



CANDIDATE
NAME

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CENTRE
NUMBER

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CANDIDATE
NUMBER

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0654/63

October/November 2022

1 hour 30 minutes

You must answer on the question paper.

No additional materials are needed.

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

- The total mark for this paper is 60.
- The number of marks for each question or part question is shown in brackets [].

This document has **20** pages. Any blank pages are indicated.

- 1 A student investigates the nutrient content of beans and carrots.

(a) Procedure

The student:

- measures 1 cm³ of liquidised beans into each of two clean test-tubes
- adds an equal depth of biuret solution to one test-tube
- adds a few drops of iodine solution to the other test-tube
- repeats the procedure with liquidised carrots instead of liquidised beans.

The beans give a positive result with both testing solutions.

The carrots give a negative result with the biuret solution and a positive result with the iodine solution.

- (i) Complete Table 1.1 with the final colours the student observes.

Table 1.1

food sample	final colour observed with biuret solution	final colour observed with iodine solution	nutrients present
beans			
carrots			

[3]

- (ii) Complete Table 1.1 to state the nutrients present in each food sample. [2]

- (b) (i) Describe how a food sample is tested with Benedict's solution. Include the observation for a positive result.

test

.....

observation

[2]

- (ii) State the nutrient that gives a positive result with Benedict's solution.

..... [1]

- (iii) Suggest why it is difficult to identify a nutrient present in carrot using Benedict's solution.

..... [1]

- (c) State the apparatus suitable for measuring a volume of 1 cm³.

..... [1]

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2 Fig. 2.1 shows a photomicrograph of some blood cells.

