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TOTAL
MARKS

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INTERNATIONAL SECONDARY CERTIFICATE EXAMINATION
MAY 2024
QUANTITATIVE REASONING: PAPER II

EXAMINATION NUMBER

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Time: 3 hours

150 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of:
 - 28 pages which includes 3 additional pages at the end for rough work and calculations if necessary.
 - 5 questions.
2. Please check that your question paper is complete.
3. **Answer ALL the questions on the question paper and hand this in at the end of the examination. Remember to write your examination number in the space provided.**
4. It is strongly recommended that all working details be clearly shown.
5. An approved non-programmable calculator may be used where necessary.
6. It is in your own interest to write legibly and to present your work neatly.
7. Maps and diagrams are not necessarily drawn to scale, unless otherwise stated.
8. THREE lined pages (pages 26–28) are included at the end of the question paper. If you run out of space for a question, use these pages. Clearly indicate the number of your answer should you use this extra space.

Question	1		2		3		4		5		Total	
	Marker	Mod	Marker	Mod	Marker	Mod	Marker	Mod	Marker	Mod	Marker	Mod
Mark												
Signature												
Total	30		40		23		28		29		150	

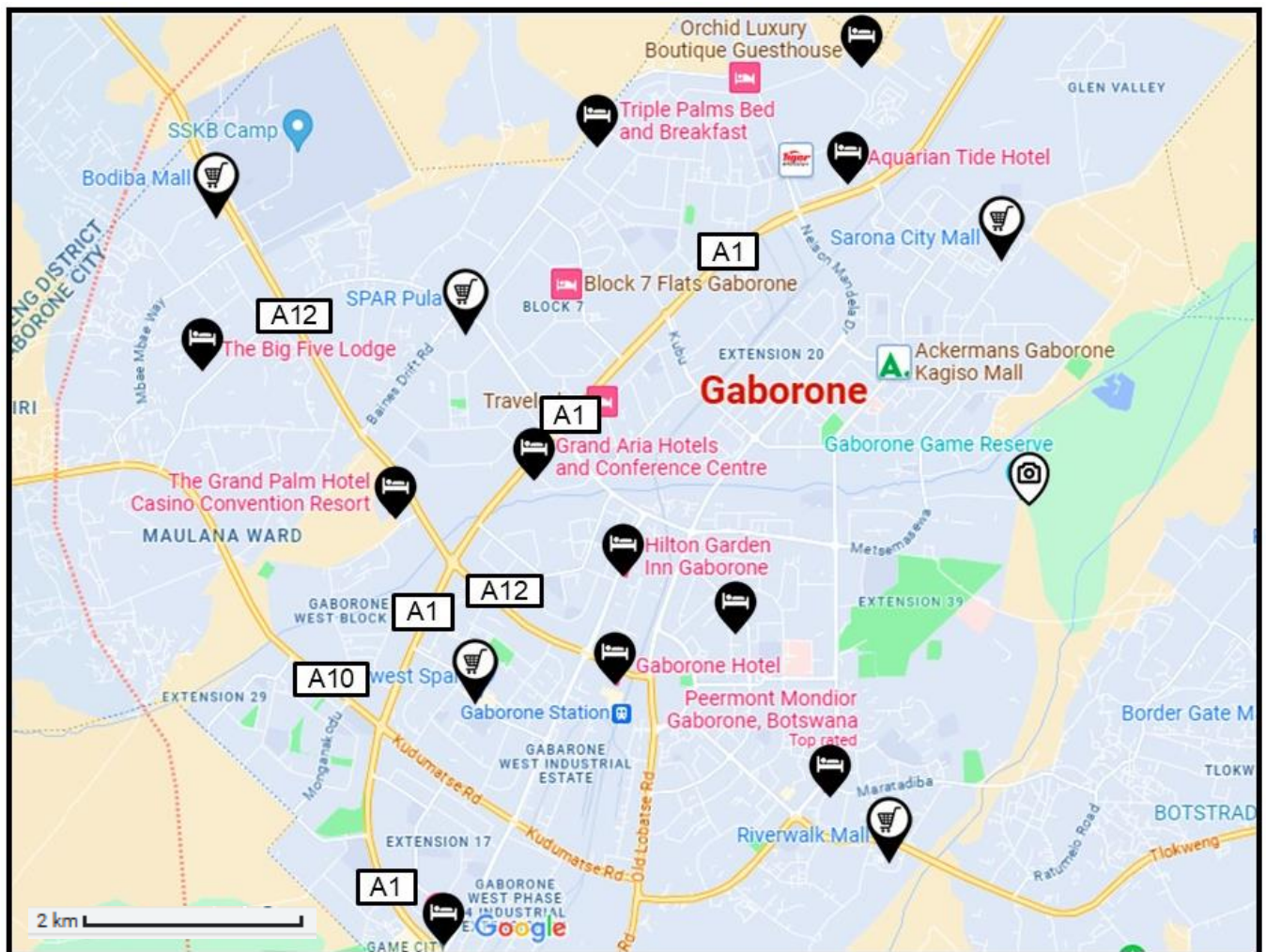
QUESTION 1

Gaborone, which covers an area of 169 m², is the capital city of Botswana. It has a population of 231 626 people.

