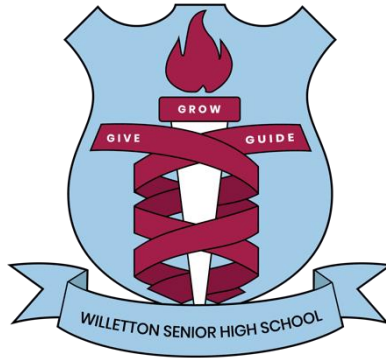# MATHEMATICS APPLICATIONS

YEAR 11 UNIT 1

TEST 2

2022

SECTION ONE- CALCULATOR FREE

TIME: 15 mins

MARKS: _____ / 20 marks

STUDENT'S NAME: _____ SOLUTIONS _____

CIRCLE YOUR TEACHER'S NAME:

Dr Duan	Mr Riemer	Mr Stillitano
Mr Galbraith	Miss Colquhoun	Mr Appleby

No calculators or Classpads are allowed during this section of the test.
Show all necessary working in order to obtain full marks.
Formula sheet provided.

Question 1

Matrices A, B, C and D are defined as shown.

$$A = [2 \quad -1] \qquad B = \begin{bmatrix} 5 \\ 3 \end{bmatrix} \qquad C = \begin{bmatrix} 6 & 4 \\ -2 & 3 \end{bmatrix} \qquad D = \begin{bmatrix} 4 & -2 & 0 \\ -1 & 3 & 2 \end{bmatrix}$$

a) Determine $c_{12} + d_{21}$

$$4 + (-1) = 3 \checkmark$$

b) State the dimensions of the column matrix.

$$2 \times 1 \quad \checkmark$$

c) Determine the values of x and y if, $\quad 2A + [x \quad 7] = [-8 \quad y]$

$$[4 \quad -2] + [x \quad 7] = [-8 \quad y]$$

$$x = -12 \checkmark$$

$$y = 5 \checkmark$$

d) Explain why CB is possible but BC is not.

columns of first must equal rows of second $\checkmark$

$$CB = 2 \times \underline{2} \quad \underline{2} \times 1$$

$$BC = 2 \times 1 \quad 2 \times 2$$

For each of the following calculations, if it is possible, state the result. If it is not possible, clearly explain why it is not possible.

e) $A + B$

Not possible
Dimensions not the same $\checkmark$

/6

f) $-3D$

$$\begin{bmatrix} -12 & 6 & 0 \\ 3 & -9 & -6 \end{bmatrix}$$ ✓✓

g) CD

$$\begin{bmatrix} 6 & 4 \\ -2 & 3 \end{bmatrix} \begin{bmatrix} 4 & -2 & 0 \\ -1 & 3 & 2 \end{bmatrix}$$

$$= \begin{bmatrix} 20 & 0 & 8 \\ -11 & 13 & 6 \end{bmatrix}$$ ✓✓

h) Postmultiply A with matrix C

$$\begin{bmatrix} 2 & -1 \end{bmatrix} \begin{bmatrix} 6 & 4 \\ -2 & 3 \end{bmatrix}$$ ✓

$$= \begin{bmatrix} 14 & 5 \end{bmatrix}$$ ✓

Question 2

[2 marks]

For the formula $R = \frac{9}{4}T - 21$, find R if $T = 36$

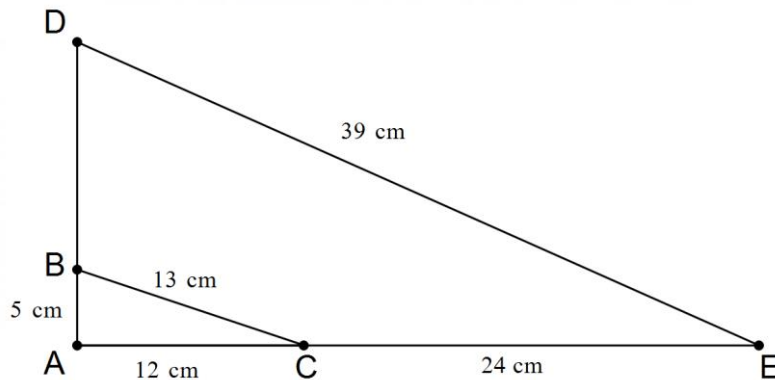$R = \dfrac{9}{4} \times 36 - 21$ ✓

$\quad = 9 \times 9 - 21$

$\quad = \underline{\underline{60}}$ ✓

See next page

$/8$

Question 3

[3, 1, 2 = 6 marks]

Consider the triangles ABC and ADE below (not to scale), where point B lies on the line AD and point C lies on the line AE.
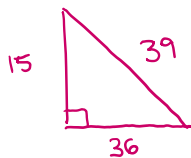

(a) Determine whether triangles ABC and ADE are right-angled. Justify your response.

