Practice exam paper

1 a Harry, James, Qi, Michael, Raswan, Jonathan, Cherry, Yan, Tyler

Harry, James, Michael, Qi, Jonathan, Cherry, Raswan, Tyler, Yan

Harry, James, Michael, Jonathan, Cherry, Qi, Raswan, Tyler, Yan

Harry, James, Jonathan, Cherry, Michael, Qi, Raswan, Tyler, Yan

Harry, James, Cherry, Jonathan, Michael, Qi, Raswan, Tyler, Yan

Harry, Cherry, James, Jonathan, Michael, Qi, Raswan, Tyler, Yan

Cherry, Harry, James, Jonathan, Michael, Qi, Raswan, Tyler, Yan
Sort Complete:
Cherry, Harry, James, Jonathan, Michael, Qi, Raswan, Tyler, Yan

b 1 Cherry
2 Harry
3 James
4 Jonathan
5 Michael
6 Qi
7 Raswan
8 Tyler
9 Yan

The middle name is the $\left(\frac{9+1}{2}=5\right)$ 5^{th} name: 5 Michael

Richard is after Michael so the list reduces to:
1 Qi
2 Raswan
3 Tyler
4 Yan

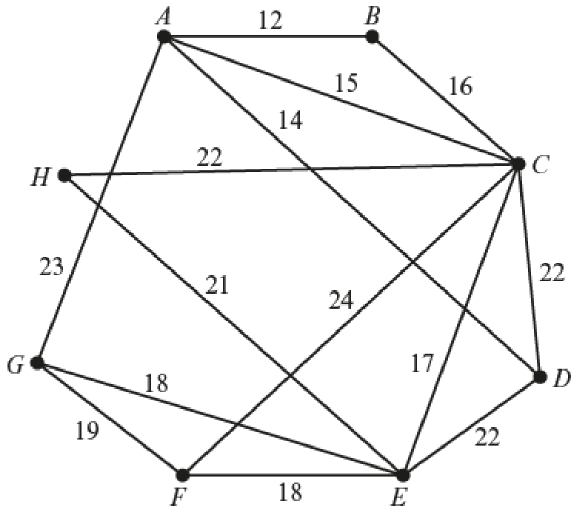
The middle name is the $\left(\frac{4+1}{2}=2.5\right)$ 3rd name: 3 Tyler

Richard is before Tyler so the list reduces to:
1 Qi
2 Raswan

The middle name in this sublist is the $\left(\frac{2+1}{2}=1.5\right)$ 2nd name:

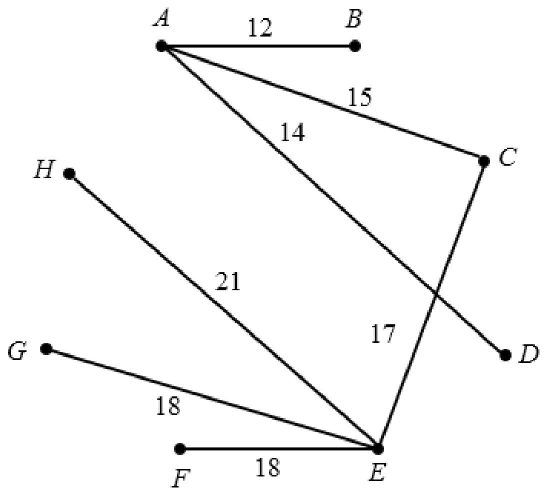
2 Raswan
The search is complete as there is no name after Raswan.
Richard is not on the list.

