MATHEMATICS APPLICATIONS

YEAR 11 - UNIT 1

TEST 2 - 2021

SECTION ONE – CALCULATOR FREE

TIME: 20 mins
MARKS: 27 marks

STUDENT'S NAME: SOLUTIONS

CIRCLE YOUR TEACHER'S NAME:

Dr Duan	Mr Riemer	Mr Stillitano
Mr Galbraith	Ms Thompson	Mr Hamilton-Brown

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

Question 1

[2, 2 = 4 marks]

(a) For the formula $E = \frac{1}{2}mv^2$, evaluate E if $m = 80$ and $v = 5$.

$E = \frac{1}{2}(80)(5)^2$ ✓

$= 40 \times 25$

$= 1000$ ✓

2

(b) For the formula $d = \frac{c+1}{19} \times D$, evaluate d if $c = 56$ and $D = 15$.

$d = \frac{56+1}{19} \times 15$ ✓

$= 3 \times 15$

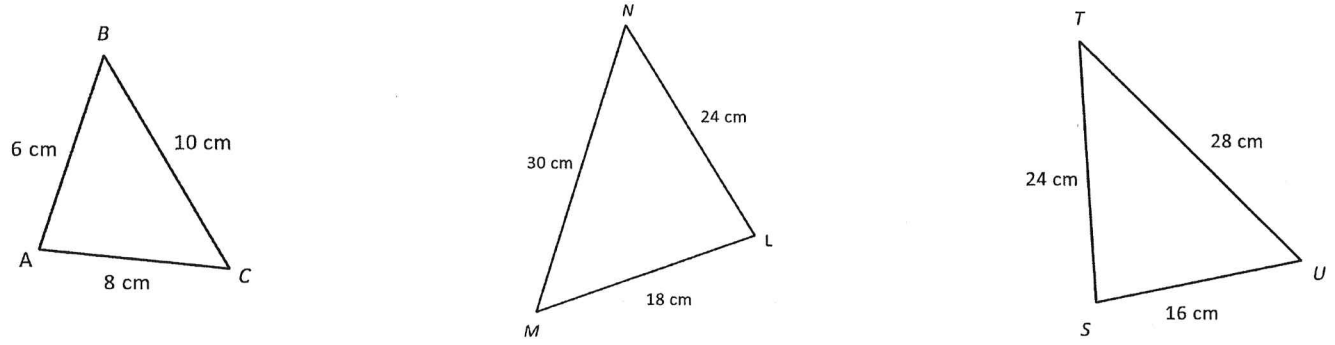
$= 45$ ✓

2

Question 2

[3, 2, 2 = 7 marks]

Consider the triangles ABC, LMN and STU below (not to scale):



(a) Which pair of triangles are similar? Justify your choice and state the scale factor.

$\triangle ABC \sim \triangle LMN$ ✓

All 3 sides in same ratio (SSS) ✓

S.F. = 3 ✓

3

FT) Accept 1/3 if they say $\triangle LMN \sim \triangle ABC$.

(b) Tiffany said ΔABC was a right-angled triangle. Is Tiffany correct? Justify your response.

$a^2 + b^2 = c^2$

$6^2 + 8^2 = 10^2$

$100 = 100$ ✓

Yes! It's right-angled. ✓

*Accept: Pythag. Triple.

2

(c) Consider another triangle, ΔXYZ, which is similar to ΔSTU. If the longest side of ΔXYZ is 7 cm, determine the scale ratio from ΔSTU to ΔXYZ.

