Mathematics Applications Year 12
2021 Test 4 - Calculator Assumed

Name: ………………………………

Marks   / 50

Cheshire   Coveney   McRae   Loh   Staffe   Giblett

Time Allowed: 50 minutes

Resources allowed: Formula sheet provided, Classpad and Calculator, 1A4 page of notes.
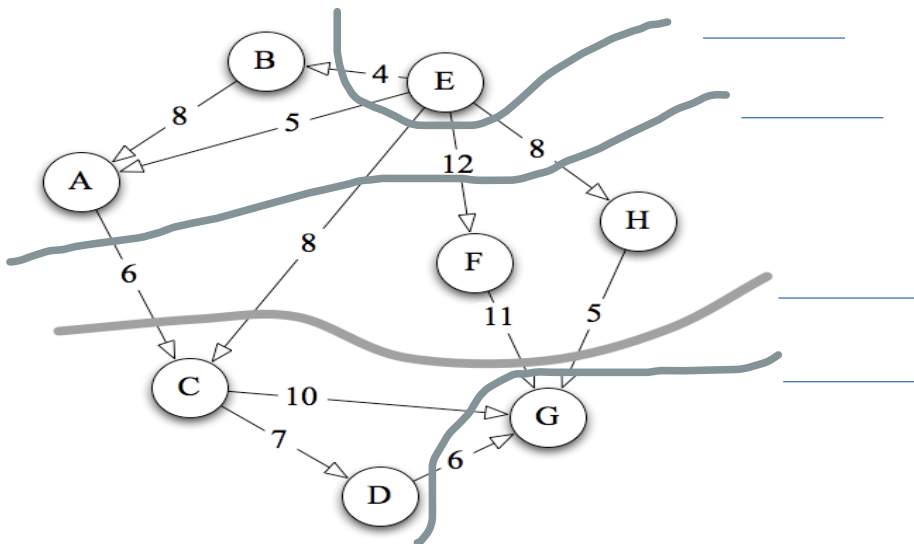
All necessary working and reasoning must be shown for full marks.

Marks may not be awarded for untidy, illegible or poorly arranged work.

Question 1   **[2, 3: 5 marks]**

The network below shows the flow of water through a system of underground pipes, where the flow is measured in thousands of litres per hour.

a) Identify the source and sink for this network.   Source: _____   Sink: _____

b) Given that one of the cuts above achieves the maximum flow, determine the value of each cut shown and state the maximum flow through the underground pipe network.

Question 2 [3, 3, 2: 8 marks]

Caleb retires with $350 000 in an annuity earning interest at 8% per annum, compounded annually. He withdraws $40 000 at the end of each year after the interest has been added to the account.

a) Write a recursive formula to model the amount, C, left in the account after n years.

b) Determine:

   i)   The number of full withdrawals that Caleb will be able to make.

   ii)   The value of the final withdrawal.

c) If Caleb had decided to only take out $35 000 at the end of each year, determine how this would affect the length of the original annuity.

Question 3 [4 marks]

Samantha was fortunate enough to win $50 000 in the lottery one weekend. She decided to invest the money into an annuity and take out money each year to use towards a holiday. The annuity will pay interest at 4.8% p.a. compounded quarterly and Samantha will take out a sum of money at the end of each year (after the interest has been added). Her first withdrawal will be $5 000 at the end of the first year, however, to keep up with inflation she has decided to take out an extra 2.5% each year (for example at the end of the second year she will withdraw $5 125).

Write a recursive rule to represent the amount, A, left in this annuity after n years.

Question 4 **[3, 2: 5 marks]**

The network below shows the distance (in metres) between various cottages on a camp site. The manager needs to upgrade the water pipes connecting each chalet as the old system is becoming hazardous to holiday makers.

a) Show, on the network below, how the manager can connect all the cottages with new piping and state the length required to minimise potential costs.
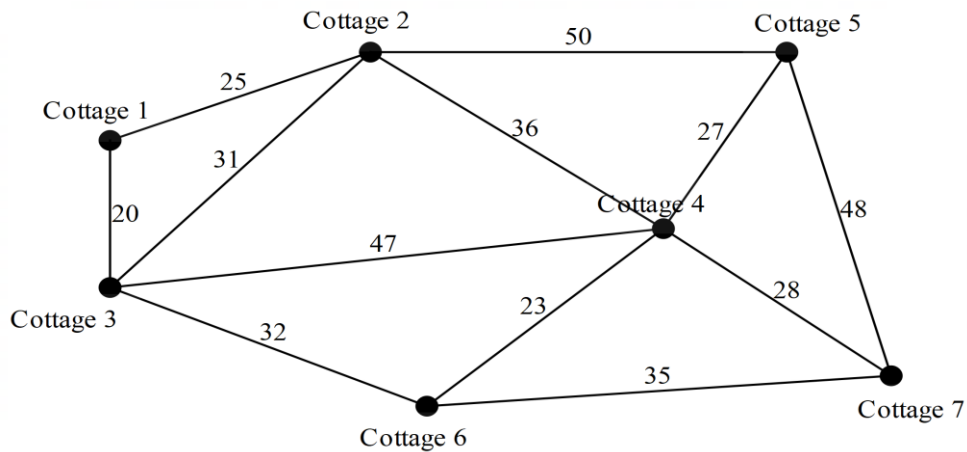
b) After doing some digging it was found that the piping directly between Cottage 1 and Cottage 2 can not be replaced. What affect will this have on the minimum amount of piping needed to connect all the cottages?

