TRINITY COLLEGE

Year 12 Mathematics Applications 3 and 4
Test 5   2017

Calculator Assumed
Finance II, Shortest Path, Minimum Spanning Trees and Maximum Flow

STUDENT'S NAME _____

DATE: Monday 7th August   TIME: 50 minutes   MARKS: 52

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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1.   (4 marks)

Andrew invests $600000 at a rate of 9% p.a. compounded daily and plans to make weekly withdrawals for 20 years.

(a)   Complete the image below of the financial application from your ClassPad with the appropriate known values, leaving the unknown blank.   [3]

Compound Interest

N	1040
I%	9
PV	−600 000
PMT	
FV	0
P/Y	52
C/Y	365

(b)   Calculate the value of the weekly withdrawals to the nearest cent.   [1]

$1245·09

2.   (7 marks)

The shortest distances, in kilometres, between towns in the North West region of Australia are shown in the table.

	Kalbarri	Monkey Mia	Carnarvon	Exmouth	Broome	Derby
Kalbarri	-	400	450	800	1350	1960
Monkey Mia	400	-	350	720	1260	2090
Carnarvon	450	350	-	370	1520	1740
Exmouth	800	720	370	-	1600	1820
Broome	1350	1260	1520	1600	-	1520
Derby	1960	2090	1740	1820	1520	-

(a)   State the shortest distance between Broome and Derby   [1]
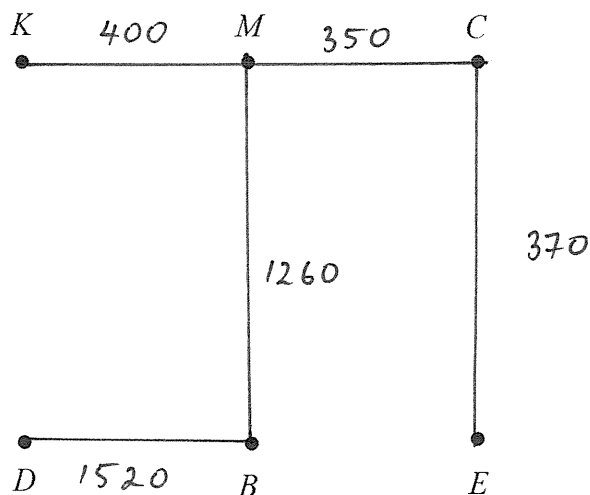
_1520 km_

(b)   What is the closest town to Exmouth   [1]

Carnarvon

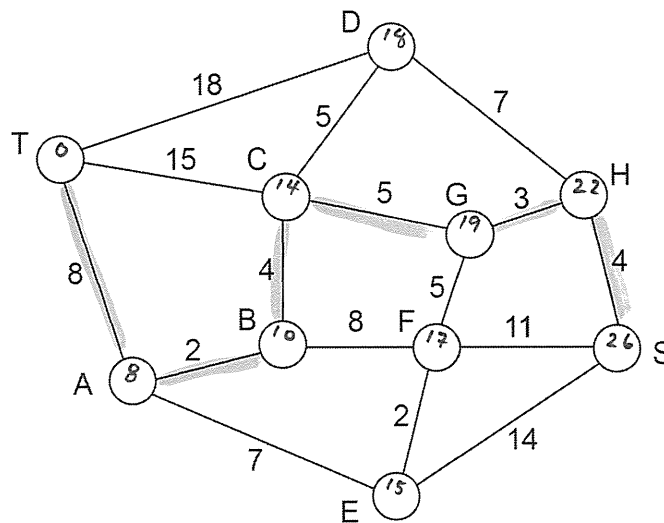(c)   What is the minimum distance of road required so that every town is connected   [3]

$400 + 350 + 1260 + 370 + 1520$

$= 3900 \, km$

(d)   Draw your answer to part (c)   [2]

3. (8 marks)

The network below shows the time, in minutes, to travel between timed stops on a tram network.

