

Created by T. Madas

# **PRACTICAL ARITHMETIC & PROBLEM SOLVING**

Created by T. Madas

**Question 1 (\*\*+)**

A wholesale vinegar merchant bought 1000 litres of vinegar at £2 a litre and 250 litres of a more expensive vinegar.

He mixed the two types of vinegar and sold it for £3200 altogether, making a profit of 25%.

Find how much he paid, per litre, for the more expensive vinegar.

£2.24

Handwritten solution for Question 1:

- COST  $\xrightarrow{+1.25} \pounds 3200$   $\therefore$  COST  $= \pounds 3200 \div 1.25 = \pounds 2560$
- COST OF CHEAP VINEGAR  $= 1000 \times 2 = \pounds 2000$
- COST OF EXPENSIVE VINEGAR  $= 2560 - 2000 = \pounds 560$
- COST OF EXPENSIVE VINEGAR PER LITRE  $= \frac{560}{250} = \pounds 2.24$

**Question 2 (\*\*+)**

The juice of 10 cartons of orange, each containing 2 litres of juice, correct to the nearest 10 ml, is to be poured into cups.

Each cup holds 210 ml, correct to the nearest 5 ml.

Determine the largest number of cups that can be filled.

96

Handwritten solution for Question 2:

- EACH BOTTLE 2L = 2000 ml, MINUS 10 ml  $\Rightarrow$  1990 ml
- EACH CUP 210 ml, MINUS 5 ml  $\Rightarrow$  205 ml
- 10 bottles  $\times$  2000 = 20000 ml
- 20000  $\div$  205 = 96.622...
- $\therefore$  96 cups

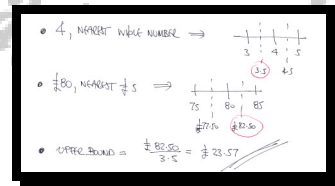
**Question 3 (\*\*+)**

A builder paid £80 for the delivery of  $4 \text{ m}^3$  of sand.

The amount he paid is known to be correct to the nearest £5 and the volume of sand is correct to the nearest  $\text{m}^3$ .

Determine the maximum cost of  $1 \text{ m}^3$  of sand.

**£23.57**

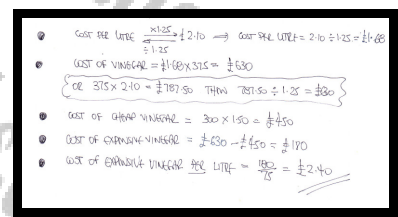
**Question 4 (\*\*+)**

A wholesale vinegar merchant bought 300 litres of vinegar at £1.50 a litre and 75 litres of a more expensive vinegar.

He mixed the two types of vinegar and sold it for £2.10 per litre, making a profit of 25%

Find how much he paid per litre for the more expensive vinegar.

**£2.40**



Question 5 (\*\*\*)

- 2 apples and 1 banana cost 77 pence.
- 1 apple and 2 bananas cost 85 pence.

Find how much money each fruit costs.

Apple : 23p , Banana : 31p

Handwritten solution for Question 5:

$$\begin{aligned} 2 \text{ Apples} + 1 \text{ Banana} &= 77p \\ 1 \text{ Apple} + 2 \text{ Bananas} &= 85p \\ \hline \text{So } 3 \text{ Apples} + 3 \text{ Bananas} &= 162p \\ \text{So } 1 \text{ Apple} + 1 \text{ Banana} &= 54p \quad (\div 3) \\ \text{And } 1 \text{ Apple} + 2 \text{ Bananas} &= 85p \\ \hline \therefore 1 \text{ Banana} &= 85 - 54 = 31p \\ 1 \text{ Apple} &= 54 - 31 = 23p \end{aligned}$$

Question 6 (\*\*\*)

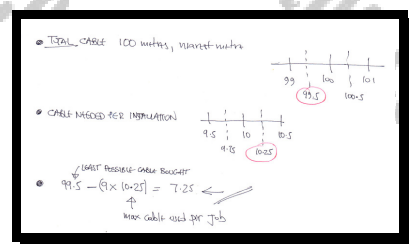
A telecom engineer bought a new reel of cable to use in his next few satellite installations.