- 1.1 Determine how many people there are per square metre in Gaborone.

(2)

- 1.2 Below is a map of Gaborone. Refer to the map and answer the questions that follow.



- 1.2.1 Hotels and inns are indicated with the following symbol: 
How many hotels and inns are shown on the map above?

(2)

1.2.2 What does the symbol below mean?



(2)

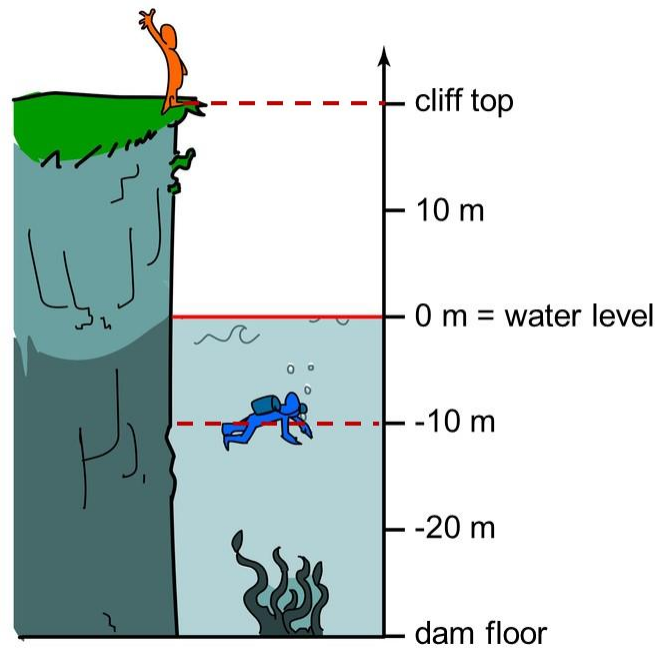
1.2.3 On the bar scale, 3 cm represents 2 km.

- (a) Measure the distance between Gaborone Station and The Big Five Lodge in cm as the crow flies. (1)
- (b) Hence calculate the distance, in kilometres, between Gaborone Station and The Big Five Lodge. (2)

1.2.4 The distance between Gaborone Station and The Big Five Lodge takes 17 minutes by car. How long does the trip take in hours?

(2)

- 1.3 A local from Gaborone stands on top of a cliff along the banks of a dam as illustrated in the diagram below:



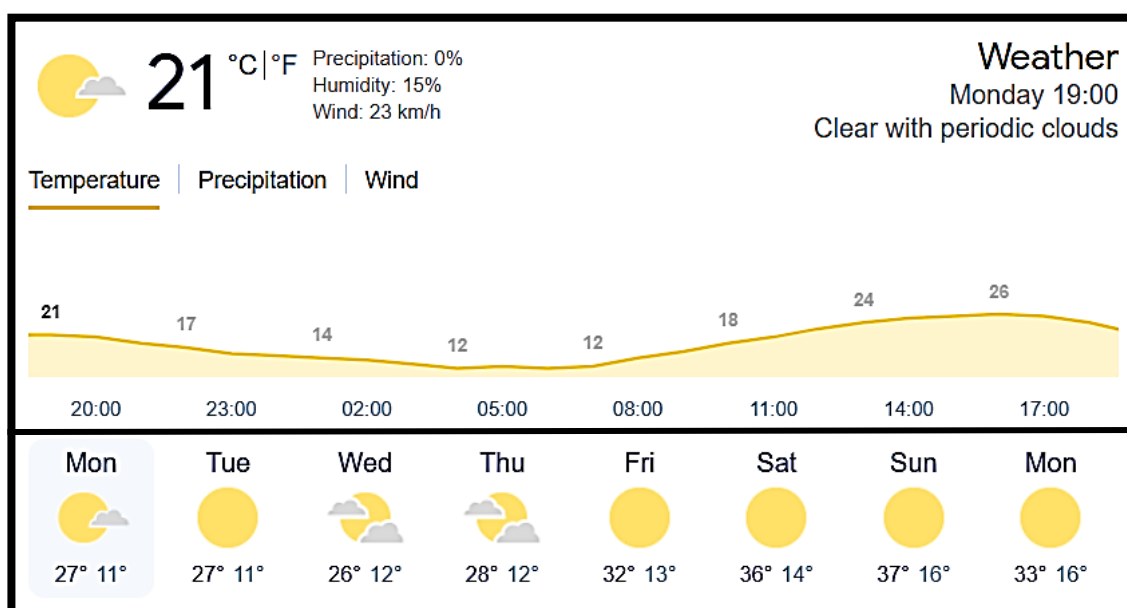
- 1.3.1 How high above the water level is the local?

