IGCSE Cambridge Topical Past Papers

COMBINED SCIENCE

0653 | Paper 6

2020 — 2024

1 – (0653/61_Summer_2020_Q1) – *B2. Cells*

A student investigates the rate of diffusion in model cells.

Agar is a type of jelly that allows substances to diffuse (move) into it. Cubes of agar are used to represent cells of different sizes.

(a)
- Cubes of agar are stained with universal indicator.
- The student records the colour of the agar cubes.

colour of agar cubes = blue-green

Fig. 1.1 shows the pH chart for the universal indicator used.

pH	1	2	3	4	5	6	7	8	9	10	11	12	13	14
colour	red			orange			green			blue				purple

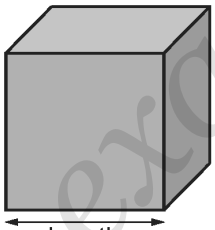
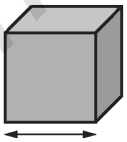
Fig. 1.1

State the pH of the agar cubes.

..... [1]

(b) The student cuts three agar cubes so that they are different sizes. The sizes of the cubes are shown in Table 1.1.

Table 1.1

	cube **A**	cube **B**	cube **C**
description	 20 mm each side	 10 mm each side	 5 mm each side
surface area / mm^2	2400	.....	.....
volume / mm^3	8000	.....	.....
$\frac{\text{surface area}}{\text{volume}}$ / mm^{-1}	0.3	0.6	1.2

(i) Calculate the surface area for cube **B** and for cube **C**.

Use the equation shown and record your values in Table 1.1.

$$\text{surface area} = (\text{length})^2 \times 6$$

[1]

(ii) Calculate the volume for cube **B** and for cube **C**.

Use the equation shown and record your values in Table 1.1.

$$\text{volume} = (\text{length})^3$$

[1]

(c)
- Each cube is put into a separate beaker.
- Sufficient dilute hydrochloric acid is added to cover each of the cubes.
- The cubes gradually change colour from blue-green to red.
- The time taken for the cubes to change to a red colour is measured.

The times displayed on the stop-clock for the three cubes are shown in Fig. 1.2.

Fig. 1.2

(i) Record in Table 1.2 these times in seconds. [2]

(ii) Complete the heading in Table 1.2.

Table 1.2

cube	$\frac{\text{surface area}}{\text{volume}}$ / mm^{-1}	...../.....
A	0.3	295
B	0.6	
C	1.2	

[1]

(iii) Describe the relationship between the value of $\frac{\text{surface area}}{\text{volume}}$ and the time taken for the agar to change colour.

.....

..... [1]

(iv) Explain why the cubes completely changed to a red colour.

.....

.....

..... [2]

(v) State **one** safety hazard in this investigation and explain how the risk from this hazard is reduced.

safety hazard .....

explanation .....

.....

[1]

(d) The temperature of the acid affects its rate of diffusion through an agar cube.

