



## Calculations

*Always use a calculator*

## Percentages

To calculate a number as a percentage. Divide the number you are trying to find by the total and multiply by one hundred. Eg dividing your test score by the total.

$$22 \text{ out of } 30 = 22/30 \times 100 = 73\%$$

## Percentage change (% increase or % decrease)

**Calculate the change** ( increase or decrease) then divide answer by the original value.

This fraction must then be multiplied by 100 to convert it to a percentage.

Eg. 50 bacteria at the start, after 5 hours they had multiplied to 700. What is the percentage change in number?          Difference =  $700 - 50 = 650$ .

$$\text{Divide by the starting value of } 50 = 13$$

$$\text{Multiply fraction } \times 100 = 13 \times 100 = 1300\%$$

## Averages

**Add** all the values (numbers) together and **divide** by how many you have added.

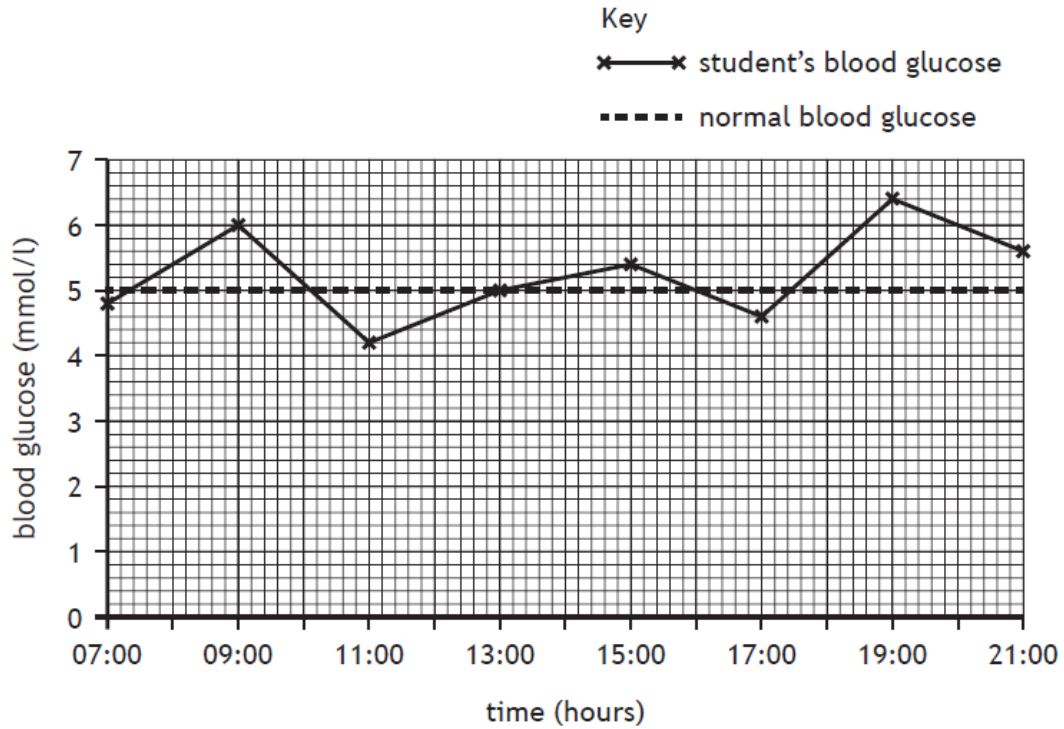
Eg. Find average of 10, 15 and 5.

$$10 + 15 + 5 = 30$$

Divide 30 by 3 (because 3 numbers were added)

$$\text{Average} = 10.$$

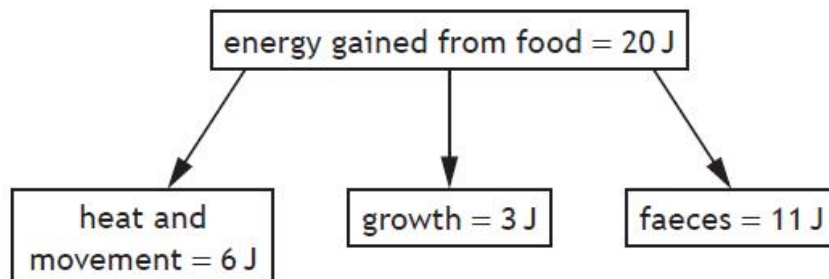
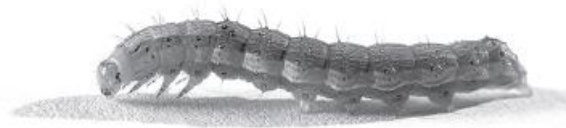
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Calculate the percentage decrease in blood glucose between 09:00 and 11:00 hours.