(2)

- 1.3.2 How far apart are the local and the diver?

(2)

1.4 The temperatures for a week in September 2023 are shown below.



1.4.1 On which day of the week was it the hottest?

_____ (2)

1.4.2 Calculate by how many degrees the temperature rose on Wednesday.

_____ (2)

1.4.3 Estimate the temperature at 05:00 on this particular Monday.

_____ (2)

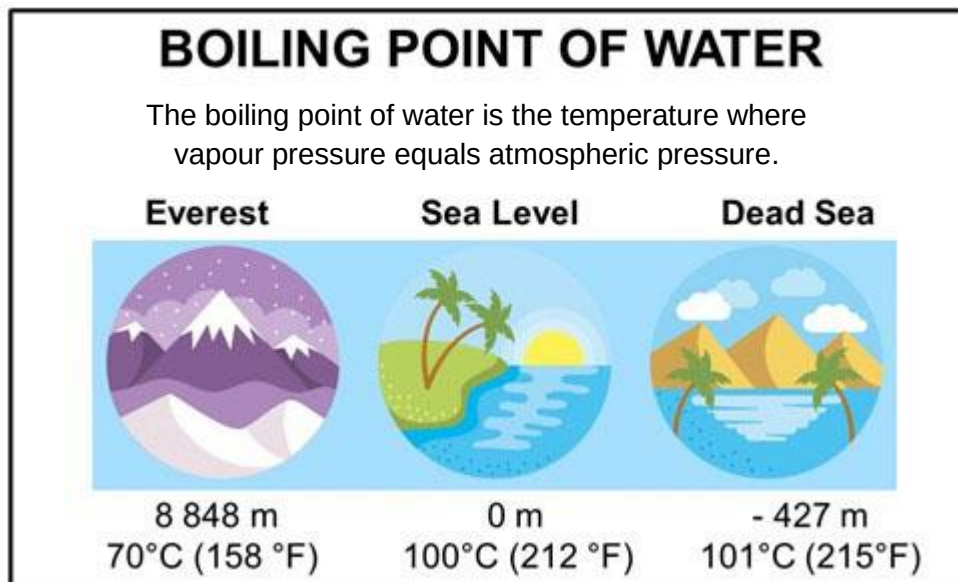
1.4.4 Using the given formula, convert the maximum temperature on Tuesday to degrees Fahrenheit (°F).

$$^{\circ}\text{F} = \frac{9}{5} ^{\circ}\text{C} + 32$$

_____ (3)

- 1.5 Water boils at a temperature of 100°C at sea level. The boiling point of water changes when the altitude (height) above or below sea level changes. For every 152,4 m change in altitude, the boiling point of water changes by $0,5^{\circ}\text{C}$.

Use the information given as well as the diagrams below to complete this question.



Complete the paragraph below by filling in the missing words or values and choosing the correct word in brackets when a choice is given. Fill your answers in the space following the paragraph.

As the altitude increases, the boiling point of water **A** (**increases/decreases**) at a rate of **B** _____ which is **C** _____ $\text{m}/^{\circ}\text{C}$. The boiling point of water at the Dead Sea is **D** _____. This boiling point **E** (**increased/decreased**) because the Dead Sea is **F** (**above/below**) sea level.

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

(6)
[30]

QUESTION 2

It takes more than soil, water, and sunshine to make the world green. At least 30% of the world's crops and 90% of all plants require cross-pollination by bees to spread and thrive.

There is no question about the importance of bees to our food supply. Without them, our gardens would be bare and our plates empty.

- 2.1 It takes 12 bees their entire lifetime to make just one teaspoon of honey. If one teaspoon is equivalent to 5 g, determine how many bees it would take to produce enough honey to fill a standard 375 g container.

(4)

- 2.2 Six hundred and eighty-three bees fly roughly 32 550 miles to gather 5,93 lbs of nectar from about 1 185 000 flowers in order to make one 9,5 oz jar of honey.