(a) Determine the fastest route from the town centre T to the train station S, stating the minimum time. To obtain full marks, numbers must be added to the network to show that an appropriate method has been used. [5]

TABCGHS   26 mins

(b) An accident at stop G made it impossible for trams to travel via this stop. What effect, if any, will this have on your answer to (a)? Justify your answer. [3]
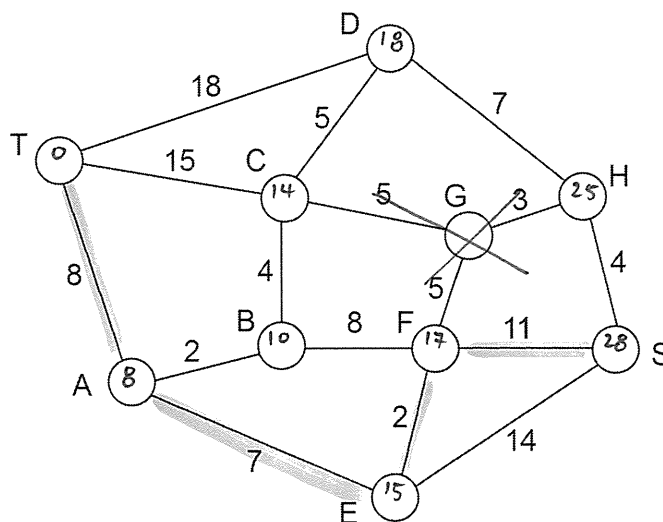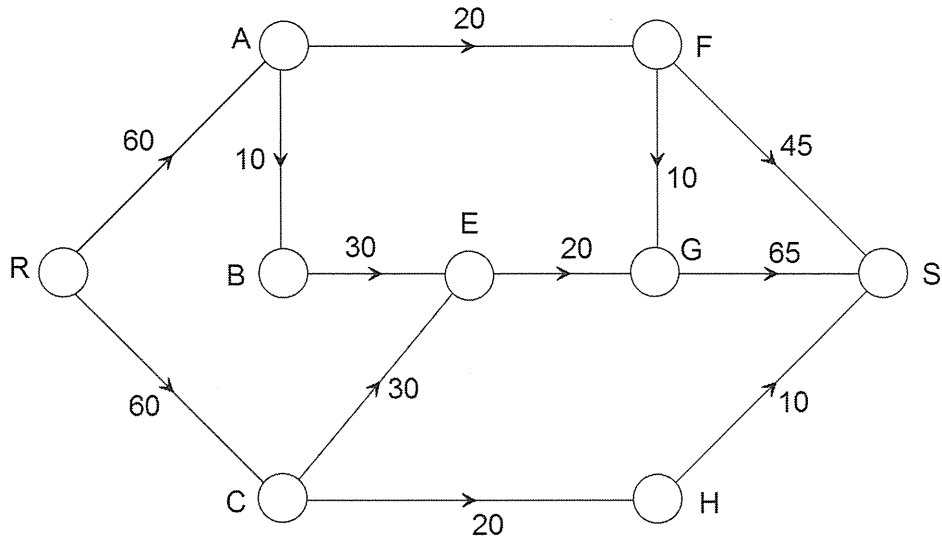

TAEFS   2 min

4. (8 marks)

Waste is moved through a treatment facility from the receiving dock R to transfer station S. The network below shows the paths that waste can take through the facility, with the number on each arc representing the maximum amount of waste, in tonnes per hour, which can be moved along that arc.

(a) What is the maximum hourly amount of waste that can be moved from the receiving dock to the transfer station? To obtain full marks, you must show systematic working.

[5]

RAFS   20

RABEGS   10   50 Tonnes/hr

RCEGS   10

RCHS   10 /
         /50

(b) Engineers have identified one arc that could be closed for maintenance without affecting the maximum hourly flow through the facility. State which arc this is.   [1]

F → G

(c) The path from A to F is to be upgraded to increase the amount of waste that can flow along it and hence increase the flow through the facility. Determine the largest possible increase in the maximum hourly flow through the facility after the upgrade is complete.