$\triangle STU \sim \triangle XYZ$

(longest side: TU) (longest side: YZ)

28 : 7 ✓

4 : 1 ✓

2

11

Question 3

[1, 1, 1, 2, 2, 4 = 11 marks]

Consider the following matrices:

$$X = \begin{bmatrix} 2 & 3 \\ 5 & 6 \end{bmatrix} \qquad Y = [-1 \quad 0 \quad 3] \qquad Z = \begin{bmatrix} 4 \\ -2 \end{bmatrix} \qquad W = \begin{bmatrix} 1 & 4 \\ -1 & -3 \\ 2 & 0 \end{bmatrix}$$

$$V = \begin{bmatrix} -1 & 3 \\ 4 & 0 \end{bmatrix}$$

(a) State the value of x_{21} 5 ✓ 1

(b) State the dimensions of the row matrix. 1 × 3 ✓ 1

(c) Determine $2W$

$2W \begin{bmatrix} 2 & 8 \\ -2 & -6 \\ 4 & 0 \end{bmatrix}$ ✓ 1

(d) Determine $X - V$

$X \begin{bmatrix} 2 & 3 \\ 5 & 6 \end{bmatrix} - V \begin{bmatrix} -1 & 3 \\ 4 & 0 \end{bmatrix} = \begin{bmatrix} 3 & 0 \\ 1 & 6 \end{bmatrix}$ ✓✓ 2

*1 mark for correct row or column.

(e) Determine YW

$Y \begin{bmatrix} -1 & 0 & 3 \end{bmatrix} W \begin{bmatrix} 1 & 4 \\ -1 & -3 \\ 2 & 0 \end{bmatrix} = \begin{bmatrix} -1+0+6 & -4+0+0 \end{bmatrix} = \begin{bmatrix} 5 & -4 \end{bmatrix}$ ✓✓ 2

1 × 3 ✓ 3 × 2 ✓ 1 × 2

(f) Determine $(V^2)Z$

$V^2 = \begin{bmatrix} -1 & 3 \\ 4 & 0 \end{bmatrix} \begin{bmatrix} -1 & 3 \\ 4 & 0 \end{bmatrix} = \begin{bmatrix} 1+12 & -3+0 \\ -4+0 & 12+0 \end{bmatrix} = \begin{bmatrix} 13 & -3 \\ -4 & 12 \end{bmatrix}$ ✓✓

*1 mark for correct row or column

$(V^2)Z = \begin{bmatrix} 13 & -3 \\ -4 & 12 \end{bmatrix} \times \begin{bmatrix} 4 \\ -2 \end{bmatrix} = \begin{bmatrix} 52+6 \\ -16+24 \end{bmatrix} = \begin{bmatrix} 58 \\ -40 \end{bmatrix}$ ✓✓ ft 4