The reel contains 100 metres of cable, correct to the nearest metre.

Each satellite installation uses 10 metres of cable, correct to the nearest half metre.

Determine the **least possible** amount of cable left in the reel after 9 satellite dish installations.

7.25 m



**Question 7 (\*\*\*)**

Machine  $A$  is three times as fast as machine  $B$  in soldering computer motherboards.

Machine  $A$  is allocated three and a half times as many motherboards to solder than is allocated to machine  $B$ .

Machine  $B$  took four hours to complete its allocation.

Determine in hours and minutes the time it took machine  $A$  to complete its allocation.

4 hours – 40 minutes

- MACHINE B TOOK 4 HOURS
- IF MACHINE A HAD THE SAME SPEED, IT WOULD HAVE TAKEN  $4 \times 3.5 = 14$  HOURS TO COMPLETE ITS ALLOCATION
- BUT MACHINE A IS THREE TIMES FASTER, SO IT TAKES  $14 \div 3 = \frac{14}{3} = 4\frac{2}{3}$  HOURS, I.E. 4 HOURS &  $\frac{2}{3}$  OF AN HOUR  
 $\therefore$  4 HOURS – 40 MINUTES

**Question 8 (\*\*\*)**

A sample of people were surveyed and asked how many cups of coffee they consumed in a typical day.

The following information is known for this survey.

- The replies were 0, 1, 2, 3 or 4 cups of coffee.
- 50% of the people surveyed consumed no coffee.
- 135 people consumed “2 cups a day”.
- In a standard pie chart the sector that represents the “4 cups a day” is  $18^\circ$ .
- The number of people that consumed “1 cup a day” is four times as large as that of those who consumed “4 cups a day”.
- The number of people that consumed “1 cup a day” is twice as large as that of those who consumed “3 cups a day”.

Determine the number of people that took part in the survey.

900

NUMBER OF CUPS	%	DEGREES	PEOPLE
0	50%		
1			
2		135	
3			
4		18°	

ANAL: FR ① IS  $18^\circ$   
 ANAL: FR ② IS  $18^\circ \times 4 = 72^\circ$   
 ANAL: FR ③ IS  $72^\circ \div 2 = 36^\circ$   
 ANAL: FR ④ IS  $360 - (50 + 18 + 36 + 72) = 54^\circ$   
 FINALLY  
 $54^\circ : 135$   
 $18^\circ : 45$   
 $36^\circ : 90$   
 $360^\circ : 900$   $\therefore 900$  people

### Question 9 (\*\*\*)

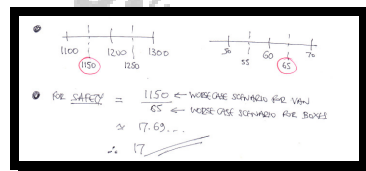
A courier is about to transport boxes in his van.

Each box has a label which reads “typical weight 60 kg”, which is known to be correct to 1 significant figure.

The van has a safety notice which reads “maximum load 1200kg”, which is thought to be correct to 2 significant figures.

Find the **largest** number of boxes that can be **safely** loaded into the van.

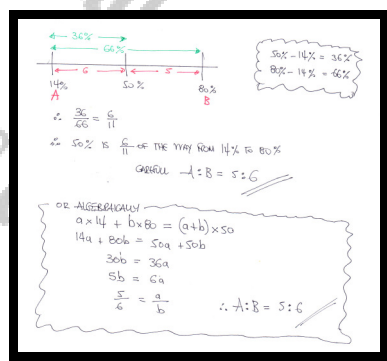
17



**Question 10 (\*\*\*\*)**

Chemicals solutions  $A$  and  $B$  contain hydrochloric acid at concentrations of 14% and 80%, by volume.

