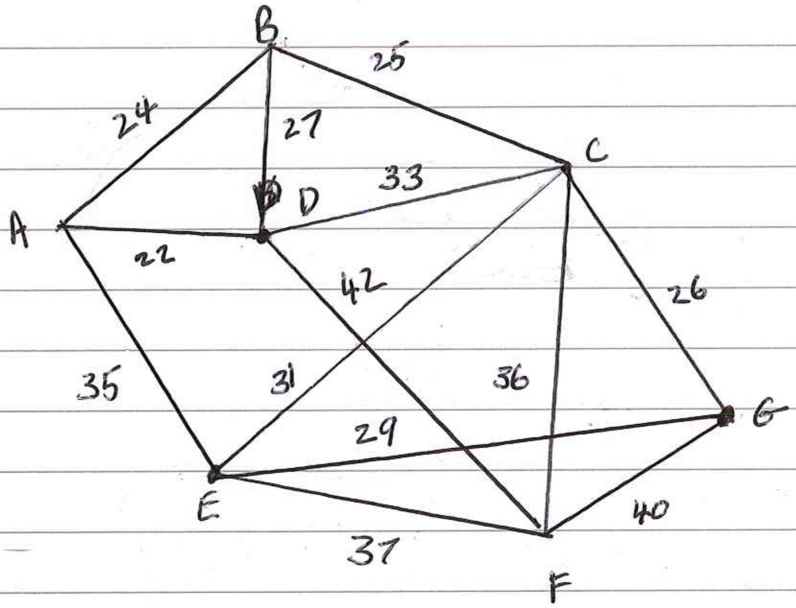
1

October Further Maths Decision 1

October 2020

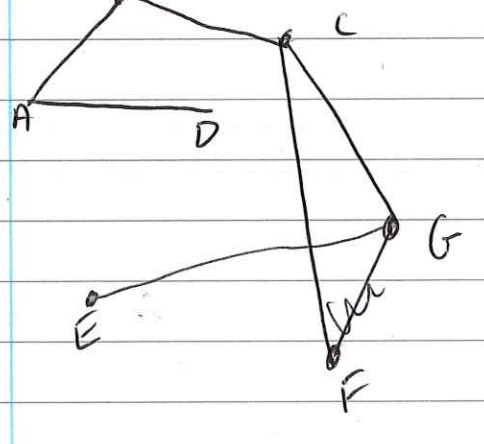
Q1



~~24~~, ~~22~~, ~~35~~, ~~25~~, ~~27~~, ~~33~~, ~~31~~, 36, ~~26~~, 42, 37, ~~29~~, ~~40~~

ascending order 22, 24, 25, 26, ~~27~~, 29, ~~31~~, ~~33~~, ~~35~~, 36, ~~40~~, ~~42~~

AD, AB, BC, CG, GE, CF



Total distance

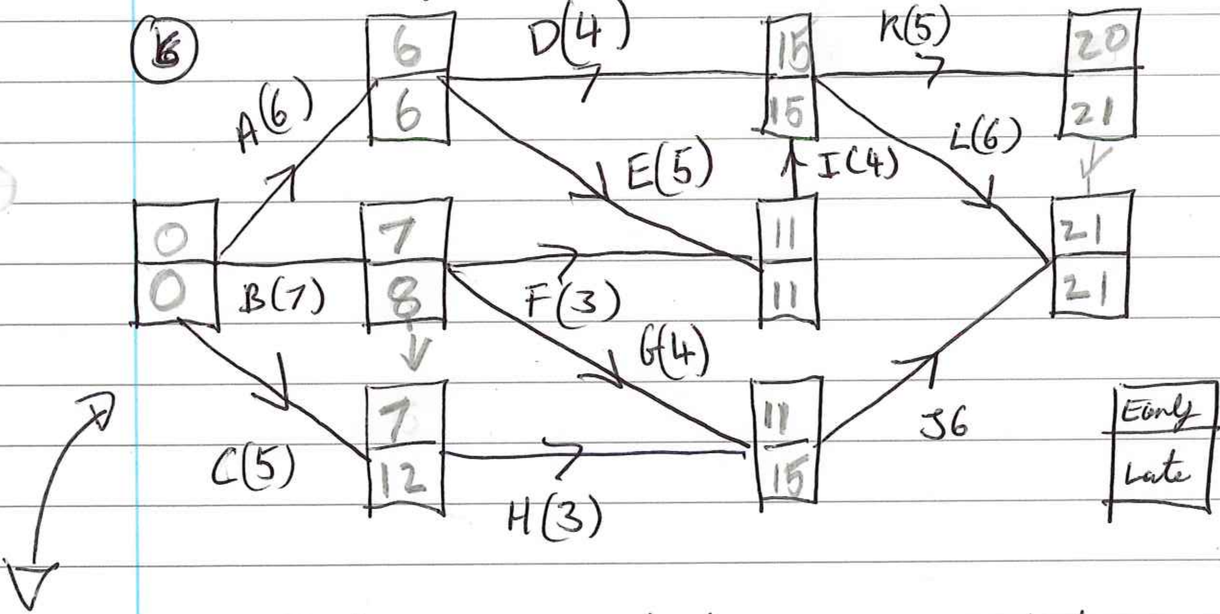
$22+24+25+26+29+36 = 162$

(2) October Further Maths Decision ~~2~~ 1

2\. (a) Dummy at K needed as two activities can't start and finish at the same event.