[2]
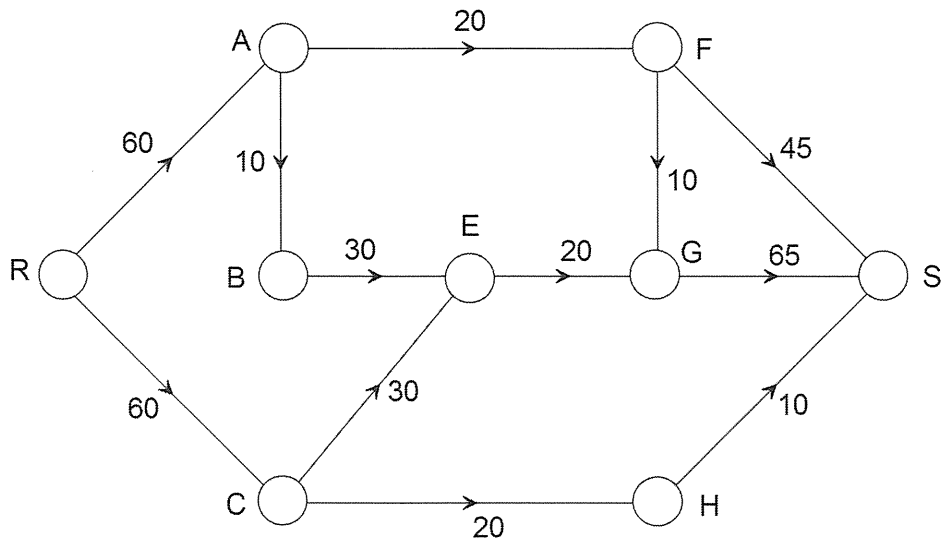
35 Tonnes/hr

5. (4 marks)

A yearly perpetual research grant of $15000 is awarded to a candidate in the genetics department at UWA. The trust is set up in an investment account that gains 7.2% interest p.a. compounded quarterly.

(a) Determine the initial value of the account [2]

$202791.95

(b) The bank renegotiates the interest rate of the account to 6.5% p.a. compounded monthly, what is the new maximum value for the grant. [2]

$13581.35

6.   (10 marks)

An electrical supply has to be made to the 14 buildings on a new industrial site. The cost of establishing a direct electrical supply between various buildings is shown in the network below, where the number on each arc represents the cost for that link, in thousands of dollars.
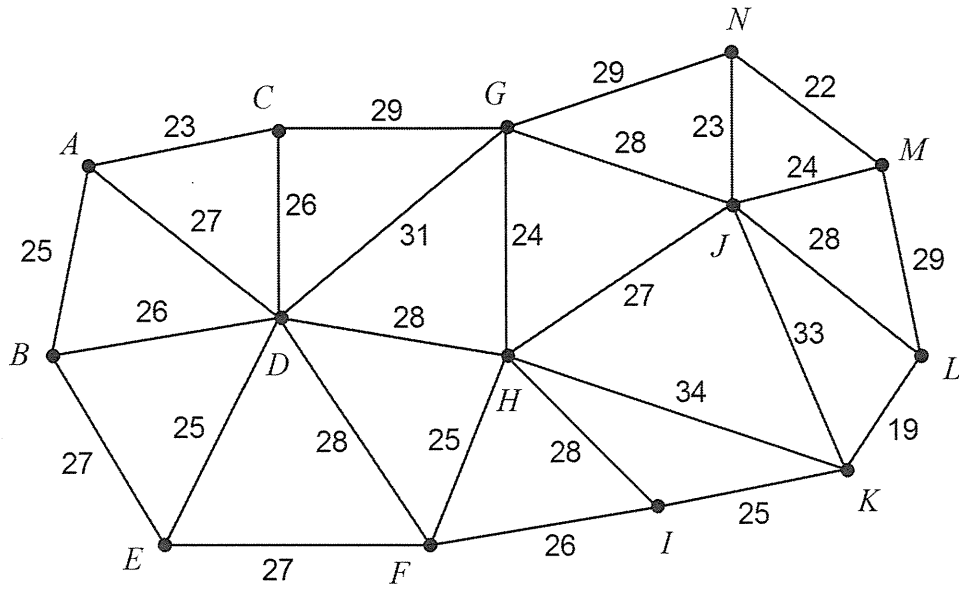