In what ratio must the two solutions be mixed, so that the resulting solution has hydrochloric acid at a concentration of 50% by volume

$$A : B = 5 : 6$$


**Question 11** (\*\*\*\*)

A painter and his helper agreed to complete a job in 35 days.

The helper does 60% of the amount of work that the painter does per day.

The painter produces the same amount of work every day. The helper produces the same amount of work every day.

The painter and his helper were working together until the end of the 10<sup>th</sup> day.

The helper broke his hand and from the 11<sup>th</sup> day onwards the painter was working by himself, continuing to work at the same rate as before.

Determine by how many days the job was delayed.

15

IN ONE DAY BOTH WORKERS PRODUCE "1/6 DAYS' WORTH OF WORK"  
 $\therefore 35 \times \frac{1}{6} = 5\frac{5}{6}$  days' worth of work to do  
IN 10 DAYS  $10 \times \frac{1}{6} = 1\frac{2}{3}$  days' worth has been completed  
 $\therefore 5\frac{5}{6} - 1\frac{2}{3} = 4\frac{1}{2}$  days left  
 $\therefore 10 + 4\frac{1}{2} = 14\frac{1}{2}$   
 $35 - 14\frac{1}{2} = 20\frac{1}{2}$  EXTRA DAYS



**Question 12 (\*\*\*\*)**

The 300 Year 11 pupils of a certain school are classed as “outstanding”, “good”, “average” or “poor”.

The following information is also available about these pupils.

- In a standard pie chart the sector that represents the “good” pupils is  $72^\circ$ .
- The “poor” pupils are as many as the “good” and “outstanding” pupils added together.
- There are four times as many “average” pupils as “outstanding” ones.

Determine the number of students in each class.

$$O = 30, \quad G = 60, \quad A = 120, \quad P = 90$$

Outstanding  
Gross  $\leftarrow 72 \frac{1}{360} = \frac{1}{3} = 60$   
Financing  
Per

• Let  $x = \text{outstanding}$   
Then  $4x = \text{average}$   
Then  $2460 = \text{per}$

•  $\frac{2 \cdot 4x + 2460}{4x} = 300$   
 $\frac{4x + 1230}{x} = 180$   
 $4x + 1230 = 180x$   
 $1230 = 176x$   
 $x = 6.99$

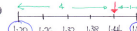
•  $\text{outstanding} = 30 \leftarrow 2$   
 $\text{GROSS} = 60 \leftarrow 72 = \frac{1}{360} \cdot 300$   
 $\text{AVERAGE} = 120 \leftarrow 4x$   
 $\text{PER} = 90 \leftarrow 2 + 60$

**Question 13 (\*\*\*\*)**

A wholesale vinegar merchant bought some vinegar at £1.20 a litre and a more expensive vinegar at £1.50 per litre.

At what ratio must he mix the two types of vinegar so he can sell it at £2.16 per litre, making a profit of 50%?

4:1

②  $\$216 \div 1.50 = \$144 \leftarrow$  COST PER LITER OF THE VIRGINE ROSE WINE  
  
 ③  $1.40 - 1.20 = 0.20$   
 $\frac{0.20}{0.30} = \frac{2}{3}$   
 ④ THE REQUIRED RATIO IS  
 COMPARE : CHAMP  
 $4 : 1$

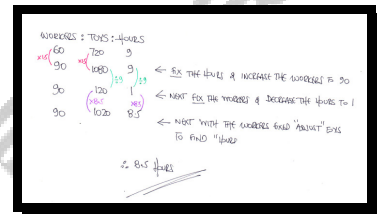
OR FORMULAY 2 PARTS : 1 PARTS (COMPARE : CHAMP)  
 $2x + 1.50 + y = 1.20 = (2x + y) \times 1.44$   
 $150x + 120y = 144(2x + y)$   
 $150x + 120y = 144x + 144y$   
 $6x = 24y$   
 $x = 4y$   
 $\frac{x}{y} = 4$   
 $\therefore$  EXPENDITURE : CHAMP =  $4 : 1$

**Question 14** (\*\*\*\*)

In a factory it has been established that 60 workers produce 720 toys in 9 hours.