2 a



By inspection the order of the arcs is:
AB (12), *AD* (14), *AC* (15), *BC* (16), *CE* (17), *EG* (18), *EF* (18), *FG* (19), *EH* (21), *DE* (22), *CD* (22), *CH* (22), *AG* (23), *CF* (24)
Order for Kruskal's Algorithm:
AB (12),
AD (14),
AC (15),
CE (17),
{FE EG} (18),
EH (21)

b

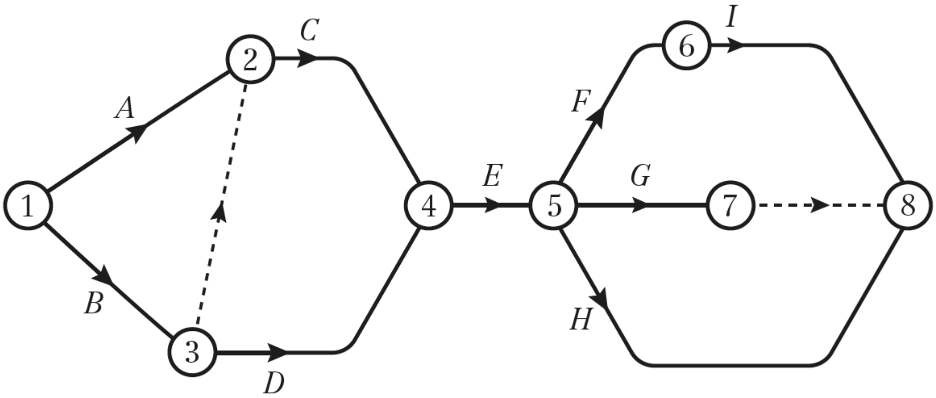


c The minimum spanning tree has weight:
12 + 15 + 14 + 21 + 17 + 18 + 18 = 115 km

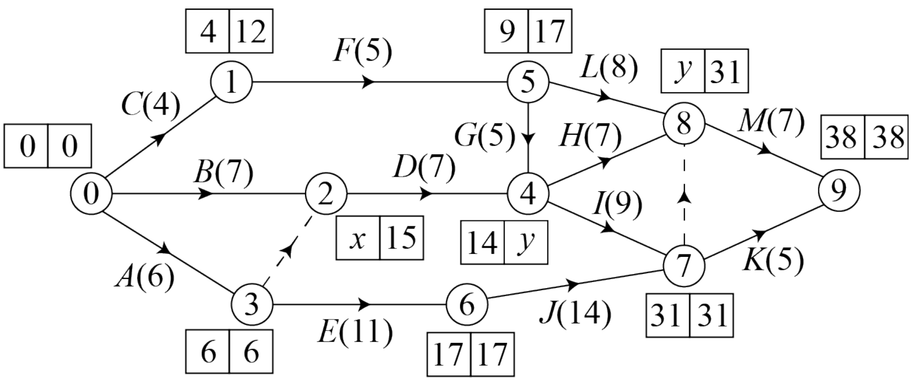
3 a

Activity	Dependent on
A	—
B	—
C	A, B
D	B
E	C, D
F	E
G	E
H	E
I	F

An activity network for this precedence table is:



b



i $x = 7$

ii $y = 31$

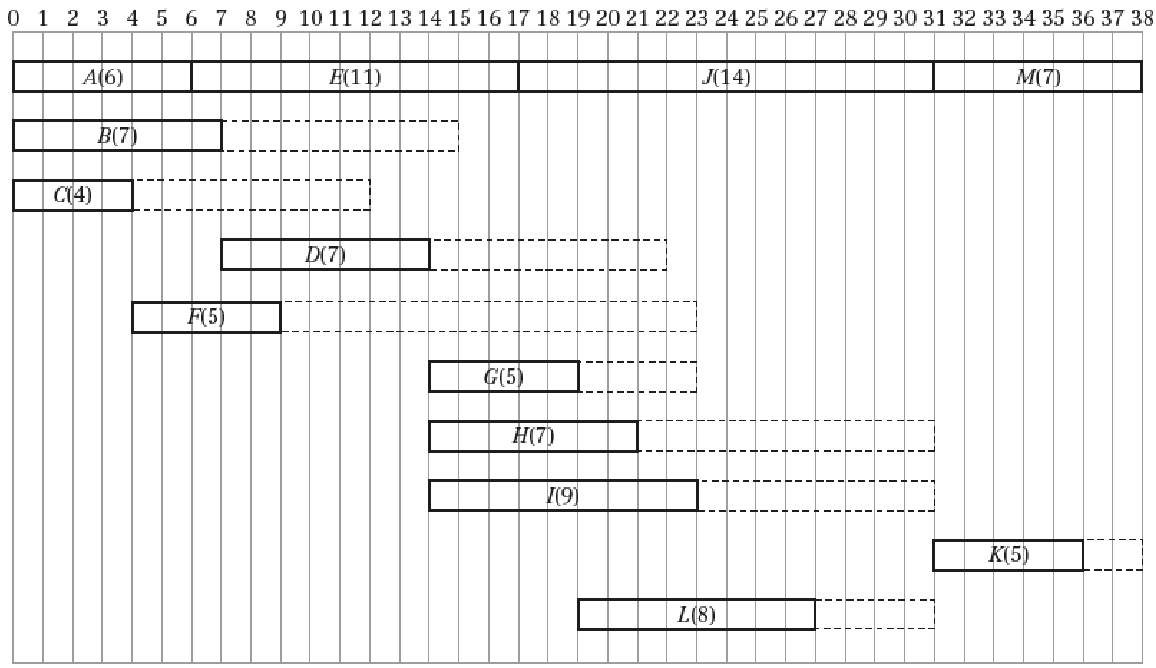
iii $z = 22$

3 c

Activity	Total Float
A	0
B	8
C	8
D	8
E	0
F	8
G	8
H	10
I	8
J	0
K	2
L	14
M	0

d i Critical activities have a float of 0, therefore the critical path is:
$A - E - J - M$

ii



4 a

A	n	A divisible by n?	$A = \frac{A}{n}$	$A = 1$?	n prime?
84	2	yes	42	no	
42	2	yes	21	no	
21	2	no			
	3				yes
		yes	7	no	
	4				no
	5				yes
		no			
	6				no
	7				yes
		yes	1	yes	

b The algorithm finds the prime factors of a number.

5 a Let x be the number of large notebooks produced and y be the number of small notebooks produced.

$0.8x + 0.6y \leq 2400 \Rightarrow 4x + 3y \leq 12000$

$3x + y \leq 7200$

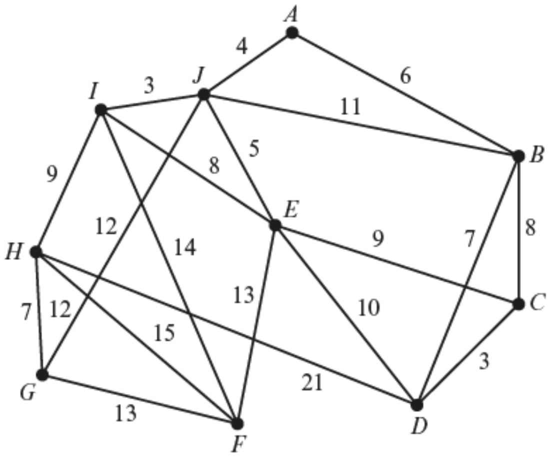
b $y \geq 0.2(x + y) \Rightarrow 0.8y \geq 0.2x \Rightarrow 4y \geq x \Rightarrow x \leq 4y$ as required

$y \leq 0.6(x + y) \Rightarrow 0.4y \leq 0.6x \Rightarrow 2y \leq 3x$

c $x \geq 0,\ y \geq 0$

d $P = 0.3x + 0.35y$

6 a



Using the route inspection algorithm;
The odd nodes are J, G, E and C
$JG + EC = 12 + 9 = 21$
$JE + GC = 5 + 26 = 31$
$JC + GE = 14 + 17 = 31$
Use $JG + EC = 21$, so the shortest route is 211 km

b 224 km

7 a

	A	*B*	*C*	*D*	*E*	*F*	*G*
A	–	8	5	14	9	15	7
B	8	–	9	6	10	11	7
C	5	9	–	11	4	13	7
D	14	6	11	–	14	5	12
E	9	10	4	14	–	9	8
F	15	11	13	5	9	–	7
G	7	7	7	12	8	7	–