✓ Yes, they are right angled

✓ ABC is a 5,12,13 pythagorean triple

✓ ∠A is a shared angle, so ADE is also right angled.

(b) Given triangles ABC and ADE are similar, determine the scale factor of triangle ABC to ADE.

scale factor = 3 ✓

(c) Calculate the length of BD.

$AD = \sqrt{39^2 - 36^2}$

$= 15 \, cm$ ✓

Scale factor to find AD acceptable

$BD = 15 - 5$

$= 10 \, cm$ ✓

END OF CALCULATOR FREE

/8

MATHEMATICS APPLICATIONS

YEAR 11 UNIT 1

TEST 2

2022

SECTION TWO- CALCULATOR ALLOWED

TIME: 35 mins

MARKS: _____ / 40 marks

STUDENT'S NAME: SOLUTIONS

CIRCLE YOUR TEACHER'S NAME:

Dr Duan   Mr Riemer   Mr Stillitano

Mr Galbraith   Miss Colquhoun   Mr Appleby

Scientific calculators or Classpads are allowed during this section of the test.
Show all necessary working in order to obtain full marks.
One single-sided A4 sheet of notes allowed.
Formula sheet provided.

Question 4

Blood Alcohol Content (BAC) is a measure, in $g/100mL$, of the percentage of alcohol in a person's blood stream. The following formulas show how a person's BAC is calculated.

$$BAC_{female} = \frac{(10N - 7.5H)}{5.5M} \qquad BAC_{male} = \frac{(10N - 7.5H)}{6.8M}$$

These formulas take into consideration the number of standard drinks, N, someone has consumed, the number of hours, H, they have been drinking for and their body mass, M, in kilograms. These formulas differ slightly for females and males.

a) Calculate the BAC of an 80kg male who has consumed 3 standard drinks across 2 hours, to 4 decimal places.

$$BAC = \frac{10 \times 3 - 7.5 \times 2}{6.8 \times 80} \checkmark$$

$$= 0.0276 \checkmark$$

b) In Australia, it is an offence to drive a car with a BAC of 0.05 or above. If Remy, a 55kg woman, consumes 5 standard drinks across four and a half hours, would she be able to drive her car home, legally? Justify.
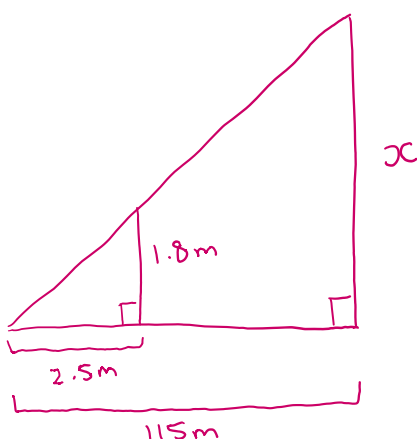
$$BAC = \frac{10 \times 5 - 7.5 \times 4.5}{5.5 \times 55} \checkmark$$

$$= 0.0537 \checkmark$$

∴ Remy cannot drive legally ✓
BAC > 0.05

Question 5

Jeremy stands in front of Perth's Bell Tower, situated on the Swan River. At a particular time of the day, Jeremy, who is 180 cm tall, casts a shadow on the ground of 2.5 m. At the same time, the shadow of the Bell Tower stretches 115 m. Calculate the actual height of the Bell Tower.
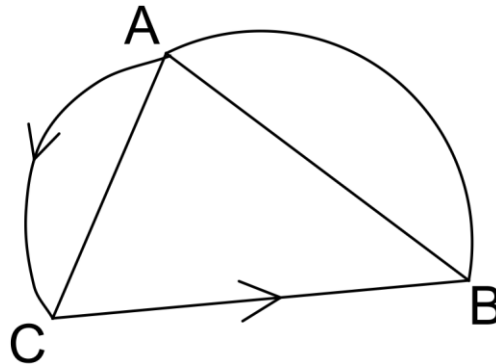
$$\frac{x}{115} = \frac{1.8}{2.5} \checkmark$$

$$x = 82.8m \checkmark$$

x

1.8m

2.5m

115m

/7

Question 6

The network below shows the possible routes between shop A, B and C.