2.2.1 What does 'lbs' stand for?

(2)

2.2.2 Determine how far, in kilometres, ONE bee flies to gather 5,93 lbs of nectar.

Note: 1 km = 0,621371 miles

(4)

2.2.3 Convert 9,5 oz to ml (rounded to the nearest whole).

Note: 1 oz = 29,5735 ml

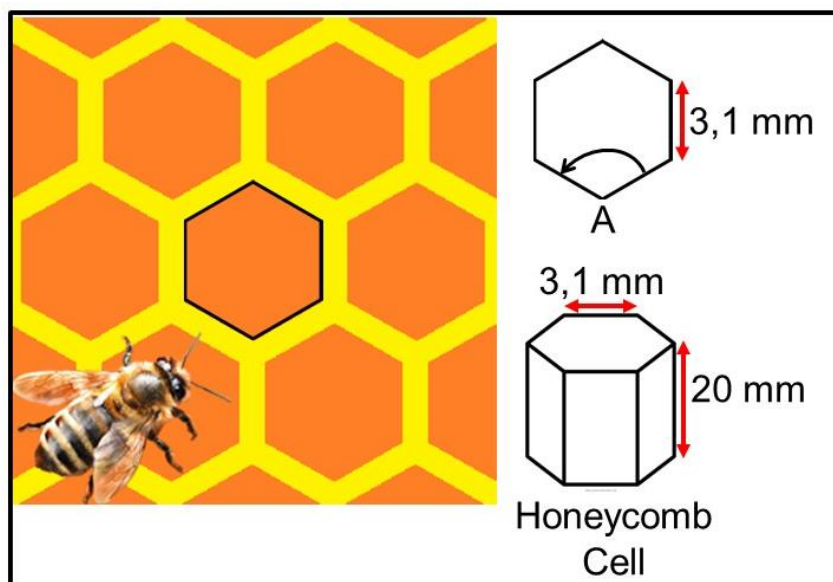
(2)

2.3 Bees can fly up to 12 miles per hour (mph). If 1 km = 0,621371 miles, calculate how fast a bee flies in km/h.

(3)

2.4 Using hexagons enables bees to make use of space efficiently whilst using as little wax as possible. Hexagons hold the maximum amount of honey, while leaving no wasted space, because they fit tightly, side by side.

Refer to the diagram below and answer the questions that follow on the next page.



- 2.4.1 Bees use regular hexagons with 6 equal sides to build honeycomb cells. Calculate the size of one interior angle indicated by 'A', using the following formula:

$$A = \frac{180^\circ(n-2)}{n}; n = \text{number of sides.}$$

(2)

- 2.4.2 Calculate the perimeter of one hexagon.

(2)

- 2.4.3 Show that the area of one hexagon is 93,53 mm², using the formula below.

$$\text{Area of a hexagon} = \frac{3 \times \sqrt{3}}{2} \times n^2, \text{ where } n \text{ represents number of sides.}$$

(2)

- 2.4.4 Hence, calculate the amount of honey, in ml, that a single honeycomb cell can hold. You may use the following information:

Volume of a hexagonal prism = Area of base × Height

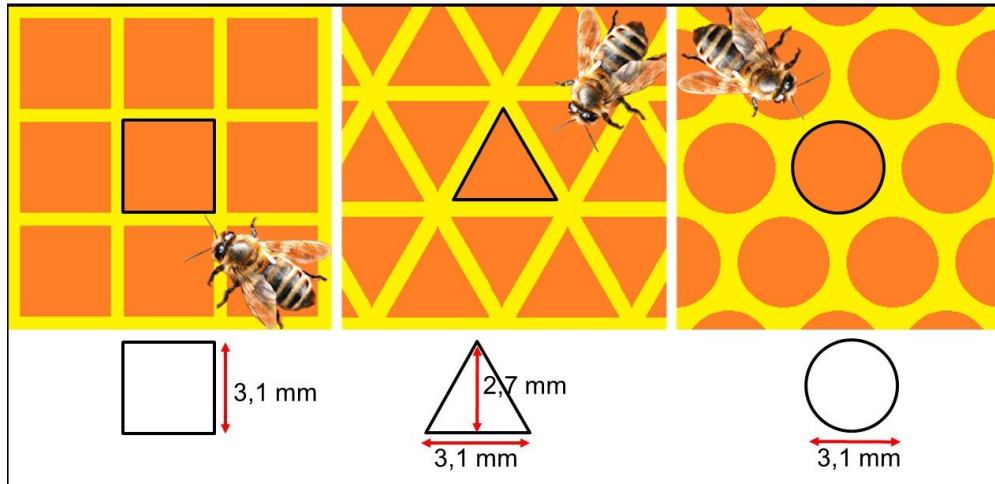
$$1\,000 \text{ mm}^3 = 1 \text{ ml}$$

(4)

- 2.4.5 Bees make hexagonal-shaped honeycomb cells, instead of using simpler shapes like squares, triangles or circles.

