TRINITY COLLEGE

Mathematics Applications Unit 3/4
Test 6 2021

Section 1 Calculator Free

Networks and Decision Mathematics

STUDENT'S NAME _____

DATE: Thursday 9th September **TIME:** 30 minutes **MARKS**: 26

INSTRUCTIONS:

Standard Items: Pens, pencils, drawing templates, eraser

Questions or parts of questions worth more than 2 marks require working to be shown to receive full marks.

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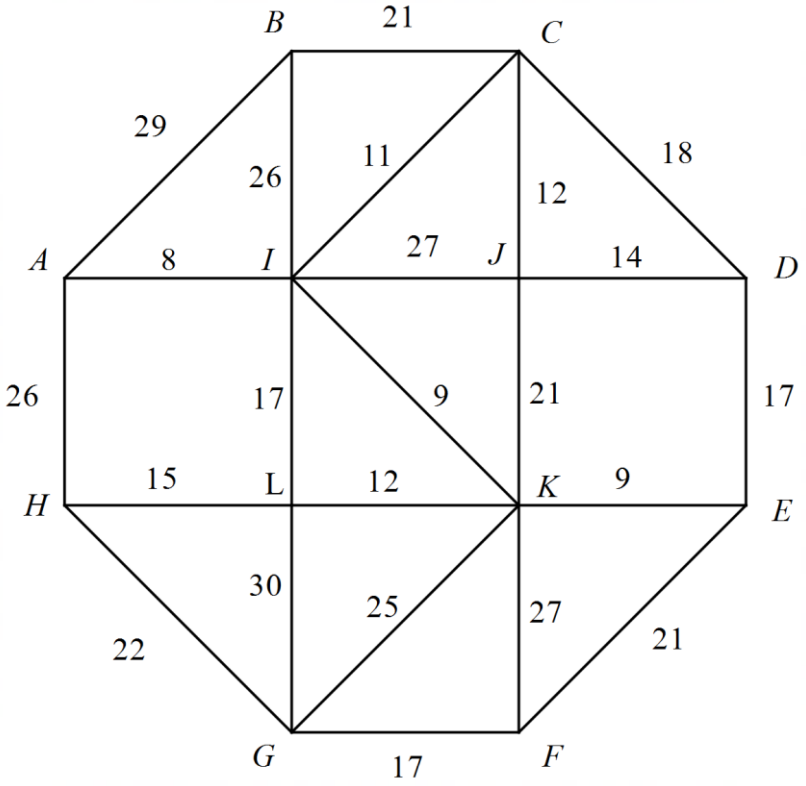
1. (7 marks)

Trinity College is investigating the cost to upgrade the wireless access points in B Block. Due to different room locations and room configurations the cost, in hundreds of dollars, to connect each access point to its nearest neighbours is given below. For the wireless access points to function correctly, they all need to be connected to each other with ethernet cable.

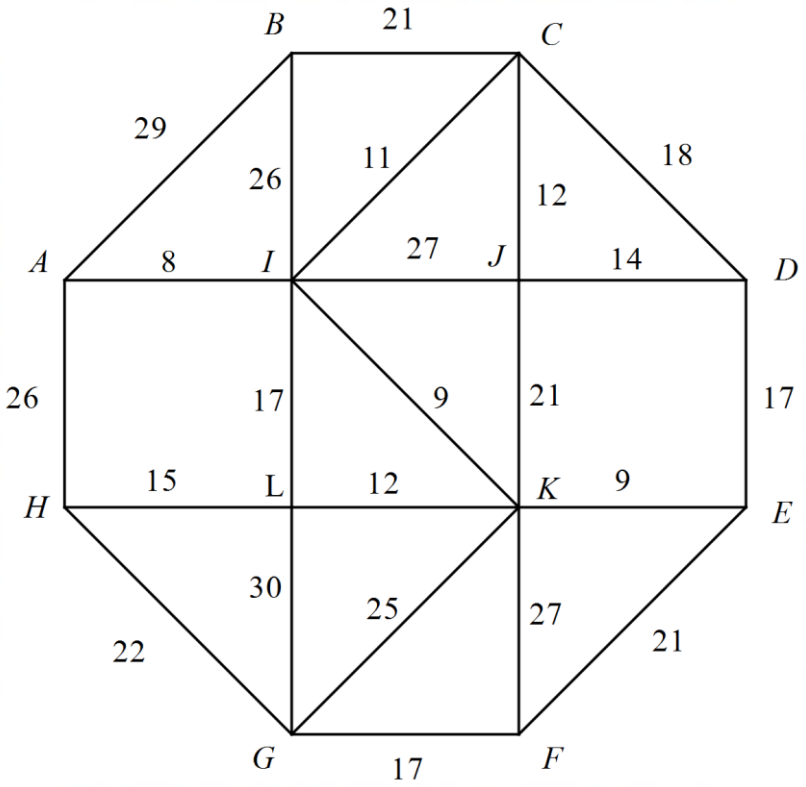


(a) Show clearly on the network the minimum solution to connect each wireless access point to form complete coverage. [3]