7 b

	5	3	6	1	7	2	4
	A	*B*	*C*	*D*	*E*	*F*	*G*
A	–	8	5	14	9	15	7
B	8	–	9	6	10	11	7
C	5	9	–	11	4	13	7
D	14	6	11	–	14	5	12
E	9	10	4	14	–	9	8
F	15	11	13	5	9	–	7
G	7	7	7	12	8	7	–

The first arc is *DF* (5).
The second arc is *DB* (6).
The third arc is *BG or FG* (7).
The fourth arc is *GA* (7).
The fifth arc is *AC* (5).
The sixth arc is *CE* (4).
The weight of the minimum spanning tree is:
$5 + 6 + 7 + 7 + 5 + 4 = 34$
$2 \times 34 = 68$ km

Or
The first arc is *DF* (5).
The second arc is *DB* (6).
The third arc is *BG or FG* (7).
The fourth arc is *CG*(7).
The fifth arc is *CE* (4).
The sixth arc is *AC* (5).
The weight of the minimum spanning tree is:
$5 + 6 + 7 + 7 + 4 + 5 = 34$
$2 \times 34 = 68$ km

c If in part (b) MST was, *DF, BD, BG,AG, AC, CE,* then you can add *EF* to create a tour.
EF has weight 9, so shortcut *EF* would give $34 + 9 = 43$ km.

If in part (b) MST found was *DF, BD, FG,AG, AC, CE,* then you can add *EB* to create a tour.
EF has weight 10, so shortcut *EF* would give $34 + 10 = 44$ km.

7 d

	5	1	6	2	7	3	4
	A	*B*	*C*	*D*	*E*	*F*	*G*
A	–	8	5	14	9	15	7
B	8	–	9	6	10	11	7
C	5	9	–	11	4	13	7
D	14	6	11	–	14	5	12
E	9	10	4	14	–	9	8
F	15	11	13	5	9	–	7
G	7	7	7	12	8	7	—

The first arc is *BD* (6).
The second arc is *DF* (5).
The third arc is *FG* (7).
The fourth arc is *GA* (7).
The fifth arc is *AC* (5).
The sixth arc is *CE* (4).
The route is *BDFGACE* and has weight;
6 + 5 + 7 + 7 + 5 + 4 = 34
EB has weight 10, therefore upper bound is 35 + 10 = 44

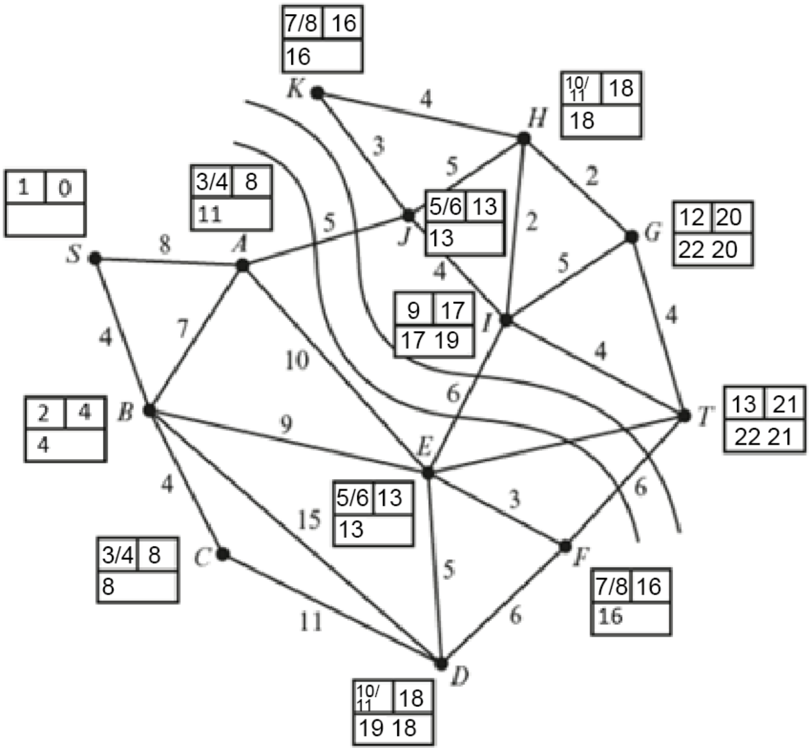
Or
The first arc is *BD* (6).
The second arc is *DF* (5).
The third arc is *FG* (7).
The fourth arc is *GC*(7).
The fifth arc is *CE* (4).
The sixth arc is *EA* (9).
The route is *BDFGACE* and has weight;
6 + 5 + 7 + 7 + 4 + 9 = 38
EB has weight 10, therefore upper bound is 38 + 8 = 46