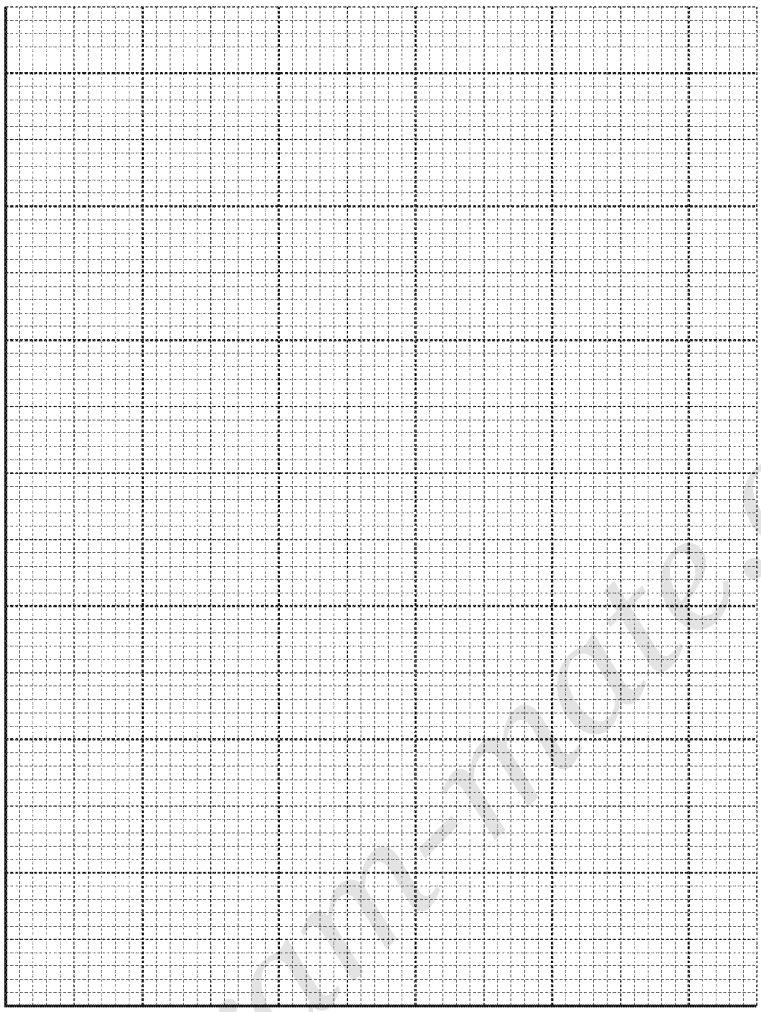
A student calculates the rate of diffusion of acid, through agar cubes of the same size, at different temperatures. The results are shown in Table 1.3.

Table 1.3

temperature / °C	rate of diffusion / mm per hour
10	10
20	18
30	25
40	29
50	33

(i) On the grid, plot the rate of diffusion against temperature.

rate of diffusion /mm per hour



temperature / °C

[2]

(ii) Draw a curve of best fit. [1]

[Total: 13]

2 – (0653/63_Summer_2020_Q1) – *B7. Transport, B2. Cells*

A student investigates the effect of temperature on the uptake of water by a stem.

Water containing a blue stain moves up the xylem of a plant, staining the xylem blue.

Fig. 1.1 shows a cut section of the stem with stained xylem tubes.

Fig. 1.1

(a) Procedure

- The student places one end of a freshly cut stem into water containing a blue stain at 20 °C.
- He leaves it in the blue stain for 60 minutes.
- He removes the stem.
- The student then cuts a 2 mm slice from the end of the stem that has been in the blue stain, as shown in Fig. 1.2.

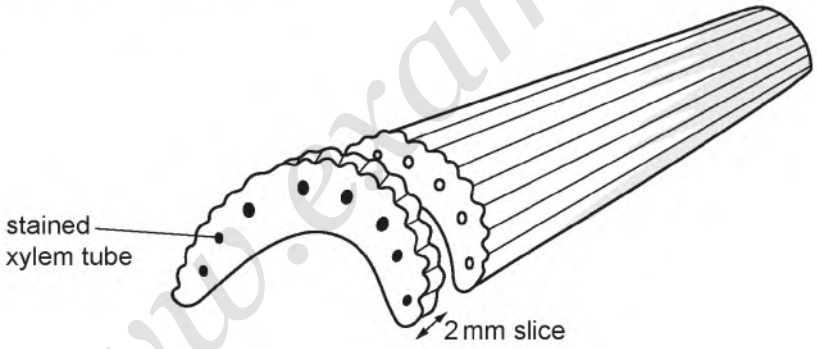


Fig. 1.2

- He observes the cut xylem tubes to see if they contain blue stain.
- If the xylem tubes contain the blue stain he takes another 2 mm slice and observes the new cut xylem tubes.
- The student repeats this until the xylem tubes are no longer stained blue.
- He then counts the number of slices cut to calculate how far the stain has travelled.
- He repeats the procedure at 25 °C, 30 °C, 35 °C and 40 °C.

Fig. 1.3 shows the cut stems at each temperature.