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2. The diagram shows the fates of 20 joules (J) of energy gained by a caterpillar from food.



Calculate the percentage of the caterpillar's energy intake that is used for growth.

1



3. Antibiotic drugs are only effective in the treatment of bacterial infections. They either kill or prevent the growth of bacteria. Sometimes antibiotics are given but do not have any effect on the particular infection.

The table gives information about the number of cases treated with antibiotics and the success rate for a range of infections.

Type of infection	Number of these cases treated with antibiotics (millions)	Number of these cases successfully treated with antibiotics (millions)	Success rate (%)
ear	23	16.1	70
common cold	18	0	0
chest	16	3.2	20
throat	15		48

Complete the table by calculating the number of cases of throat infections successfully treated with antibiotics.

1

4. A gardener treated the soil in the area where he planted vegetables with a chemical to increase the yield.

When the vegetables were picked and weighed, the total yield was 42 kilograms. The previous year the total yield was 35 kilograms.

Calculate the percentage increase in yield.

1



5. Nutritional information helps people make an informed choice about the food they eat.

Table 1 – Label from a bar of chocolate

<i>Nutritional information</i>	<i>per 100 g</i>	<i>per bar</i>	<i>% RI*</i>
Energy (kJ)	2251	630	7.5
Sugar	65 g	18 g	15.6
Protein	10 g	2.8 g	3
Total fat	25 g	7 g	10
Saturated fat	20 g	5.6 g	28
Salt	0.4g	0.1 g	1.7

\*RI = Reference Intake (formerly “guideline daily amount”)

- (i) As shown in Table 1, saturated fat makes up part of the total fat in this chocolate bar.

Calculate the percentage of total fat which is saturated.

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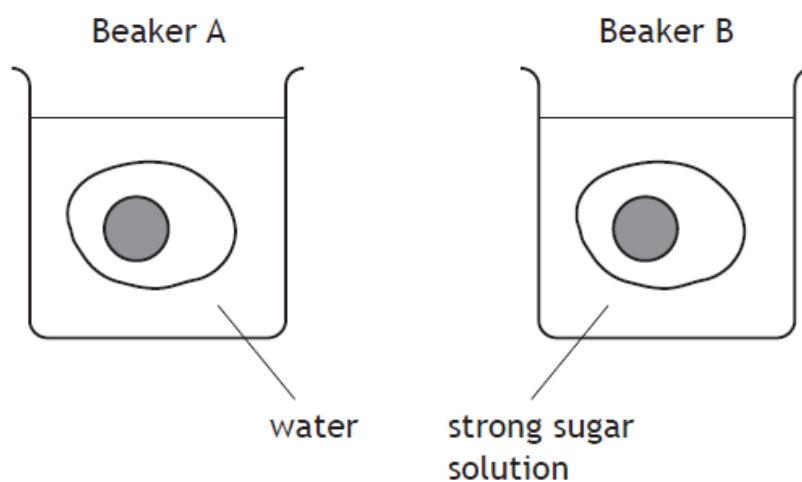
- (ii) One bar of this chocolate contains 630 kilojoules which is 7.5% of the reference intake (RI).

Calculate the total number of kilojoules which should be consumed daily.

1

6. Shells can be removed from eggs by dissolving them in vinegar for 2–3 days. The egg contents remain inside a thin membrane.

In an investigation the shells from two eggs were removed. The eggs were then weighed and placed in beakers as shown below.



After 2 hours the eggs were removed from the beakers, blotted dry and reweighed. The results are shown in the following table.

<i>Beaker</i>	<i>Mass at start (g)</i>	<i>Mass after 2 hours (g)</i>	<i>Percentage change in mass</i>
A	54.0	67.5	
B	52.1	47.8	-8.2

Complete the table by calculating the percentage change in mass for beaker A.



7. Researchers have discovered an advantageous genetic mutation that causes high bone density in humans.

One man in the USA was discovered to possess this mutation after he walked away without injury from a serious car crash. Further studies have found several members of the same extended family with this mutation.