Determine in how many hours, will 90 workers produce 1020 toys.

8.5



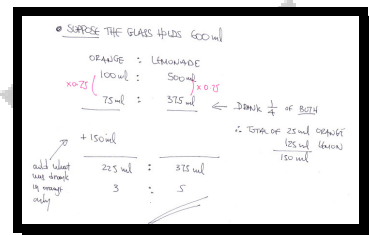
**Question 15** (\*\*\*\*)

Orange juice and lemonade are mixed in a glass in the ratio of 1:5.

After one quarter of the contents of the glass were consumed, the glass was topped up with orange juice.

What is the new ratio of orange juice to lemonade?

3:5

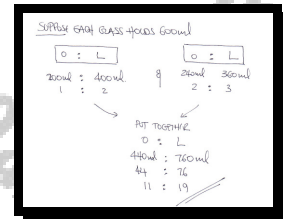


**Question 16 (\*\*\*\*)**

Two glasses, with identical capacities, contain orange juice and lemonade at the ratios of 1:2 and 2:3, respectively.

What is the resulting ratio of orange juice to lemonade, if the contents of both glasses were poured into a bigger glass?

11:19



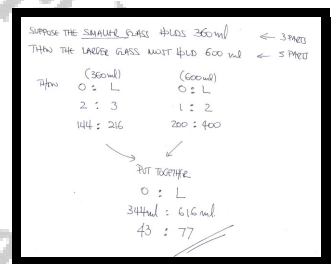
**Question 17 (\*\*\*\*)**

The capacities of two glasses are in the ratio 5:3.

The glasses contain orange juice and lemonade mixed in the ratios of 1:2 and 2:3, respectively.

What is the resulting ratio of orange juice to lemonade, if the contents of both glasses were poured into a bigger glass?

43:77



## Question 18 (\*\*\*\*)

In the Year 11 of a school there are twice as many boys doing triple science as girls.

$\frac{1}{4}$  of the boys that do triple science also do foreign languages.

$\frac{3}{5}$  of the girls that do triple science also do foreign languages.

- a) Find the fraction of the students that do triple science that also do foreign languages.

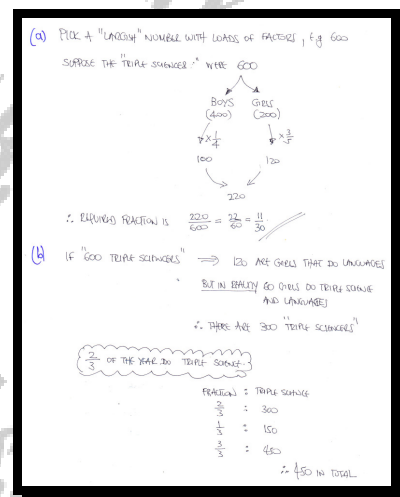
It is now given that ...

... there are 60 girls doing triple science and foreign languages.

...  $\frac{2}{3}$  of the total number of students in the year 11 do triple science.

- b) Determine the total number of students in Year 11.

$$\boxed{\frac{11}{30}}, \boxed{450}$$



**Question 19 (\*\*\*\*)**

Andrew and Bethany are preparing for a Mathematics exam by doing the same set of practice papers.

They both have one practice paper left to do and their mean scores are identical.

Andrew scores 83% on his last paper and his mean score rises to 72%.

Bethany scores 47% on her last paper and her mean score drops to 69%.