It is required at H as H requires C and B, but G only requires activity B.

(b)



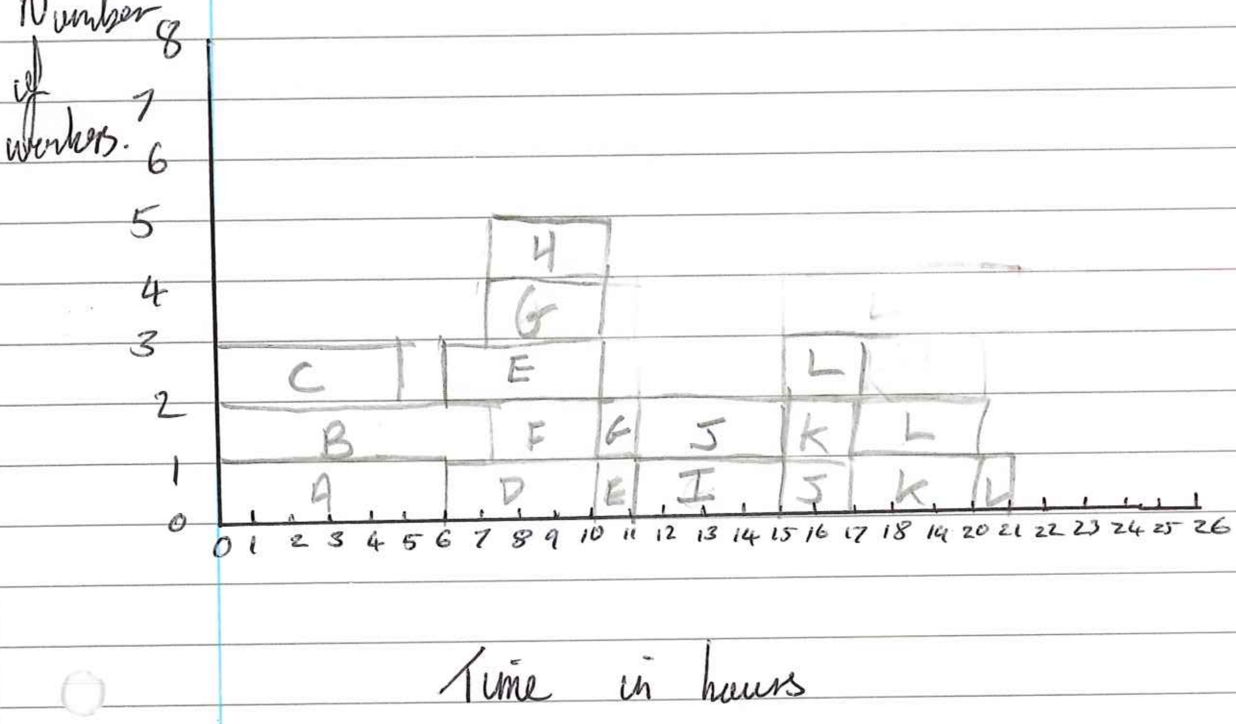
(b)

Activity	IPA	Activity	IPA	Activity	IPA
A	–	E	A	I	E, F
B	–	F	B	J	G, H
C	–	G	B	K	D, I
D	A	H	B, C	L	D, I

c(ii) 21

c(iii) A ~~[illegible]~~ E I L

(3) Q (2)



(c) Yes it can be completed with fewer workers in the minimum time.

H could be delayed to start at 10 rather than 7, as the late start time is 12. This would reduce by 1 the number of required workers.