a) Complete the remaining rows in matrix X, which represents the one stage routes for the network above.

$$X = \quad From \quad \begin{array}{c} \\ A \\ B \\ C \end{array} \begin{array}{ccc} & To & \\ A & B & C \\ \begin{bmatrix} 0 & 2 & 2 \\ 2 & 0 & 0 \\ 1 & 1 & 0 \end{bmatrix} \end{array}$$ ✓ ✓

b) By considering the matrix only, how do you know there are one-way roads?

Not symmetrical across the diagonal ✓

c) Complete the matrix, Y, which represents the two stage routes for the network above.

$$Y = \quad From \quad \begin{array}{c} \\ A \\ B \\ C \end{array} \begin{array}{ccc} & To & \\ A & B & C \\ \begin{bmatrix} 6 & 2 & 0 \\ 0 & 4 & 4 \\ 2 & 2 & 2 \end{bmatrix} \end{array}$$ ✓ ✓

d) What matrix calculation represents the relationship between matrix X and matrix Y?

$$X^2 = Y$$

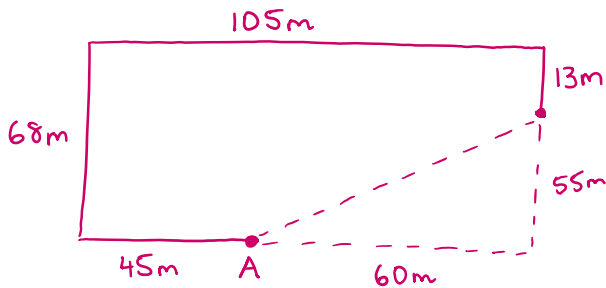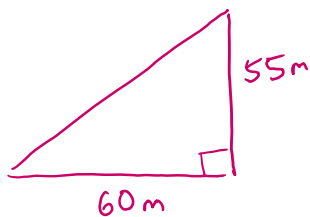/6

Question 7

Jason is marking out a soccer pitch. Jason starts at point A and goes 45 metres West, then North 68 metres, then East 105 metres and then South 13 metres before he runs out of paint.

a) Draw a labelled diagram to represent the situation.

labelled diagram ✓

b) Calculate how far, to the nearest metre, Jason is from his starting point A?

$$\sqrt{55^2 + 60^2} \quad ✓$$

$$= 81.39m$$

∴ 81m from start

Question 8

Calculate the perimeter of the shaded figure shown.

curve = $\frac{1}{4} \times 2 \times \pi \times 12$ ✓

$= 18.85$ mm ✓

$x = \sqrt{32^2 - 20^2}$

$= 24.98$ mm ✓

$y = 24.98 - 12$

$= 12.98$ mm ✓

Perimeter = $8 + 32 + 12.98 + 18.85$

$= 71.83$ mm ✓

/8
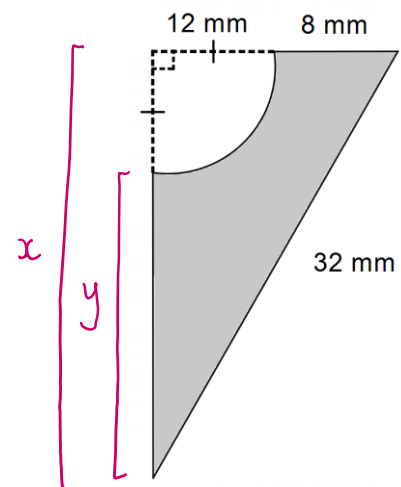
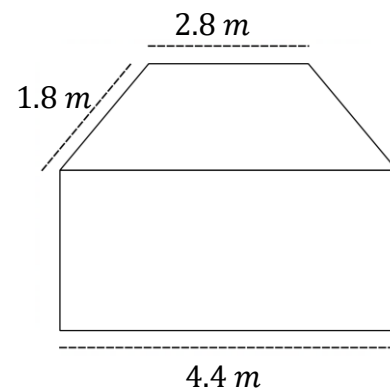**Question 9**

Martha has an outdoor gazebo with a length of $4.4\ m$ and a width of $3\ m$, as pictured below. Martha plans to retile the roof of her gazebo, which consists of trapezium faces and triangular ends. The ridge in the *centre* of the roof measures $2.8\ m$ and the slanted edges are $1.8\ m$ in length.