Determine the number of practice papers in the set.

$$n = 12$$

Handwritten solution for Question 19:

Let  $n$  = be the number of papers in total  
 Let  $T$  = be the common total after  $n$  papers

$$A: \frac{T + 83}{n} = 72 \quad \left. \begin{array}{l} T + 83 = 72n \\ T + 47 = 69n \end{array} \right\} \rightarrow$$

$$B: \frac{T + 47}{n} = 69$$

$$\frac{T + 83}{T + 47} = \frac{72n}{69n} \rightarrow \frac{72n - 83}{69n - 47} = \frac{72}{69}$$

$$34 = 36$$

$$n = 12$$

**Question 20 (\*\*\*\*)**

Three children Arnie, Barnie and Carnie have been saving pound coins in their piggy banks. The following information is known about their savings.

- The total money Arnie and Barnie have saved is £41
- The total money Barnie and Carnie have saved is £38
- The total money Arnie and Carnie have saved is £53

Find how much money each kid saved.

Arnie : £28 , Barnie : £13 , Carnie : £25

Handwritten solution for Question 20:

$$\begin{aligned} \text{Arnie} + \text{Barnie} &= \pounds 41 \\ \text{Barnie} + \text{Carnie} &= \pounds 38 \\ \text{Arnie} + \text{Carnie} &= \pounds 53 \end{aligned}$$

$$(\text{Arnie} + \text{Barnie}) + (\text{Barnie} + \text{Carnie}) + (\text{Arnie} + \text{Carnie}) = \pounds 41 + \pounds 38 + \pounds 53$$

$$\text{Arnie} + \text{Arnie} + \text{Barnie} + \text{Barnie} + \text{Carnie} + \text{Carnie} = \pounds 132$$

$$2[\text{Arnie} + \text{Barnie} + \text{Carnie}] = \pounds 132$$

$$\text{Arnie} + \text{Barnie} + \text{Carnie} = \pounds 66$$

$$\text{Arnie} + \text{Barnie} = \pounds 41$$

$$\therefore \text{Carnie} = \pounds 66 - \pounds 41 = \pounds 25$$

$$\text{Barnie} = \pounds 38 - \pounds 25 = \pounds 13$$

$$\text{Arnie} = \pounds 41 - \pounds 13 = \pounds 28$$

**Question 21 (\*\*\*\*)**

- 1 apple and 1 pear cost 52 pence.
- 1 apple and 1 banana cost 54 pence.
- 1 banana and 1 pear cost 58 pence.

Find how much money each fruit costs.

Apple : 24p , Banana : 30p , Pear : 28p

Handwritten solution for Question 21:

$$\begin{aligned} \text{Apple} + \text{Pear} &= 52\text{p} \\ \text{Apple} + \text{Banana} &= 54\text{p} \\ \text{Banana} + \text{Pear} &= 58\text{p} \end{aligned}$$

So  $2 \times \text{Apple} + 2 \times \text{Banana} + 2 \times \text{Pear} = 164\text{p}$

$$1 \times \text{Apple} + 1 \times \text{Banana} + 1 \times \text{Pear} = 82\text{p} \quad (\div 2)$$

$$\text{But } 1 \times \text{Apple} + 1 \times \text{Banana} = 54\text{p}$$

$$\text{So } 1 \times \text{Pear} = 82\text{p} - 54\text{p} = 28\text{p}$$

$$1 \times \text{Apple} = 52\text{p} - 28\text{p} = 24\text{p}$$

$$1 \times \text{Banana} = 58\text{p} - 28\text{p} = 30\text{p}$$

**Question 22 (\*\*\*\*)**

In a cinema adult tickets cost £10 each while child tickets cost £6.

For a certain film there were 125 people in the cinema, having paid in total £878.

Find how many adults and how many children were watching this film?