20 members of the family provided blood samples for DNA and biochemical testing. 7 of them were found to have high bone density. The same tests were performed on another group of 20 unrelated individuals with normal bone density.

The location of the gene mutation was able to be identified and it is hoped that the findings will help in developing medications to increase bone density for the treatment of conditions such as osteoporosis.

Calculate the percentage of the family who did not have the mutation for high bone density.

1

8. The table gives information on the numbers of mitochondria in different types of mammalian cells.

Cell type	Number of mitochondria per cell			
	Cell 1	Cell 2	Cell 3	Average
Muscle	1352	1203	1450	1335
Skin epithelium	250	330	275	
Lymphocyte	953	1112	860	975

- (i) Complete the table by calculating the average number of mitochondria per cell in skin epithelium.

1



9. Ions move in and out of cells by passive and active processes.

The table shows the concentration of three ions outside and inside a human cell.

Ions	Outside cell (mM)	Inside cell (mM)
Sodium ( $\text{Na}^+$ )	145	12
Potassium ( $\text{K}^+$ )	4	139
Chloride ( $\text{Cl}^-$ )	116	4

Calculate how many times greater the concentration of chloride ions is outside the cell compared to inside the cell.

1

10. The field of view of a light microscope measures 2 mm in diameter.  
20 plant cells were counted in a line across the diameter.

1 mm = 1000 micrometres

Calculate the average size of a cell in micrometres.

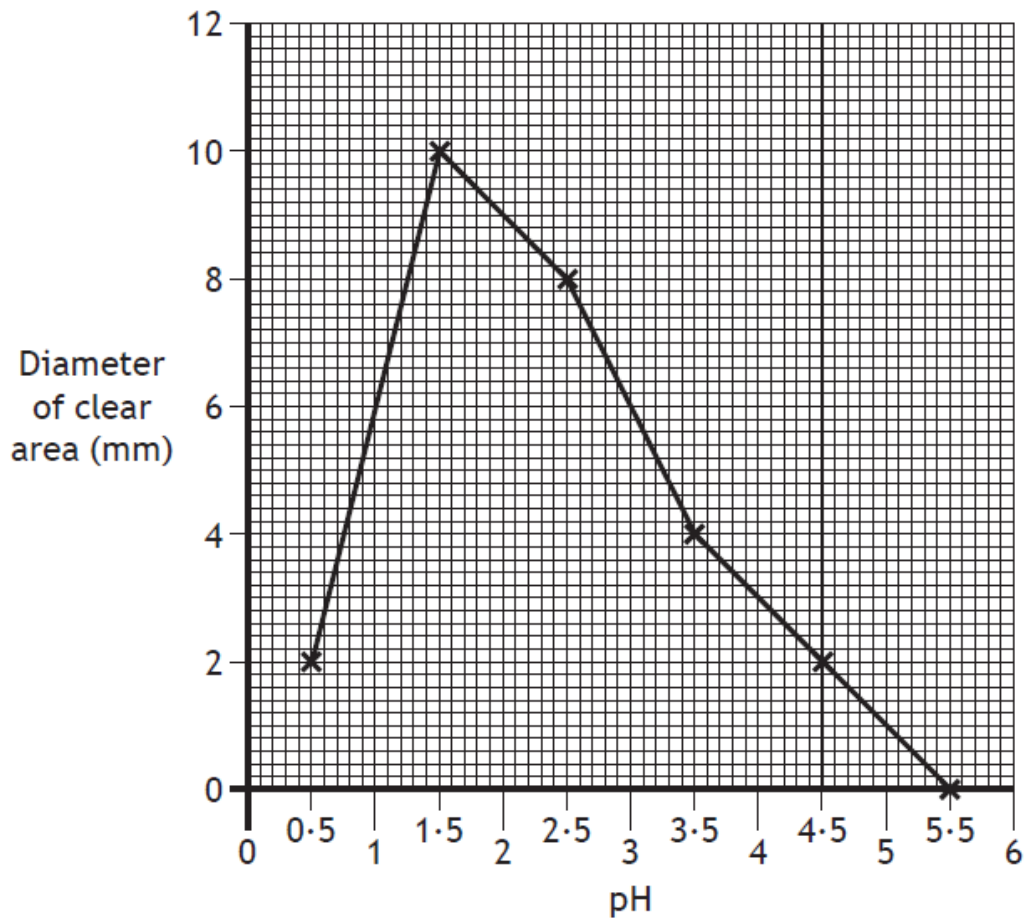
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11. An investigation was carried out into the effect of pH on the activity of the enzyme pepsin.