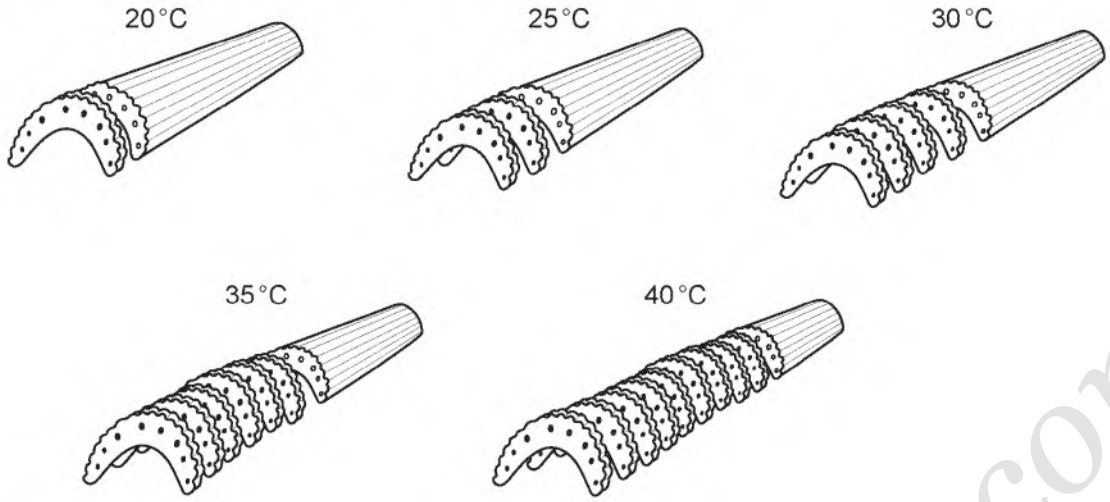


Fig. 1.3

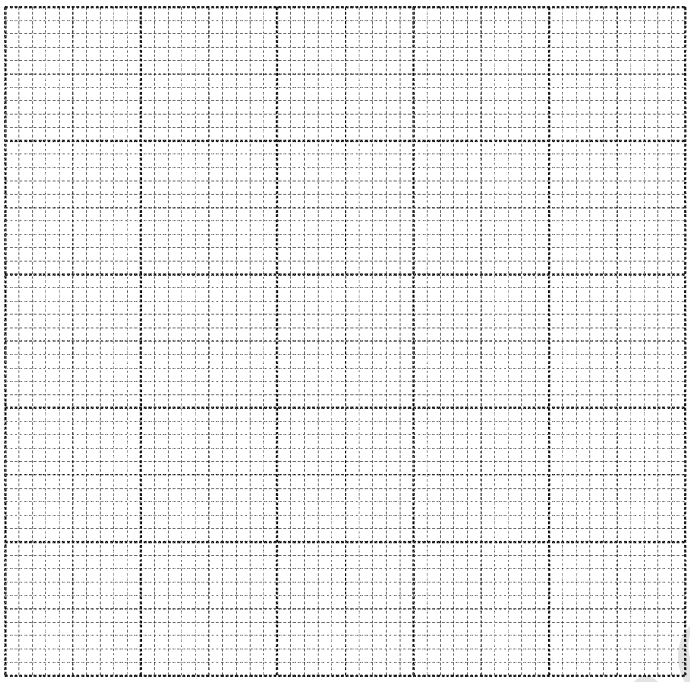
(i) Use Fig. 1.3 to complete Table 1.1.

Table 1.1

temperature / °C	number of slices	distance moved by stain / mm
20	1	2
25		
30	4	8
35		
40	9	18

[2]

(ii) On the grid, plot a graph of the distance moved by the stain (vertical) against the temperature.



[3]

(iii) Draw a curve of best fit. [1]

(iv) Describe the relationship between the temperature and the distance moved by the stain.

.....

..... [1]

(v) State **one** variable that must be kept constant in this investigation.

.....

..... [1]

(vi) Suggest **one** possible source of error when calculating the distance moved by the stain.

