Topical Past Paper Questions Worksheets

IGCSE Biology (0610) Paper 6

[Alternative to Practical]

Exam Series: Feb/Mar 2017 – Oct/Nov 2023

Format Type A:
Answers to all questions are provided as an appendix

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Introduction

Each Topical Past Paper Questions Compilation contains a comprehensive collection of hundreds of questions and corresponding answer schemes, presented in worksheet format. The questions are carefully arranged according to their respective chapters and topics, which align with the latest IGCSE or AS/A Level subject content. Here are the key features of these resources:

1. The workbook covers a wide range of topics, which are organized according to the latest syllabus content for Cambridge IGCSE or AS/A Level exams.
2. Each topic includes numerous questions, allowing students to practice and reinforce their understanding of key concepts and skills.
3. The questions are accompanied by detailed answer schemes, which provide clear explanations and guidance for students to improve their performance.
4. The workbook's format is user-friendly, with worksheets that are easy to read and navigate.
5. This workbook is an ideal resource for students who want to familiarize themselves with the types of questions that may appear in their exams and to develop their problem-solving and analytical skills.

Overall, Topical Past Paper Questions Workbooks are a valuable tool for students preparing for IGCSE or AS/A level exams, providing them with the opportunity to practice and refine their knowledge and skills in a structured and comprehensive manner. To provide a clearer description of this book's specifications, here are some key details:

- Title: Cambridge IGCSE Biology (0610) Paper 6 Topical Past Paper Questions
- Subtitle: Exam Practice Worksheets With Answer Scheme
- Examination board: Cambridge Assessment International Education (CAIE)
- Subject code: 0610
- Years covered: Feb/Mar 2017 – Oct/Nov 2023
- Paper: 6 [Alternative to Practical]
- Number of pages: 602
- Number of questions: 101

Contents

Chapter 1

Movement into and out of cells

1.1 Diffusion

1. 0610_m23_qp_62 Q: 1

Potato cells take up methylene blue dye when the potato tissue is placed into the dye solution.

If the dyed potato cells are placed in water the dye will diffuse into the water.

A student investigated the effect of temperature on the diffusion of methylene blue dye from dyed potato cells.

The student used this method:

Step 1 You are provided with a beaker of cold water, a beaker of warm water and a beaker of hot water.

Step 2 Measure the temperature of the water in the beaker of **hot** water.

Step 3 Label one test-tube **C**, one test-tube **W** and one test-tube **H**.

Step 4 Draw a line 9 cm from the base of each test-tube, as shown in Fig. 1.1. Place the three test-tubes in a test-tube rack.

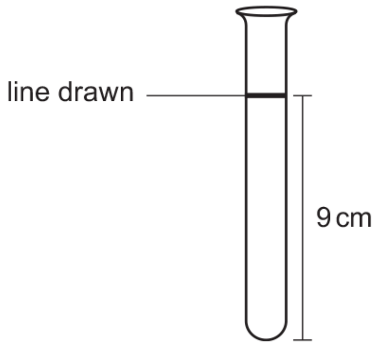


Fig. 1.1

Step 5 Fill test-tube **C** with cold water up to the line drawn in step 4. Put test-tube **C** into the beaker of **cold** water.

Step 6 Fill test-tube **W** with warm water up to the line drawn in step 4. Put test-tube **W** into the beaker of **warm** water.

Step 7 Fill test-tube **H** with hot water up to the line drawn in step 4. Put test-tube **H** into the beaker of **hot** water.

Step 8 You are provided with three potato cylinders. They have been soaked in methylene blue solution and then rinsed.

Place the three potato cylinders on the white tile and cut the three potato cylinders to approximately 2 cm in length.

Step 9 Place one of the potato cylinders from step 8 into each test-tube.

Step 10 Start the stop-clock. Leave the test-tubes for 15 minutes.

Step 11 After 15 minutes, measure the temperature of the water in the beaker of **hot** water again.

Fig. 1.2 shows part of the thermometer during step 2 and step 11.

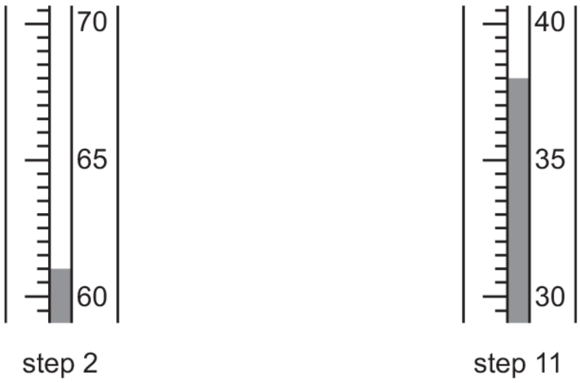


Fig. 1.2

(a) **(i)** Record the temperatures shown on the thermometer for step 2 and step 11 in Fig. 1.2.

water temperature in the beaker of **hot** water in step 2 .... °C

water temperature in the beaker of **hot** water in step 11 .... °C
[2]

Step 12 Remove the test-tubes **C**, **W** and **H** from the beakers and shake all the test-tubes for 10 seconds. Place the test-tubes into the test-tube rack.

Step 13 Observe the intensity of the blue colour of the liquid in test-tubes **C**, **W** and **H**.

Fig. 1.3 shows the student's notebook with their observations.

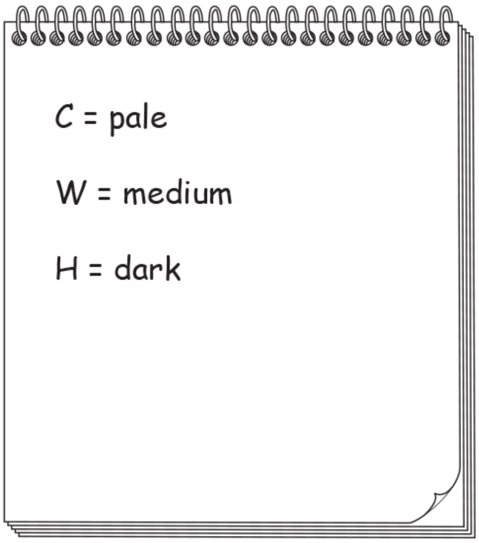


Fig. 1.3

(ii) Prepare a table and record the results shown in Fig. 1.3.

