

MATHEMATICS DEPARTMENT
REVISION (PROBLEMS IN REAL WORLD CONTEXT)

NAME: _____
CLASS: _____
DATE: _____

Question 1 [TKSS 2020]

The cash price of a new motorcycle is \$25 120.

Jack paid a down payment of 20% of the price of the motorcycle and the balance with a fixed simple interest rate of 4% per annum for a period of 3 years.

- (a)** Calculate his monthly instalment.

Answer \$..... [3]

The technical specification of his new motorbike, as stated by the manufacturer, is shown in **Table 1**.

Fuel capacity :	3.7 gallons
Fuel efficiency:	6 litres/100 km
Dimension front tyre :	120 / 70 R17
Dimension rear tyre :	180 / 55 R17
Recommended replacement:	Front tyre, every 6000km
	Rear tyre, every 2900km

Conversions:

1 gallon = 3.785 litres

1 inch = 2.54 cm

- (b) (i) Find the fuel capacity of his motorbike, correct to the nearest litre.

Answerlitres [1]

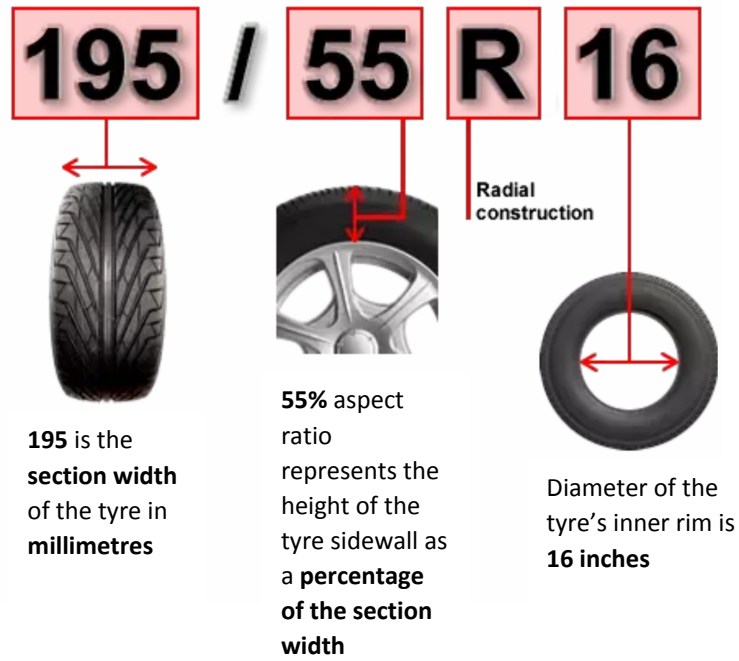
Jack starts riding with a full tank of petrol. After riding for a total distance of 190 km, he filled up the petrol tank to the brim again, by pumping 13 litres of petrol.

- (ii) Determine if the fuel efficiency stated by the manufacturer in **Table 1** is true.

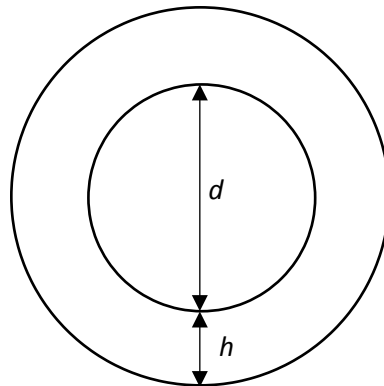
Answer

 [2]

An **example** of the dimensions for a motorbike tyre **195 / 55 R16** is explained below.



The cross-section of a wheel can be presented in **Diagram II**, where d is the diameter of inner rim, and h the height of the sidewall.



- (c) Jack replaces his tyres at the recommended distance travelled.

What would be the number of complete revolutions made, when Jack has to **first** replace a **front tyre**?

Use the information in **Table 1** and show your calculations clearly.

Answer [5]

Question 2 [Bedok View 2020]

OUR FOUR NATIONAL TAPS

SINGAPORE IS A WATER SCARCE COUNTRY BUT OUR FOUR NATIONAL WATER TAPS ENSURE US A SUSTAINABLE AND RELIABLE WATER SUPPLY.



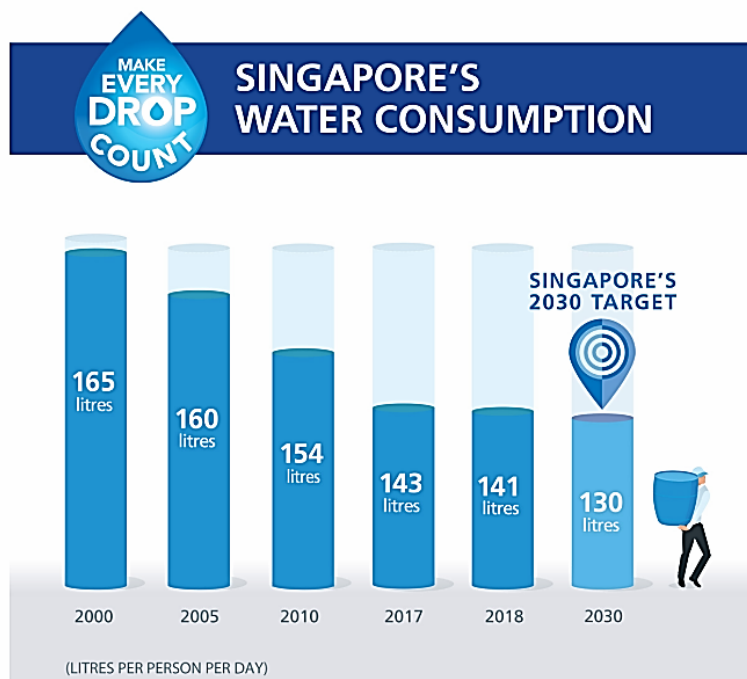
1st National Tap

With an area of about 724 km² and growing urban areas, Singapore lacks the space to collect and store all the rain that falls on it. However, through a network of rivers, canals and drains, rain that falls on two-thirds of Singapore's land area is channelled to its 17 reservoirs. This network forms the water catchment area in Singapore which has plans to extend the catchment area to 90 per cent by 2060.