'The hexagonal shape has the least amount of perimeter compared to the area of the hexagon.'

Refer to the diagrams and information given below to prove the statement above is true.



Area of the hexagonal cell = 93,53 mm²

Perimeter of the hexagonal cell = _____ mm

Area of the square cell = 9,61 mm²

Perimeter of the square cell = 12,4 mm

Area of the equilateral triangular cell = $\frac{1}{2} \times \text{base} \times \text{height} = \text{_____ mm}^2$

Perimeter of the equilateral triangular cell = _____ mm

Area of the circular cell = $3,14 \times \text{radius}^2 = \text{_____ mm}^2$

Perimeter of the circular cell = $3,14 \times \text{diameter} = \text{_____ mm}$

(8)

2.5 A beekeeper builds his own beehives. Match diagrams A to G with the written instructions in column one.

2.5.1	Purchase your supplies. You should always purchase your supplies from an esteemed bee seller.	A.	
2.5.2	Build your deep supers*. There will be two short sides that are 16,25 by 9,56 inches and two long sides that are 20 by 9,56 inches. Cut your wood to meet these measurements and create the proper joints along the edges. * A "super" refers to a section that is added to a beehive to provide additional space for honey storage.	B.	
2.5.3	Build your honey supers. The length OR width of your honey supers will be the same as your deep supers (long side: 20 by 5,75; short side: 16,25 by height of 5,75 inches). The height will vary. For a shallow super, your box should be 5¾ inches high; a medium super will be 6⅝ inches high.	C.	
2.5.4	Buy or build the bottom board with an entrance reducer. The bottom board is the first layer of your box and is just a flat piece of wood with raised edges. The board will be the same length/width of the supers, but the height of the edges is only 0,375-inches high.	D.	
2.5.5	Paint the exposed parts of your box. Although you don't have to paint your box, many beekeepers prefer to paint the exposed parts of the box white in order to reflect sunlight. If you decide to do so, use a white, non-toxic outdoor paint that will withstand the weather. Never paint inside the supers though, as this can be harmful to the bees and your honey.	E.	

2.5.6	Get the frames for your supers. The frames are the portions of the box that the bees use to form their hive and wax. You'll need 10 frames, for each deep super, and six to eight frames, depending on the size of each of your honey supers. Slide these into each super vertically until they lock into place.	F.	
2.5.7	Assemble your box. To put your box together, you'll need to layer all of the parts on top of your stand. The bottom board goes first, followed by the slatted frame (if you have one), then the deep super(s), queen excluder, honey super(s), and the cover.	G.	

(7)

2.5.1	
2.5.2	
2.5.3	
2.5.4	
2.5.5	
2.5.6	
2.5.7	

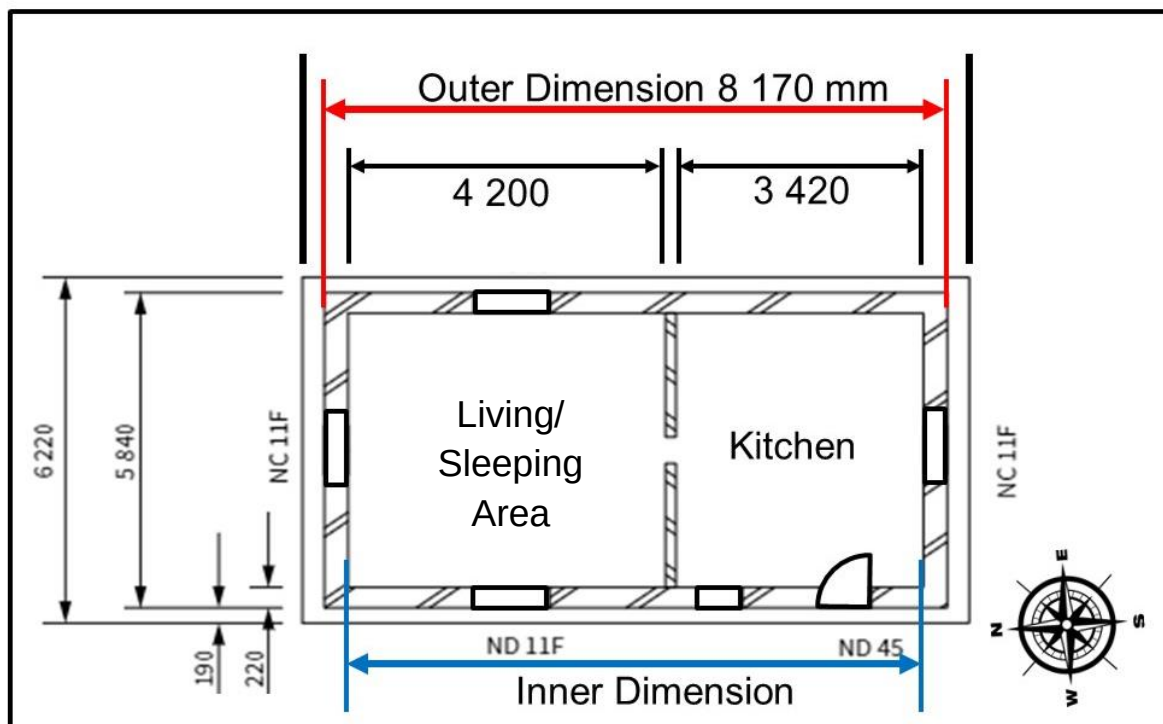
[40]