e

	1		2		3	4
	A	*B*	*C*	*D*	*E*	*G*
A	–	8	5	14	9	7
B	8	–	9	6	10	7
C	5	9	–	11	4	7
D	14	6	11	–	14	12
E	9	10	4	14	–	8
G	7	7	7	12	8	–

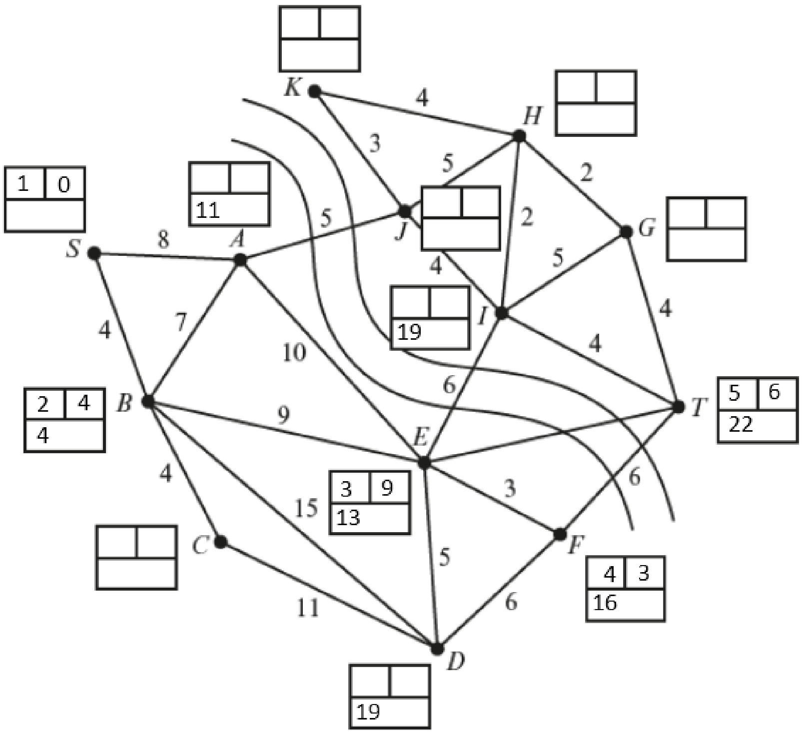
The first arc is *AC* (5).
The second arc is *CE* (4).
The third arc is *AG* (7).
The fourth arc is *GB* (7).
The fifth arc is *BD* (6).
Lower bound = weight of RMST + weights of two least arcs from *F*
= 29 + 5 + 7
= 41 km

8 a



$S - A - J - I - T$
From $T(21) - 4$ to $I(17)$
From $I(17) - 4$ to $J(13)$
From $J(13) - 5$ to $A(8)$
From $A(8) - 8$ to $S(0)$

b



The new route is $S - B - E - F - T$ and has length 22 minutes.