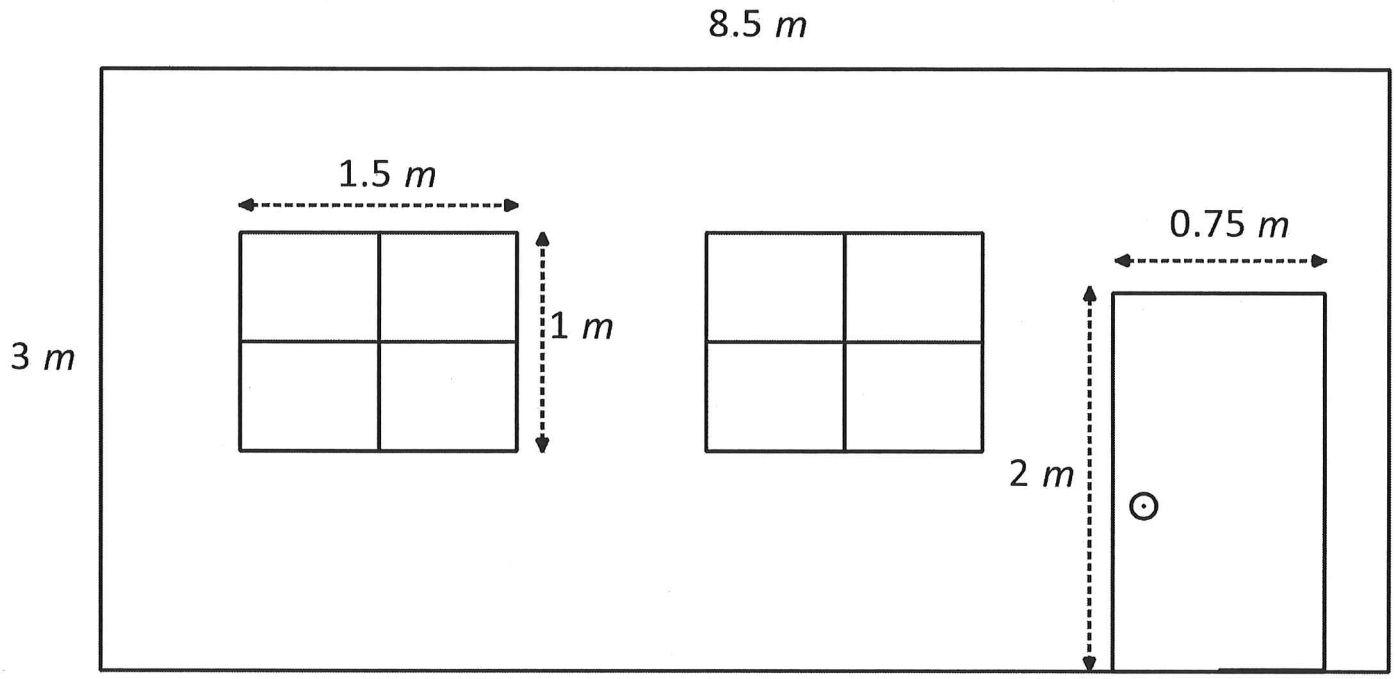
2 × 2 ✓ 2 × 1 ✓ 2 × 1

11

Question 4

[5 marks]

The classroom wall below needs to be painted (diagram not to scale). Bunnings is selling one litre tins of the desired paint for $42.10 each. The Bunnings website advertises that one tin should cover approximately 15 m^2. Excluding the door and two identical windows, determine the total cost of paint required if the teacher intends on painting two coats on the wall.



WALL — TWO WINDOWS — DOOR

$A = (3 \times 8.5) - 2(1.5 \times 1) - (2 \times 0.75)$

$= 25.5 - 3 - 1.5$ ✓

$= 21\ m^2$ (one coat) ✓

$(\times 2)$

$= 42\ m^2$ (two coats) ✓

* How many students could not do this simple calculation ☹

No. of tins $= 42 / 15$

$= 2.8$

$\approx$ 3 tins ✓

Cost $= 3 \times 42.10$

$= \$126.30$ ✓

5

END OF SECTION ONE

MATHEMATICS APPLICATIONS

YEAR 11 - UNIT 1

TEST 2 - 2021

SECTION TWO – CALCULATOR ALLOWED

TIME: 35 mins
MARKS: 35 marks

STUDENT'S NAME: SOLUTIONS

CIRCLE YOUR TEACHER'S NAME:

Dr Duan	Mr Riemer	Mr Stillitano
Mr Galbraith	Ms Thompson	Mr Hamilton-Brown

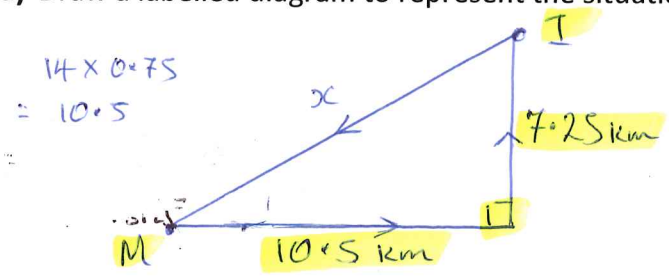
- Scientific calculators and Classpads are allowed during this section of the test.
- Show all necessary working in order to obtain full marks.
- A formula sheet will be provided.
- One single-sided A4 sheet of notes allowed.

Question 5

[2, 3 = 5 marks]

A yacht leaves a marina and sails due East at an average speed of 14 km/h for forty-five minutes. It then changes course and sails due North for a further 7.25 km, until it reaches an island. The yacht then sails directly back to the marina.