(b) Determine the minimum cost. [2]

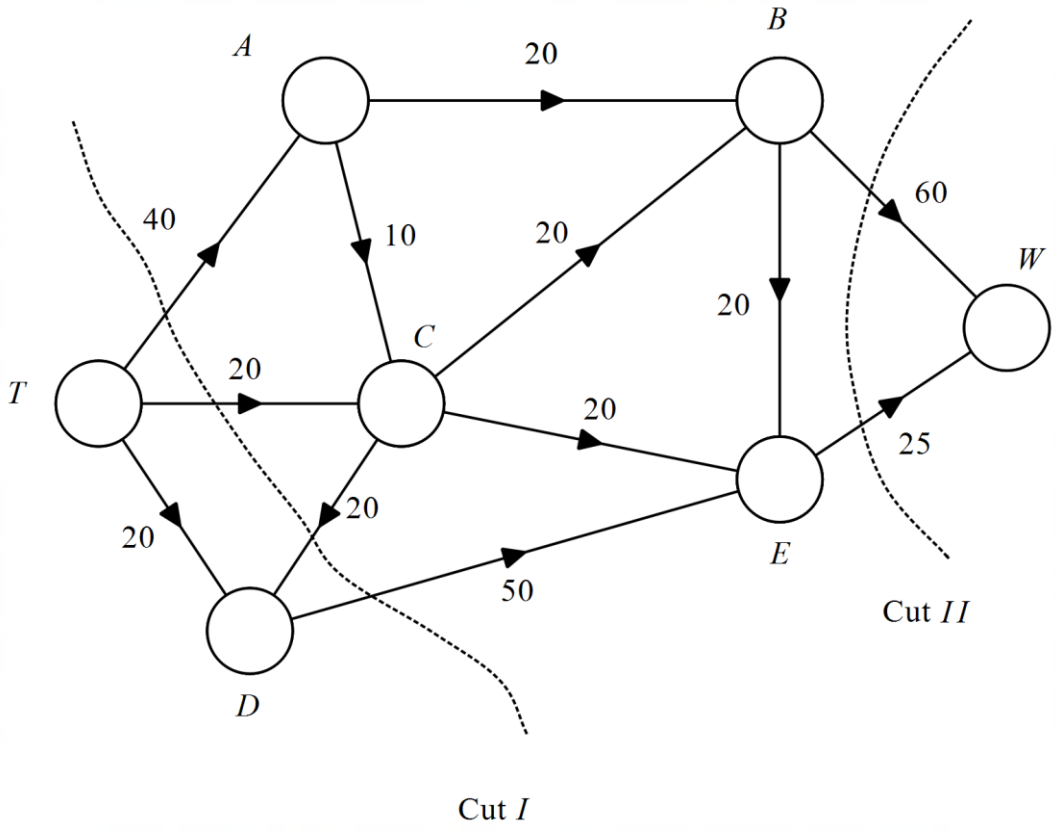
(c) A solid concrete floor underneath the current floating floor was detected during installation that was not on the original plans. As a result, the connection between I and K cannot be completed. Explain how this will change your solution for the minimum spanning tree and its corresponding cost.

[2]



2. (10 marks)

The number of cars that can travel on different roads between Trinity College (T) and Waterford (W), in 100s per hour, is given in the network below.



(a) Determine the value of the cuts marked I and II. [2]

(b) By systematically listing paths, determine the maximum number of cars that can travel between T and W each hour. [4]

The local council has received complaints regarding the amount of traffic between C and D. They plan to install a traffic calming measure that reduces the road capacity to 500 cars per hour.

(c) What affect does this have on the maximum number of cars that can now travel between T and W each hour. Explain your answer. [2]

The local council decide not to proceed with the traffic calming measure. Instead, they decide to upgrade a road.

(d) Which road should they upgrade to increase the amount of traffic that can travel between Trinity College and Waterford. Explain how this will impact the flow. [2]

3. (9 marks)

At Brother Ollie's Wheelchairs for Kids in Wangara, there are 4 workstations. Five volunteers have turned up today. From previous data, Brother Ollie knows how many wheelchairs each person can complete per day on each of the different machines.

	Machine 1	Machine 2	Machine 3	Machine 4
Adam	10	15	27	4
Bob	8	3	11	3
Cam	4	18	18	2
Daniel	4	10	7	4
Edward	8	3	10	10

(a) By first completing the matrix below and using the Hungarian algorithm, determine the appropriate allocation of volunteers to machines that will maximise the number of wheelchairs assembled. [6]

$$C \sim \begin{matrix} \\ \textit{Adam} \\ \textit{Bob} \\ \textit{Cam} \\ \textit{Daniel} \\ \textit{Edward} \end{matrix} \begin{bmatrix} & & & & \\ 8 & 3 & 11 & 3 & \\ 4 & 18 & 18 & 2 & \\ 4 & 10 & 7 & 4 & \\ 8 & 3 & 10 & 10 & \end{bmatrix}$$

