   or   BD CE   BD CE is better.
11   4   7   3

DC   DE   C   BDCEF.
BD   & EF   or   CE   &F   DCSE is best.
  5   8   4   10

B D

$B \to C D E \to F$.	$11 + 5 + 4 + 8 = 28$
C E D	$11 + 3 + 4 + 7 = 25$
D C E	$7 + 5 + 3 + 8 = 23$ ←
D E C	$7 + 4 + 3 + 10 = 24$
E C D	$9 + 3 + 5 + 7 = 24$
E D C.	$9 + 4 + 5 + 10 = 28$

Best route = A - B - D - C - E - F - A = $23 + AB + FA$
$= 23 + 9 + 10$
$= 42$

6 i
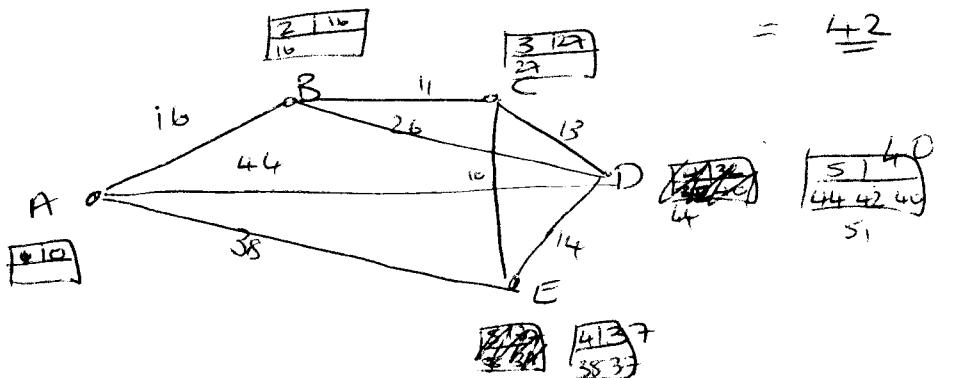
40 mins   A - B - C - D

ii Chinese Postman. → odd nodes A B C E.

Pairs → AB CE → ~~2~~ 16 + 10 = 26
  or AC BE → 27 + 21 = 48
  or AE BC. → 37 + 11 = 48.

AB CE duplicated

$$26 + 16 + 11 + 13 + 26 + 44 + 10 + 38 + 14$$
$$= 198 \text{ mins}$$

iii $A \Rightarrow B \Rightarrow C \Rightarrow E \Rightarrow D \Rightarrow A$

miss off last journey → route is ABCED.
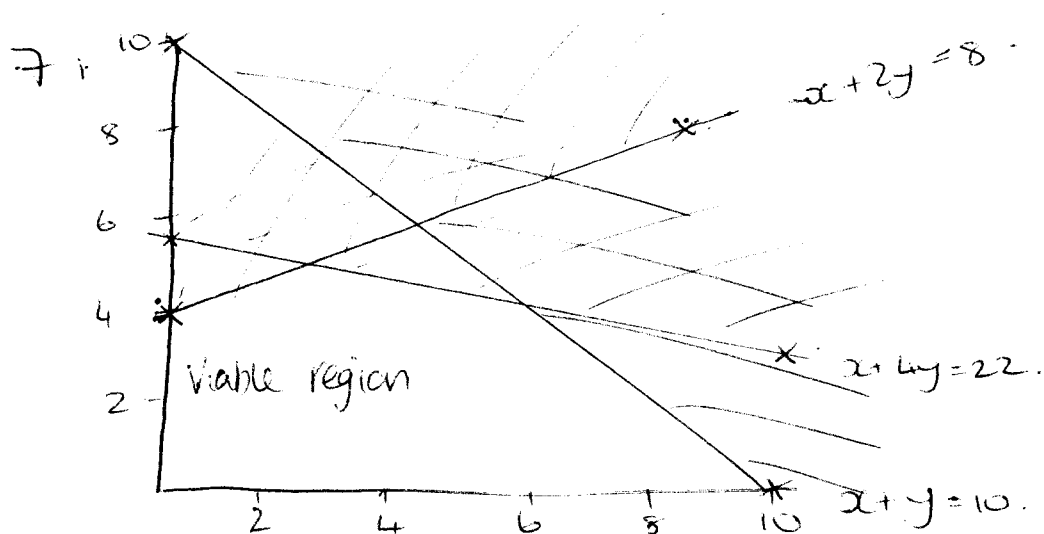
7 i

Vertices $(0, 4)$ = 16 $x + 4y = 22$
  $(10, 0)$ = −6 $-x + 2y = 8$ +
  $(2, 5)$ = 18 $6y = 30$
4y−x $(6, 4)$ = 10 $y = 5$ $x = 2$.
        $x + 4y = 22$
        $x + y = 10$.
max P is 18 when $x = 2$ $3y = 12$
        $y = 5$. $y = 4$
            $x = 6$

ii Simplex. → $P + x - 4y = 0$ ← obj
        $x + 4y + s = 22$
        $x + y + t = 10$
        $-x + 2y + u = 8$

P	x	y	s	t	u.	=	
1	1	-4	0	0	0	0	r_1
0	1	4	1	0	0	22	r_2
0	1	1	0	1	0	10	r_3
0	-1	2	0	0	1	8	r_4

Pivot on y r r_4.

1	-1	0	0	0	2	16	$r_5 = r_1 + 4r_8$
0	3	0	1	0	-2	6	$r_6 = r_2 - 4r_8$
0	2	0	0	1	-1/2	6	$r_7 = r_3 - r_8$
0	-1/2	1	0	0	1/2	4	$r_8 = 1/2 r_4$

$P = 16$ $x = 0$ $y = 4$ ie Testing vertex $(0, 4)$.

Pivot on x r r_6.

1	0	0	1/3	0	1 1/3	18	$r_9 = r_5 + r_6$
0	1	0	1/3	0	-2/3	2	$r_{10} = 1/3 r_6$
0	0	0	-2/3	1	5/6	2	$r_{11} = r_7 - 2r_{10}$
0	0	1	1/6	0	1/6	5	$r_{12} = r_8 + 1/2 r_{10}$

$P = 18$ $x = 2$ $y = 5$ ie Testing $(2, 5)$.

iii   Start at $(0, 0)$:
      Test $(0, 4)$
      Test $(2, 5)$ done .