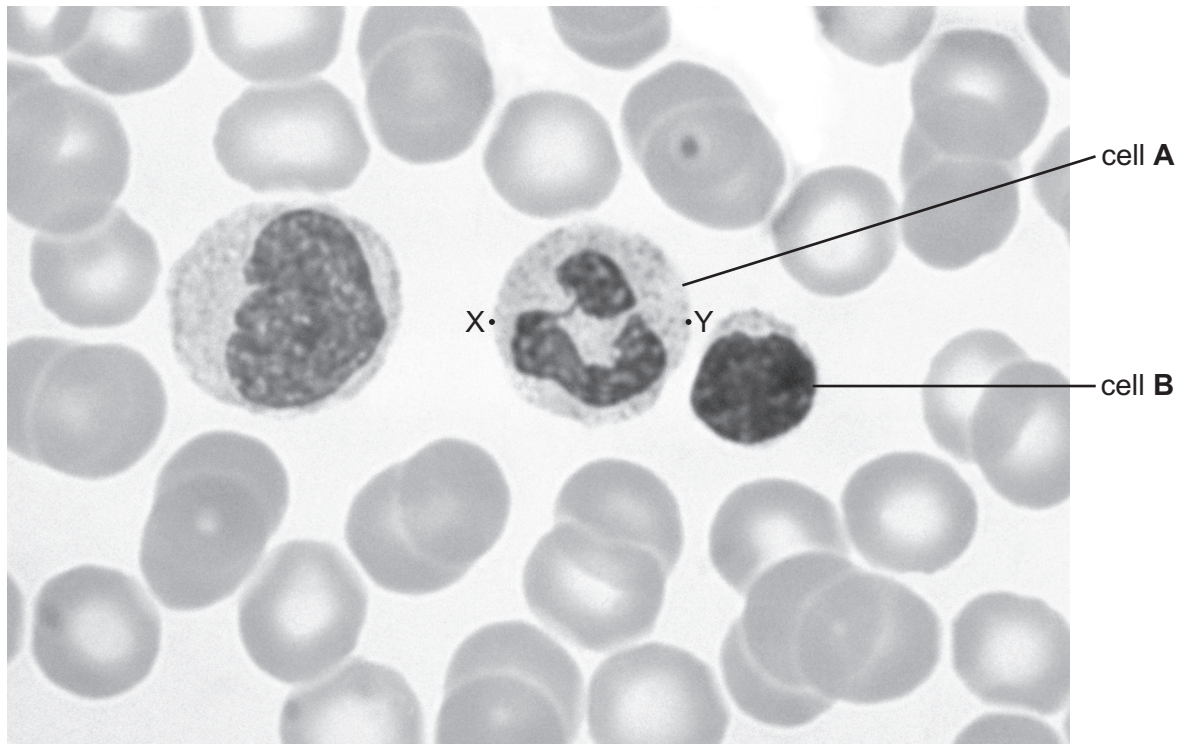
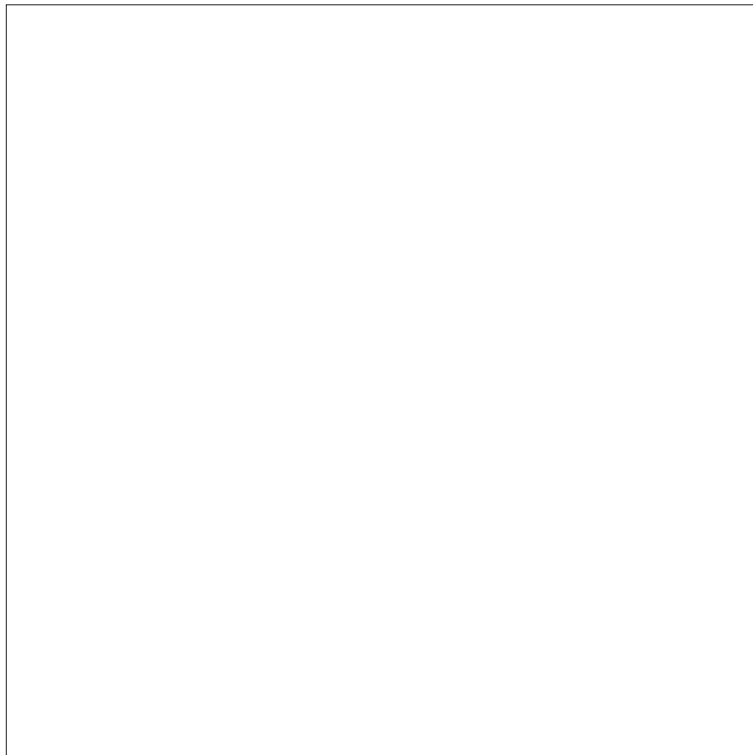


Fig. 2.1

(a) Make a large detailed pencil drawing of blood cell **A** in the box below.



[3]

- (b) (i) Measure the diameter XY of cell **A** in Fig. 2.1 in millimetres to the nearest millimetre.

diameter of cell **A** in Fig 2.1 = mm [1]

- (ii) Draw a line to show this diameter XY on your drawing in (a).

Measure the length of this line in millimetres to the nearest millimetre.

diameter of cell in drawing = mm [1]

- (iii) Use your measurements in (b)(i) and (b)(ii) to calculate the magnification m of your drawing .

Use the equation shown.

$$m = \frac{\text{diameter of cell in drawing}}{\text{diameter of cell in Fig. 2.1}}$$

Record your value to **two** significant figures.

magnification = [2]

- (c) Describe **one** difference and **one** similarity between cell **A** and cell **B**.

difference

similarity

[2]

- (d) Suggest why a nurse wears surgical gloves when obtaining a sample of blood from a patient.

.....

..... [1]

[Total: 10]

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- 3 A student investigates the reaction between dilute hydrochloric acid, HCl , and aqueous sodium hydroxide, NaOH .

M is a unit of concentration. The more concentrated a solution the higher the value of M.

A 2M solution is two times more concentrated than a solution that is 1 M.

The student uses the apparatus shown in Fig. 3.1.