(a) Draw a labelled diagram to represent the situation described above.



- triangle (with right angle) ✓
- labels ✓

2

(b) Determine the total distance the yacht travelled on the journey.

$x = \sqrt{10.5^2 + 7.25^2}$ ✓

$\sqrt{162.8125} = 12.7598$ ✓

Total Dist $= 10.5 + 7.25 + 12.7598$

$= 30.51$ km (2 dp) ✓

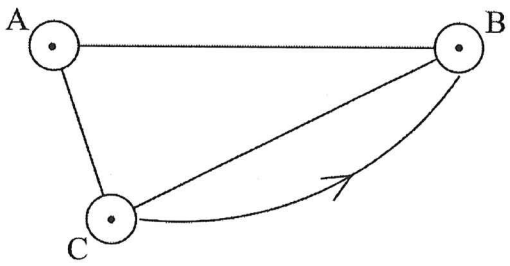
(30.5098)

3

Question 6

[1, 2 = 3 marks]

The diagram on the right is a network representation of the roads between towns A, B and C.



Below is a partially completed one-stage matrix representation of the roads between towns A, B and C.

(a) Complete the one-stage matrix for the above network diagram.

One-Stage Matrix:

	A	B	C
A	0	1	1
B	1	0	1
C	1	2	0

✓

1

(b) Determine the two-stage matrix for the above network diagram.

$$\begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 2 & 0 \end{bmatrix}^2 = \begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 2 & 1 & 3 \end{bmatrix}$$ ✓ ft

- 1 for each incorrect row or column

2

8

Question 7

[1, 2, 2, 2 = 7 marks]

A person's BMI or 'body mass index' (B) is calculated using the formula $B = \frac{m}{h^2}$, where 'm' represents 'mass in kilograms' and 'h' represents 'height in metres'.

The following spreadsheet was set up which enabled the use of this formula for two people John and Yoko:

	A	B	C	D
1	Name	m	h	B
2	John	82	1.83	24.49 ✓
3	Yoko	65	1.52	28.13 ✓

2

John's mass was recorded as 82 kg and his height was recorded as 1.83 m.
Yoko's mass was recorded as 65 kg and her height was recorded as 1.52 m.

(a) If "John" is entered into cell A2, what information would you input/type into cell C2?

1.83 ✓

1

(b) Use the formula provided above, to complete the table of values (to 2 decimal places); hence determining John and Yoko's BMI.

BMI (John) = 24.49
BMI (Yoko) = 28.13
} see table above.

(c) If $B \leq 18$ you are classed as underweight.
If $18 < B \leq 25$ you are classed as normal weight.
If $25 < B \leq 30$ you are classed as overweight.
If $B > 30$ you are classed as obese.

How would John and Yoko be classified using their B-values?

John: normal ✓
Yoko: overweight ✓

2

(d) What is the largest mass of a 1.70-metre-tall person, rounded to the nearest kg, for them to be classified as overweight?

Largest overweight BMI is 30

$\frac{m}{h^2} = 30$

$\frac{m}{1.7^2} = 30$ ✓

$m = 86.7$ $\approx$ 86 kg ✓

*must round down

2

7

Question 8

[2, 2, 4, 2 = 10 marks]

Paul and Linda are two teachers, purchasing some stationary supplies for their kindergarten classes.

Paul requires 15 rulers, 28 pens, and 18 pencils.
Linda requires 22 rulers, 15 pens and 20 pencils.

They are able to source the stationery from two different suppliers as shown below, and wish to find the lowest price for their purchase:

Supplier	Ruler ($)	Pen ($)	Pencil ($)
Office Barn	1.25	0.40	0.30
Office Depot	1.10	0.55	0.40

(a) Display the item prices above as a matrix, labelled **S**. State the size of the matrix.