(a) What is the current area of water catchment in Singapore?

Answer (a) km² [1]

The diagram below shows Singapore's domestic water consumption from the year 2000 onwards.



- (b) Population wise, Bedok is home to an estimated 289 000 residents. Given that Bedok Reservoir has a storage capacity of $1.28 \times 10^7 \text{ m}^3$, and assuming that Bedok residents maintain the rate of water consumption as in 2018, for how long can the supply of water from Bedok Reservoir last its residents? Give your answer correct to the nearest day.

Answer (b) days [3]

2nd National Tap

The table below shows five NEWater plants and their capacities for producing clean recycled water from used water.

NEWater Plant Name	Capacity per day (m^3)
Bedok (PUB)	85 000
Kranji (PUB)	80 000
Ulu Pandan (Keppel Segher)	148 000
Changi (Sembcorp)	228 000
Changi (BEWG-UESH)	227 000

3rd National Tap

The table below shows four Desalination plants which can convert sea water to fresh water.

Desalination Plant Name	
SingSpring Desalination Plant	These 4 desalination plants have a combined capacity of producing 160 mgd of water.
Tuas South Desalination Plant	
Tuas Desalination Plant	
Marine East Desalination Plant	

Additional Information

1) 1 mgd represents 1 million gallons of water per day.

$$1 \text{ mgd} = 4546.09 \text{ m}^3/\text{day}$$

2) Water demand in Singapore is currently about 430 million gallons a day (mgd)

with homes consuming 45% and the non-domestic sector taking up the rest.

The following is a statement reported by Uma Sharkeri in Business Times 29 June 2010.

“PUB’s near-term targets called for 40% of Singapore’s water demand to be met by NEWater and 25% to be met by desalinated water by 2020.”

- (c) Has PUB achieved its targets as stated in the Business Times reported 10 years ago? Justify your decision with calculations.

Answer (c)

.....

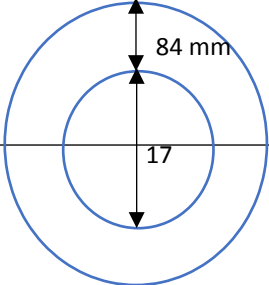
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.....

.....

[5]

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	(c)	 Front tyre: $h = 0.7 \times 120$ $= 84 \text{ mm or } 8.4 \text{ cm}$ $d = 17(2.54) + 2(\text{their height}) = 59.98 \text{ cm OR}$ $r = 17 (2.54)(0.5) + \text{their height}$ $= 29.99 \text{ cm}$ Circumference (front tyre) $= 2\pi (\text{their radius})$ $= 188.43 \text{ cm}$ $= 1.884 \text{ m}$ $= 0.001884 \text{ km}$	B1 M1 M1 M1 A1	Find height using % of width Find diameter or radius in cm using their height Find circumference Find no. of revolutions using circumference
			11 marks	

Number of complete revolutions
 $= 6000 \div (\text{their circumference})$
 $= 3184514$

2	(a)	$\text{Water catchment area} = \frac{2}{3} \times 724$ $= 482.666$ $= 483 \text{ km}^2 \text{ (3 s.f.)} \quad \text{[B1]}$	
	(b)	$\begin{aligned} 1 \text{ litre} & \text{-----} 1000 \text{ cm}^3 \\ 141 \text{ litres} & \text{-----} 141000 \text{ cm}^3 \\ & \frac{141000}{100^3} \text{ m}^3 \\ & = 0.141 \text{ m}^3 \end{aligned}$ Vol of water used by one person per day = 0.141 m³ Vol of water used by Bedok residents per day = 289000 × 0.141 $= 40749 \text{ m}^3$ $\text{Number of days} = \frac{1.28 \times 10^7}{40749} \quad \text{[M1]}$ $= 314.118$ $= 314 \text{ (to nearest day)} \quad \text{[A1]}$	To award M1 if correct conversions of all units are observed.
	(c)	$\begin{aligned} \text{Total volume of NEWater produced per day} \\ & = (85 + 80 + 148 + 228 + 227) \times 1000 \\ & = 768\,000 \text{ m}^3 \\ & = 168.9363 \text{ mgd} \end{aligned}$ Percentage of demand = $\frac{168.9363}{430} \times 100\% \quad \text{[M1]}$ $= 39.2875\ldots$ $= 39.3\% \text{ (3 s.f.)}$ Desalinated water as percentage of demand = $\frac{160}{430} \times 100\% \quad \text{[M1]}$ $= 37.209\ldots$ $= 37.2\% \text{ (3 s.f.)}$ PUB <u>falls short of its target of 40%</u> of NEWater production by about <u>0.7%</u> (accept $40\% > 39.3\%$). [A1] PUB <u>exceeds its target of 25%</u> of desalinated water production by <u>12.2%</u> (accept $25\% < 37.2\%$). [A1]	To award M1 if correct conversions of all units are observed.

[Total : 9m]