When the protein is broken down, cloudy agar becomes clear.

The results are shown in the graph.

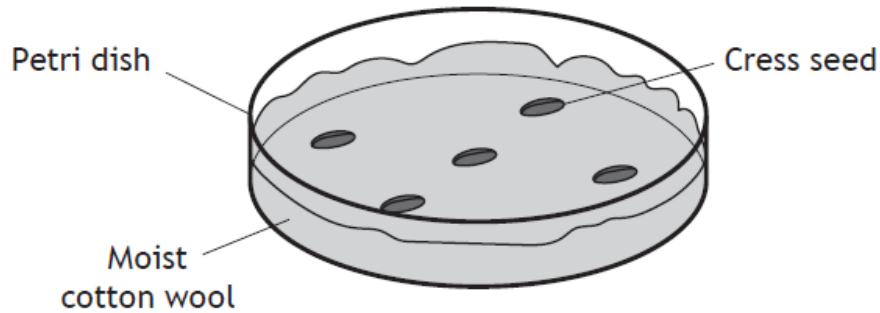


Calculate how many times more active the enzyme is at pH 2.5 than at pH 4.5.



12. To investigate the effect of competition on the growth of cress seeds, five Petri dishes, labelled A–E, were set up and left for six days. Each dish contained a layer of moist cotton wool with different numbers of cress seeds sown evenly across its surface.

Dish A is shown in the diagram.



The results are shown in the table.

<i>Dish</i>	<i>Number of seeds sown</i>	<i>Number of seedlings surviving after six days</i>	<i>Percentage of seedlings surviving after six days</i>
A	5	5	100
B	10	10	100
C	20		95
D	40	34	85
E	80	60	75

Complete the table by calculating the number of seedlings surviving in Dish C.



13. The distribution of organisms may be affected by abiotic factors.

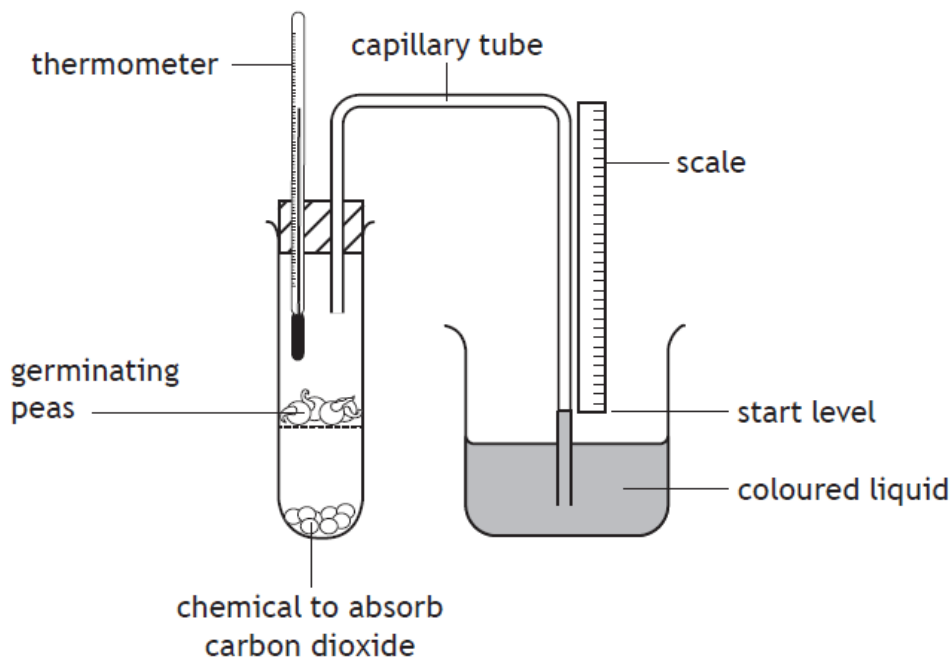
The table shows the results of a study into the effect of soil moisture levels on the distribution of three species of plant.