93 children and 32 adults

**SUPPOSE ALL 125 WERE KIDS**

- THEN THEY WOULD HAVE PAID  $6 \times 125 = \pounds 750$
- BUT THEY PAID  $\pounds 878$  INSTEAD
- THIS MUST BE DUE TO THE "EXTRA  $\pounds 4$ " THAT EACH ADULT PAYS
- $\pounds 128 \div 4 = 32$  —
- $\therefore 32$  ADULTS & 93 KIDS

**SUPPOSE ALL 125 WERE ADULTS**

- THEN THEY WOULD HAVE PAID  $\pounds 1250$
- BUT THEY PAID  $\pounds 878$  INSTEAD
- THIS MUST BE DUE TO THE "EXTRA  $\pounds 4$ " THAT EACH KID PAYS
- $\pounds 372 \div 4 = 93$
- $\therefore 93$  KIDS & 32 ADULTS

**ALGEBRAICALLY BY ALGEBRA**

$a = \text{adult}$   
 $c = \text{child}$

$$\begin{aligned} a + c &= 125 \\ 10a + 6c &= 878 \end{aligned} \Rightarrow \begin{aligned} c &= 125 - a \\ 10a + 6(125 - a) &= 878 \\ 10a + 750 - 6a &= 878 \\ 4a &= 128 \\ a &= 32 \\ \therefore c &= 93 \end{aligned}$$

**Question 23 (\*\*\*\*+)**

Sulphuric acid is a colourless liquid which can be diluted with water.

Pure sulphuric acid is to be added to a 200 ml water solution, which also contains sulphuric acid of concentration 15% by volume.

How many ml of pure sulphuric acid must be added so that the resulting solution contains sulphuric acid of concentration 32% by volume.

50 ml

- LET  $x$  BE THE SULPHURIC ACID TO BE ADDED, IN ml
- ORIGINAL SOLUTION OF 200 ml CONTAINS 15% ACID, i.e. 30 ml

THIS  $\frac{30+x}{200+x} = \frac{32}{100}$

$$\begin{aligned} 3000 + 100x &= 6400 + 32x \\ 68x &= 3400 \\ x &= 50 \end{aligned}$$

$\therefore 50$  ml

**Question 24** (\*\*\*\*+)

Two towns,  $A$  and  $B$ , are connected by a straight direct road of length  $400$  km.

At  $08:00$  a car leaves  $A$ , travelling with constant speed, arriving at  $B$  at  $14:40$ .

At  $08:15$  another car leaves  $B$ , also travelling with constant speed, arriving at  $A$  at  $13:15$ .

Determine ...

... the time when the cars go past each other.

... the distance from  $A$  when the cars go past each other.

**11:00**, **180 km**

**CAR A**  
 STARTS AT 08:00  
 ARRIVES AT 14:40  
 $\downarrow$   
 6 hours - 40'  
 $6 \frac{2}{3}$  hours  
 $\frac{20}{3}$  hours  
 $\bullet 400 \text{ km in } \frac{20}{3} \text{ hours}$   
 $\frac{3600}{20} \times \frac{400}{3} = \frac{3600 \times 400}{20 \times 3} = 60 \text{ km/h}$

**CAR B**  
 STARTS AT 08:15  
 ARRIVES AT 13:15  
 $\downarrow$   
 5 hours EXACTLY  
 $\bullet 400 \text{ km in 5 hours}$   
 $\text{SPEED} = \frac{400}{5} = 80 \text{ km/h}$

**MEETING AT 08:15**  
 CAR A:  $\frac{1}{3} \text{ hours} \times 60 = 15 \text{ km}$   
 $400 - 15 = 385 \text{ km}$  REMAINING WHEN B ALSO STARTS

KNOW WHEN THEY MEET, DISTANCE IS "COVERED"  
 AT THE RATE OF  $40 \text{ km} + 80 \text{ km} = 120 \text{ km}$   
 (SOME ONES - HOW TOWARDS EACH OTHER)  
 $\text{TIME} \quad 385 \div 120 = \frac{385}{120} = \frac{77 \times 5}{24 \times 5} = \frac{77}{24} = 3 \frac{1}{24} \text{ hours}$   
 SO CARS GO PAST EACH OTHER  $2 \frac{1}{2}$  hours AFTER 08:15  
 i.e.  $3 \frac{1}{24} + 2 \frac{1}{2} = 11$  i.e. AT 11:00