2.8 m   *horizontal ridge*

1.8 m

2.8 m

1.8 m

roof base

3 m

4.4 m

4.4 m
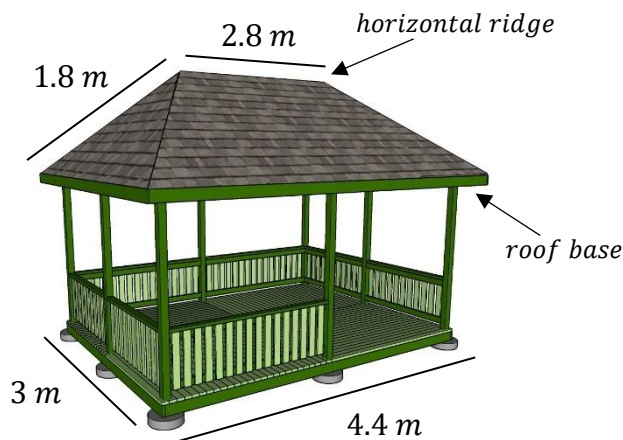
3D Design

Front View

a) If the perpendicular height from the base of the roof to the centre ridge is $0.59\ m$, calculate the slanted height of the trapezium face.

$$x = \sqrt{0.59^2 + 1.5^2} \checkmark$$

$$= 1.61m \quad \checkmark$$

0.59   x   1.5

b) Calculate the perpendicular height of the triangular ends.

1.8   h   3

$$h = \sqrt{1.8^2 - 1.5^2} \quad \checkmark$$

$$= 0.99m \quad \checkmark$$

c) Calculate the total area of roof that needs to be retiled.

2.8   1.61   4.4

0.99   3

$$A = 2 \times \left(\frac{2.8 + 4.4}{2} \times 1.61\right) + 2 \times \left(\frac{1}{2} \times 3 \times 0.99\right)$$

$$= 14.59\ m^2 \quad \checkmark$$

d) Martha wishes to create a model of the gazebo that is in a ratio of 1 : 30, model to real life gazebo. Calculate the area of the roof of the model gazebo, in cm^2.

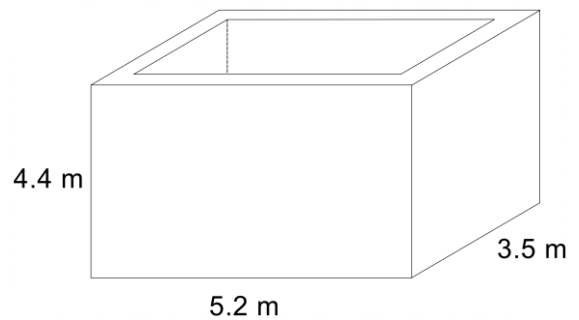$$\frac{14.59}{30^2} = 0.0162\ m^2 \quad \checkmark$$

$$= 162.11\ cm^2 \quad \checkmark$$

/9

Question 10

[4, 2, 4 = 10 marks]

The exterior dimensions of a rectangular concrete water tank are as shown on the diagram. The thickness of the concrete sides will be 10 cm and the thickness of the concrete base will be 15cm.

4.4 m

3.5 m

5.2 m

a) Calculate the volume of the concrete required.

Dimensions:

5.2 − (0.1 × 2) = 5m

3.5 − (0.1 × 2) = 3.3m   } ✓

4.4 − 0.15 = 4.25 m

$V_{concrete}$ = 4.4 × 5.2 × 3.5 ✓ − 5 × 3.3 × 4.25 ✓

= 9.955 m³ ✓

b) Calculate the capacity of the water tank to the nearest tenth of a kilolitre.

5 × 3.3 × 4.25 = 70.125 m³ ✓

= 70.1 kL ✓

c) The interior walls and floor of the water tank require one coat of a special water sealant which costs \$87/L. Calculate the cost of sealing the interior surface of this water tank, if the application rate is 1.5 square metres per litre.

A = 2 × 4.25 × 5 + 2 × 3.3 × 4.25 + 5 × 3.3 ✓

= 87.05 m² ✓

Sealant = $\frac{87.05}{1.5}$ = 58.03̇ L ✓

Cost = 58 × 87

= \$5048.90 ✓

END OF CALCULATOR ASSUMED