Q3 October Further Maths Decision 1

Time Matrix

	A	B	C	D	E
A	–	8	4	7	∞
B	8	–	3	∞	10
C	4	3	–	∞	6
D	7	∞	1	–	1
E	∞	10	6	1	–

Route Matrix

	A	B	C	D	E
A	A	B	C	D	E
B	A	B	C	D	E
C	A	B	C	D	E
D	A	B	C	D	E
E	A	B	C	D	E

(b) Time Matrix

	A	B	C	D	E
A	–	7	4	7	10
B	7	–	3	14	9
C	4	3	~~4~~ –	11	6
D	5	4	1	–	1
E	10	9	6	1	–

	A	B	C	D	E
A	A	C	C	D	C
B	C	B	C	C	C
C	A	B	C	A	E
D	C	C	C	D	E
E	C	C	C	D	E

5 Q3 b

Time Matrix

	A	B	C	D	E
A	–	7	4	7	8
B	7	–	3	14	9
C	4	3	–	11	6
D	5	4	1	–	1
E	6	5	2	1	–

	A	B	C	D	E
A	A	C	C	D	D
B	C	B	C	C	C
C	A	B	C	A	E
D	C	C	C	D	E
E	D	D	D	D	E

(c) (i) A C B E D A

(ii) $4+3+9+1+5 = 22$ mins

(iii) A C B C E D C A

6

4 October Further Maths Decision 1

(a) $2y \leq 5x$
$y \geq x + 1$
$6x + 5y \leq 30$

$P = 3x + y$

(b) $2y = 5x$ (1)
$6x + 5y = 30$ (2) $\Rightarrow 12x + 10y = 60$

sub (1) in (2) $12x + 25x = 60$
$37x = 60$

$x = 60/37$
$y = 150/37$
$P = 330/37$

$y = x + 1$ (1)
$6x + 5y = 30$ (2)

sub (1) into (2) $6x + 5(x+1) = 30$
$6x + 5x + 5 = 30$
$11x + 5 = 30$
$11x = 25$
$x = 25/11$
$y = 36/11$
$P = 111/11$

$\left.\begin{array}{l} 2y = 5x \\ y = x+1 \end{array}\right\}$ $2(x+1) = 5x$
$2x + 2 = 5x$
$2 = 3x$
$x = 2/3 \Rightarrow y = 5/3$

$P = 11/3$

Optimum

$x = 25/11$
$y = 36/11$

Q4

c $\quad Q = 3x + ay$

$$3 \times \frac{60}{37} + a \times \frac{150}{37} < 3 \times \frac{25}{11} + a\frac{36}{11}$$

$$\frac{150}{37}a - \frac{36}{11}a < \frac{795}{407} \qquad \cancel{a <} \ \cancel{\frac{119}{560}} \qquad a < \frac{5}{2}$$

$$3 \times \frac{2}{3} + a \times \frac{5}{3} < 3 \times \frac{25}{11} + a \times \frac{36}{11}$$

$$\frac{5a}{3} - \frac{36a}{11} < \frac{53}{11}$$

$$a < -3$$

So $\quad -3 < a < 5/2$

8

5(a) If $x \geq 21$ the extra 10 would not fit into the bin.

If $x \leq 13$ the 18 would go in bin 2

So as discrete $13 < x < 21$

(b) $x < 24$ as swapped with 24

but x not swapped with 8 so

$x \leq 8$

$8 \leq x < 24$

Also x not swapped with 17 $x \leq 17$

$8 \leq x \leq 17$

But distinct numbers $8 < x < 17$

when combine with other constraint

$13 < x < 21$

(9) 4C

To fit in bin 3 and satisfy $13 < x < 21$

then x could be 14 or 15.

But only 1 bin full, so x must be 14.

(10) (b) (a) As the graph has two odd nodes it is semi-Eulerian.

(see next page)