[2]

(iii) State a conclusion for these results.

....

....

.... [1]

(iv) Identify **one** possible source of error in step 8.

....

....

.... [1]

(v) Identify **one** safety hazard in the investigation.

....

....

.... [1]

(vi) The readings on the thermometer in Fig. 1.2 show that the maintenance of the temperature of the water during the investigation was a source of error.

Suggest an improvement to reduce this error.

....

....

.... [1]

(vii) The student did **not** repeat the investigation and only collected one set of results.

Explain why it is better to collect several sets of results.

....

....

.... [1]

(b) A student investigated the effect of surface area on diffusion.

The student used this method:

- Cut four cubes from a potato. Each cube should be a different size.
- Put the potato cubes into a methylene blue solution for 24 hours.
- After 24 hours, remove the potato cubes from the solution and rinse them in cold water.
- Fill four test-tubes with water. Place one potato cube into each test-tube. Leave the test-tubes for 15 minutes.
- Some of the methylene blue dye will diffuse out of the potato cube into the water during the 15 minutes. Shine a light through the water in the test-tube after 15 minutes.
- Measure the percentage of light that is absorbed by the methylene blue dye in the water in each test-tube.
- The higher the concentration of methylene blue dye in the water the greater the percentage of light absorbed.

(i) State the independent variable and the dependent variable in the investigation described in **1(b)**.

independent variable ....

....

dependent variable ....

....
[2]

(ii) State **one** variable that was kept constant in the investigation described in **1(b)**.

.... [1]

(iii) Fig. 1.4 is a graph showing the student's results.

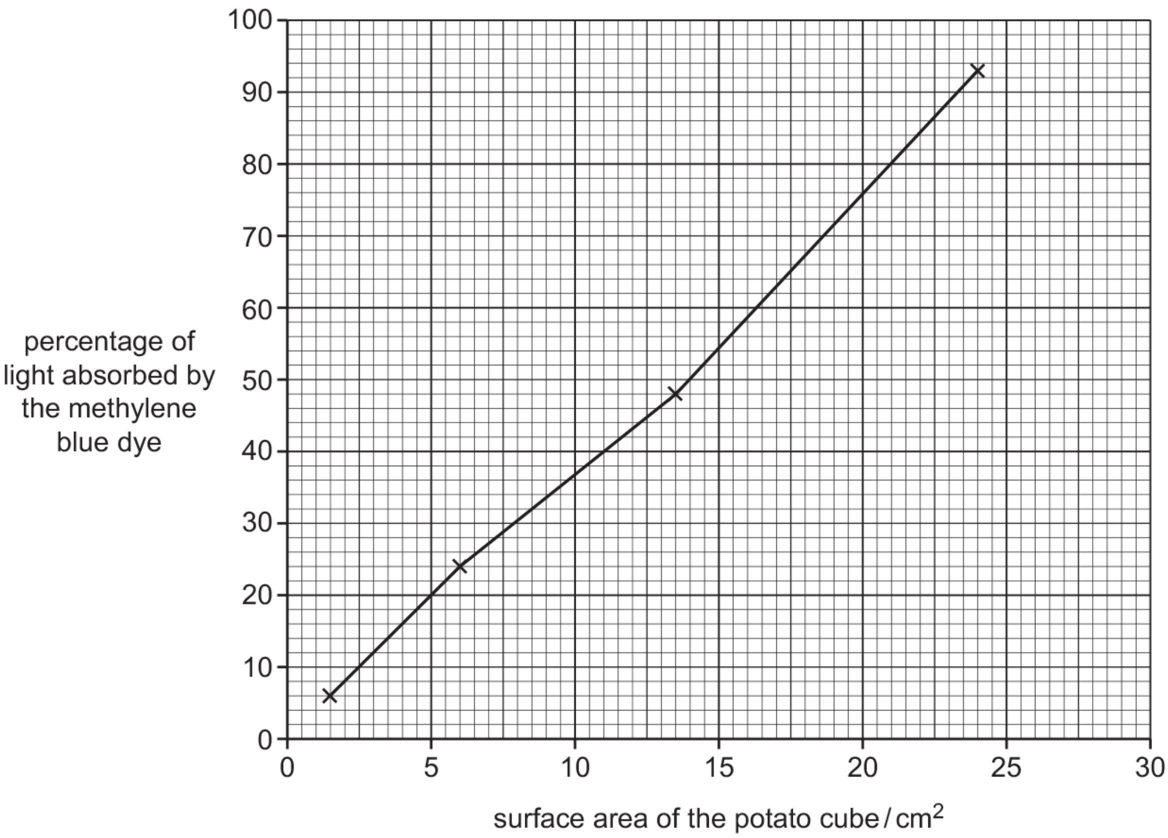


Fig. 1.4

Using Fig. 1.4, estimate the percentage of light absorbed by the methylene blue dye when the surface area of the potato cube is 18 cm^2.

Show on Fig. 1.4 how you obtained your estimate.

.... %
[2]

[Total: 14]

2. 0610_m20_qp_62 Q: 1

(a) Beetroot is the large fleshy root of a beet plant. The cells of beetroot contain a coloured pigment. This pigment may leak from the cells if the cell membranes are damaged.

A student investigated the effect of temperature on the leakage of pigment from beetroot cells.

Step 1 Cylinders of varying length were cut from a beetroot. The student was provided with two of the beetroot cylinders. The student cut both cylinders to 3 cm in length.

Step 2 The student labelled one test-tube **C** and another test-tube **H**.

Step 3 The student put some cold water into test-tube **C** and some hot water into test-tube **H**.

Step 4 The student measured the temperature of the water in test-tube **C** and in test-tube **H**.

Sections of the thermometers are shown in Fig. 1.1.