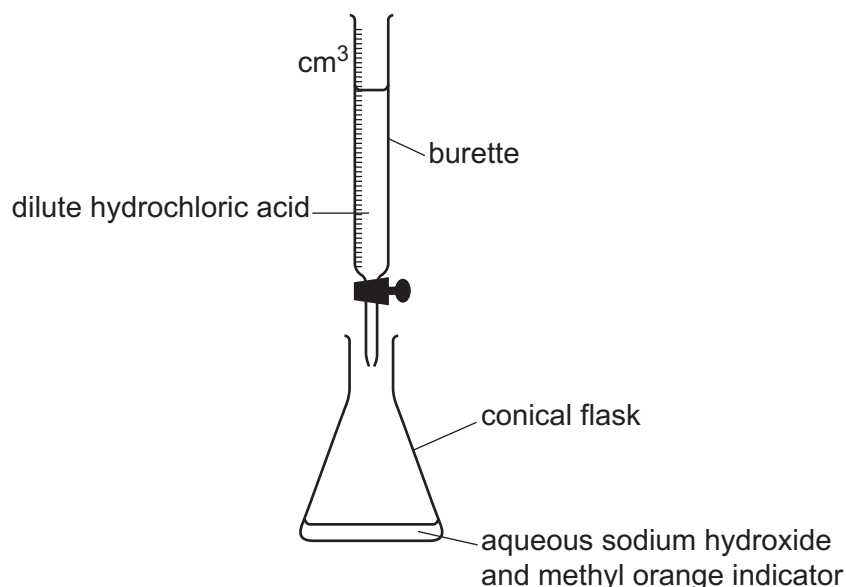


Fig. 3.1

(a) Procedure

The student:

- Step 1 measures 25 cm^3 of 0.5 M aqueous sodium hydroxide in a measuring cylinder and pours it into a conical flask
- Step 2 adds five drops of methyl orange indicator to the aqueous sodium hydroxide
- Step 3 fills the burette with dilute hydrochloric acid
- Step 4 records in Table 3.1 the reading on the burette
This is the reading at the start of the experiment and is the **second** row in Table 3.1.
- Step 5 slowly adds the dilute hydrochloric acid from the burette into the aqueous sodium hydroxide in the conical flask
- Step 6 stops adding dilute hydrochloric acid when the methyl orange turns orange
This is when the aqueous sodium hydroxide has been neutralised.
- Step 7 records in Table 3.1 the reading on the burette
This is the reading at the end of the experiment and is the **first** row in Table 3.1.

The student repeats the procedure with 0.4 M, 0.3 M, 0.2 M and 0.1 M aqueous sodium hydroxide, using a clean conical flask each time.

Table 3.1

	concentration of aqueous sodium hydroxide				
	0.5 M	0.4 M	0.3 M	0.2 M	0.1 M
reading on burette at the end of the experiment/cm ³	42.20		27.75	18.60	13.50
reading on burette at the start of the experiment/cm ³	0.00	1.20	2.05		5.40
volume of dilute hydrochloric acid added/cm ³	42.20		25.70		8.10

- (i) Fig. 3.2 shows the readings on the burette at the end of the experiment for 0.4 M aqueous sodium hydroxide and at the start of the experiment for 0.2 M aqueous sodium hydroxide.

Record these values in Table 3.1.



burette reading at the
end for 0.4 M



burette reading at the
start for 0.2 M

Fig. 3.2

[2]

- (ii) Complete Table 3.1 by calculating the missing volumes of dilute hydrochloric acid added.

Use the equation shown.

volume of dilute hydrochloric acid added	=	reading on burette at the end of the experiment	–	reading on burette at the start of the experiment
--	---	--	---	--

[1]

- (iii) Suggest what the student can do to have more confidence in their measured results.

.....
 [1]

- (iv) Explain why a clean conical flask is used for each experiment.