	Adam	Bob	Cam	Daniel	Edward
Machine					

(b) Determine the maximum number of wheelchairs that can be assembled in a day. [1]

(c) Due to circumstances beyond their control, Adam must use machine 2 and Bob must use machine 3. Explain how this will change your allocation found in part (a) and what affect this will have on the number of wheelchairs assembled. [2]

TRINITY COLLEGE

Mathematics Applications Unit 3/4
Test 6 2021

Section 2 Calculator Assumed

Networks and decision mathematics

STUDENT'S NAME _____

DATE: Thursday 9th September **TIME:** 20 minutes **MARKS**: 17

INSTRUCTIONS:

Standard Items: Pens, pencils, drawing templates, eraser

Special Items: Three calculators, notes on one side of a single A4 page (these notes to be handed in with this assessment)

Questions or parts of questions worth more than 2 marks require working to be shown to receive full marks.

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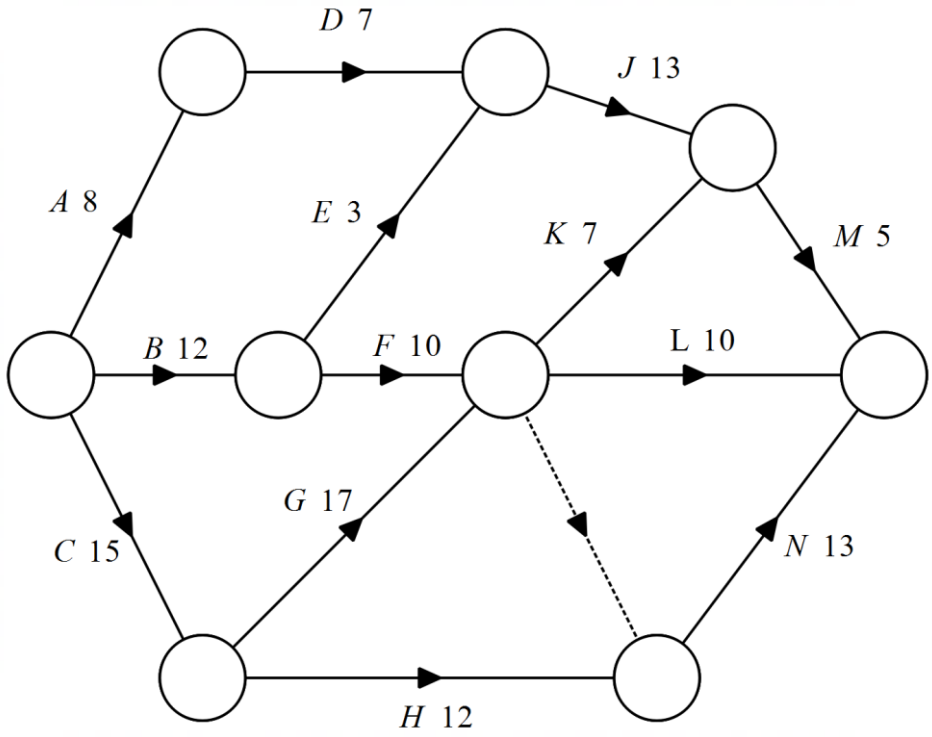
4. (9 marks)

Noah and Peter are coordinating a model building project. The number on each edge gives the time, in minutes, to complete each task. Each task requires one person.



(a) Complete the precedence table below. [2]

Activity	A	B	C	D	E	F	G	H	J	K	L	M	N
Time (mins)	8	12	15	7	3	10	17	13	14	10	17	18	13
Immediate predecessor	-	-	-	A	B	B	C	D	D,E	F,G	F,G		

(b) By demonstrating on the network above, determine the critical path and the minimum completion time for the project. [3]

(c) Determine the float time for activity:

(i) *F* [1]

(ii) *M* [1]

(d) The building project starts at 7 am, determine the latest time that activity *H* could start without changing the completion time. [2]

5. (5 marks)

The distance between stalls, in metres, for Unfair Day are given in the table below. Power must be provided to every stall with the main power junction box located at stall E.

	A	B	C	D	E	F
A	-	25	15	20	35	25
B	25	-	20	35	18	26
C	15	20	-	33	45	24
D	20	35	33	-	27	31
E	35	18	45	27	-	40
F	25	26	24	31	40	-

(a) Using Prim's algorithm, determine the minimum length of cable required to power all stalls. [3]

(b) If 20 m of 250V 10A Heavy Duty Extension Lead costs $19, determine the minimum cost of connecting each stall. Each stall has a junction that a lead can plug into. Extension leads may not be cut but can be joined. [2]

6. (3 marks)

Liam and Nick are planning a small building project. The table below shows the required activities, together with the times taken (in days) and the immediate predecessors for each activity.

Activity	A	B	C	D	E	F	G	H
Time (days)	2	3	4	3	7	4	5	2
Immediate predecessors	–	–	A, B	B	C	C, D	F	D

Draw the project network below, showing all activities and durations.