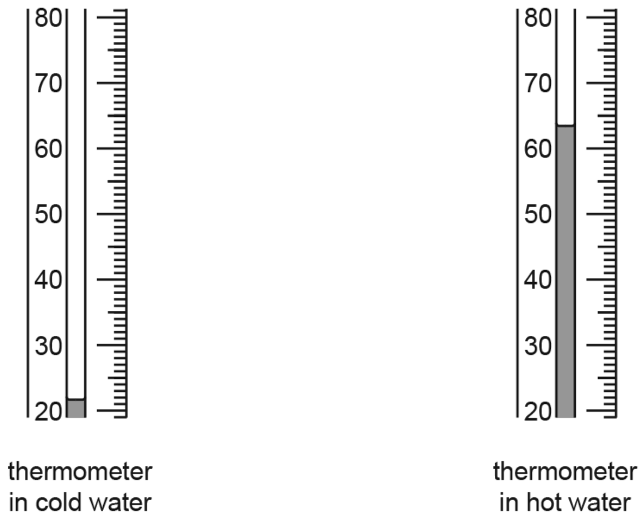


Fig. 1.1

Step 5 The student put one beetroot cylinder into test-tube **C** and one beetroot cylinder into test-tube **H**. A stopper was placed in each test-tube.

Step 6 The student waited for 10 minutes.

Step 7 After 10 minutes the student shook both test-tubes.

Step 8 The student observed the colour of the liquid in both test-tubes.

The student's observations are shown in Fig. 1.2.

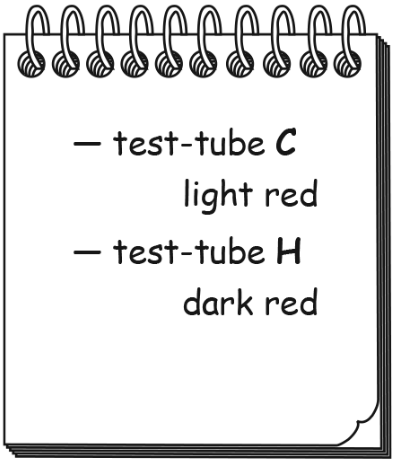


Fig. 1.2

(i) Prepare a table to record the results shown in Fig. 1.1 and Fig. 1.2.

[3]

(ii) State a conclusion for these results.

....

....

.... [1]

(iii) In step 1 the two beetroot cylinders were cut to the same length.

Suggest why this was necessary.

....

....

.... [1]

(iv) Identify **one** possible source of error in step 3.
Suggest a piece of apparatus that could be used to reduce this error.

error ....

....

apparatus ....

....
[2]

(v) In step 7 the student shook the test-tubes. It was important that the shaking of both test-tubes was the same.

Suggest **two** ways that this could be achieved.

1 ....

....

2 ....

....
[2]

(b) A student repeated the investigation in **1(a)** at five different temperatures. They carried out three trials at each temperature.

The student measured the percentage of light that passed through the liquids in the test-tubes.

The coloured pigment reduces the percentage of light that can pass through the liquid. The higher the pigment concentration the less light passes through the liquid.

The student's results are shown in Table 1.1.

Table 1.1

temperature / °C	percentage of light that passes through the liquid			
	trial 1	trial 2	trial 3	average
10	100	99	98	99
20	94	48	96	95
40	80	77	77	78
60	26	30	31	29
90	1	2	0	1

(i) State the variable that was changed (independent variable) in the investigation described in **1(b)**.

.... [1]

(ii) Suggest **two** ways in which the method described in **1(b)** is an improvement to the method used in **1(a)**.

1 ....

....

2 ....

....
[2]

(iii) The student decided that the result for trial 2 at 20 °C was anomalous.

State what is meant by an anomalous result.

....

....

.... [1]

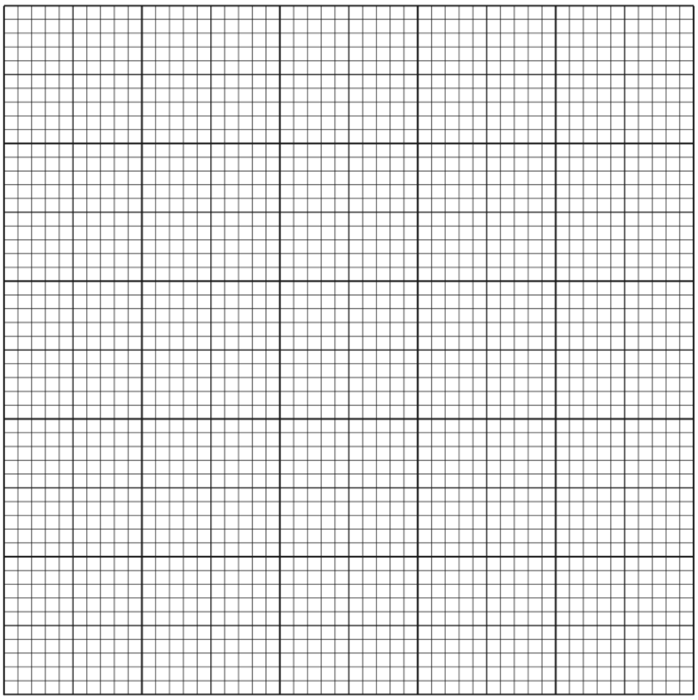
(iv) State how the student dealt with the anomalous result when calculating the average value for 20 °C.

....

....

.... [1]

(v) Plot a line graph on the grid of the temperature against the average percentage of light that passes through the liquid using the data in Table 1.1.



[4]

(vi) Estimate the percentage of light passing through the liquid at 50 °C.

Show on your graph how you obtained your estimate.

....%
[2]

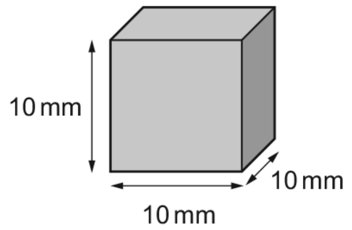
[Total: 20]

3. 0610_s20_qp_63 Q: 1

A student investigated the effect of concentration on the rate of diffusion in model cells.

