Mathematics Applications Year 12
Test 4   2019
Calculators allowed, 1 page of notes

SHENTON
C O L L E G E

NAME:_____

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Time: 50 min   Marks:_____ / 49   ☐ Units

Show all working in the spaces provided.   ☐ Rounding
Full marks may not be awarded without sufficient working.

Question 1   [6: 3, 3 marks]

Digby, the gardener at Kings Park, wishes to renew the network of reticulation pipes which water the garden beds located at various buildings around the Park. The table below shows the existing network of pipes, in metres.

(a)   On the table below show working, using Prim's Algorithm, to find the minimum length of piping needed to replace to connect the garden beds. State this distance.

	Botanic Gardens	**F**rasers Restaurant	**A**spects Gift Shop	**G**azebo	**D**igby's Shed	**S**ticky Beaks Cafe	**Z**amia Cafe
Botanic Gardens	--	120	60	100	--	425	--
Frasers Restaurant	120	--	35	60	--	--	--
Aspects Gift Shop	60	35	--	45	60	--	--
Gazebo	100	60	45	--	110	400	800
Digby's Shed	--	--	60	110	--	585	750
Sticky Beaks Cafe	425	--	--	400	585	--	650
Zamia Cafe	--	--	--	800	750	650	--

(b)   Use your working from the table to draw a network which shows the minimum connections.

Question 2   [10: 2, 1, 4, 1, 2 marks]

Each year during Spring, grain is harvested across Western Australia where it is stored in Silos before making its way to Port for overseas distribution. The network below shows the number of trucks per day, which may travel on the country roads, taking the grain to the port.
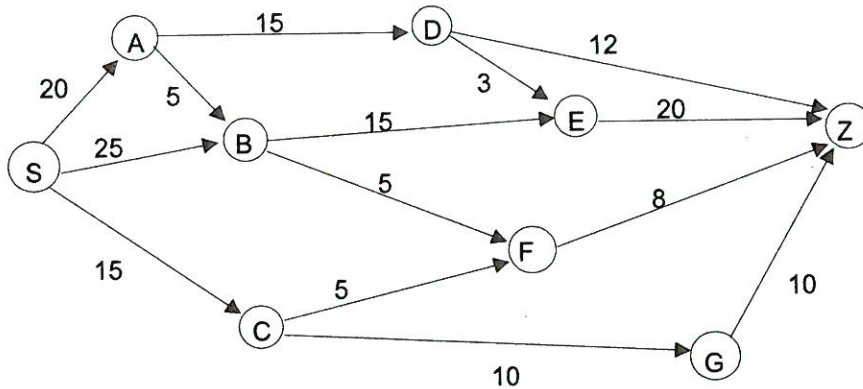
(a)   Identify the source _____ and the sink _____ of the network.

(b)   Explain why the maximum flow cannot exceed 60 trucks per day.

(c)   By listing your paths determine the maximum number of trucks possible for each day. Clearly show your working on the diagram.

(d)   Show clearly on the above network, a minimum cut which matches your calculated maximum flow.

(e)   If you could upgrade one road to increase the number of trucks per day, which road would you choose? Clearly state the new number of trucks per day limit.

Question 3   [8:1, 3, 1, 1, 2 marks]

Josh Kennedy, from the West Coast Eagles, wishes to retire at the end of the 2019 season. He has savings of $500 000 from his successful football career and wishes to deposit this amount into an annuity which which will earn interest of 2.9% p.a. compounded annually. He plans to study for a number of years and to do this he will withdraw $50 000 at the end of the first year, $51 000 at the end of the second year, $52 020 at the end of the third year, and so on, increasing each amount by 2%.

(a)   What will be his account balance after one year?

(b)   Write a recurrence relation which Josh can use to model his annuity.

(c)   What will be the balance of his annuity immediately after the eighth withdrawal?

(d)   How long will it take for the balance of the account to reach zero?

(e)   How much will the last payment be?

Question 4   [5: 3, 2 marks]

Water pipes from Mundaring Weir, are connected to small towns throughout the Wheatbelt, and are represented as a network (in kilometres) given below.