<i>Sample site</i>	<i>Soil moisture (units)</i>	<i>Number of plants</i>		
		<i>Species E</i>	<i>Species F</i>	<i>Species G</i>
1	20.2	11	15	12
2	23.4	13	14	11
3	22.1	12	16	10
4	24.5	15	17	15
5	26.6	18	13	12
6	28.4	19	15	14

Calculate the average number of plants per sample site for species F.

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14. A student investigated the effect of temperature on the rate of respiration in germinating (growing) peas. Using the arrangement shown, four respirometers labelled A–D were set up at the temperatures shown in the table below.



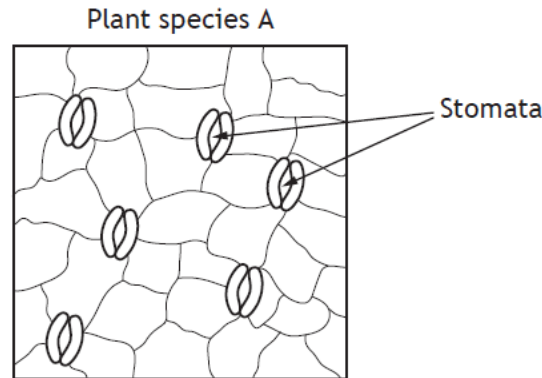
The level of the coloured liquid was measured on the scale at the start of the investigation and again after 20 minutes. The rise in liquid level was due to oxygen uptake by the germinating peas. The results are shown in the table.

Respirometer	Temperature (°C)	Contents	Rise in liquid level (mm)	Rate of oxygen uptake (mm per minute)
A	15	Germinating peas	14	0.7
B	15	Dead peas	0	0
C	25	Germinating peas	26	
D	25	Dead peas	0	0

Complete the table above by calculating the rate of oxygen uptake per minute by the peas in respirometer C.

15. A student investigated the link between transpiration rate and the number of leaf stomata.

A microscope was used to look at the number of stomata on a leaf surface of plant species A as shown.



The area shown on the diagram above measures  $0.04 \text{ mm}^2$ .

Calculate the expected number of stomata present in  $1 \text{ mm}^2$  on this leaf surface.

1

16. Certain varieties of potato plant are eaten by beetles, reducing the yield of potatoes. A beetle-resistant variety of potato plant was developed.

In an investigation, the beetle-resistant variety was grown outdoors in one field and the non-resistant variety grown in another.

The yields of both varieties were recorded and the results are shown in the graph below.



Calculate the difference in yield between the two varieties.

1



17. Environmental scientists carried out a study on lichen species at four different sites and obtained the results shown in the table below.

Site	Number of lichen species present		
	Shrubby	Leafy	Crusty
A	0	5	19
B	3	2	0
C	16	3	0
D	7	14	2

Calculate the average number of leafy lichen species present at the four sites.

1

18. In an investigation, students estimated the population and biomass of some organisms found on part of a rocky shore.

The table below shows the results.

Organism	Population	Average mass of one organism (g)	Biomass of population (g)
Seaweed	220	500	110 000
Limpet	1 100		33 000
Crab	100	90	9 000
Gull	5	700	3 500

Complete the table to show the average mass of one limpet.

1



19. A group of students carried out a five year investigation into plant growth in an area of abandoned farmland.

They sampled the area using quadrats.

The results are shown in the table below.

Year	Average abundance of each plant		
	Meadow grass	Ragwort	Pink campion
2011	8	15	9
2012	16	14	7
2013	24	12	4
2014	25	8	2
2015	25	5	1

Calculate the average decrease per year in the abundance of ragwort over the five-year period.

1

20. During a reflex action, the speed at which the information flows was measured to be 90 metres per second.

Calculate how long it would take for the information to complete a reflex arc which was 0.9 m in length.

1



21. Five leaves were collected from a horizontal stem and another five from a vertical stem. The widths of the leaves were measured and the results are shown in the table below.

leaf	Leaf width (mm)	
	Horizontal stem	Vertical stem
1	52	32
2	60	34
3	56	35
4	50	44
5	52	35
average	54	

Complete the table by calculating the average width of the leaves from the vertical stem.