Cubes of agar jelly containing universal indicator were used to represent the model cells.

(a) A student used a scalpel to cut four identical cubes from a large piece of agar. Each cube had the dimensions shown in Fig. 1.1. Each agar cube was green in colour at the start of the investigation.



not to scale

Fig. 1.1

(i) Calculate the surface area and volume for the cube shown in Fig. 1.1.

surface area .... mm^2

volume .... mm^3

[2]

Step 1 The student used the information in Table 1.1 to add the appropriate volumes of 1.0 mol per dm^3 hydrochloric acid (HCl) and water to four test-tubes labelled **A**, **B**, **C** and **D**.

Table 1.1

test-tube	volume of 1.0 mol per dm^3 HCl / cm^3	volume of water / cm^3	final concentration of HCl / ....
A	5.0	0.0	1.0
B	2.5	2.5	....
C	0.5	4.5	0.1
D	0.0	5.0	0.0

(ii) Complete Table 1.1 by:

- stating the unit for the final concentration of HCl
- calculating the missing concentration for test-tube **B**.

[2]

Step 2 One green agar cube was put into each of test-tubes **A**, **B**, **C** and **D**.

Step 3 A stop-clock was started.

Step 4 The student observed the colour change in the agar cubes. The agar cubes changed colour from green to red, as shown in Fig. 1.2, in test-tubes **A**, **B** and **C**.

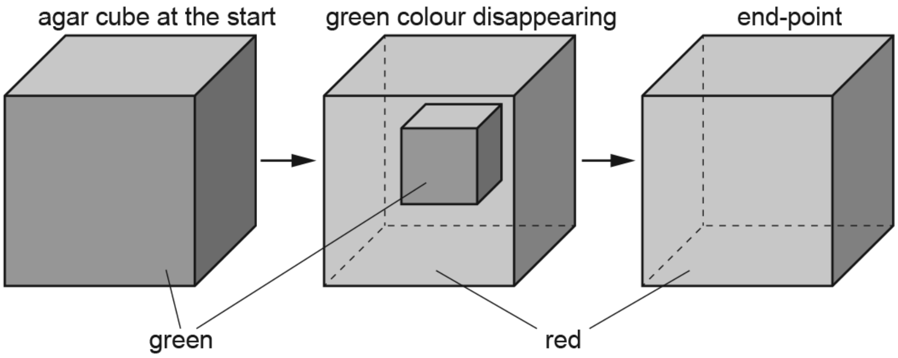


Fig. 1.2

Step 5 After six minutes the agar cube in test-tube **D** had not changed colour. The student stopped observing the agar cubes and stopped the stop-clock.

The times taken for the agar cubes in test-tubes **A**, **B** and **C** to change colour and the time at which the student stopped the stop-clock in step 5 are shown in Fig. 1.3.

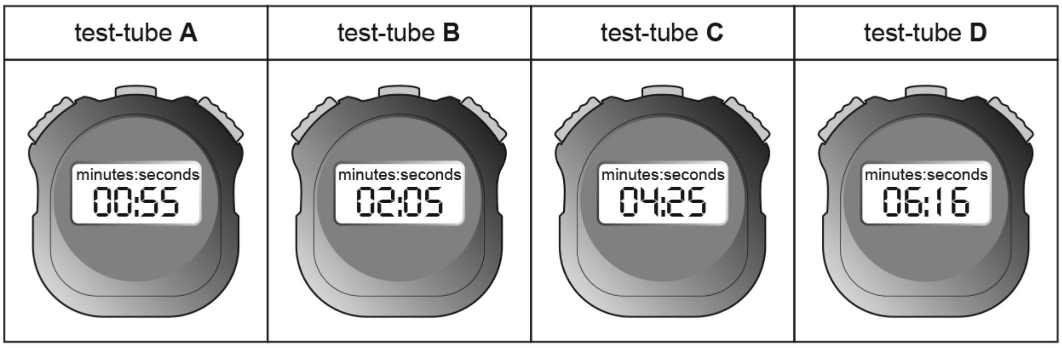


Fig. 1.3

(iii) Convert the times in Fig. 1.3 to seconds.

Prepare a table and record these results.

If the time taken is greater than six minutes, record the time as **>360** for that cube.

[4]

(iv) State a conclusion for these results.

....

....

.... [1]

(v) Describe the purpose of test-tube **D**.

....

....

.... [1]

(vi) Identify **one** safety hazard when carrying out this investigation and describe how the risk of this hazard could be reduced.

safety hazard ....

....

method of reducing the risk ....

....

....
[2]

(b) (i) A student calculated the rate of diffusion of acid into an agar cube.

The student observed that the acid travelled 2 mm in 120 seconds.

Suggest **how** the student could calculate the **rate** of diffusion.

....

....

.... [1]

(ii) Plan an experiment to investigate the **relationship** between the size of the agar cubes and the time taken for the agar to change colour.

....

....

....

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....

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....

....

....

....

.... [6]

[Total: 19]

4. 0610_s19_qp_61 Q: 1

A student measured the distance moved by different concentrations of citric acid solution through agar jelly.

The agar contained Universal Indicator which changed colour in the presence of acid. The agar mixed with Universal Indicator was green at the beginning of the investigation.

Step 1 Three test-tubes were labelled **A**, **B** and **C**. Three different concentrations of citric acid solution were made.

Table 1.1 shows the volumes of 5% citric acid solution and distilled water that were used to make each solution.

Table 1.1

	solution		
	A	**B**	**C**
volume of 5% citric acid solution / cm^3	1.0	2.0	10.0
volume of distilled water / cm^3	9.0	8.0	0.0
percentage concentration of citric acid solution	0.5	1.0	5.0

Step 2 The base of a Petri dish containing agar and Universal Indicator was labelled **A**, **B** and **C**.

Three holes were cut into the agar. This is shown in Fig. 1.1.