.....

..... [1]

(vii) The student stated that there was a risk of cutting his hand when using the knife.

Describe **one** method of reducing this risk.

.....

..... [1]

(b) Fig. 1.4 shows a close-up of the cut end of the stem.

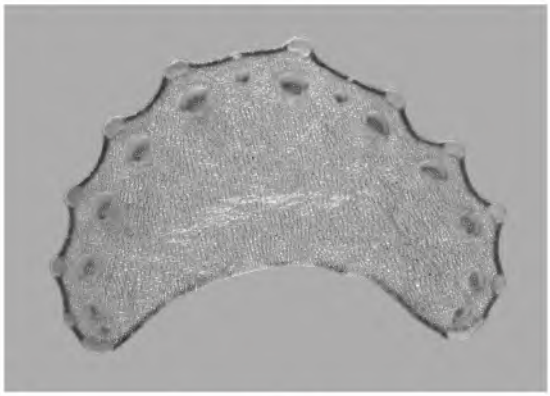


Fig. 1.4

Make an enlarged detailed drawing of the cut stem shown in Fig. 1.4.

[3]

[Total: 13]

3 – (0653/61_Winter_2020_Q1) – *B2. Cells, B3. Biological Molecules*

(a) A student investigates the amount of vitamin C in orange juice.

She is given half an orange, as shown in Fig. 1.1.

Fig. 1.1

In the box, make a large drawing of the orange shown in Fig. 1.1.

[3]

(b) The student tests the juice from the orange with DCPIP.

DCPIP is a dark blue solution that turns colourless when vitamin C is added.

If the orange juice contains a lot of vitamin C, less orange juice is needed to turn the DCPIP colourless.

Procedure

The student:

- puts 2.0 cm^3 DCPIP into a test-tube
- fills a syringe with 10.0 cm^3 orange juice
- adds orange juice to the DCPIP until the DCPIP turns colourless
- records the volume of orange juice **remaining** in the syringe in Table 1.1.

The student repeats the procedure two more times (experiment **2** and experiment **3**).

(i) Fig. 1.2 shows the volume of orange juice **remaining** in the syringe in experiment **3**.

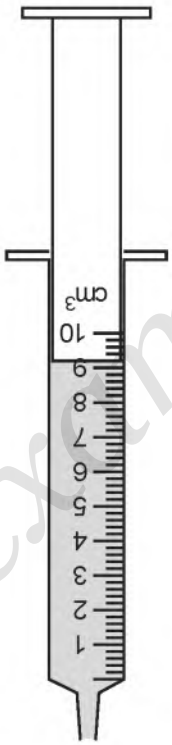


Fig. 1.2

Record in Table 1.1 the volume of orange juice **remaining** in the syringe in experiment **3**.

Table 1.1

experiment	volume of orange juice **remaining** in syringe / cm^3	volume of orange juice **added** to the DCPIP / cm^3
1	9.4	0.6
2	9.3	0.7
3		

[1]

(ii) The student calculates the volume of orange juice **added** to the DCPIP in experiment **1** and experiment **2** using the equation shown.

volume of orange juice **added** = 10.0 – volume of orange juice **remaining** in the syringe

Calculate the volume of orange juice **added** to the DCPIP in experiment **3** and record your answer in Table 1.1.

[1]

(iii) Calculate the average volume of orange juice **added** to the DCPIP.

Show your working.

average volume of orange juice **added** = ... cm^3 [1]

(iv) Explain why the student repeats the experiment.

.....