QUESTION 3

Joseph is a general contractor and is renovating the kitchen and living/sleeping area of a studio apartment.



- 3.1 The floor plan of the studio apartment is given below. The measurements are given in millimetres.



Refer to the floor plan and answer the questions that follow.

- 3.1.1 How many windows does the studio apartment have?

(2)

- 3.1.2 Give the elevation of the wall with the kitchen window and door.

(2)

- 3.1.3 Calculate the thickness of the outer walls if the wall between the Kitchen and Living/Sleeping area is 110 mm wide.

(3)

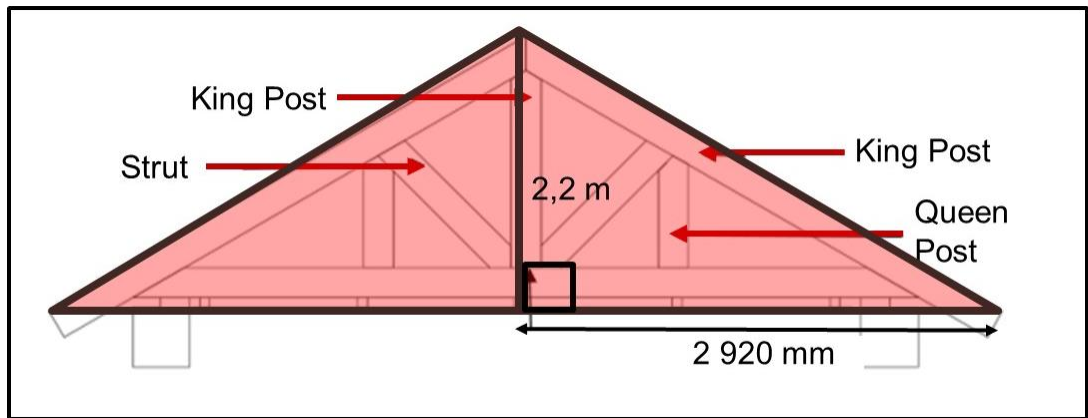
- 3.1.4 With a ruler, measure the line indicating the outer dimension of the studio apartment.

(2)

- 3.1.5 Calculate the scale of the floor plan in the format 1 : _____, to the nearest whole number.

(4)

- 3.2.2 Joseph needs to calculate the total length of diagonal King Posts to replace all the roof trusses in this renovation. Using the diagram as an aid, as well as the theorem of Pythagoras, calculate the total length of diagonal King Posts needed for the renovation.



$$\text{hypotenuse}^2 = (\text{side}_1)^2 + (\text{side}_2)^2$$

(4)
[23]

QUESTION 4

Brittany is studying to be a chef.

She has been tasked to use tomato soup as her main ingredient in a cooking assessment.

She decided to make a Savoury Tomato Soup Snacking Cake.

The recipe is shown below:

Savoury Tomato Soup Snacking Cake

With a gooey, cheesy caramelised onion topping

- 1 cup caramelised onions
- 1 cup sun-dried tomatoes, divided
- 1 cup (4 ounces) shredded Parmesan cheese
- $\frac{1}{2}$ cup (2 ounces) shredded Cheddar cheese
- $2\frac{2}{3}$ cups (319 grams) all-purpose flour
- 1 tablespoon baking soda
- 2 teaspoons baking powder
- 2 tablespoons brown sugar
- $\frac{3}{4}$ teaspoon fresh ground black pepper
- 2 teaspoons celery salt
- $\frac{1}{2}$ teaspoon garlic powder
- 1 tablespoon Italian seasoning
- 1 tablespoon crushed red pepper flakes
- 2 large eggs
- 1 can tomato soup
- $\frac{1}{2}$ cup olive oil
- 1 cup sour cream



- 4.1.1 Brittany only has a teaspoon available to measure the ingredients. If one tablespoon is equivalent to three teaspoons, determine how much brown sugar she needs.