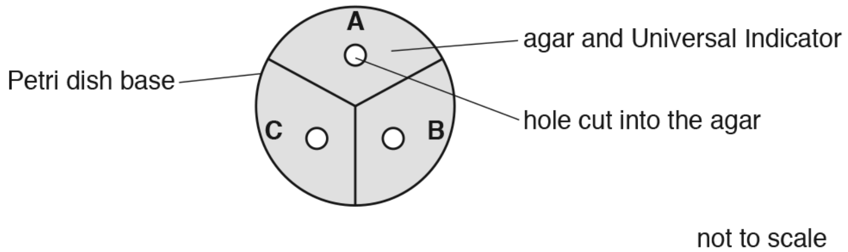

Fig. 1.1

Step 3 The student was provided with one dropping pipette. Three drops of solution **A** were placed into the hole in section **A** of the Petri dish.

Step 4 Three drops of solution **B** were placed into the hole in section **B** of the Petri dish.

Step 5 Three drops of solution **C** were placed into the hole in section **C** of the Petri dish.

Step 6 A stop-clock was started.

Step 7 After 30 minutes the student observed the colour change in the agar around the hole in each section of the Petri dish. The colour change was caused by the diffusion of the citric acid solution through the agar.

Step 8 A ruler was used to measure the distance travelled by each concentration of citric acid solution through the agar.

Fig. 1.2 shows the appearance of the Petri dish after 30 minutes.

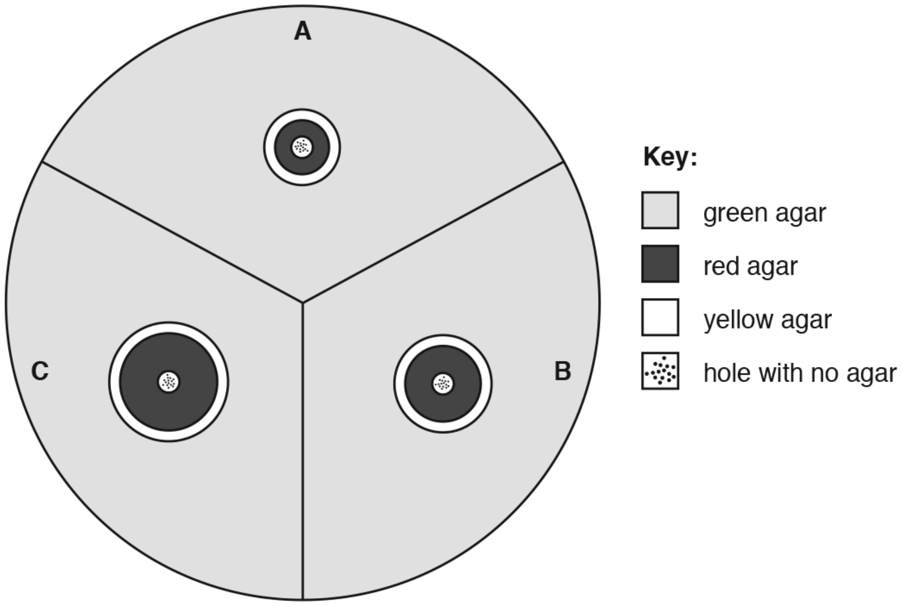

Fig. 1.2

(a) Use a ruler to measure the distance travelled by each concentration of citric acid solution after 30 minutes in Fig. 1.2.

Record these results in your table in **1(a)(i)**.

(i) Prepare a table to record the results.

You should include:

- the concentration of the citric acid solutions
- the distance travelled by the citric acid solutions.

(ii) Describe how you decided where to measure the distance travelled by the citric acid solutions.

....

....

.... [1]

(iii) State a conclusion for these results.

....

....

.... [1]

(iv) The citric acid moves through the agar by diffusion. The diffusion coefficient is used to show the effect of concentration on diffusion.

The formula to calculate the diffusion coefficient is:

$$\text{diffusion coefficient} = \frac{(\text{distance travelled})^2}{\text{time}}$$

Calculate the diffusion coefficient for a 10% solution of citric acid that travelled 14 mm in 30 minutes.

Give your answer to two significant figures.

Space for working.

.... mm^2 per minute
[2]

(v) Universal Indicator is used to estimate the pH value of substances.

Estimate the pH value for the green agar and the red agar.

green agar pH ....

red agar pH ....
[2]

(b) **(i)** State **two** variables that have been kept constant in this investigation.

1 ....

2 ....
[2]

(ii) Identify **one** potential source of error in this investigation and suggest how the error could affect the results.

error ....

....

effect on results ....

....

....
[2]

(c) Describe how you could adapt this method to find the effect of temperature on the rate of diffusion. Agar melts at 70 °C.

....

....

....

....

....

....

....

....

....

....

....

....

....

.... [6]

[Total: 19]

1.2 Osmosis

5. 0610_s22_qp_62 Q: 1

A student investigated the effect of temperature on the diffusion of vitamin C.

Vitamin C is an important part of a balanced diet and is found in some fruits and vegetables. When vegetables are boiled in water the vitamin C diffuses out into the surrounding water. A dialysis tubing bag filled with vitamin C solution was used to represent a vegetable.

The blue dye DCPIP was used as an indicator for the presence of vitamin C. High concentrations of vitamin C decolourise DCPIP quickly.

The student used the method described in step 1 to step 14.

Step 1 A syringe was used to fill a dialysis tubing bag with 10 cm^3 of vitamin C solution.

Step 2 The outside of the filled dialysis tubing bag was rinsed by dipping it into a beaker of distilled water.

Step 3 A large test-tube was labelled **hot**. The dialysis tubing bag was put into the large test-tube and secured in place with an elastic band, as shown in Fig. 1.1.

Step 4 Steps 1 to 3 were repeated with a second dialysis tubing bag and a large test-tube labelled **cold**.