.....
 [1]

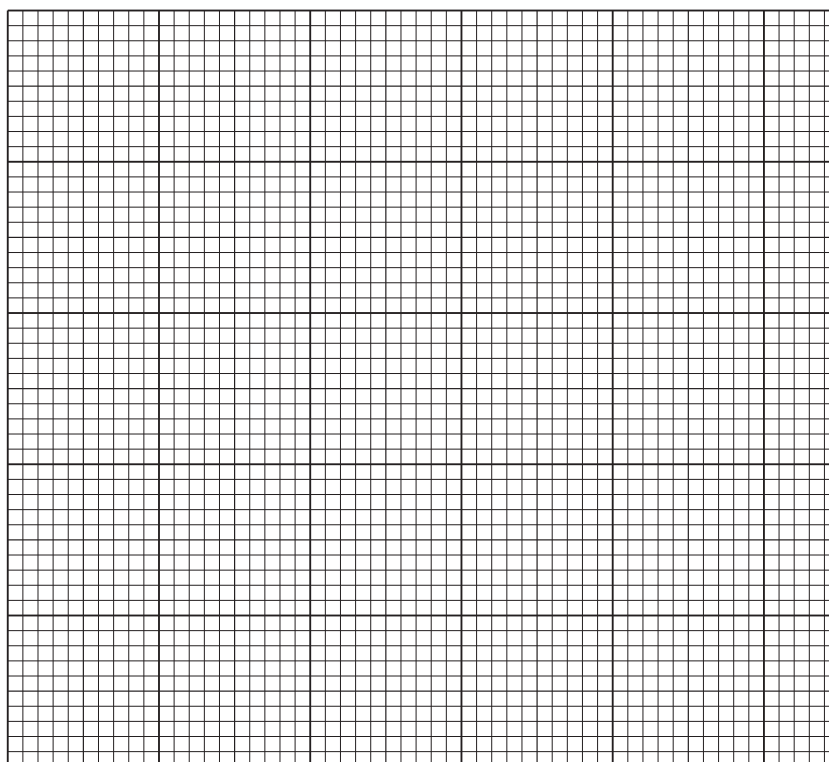
- (v) Methyl orange indicator is red in acid, yellow in alkali and orange when neutral.

In Step 6 another student adds too much acid to the mixture.

Suggest the colour of their final mixture in the conical flask.

..... [1]

- (b) (i) On the grid, plot a graph of volume of dilute hydrochloric acid added (vertical axis) against the concentration of aqueous sodium hydroxide.



[3]

- (ii) Draw the line of best fit.

[1]

- (iii) State the relationship between the volume of dilute hydrochloric acid added and the concentration of aqueous sodium hydroxide.

Explain how you used your graph to determine the relationship.

.....

 [2]

- (c) The student repeats the procedure, and finds that 12.00 cm^3 of dilute hydrochloric acid is needed to exactly neutralise a 25 cm^3 sample of aqueous sodium hydroxide.

Use your graph to estimate the concentration of the aqueous sodium hydroxide.

Show on your graph how you arrived at your answer.

concentration = M [2]

[Total: 14]

- 4 A student identifies four gases **P**, **Q**, **R** and **S**.

(a) **Procedure**

A student collects four test-tubes of each gas **P**, **Q**, **R** and **S**.

The student tests each gas with a glowing splint, a lighted splint, a piece of damp red litmus paper and limewater.

Some of the results are shown in Table 4.1.

Table 4.1

test used	observations			
	P	Q	R	S
glowing splint	relights	goes out	goes out	goes out
lighted splint	burns brighter	pops	goes out	goes out
limewater	colourless	colourless	milky	colourless
damp red litmus paper				

- (i) State the identity of gases **P**, **Q** and **R**.

P is

Q is

R is

[3]

- (ii) The student has been told that the only two gases that change the colour of damp litmus paper are chlorine gas and ammonia.
Gas **S** is ammonia.

Complete the table for the results of each gas with damp, red litmus paper.

[2]

[Total: 5]

- 5 A student measures the spring constant k of a spring by two different methods.