(a)   Show, on the diagram, the minimum amount of pipe which has to be laid for water to be connected to every town? State this amount.
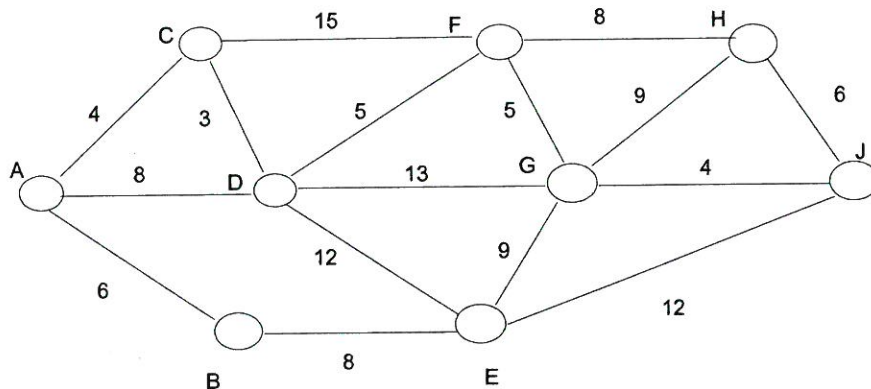

(b)   Town B has a large dam and the water company has decided it is uneconomical to provide water pipes to that town. How many kilometres of piping is the company saving if Town B is now excluded?

Question 5   [4 marks]   The following activities are involved in the completion of a project. In the space below, construct a project network for these activities.

Activity	Time needed (in hours)	Immediate Predecessor(s)
A	20	-
B	12	A
C	10	-
D	7	C
E	11	C
F	5	B,E
G	10	B,E
H	8	G
I	˙4	F
J	5	D
K	9	J,H

Question 6   [11: 1, 4, 1, 2, 1, 2 marks]

The following project network shows completion time of activities **A** to **J** in minutes.
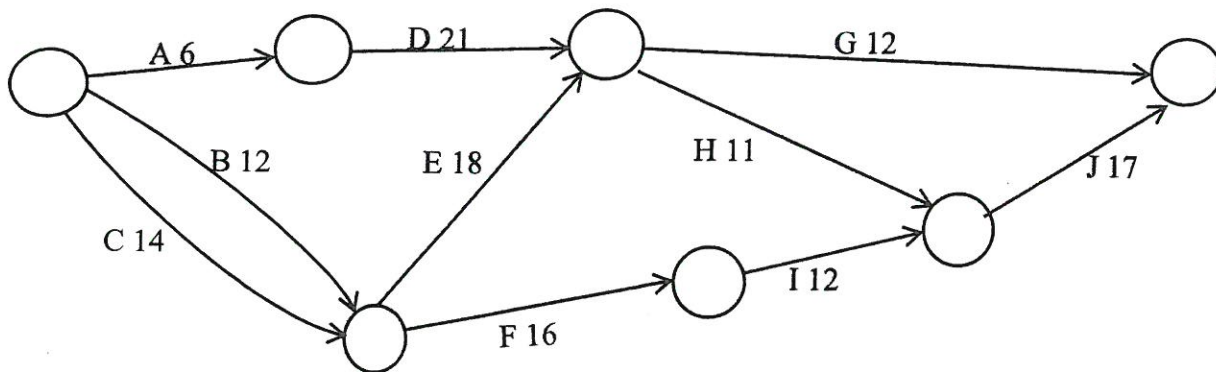
(a)   How many activities are required to be completed for this project?

(b)   State the critical path and the minimum completion time for the project, after showing full working on the network above.

(c)   Determine the float time of activity D?

(d)   If activity J could be completed in 10 minutes, how would the critical path and minimum completion time be affected?

The project commenced at 8.30am on Monday.

(e)   What would be the latest starting time for activity D?

(f)   If only activity D was delayed by 8 minutes, what time would the project be completed?

Question 7   [3 marks]

The Country Women's Association wants to set up an honorary scholarship for a high performing young rural student each year, to help pay for their living costs while at University. How much will they need to put into an account (rounded to the nearest $1 000) to ensure that they can draw $12 500 from an account perpetually each year if the account has an interest rate of 4.5% p.a compounding monthly?

Question 8   [2 marks]

A youthful 60 year old teacher wants to retire and be able to afford to live until she is at least 98 years old, so that she can go trekking and enjoy her family. She will need to withdraw $65 000, from an annuity, once a year. What is the minimum amount she would need to have saved up by the time she retires if her bank gives her an interest rate of 4.9% p.a. compounded quarterly?

-     End of Test   -