..... [1]

ANSWERS

1 – (0653/61_Summer_2020_Q1) – *B2. Cells*

(a)	8 / 9 ;	1
(b)(i)	(surface area) cube **B** = 600 **AND** cube **C** = 150 ;	1
(b)(ii)	(volume) cube **B** = 1000 **AND** cube **C** = 125 ;	1
(c)(i)	(cube **B**) 145 ; (cube **C**) 47 ;	2
(c)(ii)	time (to change colour to red) **AND** / s ;	1
(c)(iii)	increase in surface area to volume ratio takes less time to change / ORA ;	1
(c)(iv)	acid diffuses in ; pH changes to acidic ;	2
(c)(v)	cutting **AND** use knife, on solid surface / away from body ; **OR** acid / indicator **AND** use, gloves / goggles ;	1
(d)(i)	suitable scale chosen ; all points plotted correctly ;	2
(d)(ii)	suitable curve of best fit ;	1

2 – (0653/63_Summer_2020_Q1) – *B7. Transport, B2. Cells*

(a)(i)	number of slices: (25 °C) 2 **and** (35 °C) 6 ; distance moved: (slices × 2) (25 °C) 4 **and** (35 °C) 12 ;	2
(a)(ii)	suitable scale chosen ; labels correct for both axes, including units ; all points plotted correctly ;	3
(a)(iii)	suitable curve of best fit ;	1
(a)(iv)	increase in temperature, increase in distance moved / ORA ;	1
(a)(v)	type of stain / concentration of stain / age of celery / type of celery / AVP ;	1
(a)(vi)	cut every 2 mm / not clear when stain stops ;	1
(a)(vii)	cut, on solid surface / away from fingers ;	1
(b)	size - larger than original ; quality – smooth line, no breaks ; detail – correct number of vascular bundles ;	3

3 – (0653/61_Winter_2020_Q1) – *B2. Cells, B3. Biological Molecules*

(a)	fills more than 50% space ; continuous line around outside, pith and segments indicated ; 8 or more segments within the pith and gap in centre shown ;	3
(b)(i)	volume remaining = 9.2 ;	1
(b)(ii)	calculation of volume added = 0.8 ;	1
(b)(iii)	calculation of average shown = (0.6 + 0.7 + 0.8) ÷ 3 = 0.7 ;	1
(b)(iv)	to identify, anomalous results / outliers / to check results are, the same / similar ;	1

4 – (0653/62_Winter_2020_Q1) – *B2. Cells*

(a)	fills more than 50% of the space ; continuous smooth outline with lines and circles seen ; 11 sections with circles at either end ;	3
(b)(i)	86 mm ;	1
(b)(ii)	correct calculation 0.057 ;	1
(c)	*similarity*: shape, e.g. round, sections ; *difference:* pattern, e.g. internal structure different, holes / pores / AW, number of sections, size ;	2

5 – (0653/62_Winter_2020_Q2) – *B2. Cells*

	1 mark from each section and then additional 3 marks **1 apparatus** beaker / test-tube / conical flask ; measuring cylinder / balance / ruler ; stop-watch / timer ; scalpel / cork borer AW ; **2 method and measurements** cut potato / carrot, into pieces of same size ; immerse / submerge, in salt solution ; measure mass / dimensions, at beginning AND end ; dry before final mass ; repeats ; **3 control variables** same, mass / volume / surface area of tissue ; same, volume / concentration, of salt solution ; same temperature ; same time ; **4 processing/conclusion** calculate surface area of tissue ; calculate / compare, change in, mass / volume / surface area ; calculate / compare, <u>percentage</u>, change / loss in mass ; plant tissue which loses most, mass / volume / surface area, has lost most water ORA	7

6 – (0653/62_Summer_2021_Q1) – *B2. Cells, B8. Gas Exchange And Respiration*

(a)(i)	(**B**) 205 ; (**C**) 44 ;	2
(a)(ii)	more glucose, greater rate of respiration / less time taken ;	1
(a)(iii)	to spot anomalous results / to spot outliers ;	1
(a)(iv)	type of yeast / volume of yeast / temperature / (total) volume of solution / volume of methylene blue ;	1
(a)(v)	Benedict's **AND** blue ;	1
(b)	limewater **AND** milky ;	1
(c)(i)	48 (mm) ;	1
(c)(ii)	0.0096 (mm) ;	1
(c)(iii)	**M1** clear and continuous outline of yeast cell ; **M2** drawing size is half or more of the box ; **M3** cell wall shown with two concentric 'circles' ; **M4** large vacuole shown off centre ;	4