The spring constant k of a spring is a measure of how difficult the spring is to stretch.

(a) Method 1

The student:

- measures the unstretched length l_0 of the spring
- attaches the spring to a clamp
- suspends a mass $m = 300\text{ g}$ on the spring as shown in Fig. 5.1
- measures the new, stretched length l_1 of the spring.

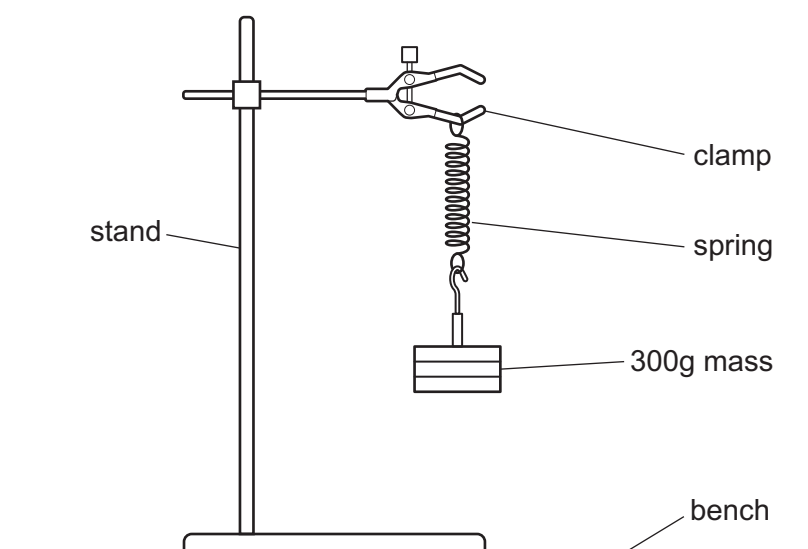


Fig. 5.1

Fig. 5.2 is a full size diagram showing the unstretched spring and the spring when it has been stretched by the 300 g mass.

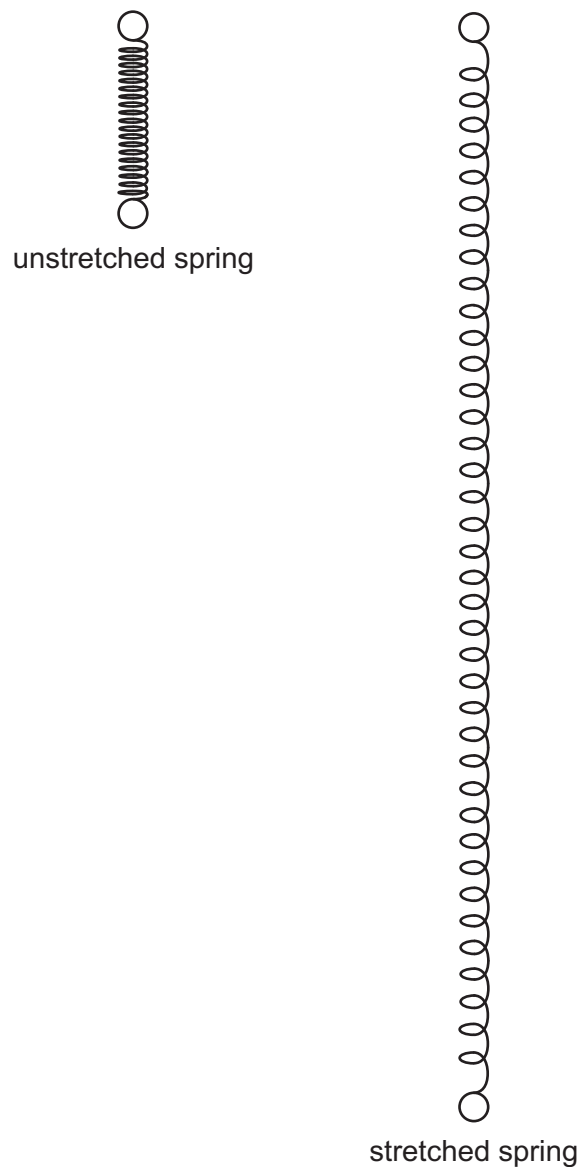


Fig. 5.2

- (i) Measure the unstretched length l_0 of the spring in centimetres to the nearest 0.1 cm.