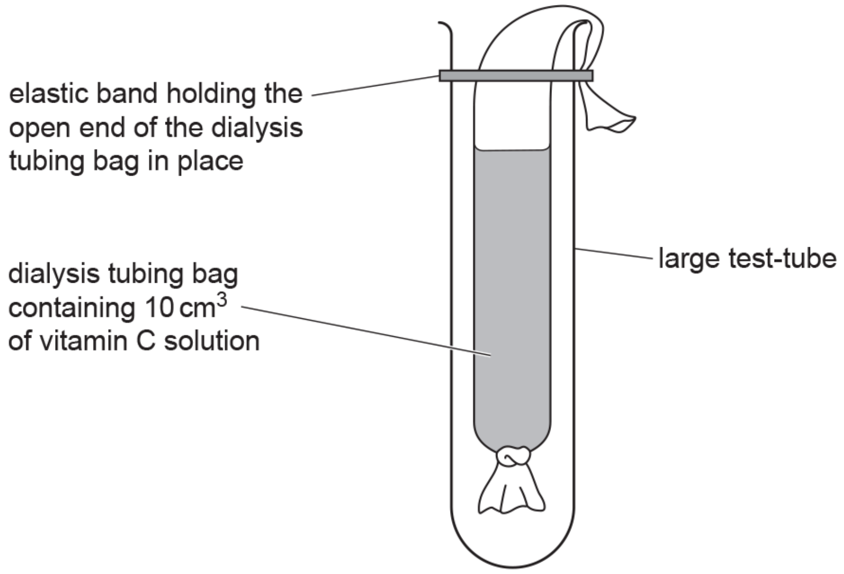

Fig. 1.1

Step 5 The large test-tube labelled **hot** was half-filled with hot water.

Step 6 The large test-tube labelled **cold** was half-filled with cold water.

Step 7 The temperature of the water in the large test-tube labelled **hot** was measured.

Step 8 The temperature of the water in the large test-tube labelled **cold** was measured.

Fig. 1.2 shows the readings on the thermometer used in step 7 and step 8.

hot water **cold** water

Fig. 1.2

(a) (i) State the temperatures of the hot water and the cold water shown on the thermometers in Fig. 1.2. Include the unit.

temperature of the **hot** water ....

temperature of the **cold** water ....

[2]

Step 9 The dialysis tubing bags were left in the large test-tubes for 15 minutes.

Step 10 After 15 minutes, the dialysis tubing bags were removed from the large test-tubes and discarded. 1 cm^3 of the liquid remaining in the large test-tube labelled **hot** was put into a clean standard test-tube.

Step 11 A syringe was filled with 10 cm^3 of DCPIP solution.

Step 12 One drop of DCPIP was added to the liquid in the standard test-tube and swirled to mix. After a few seconds the blue colour disappeared.

Step 13 The student continued to add drops of DCPIP until the blue colour remained after mixing.

Step 14 Steps 10 to 13 were repeated with 1 cm^3 of the liquid remaining in the test-tube labelled **cold**.

The **unused** volumes of DCPIP **remaining** in the syringes are shown in Fig. 1.3.

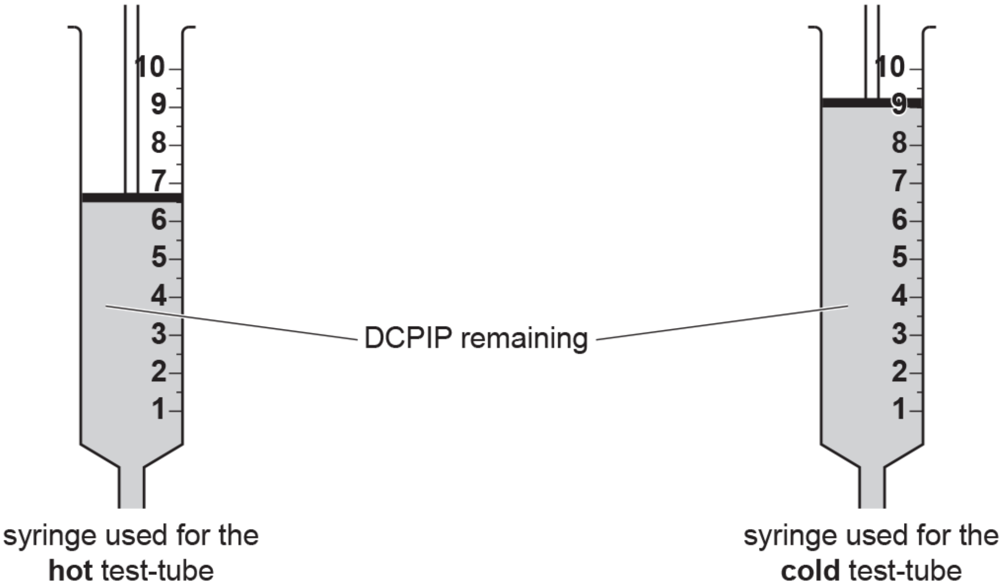

Fig. 1.3

(ii) Record the volumes of the DCPIP remaining in the syringes shown in Fig. 1.3.

syringe used for the **hot** test-tube ....

syringe used for the **cold** test-tube ....

[1]

(iii) Prepare a table to record the volume of DCPIP that has been **used** in each test-tube, in the space provided.

Use your answer in **1(a)(ii)** and the equation to calculate the volume of DCPIP that has been **used** in each test-tube:

volume of DCPIP used = 10 – volume of DCPIP remaining in the syringe

[3]

(iv) State a conclusion for these results.

....

....

.... [1]

(v) Suggest why the dialysis tubing bag was rinsed in step 2.

....

....

.... [1]

(vi) Identify **one** source of error in step 5 or step 6 and suggest a suitable piece of equipment to overcome this error.

error ....

....

equipment ....

....
[2]

(vii) Identify the variable that the student changed (independent variable) and the variable that was measured (dependent variable) in this investigation.

independent variable ....

....

dependent variable ....

....
[2]

(viii) Suggest why repeating the procedure several times would improve the investigation.

....

....

.... [1]

(b) Dialysis tubing acts as a partially permeable membrane and can be used to represent a model cell to investigate osmosis.

Plan an investigation to find out how different concentrations of sugar solutions affect the movement of water into or out of dialysis tubing.