$\therefore$  DISTANCE FROM TOWN A IS  $15 \text{ km} + \left(\frac{1}{24} \times 60\right) = 15 + 2.5 = 17.5 \text{ km}$



**Question 25** (\*\*\*\*+)

A train travelling at constant speed, takes 14 seconds to cross a bridge of length 240 metres and 6 seconds to go past a lamp post.

Determine the speed and the length of the train.

$$\boxed{\text{speed} = 12 \text{ ms}^{-1}}, \quad \boxed{\text{length} = 180 \text{ m}}$$

THE DIFFERENCE IN THE TIMES IS DUE TO THE LENGTH OF THE TRAIN  
HAVING TO CROSS THE BRIDGE LENGTH OF 240m  
 $\therefore \text{SPEED OF TRAIN IS } \frac{240\text{m}}{6\text{s}} = 30 \text{ ms}^{-1} \quad (= 108 \text{ km h}^{-1})$   
 LENGTH OF TRAIN IS  $6 \times 30 = 180 \text{ m}$

**Question 26** (\*\*\*\*+)

40 soldiers in a camp, have food supplies which can last them for 30 days.

After 10 days 20 soldiers left the camp, without taking any food supplies.

After a further period of 10 days, another 10 soldiers arrived in the camp, without bringing with them any food supplies.

The food supplies in the camp are now rationed by 20%, in order to sustain all the 30 soldiers for as long as possible.

The food supplies run out  $d$  days after the arrival of these 10 soldiers.

Determine the value of  $d$ .

$$\boxed{15}, \quad \boxed{d = 25}$$

- LET THE INITIAL DAILY SUPPLIES BE  $x$  UNITS, 40 SOLDIERS RATIONED BY 20% THEY WILL DROP TO  $4x$  PER DAY
- INITIAL SUPPLIES:  $40 \times 30 \times x = 1200x$  UNITS AVAILABLE
- AFTER 10 DAYS:  $40 \times 10 \times x = 400x$  UNITS CONSUMED IN THE FIRST 10 DAYS  
 $1200x - 400x = 800x$  UNITS LEFT
- 20 SOLDIERS LEFT (AS 20 WERE LEFT), FOR ANOTHER 10 DAYS  
 $20 \times 10 \times x = 200x$  UNITS WERE CONSUMED
- THIS AFTER 20 DAYS THERE ARE  $600x$  UNITS LEFT
- NOW THERE ARE 30 SOLDIERS, WITH FOOD RATIONED BY 20%  
 $\Rightarrow 30 \times d \times 4x = 600x$   
 $\Rightarrow 120d = 600$   
 $\Rightarrow d = 5$

**Question 27 (\*\*\*\*\*)**

The parliament of a particular country consists entirely of representatives of two political parties, the Preservative Party and the Vapour Party.

Before last night's General Elections the Preservative Party had 4 times as many representatives as the Vapour Party. As a result of last night's General Elections the Preservative Party has 64 fewer representatives than before which now means that the Preservative Party had twice as many representatives as the Vapour Party.

Determine the total number of representatives in this parliament.