Do **not** include the loops at the end of the spring in your measurement.

$$l_0 = \dots\dots\dots \text{ cm [1]}$$

- (ii) Measure the new length l_1 of the spring in centimetres to the nearest 0.1 cm.

Do **not** include the loops at the end of the spring in your measurement.

$$l_1 = \dots\dots\dots \text{ cm [1]}$$

- (iii) Calculate the extension e of the spring produced by the mass.

Use the equation shown.

$$e = l_1 - l_0$$

$$e = \dots\dots\dots \text{ cm [1]}$$

- (b) (i) It is important to avoid a line-of-sight (parallax) error when measuring the length of a spring.

Describe **one** way the student avoids this error.

.....
 [1]

- (ii) Stretched springs are potentially dangerous because of the elastic energy stored in them.

State **two** safety precautions that the student takes when doing the experiment. Explain how each precaution reduces the risk.

1

 2
 [2]

- (c) Calculate a value k_1 for the spring constant of the spring.

Use the equation shown.

$$k_1 = \frac{W}{e}$$

where W , the weight of the 300g mass = 3.0 N.

$$k_1 = \dots\dots\dots \text{ N/cm [1]}$$

(d) Method 2

The student:

- pulls the mass down a small distance and releases it so that the mass oscillates up and down
- measures the time taken t_1 for 20 oscillations of the mass.

Fig. 5.3 shows the reading on the stop-watch.



Fig. 5.3

Record the time taken t_1 in Table 5.1.

Table 5.1

mass/g	time for 20 oscillations/s			average time for 20 oscillations t_{av}/s	average period T_{av}/s
	t_1	t_2	t_3		
300		14.4	14.1		

[1]

(e) The student repeats **Method 2** two more times and records the times t_2 and t_3 in Table 5.1.

- (i)** Calculate the average time t_{av} for 20 oscillations of the mass.

Use the equation shown.

$$t_{av} = \frac{(t_1 + t_2 + t_3)}{3}$$

Record your answer in Table 5.1.

[1]

- (ii)** State why repeating the timing and calculating the average time for 20 oscillations is good experimental practice.

.....

..... [1]

- (f) Calculate the average period T_{av} of the oscillations. The period is the time for one oscillation of the mass.

Record your answer in Table 5.1.

[1]

- (g) Calculate a value k_2 for the spring constant of the spring.

Use the equation shown.

$$k_2 = \frac{0.12}{(T_{av})^2}$$

$$k_2 = \dots\dots\dots \text{ N/cm [1]}$$

- (h) (i) Use your answers to (c) and (g) to calculate $(k_1 - k_2)$, the difference between your two measured values of k .

$$(k_1 - k_2) = \dots\dots\dots \text{ N/cm [1]}$$

- (ii) State whether or not the difference in the values of k_1 and k_2 allows the values to be considered equal within the limits of experimental accuracy.

Explain your answer.

statement

explanation

..... [1]

[Total: 14]

- 6 A ball is dropped from rest at a height H above the ground. The ball rebounds and bounces back up to a height h .

Plan an experiment to investigate the relationship between the bounce height h and the height H from which the ball is dropped.

You are provided with a selection of balls of different sizes and different materials.

You may use any other apparatus normally found in a school laboratory.

Include in your answer:

- the apparatus you will use
- a brief description of the method, including how you will ensure your results are accurate
- the variables you will control
- a table with column headings to show how you will present your results (you are not required to enter any readings in the table)
- how you will process your results to reach a conclusion.

You may include a labelled diagram if it helps to explain your plan.

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