....

....

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....

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....

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....

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.... [6]

[Total: 19]

Appendix A

Answers

1. 0610_m23_ms_62 Q: 1

Question	Answer	Marks	Guidance
(a)(i)	61 (°C) ; 38 (°C) ;	**2**	
(a)(ii)	table drawn with minimum of two columns <u>and</u> a header line ; appropriate, column / row, headings <u>and</u> correct data recorded in data cells ;	**2**	
(a)(iii)	as temperature increases (the rate of) diffusion is, faster ; **ora**	**1**	
(a)(iv)	differences in (the volume / concentration of) dye in the cylinders / differences in, rinsing / soaking / AW ; differences in, length of the (potato) cylinders ;	**1**	
(a)(v)	(use of a) scalpel / knife (to cut the cylinder) ; heat / hot (water) ; AVP ;	**1**	(use of) methylene blue / <u>allergy</u> from potato
(a)(vi)	use of a thermostatically controlled water-bath / method of maintaining temperature in a water-bath described ;	**1**	
(a)(vii)	to identify anomalous results ;	**1**	
(b)(i)	*independent variable:* surface area of, cube / pieces / potato / AW ; *dependent variable:* percentage of light (absorbed) ;	**2**	
(b)(ii)	tissue / potato ; (length of) time (soaking in methylene blue / in water in test-tube) ; type of dye ;	**1**	
(b)(iii)	indication on graph ; 67 ± 1(%) ;	**2**	**ecf** from incorrect indication on graph

2. 0610_m20_ms_62 Q: 1

	Answer	Mark	Partial Marks
(a)(i)	**1** table drawn with header lines and at least 2 columns ; **2** headings with unit for temperature ; **3** recording of two correct temperatures and 2 observations that correspond with the temperatures ;	**3**	**R** units in data cells
(a)(ii)	more (pigment) is leaked at higher temperatures / AW ; **ora**	**1**	
(a)(iii)	same, surface area / area of beetroot exposed to water / AW ; **ora** same, number of cells / amount of pigment (of tissue at start) ; **ora**	**1**	
(a)(iv)	*error* volume (of water was not stated) / AW ; *apparatus* measuring cylinder / syringe / (graduated) pipette / burette ; OR *error* temperature would change over time ; *apparatus* (named) insulating material / lid ; named correct equipment matching an error from a different step in the procedure ;	**2**	**A** (thermostatically) controlled water-bath
(a)(v)	duration of shaking / AW ; intensity / AW ;	**2**	
(b)(i)	temperature ;	**1**	
(b)(ii)	wider range (of temperatures) ; **ora** repeats ; **ora** measured light (that passes through liquid) ; **ora**	**2**	**A** calculates an average / identifies anomalies ; **ora** **A** collects numerical / quantitative, data / not subjective
(b)(iii)	result that does not fit the pattern / does not fit with the other results / not concordant / AW ;	**1**	
(b)(iv)	did not include anomaly (in the average) / AW ;	**1**	
(b)(v)	**A**xes – labelled with units ; **S**cale – suitable scale and plotted points occupies at least half the grid ; **P**lots – all points plotted accurately ± half a small square ; **L**ines – suitable line drawn ;	**4**	
(b)(vi)	intersection on trendline at 50°C shown ; value from graph ;	**2**	

3. 0610_s20_ms_63 Q: 1

	Answer	Mark
(a)(i)	*surface area:* 600 ; *volume:* 1000 ;	**2**
(a)(ii)	*heading:* mol per dm^3 ; *concentration:* 0.5 ;	**2**
(a)(iii)	table drawn with two columns and a header row ; headings with unit: test-tube **and** time / s ; all four results recorded ; correct conversion to seconds: **A** 55, **B** 125, **C** 265 and **D** recorded as **>360** ;	**4**
(a)(iv)	*conclusion consistent with results* higher concentration, diffuses fastest / has the shortest time **; ora**	**1**
(a)(v)	to see if water alone causes the colour change / as a control ;	**1**
(a)(vi)	*hazard:* cutting cubes; *precaution* cut on surface / cut away from hand ; OR *hazard:* use of acid ; *precaution* wear suitable, gloves / eye protection ;	**2**
(b)(i)	distance travelled divided by time taken / divide 2 by 120 ;	**1**
(b)(ii)	*methods - two from:* 1&2 use ruler to cut cubes of different sizes ; place cubes into an acid ; stop timing when end-point reached ; use of (thermostatically controlled) water-bath to maintain temperatures ; *independent variable:* 3 at least three different size cubes ; *variables kept constant – two from mp 4-8:* 4 temperature ; 5 concentration of acid / pH ; 6 volume of acid ; 7 type of agar ; 8 shape of agar (cubes) ; *dependent variable:* 9 time taken for cube to become completely pink ; 10 ref. to at least two further replications / repeat investigation two more times ; 11 ref. to relevant safety precaution ;	**6**

4. 0610_s19_ms_61 Q: 1

	Answer	Mark	Partial Marks
(a)(i)	table drawn with a minimum of two columns and a line separating headings from data ; headings with correct units: percentage concentration of citric acid (solution) **and** distance (travelled) / cm or mm ; three correct distances recorded ;	**3**	
(a)(ii)	from (edge of) hole to (edge of) the (red or yellow) circle ; diameter / radius of (red or yellow) circle ;	**1**	
(a)(iii)	the higher the concentration (of solution) the further (the acid) moves / AW;	**1**	
(a)(iv)	6.5 ;;	**2**	
(a)(v)	*green agar pH:* 7 ; *red agar pH:* 1 / 2 ;	**2**	**A** value in range 7–8 / neutral **A** value lower than 7/ acidic
(b)(i)	number of drops / three drops (of citric acid / solution in the holes) ; agar / agar concentration / depth of agar / volume of agar ; size of, holes / wells / AW ; type of indicator / concentration or volume of indicator ; time / 30 minutes ; temperature ; AVP ; e.g. one type of acid / same stock solution of citric acid	**2**	