AG $\quad 60+y$

$409 = 320 + x + y + 60 + y$

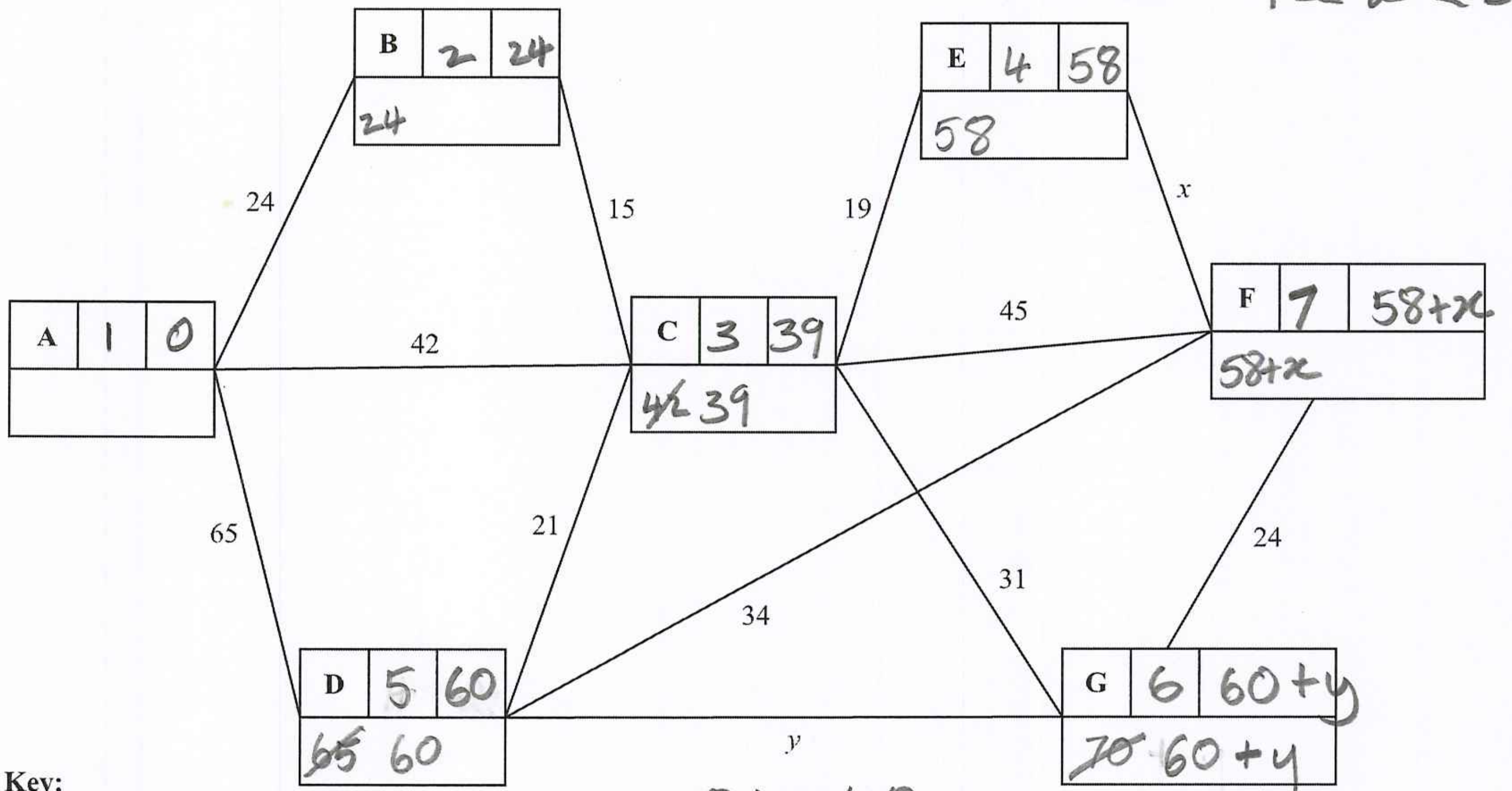
(1) $29 = x + 2y$

F to G via A $= 58 + x + 60 + y = 140$

(2) $22 = x + y$

$$\begin{array}{r} 29 = x + 2y \\ - \quad 22 = x + y \\ \hline 7 = y \end{array} \Rightarrow x = 15$$

6. (a)



$12 < x < 26$

$0 < y < 10$

Key:

Vertex	Order of labelling	Final value
Working values		

12

7.

$x + 2y + 3z \leq 45$

$3x + 2y \geq 9$

$-x + 4z \geq 4$

$P = 2x + y + 3z$

Basic variable	x	y	z	s_1	s_2	s_3	a_1	a_2	Value
s_1	1	2	3	1	0	0	0	0	45
a_1	3	2	0	0	–1	0	1	0	9
a_2	–1	0	4	0	0	–1	0	1	4
P	–2	–1	–3	0	0	0	0	0	0
A	-2	-2	-4	0	1	1	0	0	13

Table 1

$x + 2y + 3z + S_1 = 45$

$3x + 2y - S_2 + a_1 = 9$

$-x + 4z - S_3 + a_2 = 4$

$A = -(a_1 + a_2)$

$A = -9 - S_2 + 2y + 3x$

$-4 - S_3 - x + 4z$

$-13 = A - 2x - 2y - 4z + S_2 + S_3$

P 6 2 6 7 8 A 0 1 8 2 0

13

(1) c(i) As the value for the ~~basic~~ objective ~~feasible solution~~ of A is zero then there is a basic feasible solution

c(ii) $x = 3$ $y = 0$ $z = 7/4$
$S_1 = 147/4$ $S_2 = S_3 = 0$

(d)

Basic Variable	x	y	z	s_1	S_2	S_3	Value	Row Ops
S_2	0	$10/7$	0	$12/7$	1	$9/7$	63	$R_1 \div 7/12$
x	1	$8/7$	0	$4/7$	0	$3/7$	24	$R_2 + 1/3 R_1$
z	0	$2/7$	1	$1/7$	0	$-1/7$	7	$R_3 + 1/12 R_1$
P	0	$15/7$	0	$11/7$	0	$3/7$	69	$R_4 + \frac{11}{12} R_1$

e(i) As no negatives in objective row then this is an optimal solution

(ii) 69

(d) $S_2 = 63$ $x = 24$ $z = 7$