(2)

- 4.1.2 Calculate how many grams there are in one cup of all-purpose flour.

(3)

- 4.1.3 The recipe makes a cake to serve to 12 people. How many cans of soup are needed to make enough Snacking Cake to serve her whole class of 300 people?

(3)

- 4.2 Brittany purchases Heinz Cream of Tomato Soup in bulk. Refer to the images below and answer the questions that follow.



- 4.2.1 Show, using calculations, that 32 cans of soup can fit into the box. The cans must be placed upright in the box.

(6)

4.2.2 Each can of soup has a mass of 380 g.

Calculate the cost to send this box filled with cans of tomato soup within sub-Saharan Africa by taking into account the dimensions and total weight of the package.

Additional information is given below. Use this information to complete this question.

DHL EXPRESS TARIFFS

33,7 × 32,2 × 34,5 cm (max 12,5 kg)	R2 530
41,7 × 35,9 × 36,9 cm (max 17,5 kg)	R3 295
48,1 × 40,4 × 38,9 cm (max 22,5 kg)	R3 910

(5)

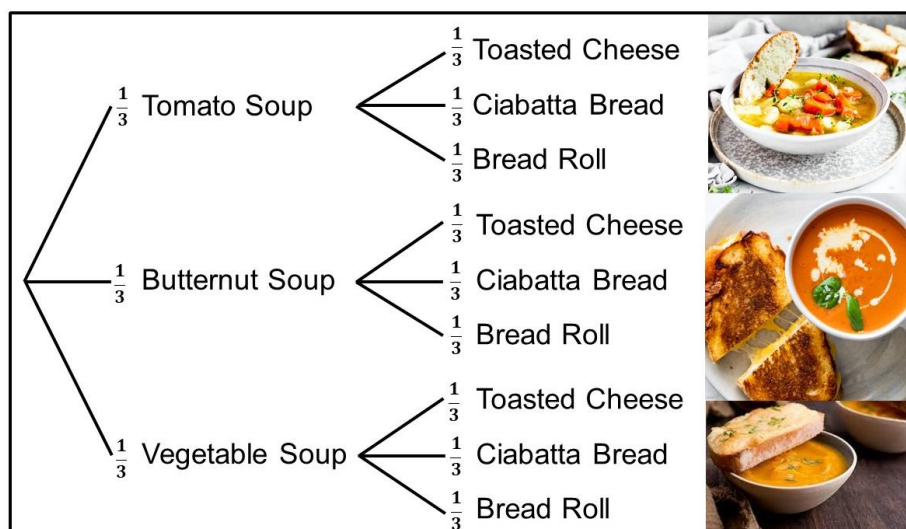
- 4.2.3 Determine the area, in square centimetres, of the label on the can of Heinz Tomato Soup.

You may use the following formula:

Area of label = Circumference of circular face $\times$ height where $\pi = 3,14$.

(4)

- 4.3 Alonso, a fellow student in Brittany's cooking class, had to provide a light meal, serving soup. The tree diagram below shows his various meal options.



- 4.3.1 Determine the probability that Alonso would decide to serve Butternut Soup and Ciabatta Bread.

(2)

- 4.3.2 Calculate the probability that Alonso would decide to serve Butternut or Vegetable Soup and Ciabatta Bread.

(3)
[28]

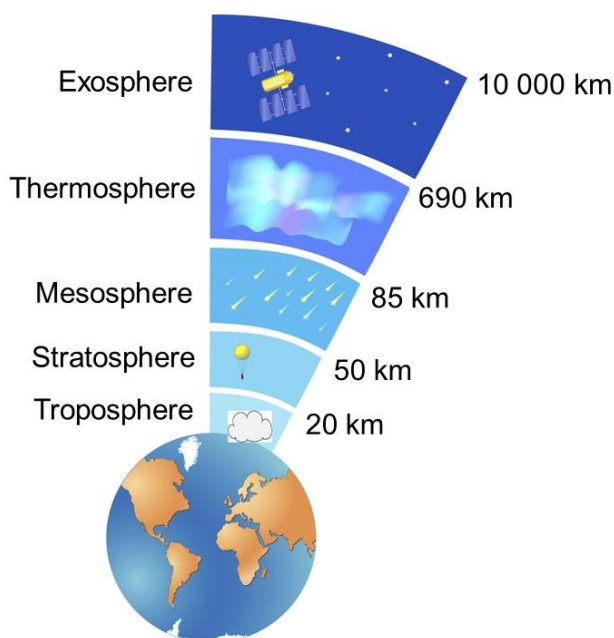
QUESTION 5

Avid flight passengers often wonder how high the plane flies and why. Planes usually fly in the Stratosphere, the second major layer of the earth's atmosphere.