$S \begin{bmatrix} 1.25 & 0.40 & 0.30 \\ 1.10 & 0.55 & 0.40 \end{bmatrix}$ ✓ 2×3 ✓ 2

OR $[3 \times 2]$

(b) Determine suitable matrices to represent Linda (matrix **L**) and Paul's (matrix **P**) required items, that can be multiplied by matrix **S**. 3×1 or 1×3 ???

$P \begin{bmatrix} 15 \\ 28 \\ 18 \end{bmatrix}$ ✓ 3×1 $\quad L \begin{bmatrix} 22 \\ 15 \\ 20 \end{bmatrix}$ ✓ 3×1 2

OR $[1 \times 3]$ FT from (a)

(c) Using the matrices above, to determine the amount that both Linda and Paul would spend at each at supplier.

$S \begin{bmatrix} 1.25 & 0.40 & 0.30 \\ 1.10 & 0.55 & 0.40 \end{bmatrix} \times P \begin{bmatrix} 15 \\ 28 \\ 18 \end{bmatrix} = \begin{bmatrix} 35.35 \\ 39.10 \end{bmatrix}$ ✓ → 0.B ✓ → 0.D.

$S \begin{bmatrix} 1.25 & 0.40 & 0.30 \\ 1.10 & 0.55 & 0.40 \end{bmatrix} \times L \begin{bmatrix} 22 \\ 15 \\ 20 \end{bmatrix} = \begin{bmatrix} 39.50 \\ 40.45 \end{bmatrix}$ ✓ → 0.B ✓ → 0.D 4

(d) Determine which of the two suppliers Paul and Linda should shop at. Justify your answer.

They should both shop at Office Barn. ✓

- Paul makes a (39.10 − 35.35) = $3.75 saving.
- Linda makes a (40.45 − 39.50) = $0.95 saving.

(Any reasonable answer) ✓ 2

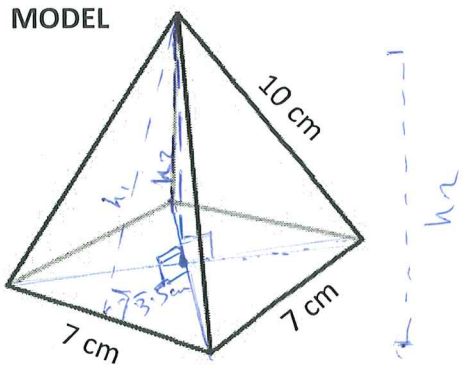
10

Question 9

[4, 6 = 10 marks]

An engineer used a 3D-printer to create a 1 : 25 scale model of a glass fish-tank which is to be displayed in an aquarium.

The tank is shaped as a square-based pyramid with the dimensions as shown in the diagram, to allow for greater strength and stability.



(a) Calculate the amount of glass, including the floor (in m^2) that would be needed to create this fish-tank.

$h_1 = \sqrt{10^2 - 3.5^2}$

$= 9.3675$ cm

* The height is NOT 10 cm

S.A. (model) $= \square + 4\triangle$

$= (7 \times 7) + 4\left(\frac{7 \times 9.3675}{2}\right)$

$= 180.145\ cm^2$ ✓ ft

S.A. (actual) $= 180.145 \times 25^2$

$= 112\,590.625\ cm^2$ ✓ ft $(\div 100^2)$

$= 11.26\ m^2$ ✓ ft

4

(b) Determine the amount of water (in kL) required to fill the actual aquarium, to 85% of its capacity.

$h_2 = \sqrt{9.3675^2 - 3.5^2}$

$= 8.69$ cm ✓

V (model) $= \frac{1}{3} A \times h$

$= \frac{1}{3}(49)(8.69)$ ✓ ft

$= 141.93666\ldots\ cm^3$ ✓ ft

V (actual) $= 141.93666 \times 25^3$

$= 2\,217\,760.417\ cm^3$ or mL ✓ ft $(\div 1000^2)$

$= 2.21776\ldots\ kL$ ✓ ft $(\times 0.85)$

$= 1.885\ kL$ ✓ ft

6

10

END OF SECTION TWO