Question 5 **[3, 2: 5 marks]**

Lucy invested a sum of money into a perpetuity that paid $32 500 a year. The money was invested in an account that paid interest at a rate of 6.5% p.a., compounded monthly.

(a) How much did Lucy invest?

(b) If instead, Lucy had put her sum of money in a shoebox under the bed and just spent $32 500 each year, approximately how many years would the money have lasted?

Question 6   **[3, 2, 2: 7 marks]**

The following grid details the distances (in metres) of internet cabling that connects the Administration office and several other offices throughout Shenton College.

	Admin	Maths	HASS	English	PE	Arts
Admin	_	40	87	101	99	-
Maths	40	-	85	-	102	83
HASS	87	85	-	95	-	92
English	101	-	95	-	95	74
PE	99	102	-	95	-	-
Arts	-	83	92	74	-	-

The cabling is to be replaced by new fibre optic cables to improve internet speeds throughout the campus.

a) Use Prim's algorithm on the grid above to indicate the shortest amount of cabling required to connect the offices and state this minimum amount below.

b) Using your calculations in part a), draw a network representing the cabling needed to connect all the offices.

c) Determine the total cost of replacing the cabling if it costs $56.50 per metre plus an extra $35 for a new connection terminal at each office?

The table below shows an activity chart for the completion a renovation project.

Task	Completion Time (days)	Predecessors
A	3	-
B	6	-
C	2	-
D	4	A
E	5	B
F	4	C
G	3	F
H	8	D, E, G
I	7	F
J	3	H, I

a) Using the chart above, complete the project network for the renovation project.
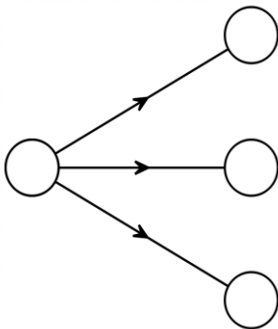
b) Use your project network to:

i) identify the critical path for this renovation and state the minimum time needed to complete all scheduled tasks.

ii) State the latest starting time allowed for Task G without affecting the minimum completion time.

c) If Task B was reduced by two days, describe the affect this will have on the float time for Task F, given the minimum completion time is not to be affected.

Question 8 [4, 2, 2: 8 marks]

The following network outlines a heavy freight rail system. The numbers show the maximum volume of freight (in hundreds of tonnes per day) that can be carried on each section of the system.
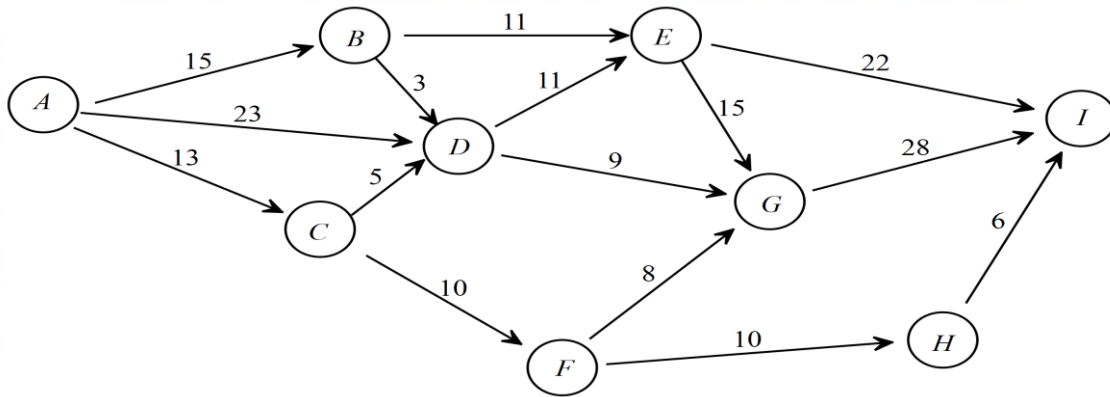
a) By listing your paths in the space below, determine the maximum flow possible for each day. Clearly show your working on the diagram.

b) Show the volume of freight per day that achieves the maximum flow through system below.
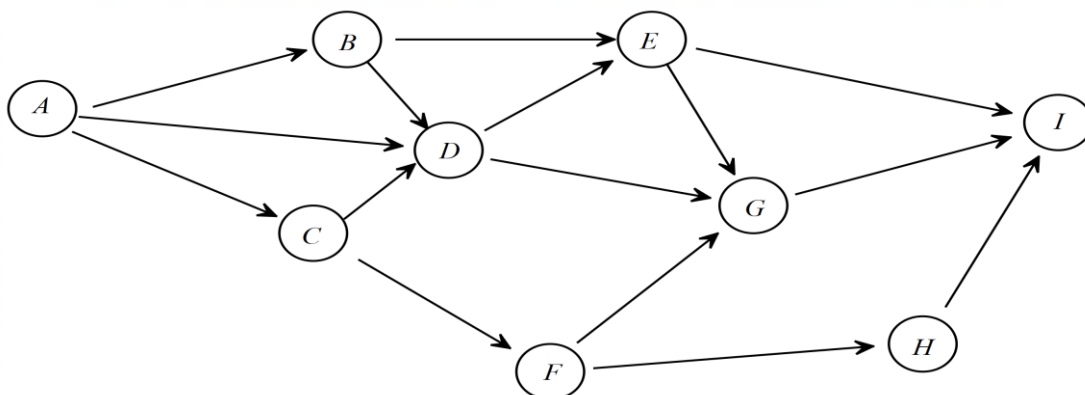
c) If you could upgrade only one rail line, from the original network, to increase the maximum flow of freight, which one would you choose? State the effect this may have on the maximum volume of freight per day.