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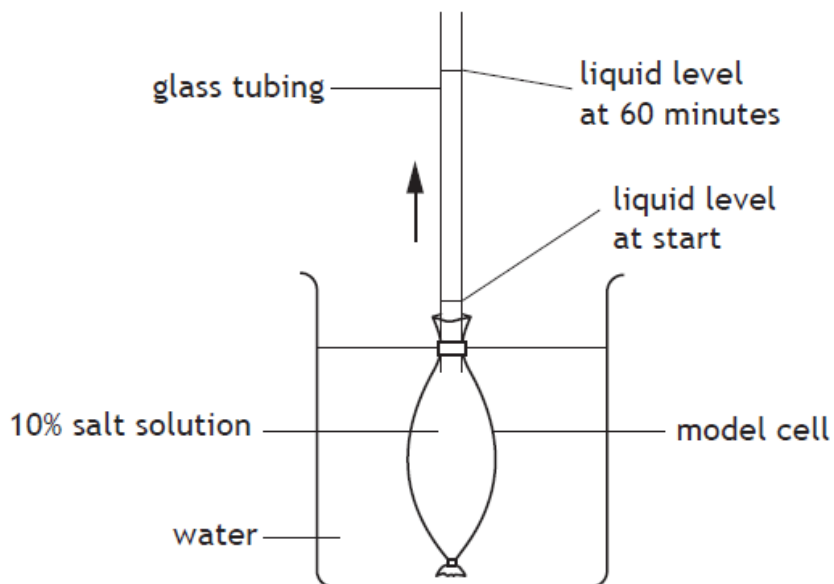
22. The table below shows the results of an investigation into the effect of temperature on egg laying in adult red spider mites.

Feature	Temperature (°C)		
	20 °C	25 °C	30 °C
Average length of egg laying period (days)	24	18	12
Average number of eggs laid per female during egg laying period	72	72	72

As the temperature increases, the average number of eggs laid per female per day

- A increases
- B decreases
- C stays the same
- D halves.

23. The apparatus shown below was used to investigate the movement of water into and out of a model cell. The model cell had a selectively permeable membrane.



The liquid level in the glass tubing was measured every 10 minutes for 60 minutes.

The results are shown in the table below.

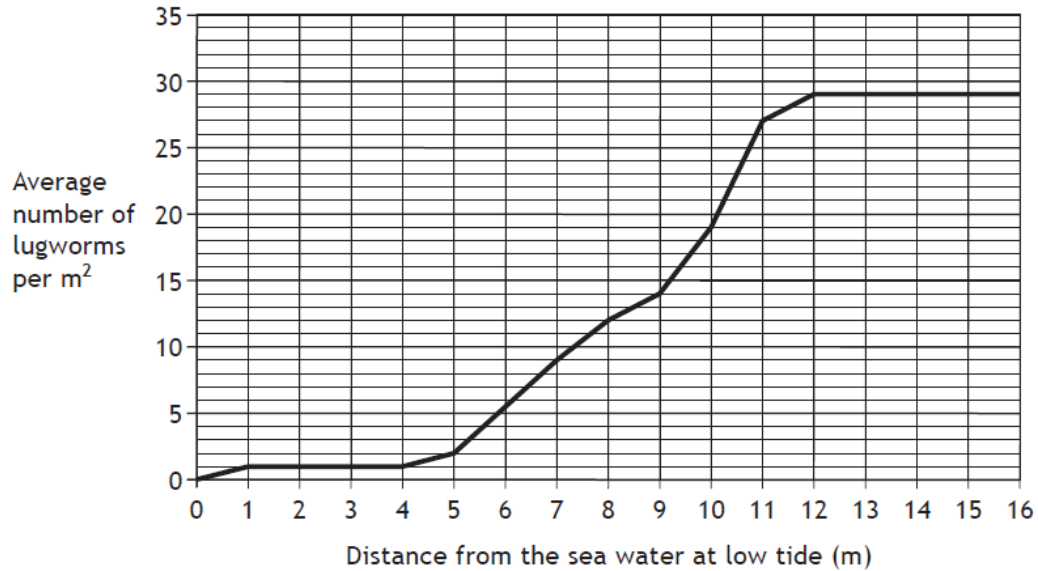
<i>Time (minutes)</i>	<i>Liquid level (mm)</i>
0	10
10	22
20	32
30	40
40	48
50	56
60	64

Calculate the average rate of movement of liquid in the glass tubing.





24. Lugworms live on the seashore in dark moist burrows under the sand. The graph below shows the average number of lugworms at different distances from the seawater at low tide.



Calculate how many times greater the average number of lugworms at 11 metres is compared to 7 metres from the seawater at low tide.