BD or CD
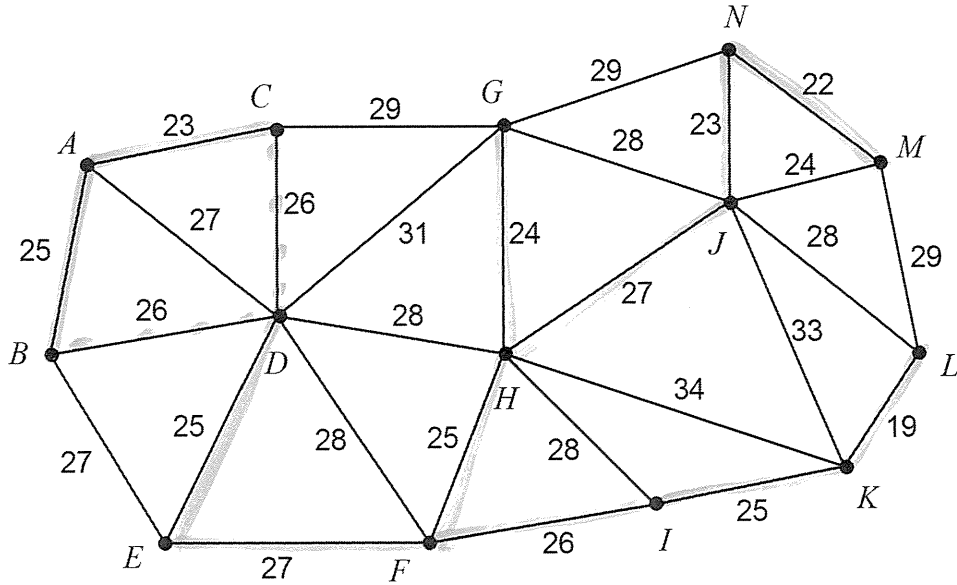
(a)   Clearly indicate the minimal spanning tree on the network above.   [5]

(b)   Determine the minimum cost of establishing the electrical supply to the 14 buildings.
                                                                                            [2]

$ 317 000

(c)   If the cost of the link between H and J was underestimated by $3 000, explain what effect, if any, this would have on the solution in part (b). Justify your answer.   [3]

Would increase cost by $1000.

Path GJ instead of HJ.

7. (7 marks)

An annuity is modelled by the monthly recursive sequence $T_n = aT_{n-1} - b$, $T_0 = c$. A withdrawal of \$5000 is made after the 6% p.a. interest is added every month. Given the initial value is \$420000, determine the following.

(a) The value of a, b and c. [3]

$$a = 1.005 \qquad b = 5000 \qquad c = 420\,000$$

(b) The total amount of time that withdrawals of \$5000 can continue. [2]
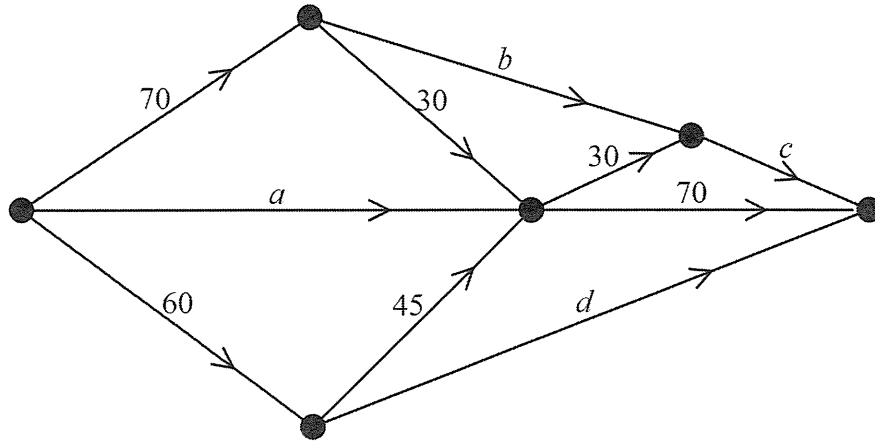
$$109 \text{ months}$$

(c) The amount that could be withdrawn every month to classify the investment as a perpetuity. [2]

$$\$2100$$

8. (4 marks)

The network below shows the flow along each arc that would maximise the flow from the source to the sink, determine the values of a, b, c and d in the network.

$a = 25$

$b = 40$

$c = 70$

$d = 15$

END OF QUESTIONS