240

LET THE TOTAL BE T

BEFORE	AFTER
$P : V$	$P : V$
$4 : 1$	$2 : 1$
$\uparrow \quad \uparrow$	$\uparrow \quad \uparrow$
$\frac{4}{3}T \quad \frac{1}{3}T$	$\frac{2}{3}T \quad \frac{1}{3}T$

• "LEAD" BEFORE ELECTION  
 $\frac{4}{3}T - \frac{1}{3}T = \frac{3}{3}T$

• "LEAD" AFTER ELECTION  
 $\frac{2}{3}T - \frac{1}{3}T = \frac{1}{3}T$

• "LEAD" DECREASED BY 64  
 $\Rightarrow \frac{3}{3}T - \frac{1}{3}T = 64$   
 $\Rightarrow (\frac{3}{3} - \frac{1}{3})T = 64$   
 $\Rightarrow \frac{2}{3}T = 64$   
 $\Rightarrow T = \frac{64 \times 3}{2}$   
 $\Rightarrow T = 240$

ALTERNATING BY TRIAL QUANTITY AKA "THE SUPPOSE METHOD"

- "SUPPOSE" THE PARLIAMENT HAD 3000 MEMBERS (LARGE NUMBER WHICH HAS LOTS OF ZEROS)
- BEFORE THE ELECTION  $4:1 \Rightarrow 2400 \leftarrow P$   
 $750 \leftarrow V$   
 $2400 \leftarrow \text{TOTAL}$
- AFTER THE ELECTION  $2:1 \Rightarrow 2400 \leftarrow P$   
 $1200 \leftarrow V$   
 $1200 \leftarrow \text{LEAD AFTER}$
- LEAD REDUCTION IS  $2400 - 1200 = 1200$
- IF TOTAL = 3000, CUT IN LEAD WOULD HAVE BEEN 960
- BUT ACTUAL LEAD IS CUT BY 64!
- $960 \div 64 = 15$
- $\therefore 3000 - 15(3) = 2400$  AS ANSWER

**Question 28 (\*\*\*\*)**

Two walkers,  $A$  and  $B$ , start their walk at the point  $P$  and at the same time.

They both walk in the same direction along a straight horizontal road, each with constant speed.

The points  $Q$  and  $R$  lies on that road so that  $|PQ| = 1 \text{ km}$  and  $|QR| = 3 \text{ km}$ .

Walker  $B$  passes through  $Q$  60 s after walker  $A$  passed through  $Q$ .

When walker  $A$  passes through  $R$ , walker  $B$  is 400 m behind  $A$ .

Determine the speeds of the two walkers, in  $\text{km h}^{-1}$ .

$$V_A = 6\frac{2}{3} \text{ km h}^{-1}, \quad V_B = 6 \text{ km h}^{-1}$$

**Diagram:** A horizontal line represents a road. Point P is at the left end. Point Q is 1 km to the right of P. Point R is 4 km to the right of P (1 km PQ + 3 km QR). Distances are labeled: 1 km between P and Q, and 4 km between P and R.

**Let:**

- Let the speed of  $A$  be  $V$
- Let the speed of  $B$  be  $U$
- Let the time  $A$  takes to cover the first 1000 m be  $T_1$
- Let the time  $A$  takes to cover 4000 m be  $T_2$

**Looking at the journey from P to Q:**

$$VT_1 = 1000$$

$$U(T_1 + 60) = 1000$$

**Looking at the journey from P to R:**

$$VT_2 = 4000$$

$$U(T_2 - 60) = 3000 \text{ (4000 behind)}$$

**Eliminate Times:**

$$\frac{VT_1}{U(T_1 + 60)} = 1$$

$$\Rightarrow \frac{10}{U(T_1 + 60)} = 1$$

$$\Rightarrow 10T_1 = 9T_1 + 540$$

$$\Rightarrow T_1 = 540$$

**We can now find the speeds:**

- $VT_1 = 1000$   
 $540V = 1000$   
 $V = \frac{10}{54} \text{ ms}^{-1}$   
 $\downarrow \times \frac{3600}{1000}$   
 $\downarrow \frac{36}{54}$   
 $6\frac{2}{3} \text{ km h}^{-1}$
- $U(T_1 + 60) = 1000$   
 $600U = 1000$   
 $U = \frac{5}{3} \text{ ms}^{-1}$   
 $\downarrow \times \frac{3600}{1000}$   
 $6 \text{ km h}^{-1}$