<table>
<tr><th></th><th>Answer</th><th>Mark</th><th>Partial Marks</th></tr>
<tr><td>(b)(ii)</td><td>
<table>
<tr><th>error</th><th>effect on results</th></tr>
<tr><td>drop sizes vary ;</td><td>larger volume produces greater diffusion distance ; ora</td></tr>
<tr><td>no repeats ;</td><td>unable to identify anomalous results ;</td></tr>
<tr><td>one dropping pipette used for all three solutions / contamination;</td><td>a weaker solution would produce a smaller diffusion distance ;</td></tr>
<tr><td>longer diffusion time / citric acid added at different times / circles measured at different times ;</td><td>greater / lesser distance travelled ;</td></tr>
<tr><td>AVP; e.g. edge of colour change difficult to judge / subjective</td><td>matching AVP effect; e.g. over/under estimation of diffusion distance</td></tr>
</table>
</td><td>2</td><td>AW throughout
mark as a pair, effect must match the source of error</td></tr>
</table>

	Answer	Mark	Partial Marks
(c)	*any two from given method* ;; • agar plates used • indicator (in agar) • holes made in agar • (citric) acid added • left for fixed (stated) time • measure distance moved/diameter/radius *any three from novel method* ;;; • using range of at least 2 temperatures • temperatures specified and **all** less than 70 (°C) • idea of keeping temperature constant • ref to temperature equilibration time prior to adding citric acid • measure time taken to reach specified diameter *any additional points:* same concentration of citric acid ; wear gloves / goggles ; repeating the investigation at least twice / three holes in each plate / use three dishes at each temperature ; AVP ;	**6**	

5. 0610_s22_ms_62 Q: 1

Question	Answer	Marks	Guidance
(a)(i)	(hot water) 38.5 **and** (cold water) 17(.0) ; °C ;	**2**	
(a)(ii)	(hot test-tube) 6.5 **and** (cold test-tube) 9(.0) ;	**1**	
(a)(iii)	table drawn with a minimum of two columns and header line ; headings including units ; data recorded as 3.5 and 1(.0) **and** hot / cold or stated temperatures ;	**3**	**ecf** values from **1(a)(ii)**
(a)(iv)	*any one from:* (vitamin C) diffuses, more / faster, at high(er) temperature / in hot water ; greater volume of / greater amount of / more, DCPIP used, at high(er) temperature / in hot water ;	**1**	
(a)(v)	to remove vitamin (C) (from the outside of the bag) / *idea that* rinsing prevents contamination (by vitamin C) ;	**1**	
(a)(vi)	*error:* volume was not measured ; *equipment:* use a syringe / measuring cylinder / burette / graduated pipette ; OR *error:* temperature was not controlled ; *equipment:* use a thermostatically controlled water-bath ;	**2**	
(a)(vii)	*independent variable:* temperature ; *dependent variable:* volume of DCPIP ;	**2**	
(a)(viii)	so that anomalous results can be, identifed / excluded ;	**1**	

Question	Answer	Marks	Guidance
(b)	*independent variable:* 1 at least two concentrations of sugar solution ; *dependent variable:* 2 (measuring) mass / volume, before **and** mass / volume, after or change in, mass / volume (of dialysis tubing or test-tube) ; *3/4/5 variables kept constant, max. three from:* • volume of water (in dialysis tubing / test-tube) • volume of sugar solution (in dialysis tubing / test-tube) • temperature • (soaking) time • type of dialysis tubing / surface area of tubing • type of sugar *6/7/8 method, max three from description of how to:* • make sugar solution, concentrations / dilutions • maintain the temperature (during the investigation) • make a model cell e.g., knotting dialysis tubing at both ends / other methods of securing dialysis tubing at both ends • remove excess liquid from the tubing (if mass measured) • measure, mass / volume / height, of water / sugar solution e.g., use of a balance / measuring cylinder / syringe / ruler **9** repeat the whole investigation at least twice more (three trials) ;	**6**	

6. 0610_s22_ms_63 Q: 1

Question	Answer	Marks	Guidance
(a)(i)	temperatures recorded as 21.5 and 41(.0) ; °C ;	**2**	
(a)(ii)	table drawn with minimum three columns and headings underlined ; headers and length units correct ; four lengths recorded including 112 and 115 in correct positions ; correct final length measurements from Fig 1.4 i.e.,117±1 and 124±1 ;	**4**	**R** if units in body of table e.g. beaker / temperature — initial length / mm — final length / mm cold — 112 — 117 ±1 hot — 115 — 124 ±1
(a)(iii)	correct calculation for both ; cold = 5 (mm) hot = 9 (mm)	**1**	**ecf** for incorrect measurements in **1(a)(ii)**
(a)(iv)	higher temperature increases the rate of osmosis / more water moves into the raisins / AW, in hot water (compared to cold) / **ora** ;	**1**	
(b)(i)	*any one from:* type of raisin / fruit ; volume of water added ; number / amount, of raisins in each group ; orientation of raisins ; time left in water ;	**1**	
(b)(ii)	*any one from:* each raisin has only small change / a large group will give a larger change ; smaller percentage error in a large measurement / larger measurement more accurate ; some of the raisins may not change as expected / AW ;	**1**	
(c)(i)	mass (of potato cylinder) ;	**1**	

Question	Answer	Marks	Guidance
(c)(ii)	–28.1 (%) ;;;	**3**	MP1 correct figures selected from table 1.14 and 0.82 or 0.32 MP2 correct calculation and answer to any number of decimal places MP3 correct rounding to one decimal place **ecf** for incorrect MP2 and MP3 from incorrect previous step
(c)(iii)	axes labelled with units ; suitable even scale and plotting area occupies at least half the grid in both directions ; at least four points plotted accurately ± half a small square ; suitable line drawn ;	**4**	
(c)(iv)	correct reading from candidate's graph ; indication on the graph of where reading taken ;	**2**	
(c)(v)	starting mass was not the same / to allow a comparison / AW ;	**1**	
(c)(vi)	remove any excess solution so that it is not included in the mass ;	**1**	