In addition to less turbulence, this layer of the atmosphere allows for much better fuel economy. This is because at higher altitudes, there is less air resistance.



- 5.1 The diagram below shows the different layers of the earth's atmosphere and the thickness of each layer. Refer to the diagram and answer the questions that follow.



- 5.1.1 Determine the thickness of the earth's atmosphere in metres.

(2)

- 5.1.2 Calculate the thickness of the Stratosphere.

(2)

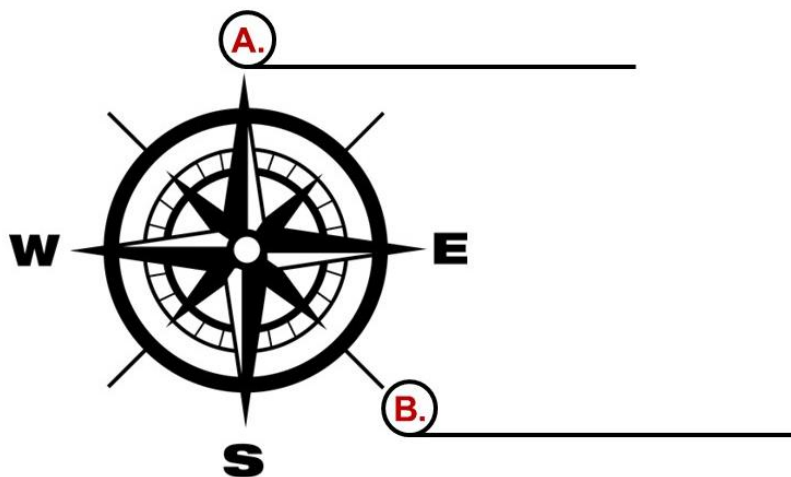
5.2 John is planning a trip from Walvis Bay to Johannesburg for business.

Refer to the map below showing the flight path to answer the questions that follow.



[Resource: Google Maps]

5.2.1 A compass with the eight cardinal points is given below. Fill in the compass direction for the cardinal points labelled **A** and **B**.



(2)

5.2.2 Give the general compass direction of Gaborone from Bulawayo.

(2)

- 5.2.3 Determine how much longer the journey takes when travelling by car rather than flying. Use the quickest car trip to compare.

(2)

- 5.2.4 (a) The distance between Walvis Bay and Johannesburg is 1 417 kilometres (881 miles). Use this information to calculate how many kilometres there are in a mile.

(2)

- (b) Calculate the speed, in km / h, at which the aeroplane flew from Walvis Bay to Johannesburg. You may use the formula below.

$$\text{Speed} = \frac{\text{distance}}{\text{time}}$$

(2)

- 5.3 A Boeing 747 uses approximately 4 litres of fuel every second.

- 5.3.1 Calculate the amount of fuel the Boeing will use on the flight from Walvis Bay to Johannesburg.

(3)

5.3.2 The cost of jet fuel is R15,27 per litre. Calculate the cost of the fuel for this flight.

(2)

5.3.3 John booked a ticket on www.cheapflights.co.za. Below is a screenshot showing the details of his chosen flight.



11 November 2023
13:30
Walvis Bay Rooikop

2hrs 10min
Non-Stop (Economy)



15:40
Johannesburg, O.R. Tambo
International

R3 679
[Book Now](#)

20kg Suitcase



8kg Hand luggage



Airlink rounds the fuel cost off to **R477 000** for ease of calculation when considering other aspects related to the flight. Use this figure in the following calculations.

(a) Determine how many tickets Airlink needs to sell to break-even on this flight.

(2)

(b) The Airlink flight from Walvis Bay to Johannesburg is an Embraer ERJ 190. It seats 98 passengers. Calculate how much Airlink should sell a ticket for to break-even.

(3)

- (c) Given that 98 passengers weigh a total of 8 428 kg. Determine the total mass added to the aeroplane if $\frac{2}{3}$ of passengers have a suitcase and 96% of passengers also have hand luggage.

Determine the total passenger mass carried by the flight.

(5)
[29]

Total: 150 marks

ADDITIONAL SPACE (ALL QUESTIONS)

**REMEMBER TO CLEARLY INDICATE AT THE QUESTION THAT YOU USED THE
ADDITIONAL SPACE TO ENSURE THAT ALL ANSWERS ARE MARKED.**

[illegible]

[illegible]

[illegible]