2021 O' Levels 6093/3 – Recommended Answers

1a. 179 [1] (in whole numbers)

1b.

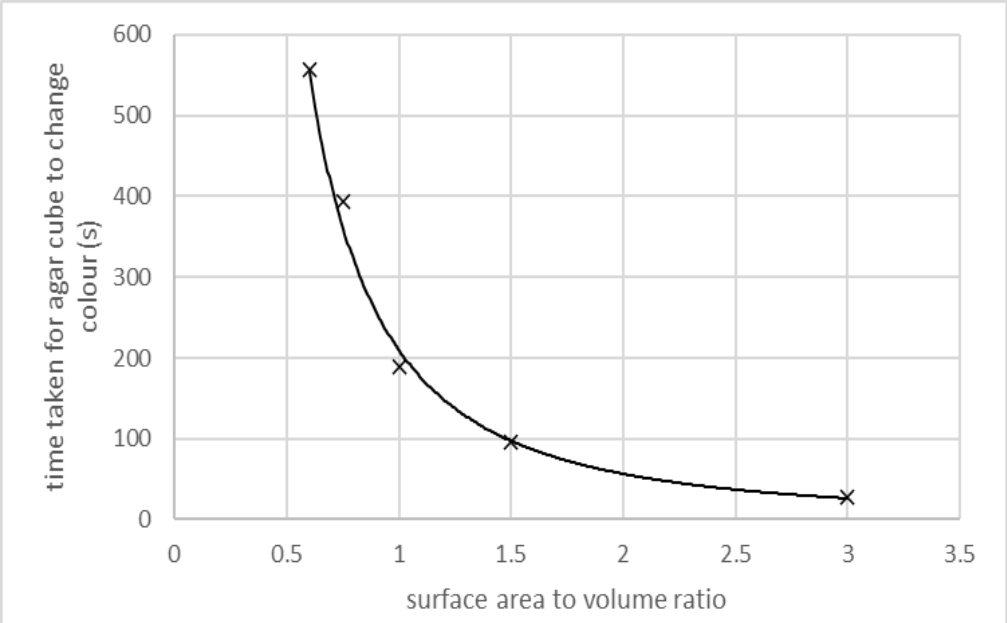
dimensions of agar cube / mm	surface area / mm^2 [1]	volume / mm^3	surface area : volume ratio [1]	distance from surface to the centre of agar cube / mm [1]
2x2x2	24	8	3	1
4x4x4	96	64	1.5	2
6x6x6	216	216	1	3
8x8x8	384	512	0.75	4
10x10x10	600	1000	0.6	5

1c. [1m – values for time taken fall within 20% of range
1m – time taken increases as SA:V decreases]

surface area : volume ratio	Time taken for whole cube to change colour / s
3	27
1.5	96
1	189
0.75	393
0.6	557

1d. [1] each. Total: [4]

- Vertical axis labelled "time taken for agar cube to change colour (s)" & horizontal axis labelled "surface area to volume ratio" [1]
- Scale: Appropriate and graph occupies at least ½ of grid [1]
- All points plotted in accurately [1]
- Best fit line: Smooth curve that does not extrapolate [1]



1e. As surface area to volume ratio increases, time taken for the agar cube to change colour decreases [1].

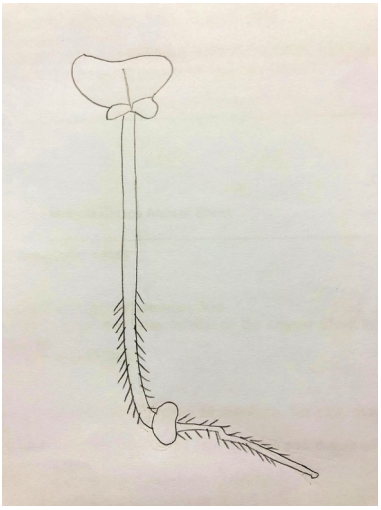
1f. [1] for each key variable and explanation
key variable 1: concentration of hydrochloric acid
explanation: To ensure that the concentration gradient for diffusion is the same for all cubes.
key variable 2: type of agar used
explanation: To ensure that the density of all cubes are the same.

1g. source of error: It is difficult to determine the exact time when the entire cube changes colour completely [1].
improvement: Repeat the experiment to obtain an average time taken for the time taken for the cube to change colour to improve the reliability of result [1].
source of error: Before the timing of the stopwatch started, diffusion of the acid has already started for the first four cubes, so their measured time taken will be shorter than expected [1].
improvement: Use separate stopwatches for each cube and start timing each one immediately after the cube is immersed in acid. / Conduct the experiment for each cube one after another [1].

1h. [1] each. Total: [3]
- The agar blocks are cubes but not all cells are cuboidal in shape, so the rate of diffusion will be different.
- The agar block has the same consistency throughout but cells contain organelles which will affect the rate of diffusion differently.
- The material that the agar block is made up of is different from that of cells, so the rate of diffusion will be different.

2a. i.

<u>Drawing of white mustard plant</u>



[1] each. Total: [4]
- Proportion: the thickness of the stem is proportional to the length of the plant + size of the leaves is proportional
- Quality of lines: clean & continuous drawing lines
  Resemblance to specimen:
- Shape of leaves
- Distribution of root hairs: fine root hairs found on the tap root of the plant

Note:
- *Draw seedling upright (in the orientation that it is in natural form)*
- ***No mark awarded if the size of the drawing is too small*** *(For long structure, generally ≥¾ vertical space used)*

ii. [1m for working. 1m for answer in 2 sf]
Magnification = length of drawing / length of actual

2b. NIS

2c. NIS

2d. i. The leaves and stems are stained red [1].

ii. Aerobic respiration occurs in mitochondria, which releases energy [1]. This energy is used in cell division and making of new protoplasm [1].

2e. [1] for each area of discussion. Total: [5]
[P: For not describing the steps explicitly]

Constant variables (≥3)	- age of seeds - species of white mustard plants - light intensity provided to plants* - volume of water provided to plants* * : Must be included
Independent variables	Time gap of observing the roots
Dependent variable	Extent of staining of roots by TTC
Significant apparatus	- At least 5 specimens* - Water* - TTC* - Light source* - Receptable to grow seedlings (e.g. Petri dish) - Medium (e.g. filter paper/ wool) - Measuring cylinder * : Must be included
Interpretation	The darker the stain of the root, the higher the rate of respiration which indicates a higher activity of mitochondria

1. Grow seeds of the same age and species of white mustard plants in separate petri dishes with same mass of wool
2. Expose the petri dish to the same light intensity.
[Note: Light, not a requirement in seed germination, is essential during photosynthesis by seedling]
3. Water the seeds daily with equal volume of water.
4. After the seeds germinate, remove 5 plants and soak them in a fixed volume of TTC for 30 minutes at the same time each day for the next 10 days.
5. Observe the roots of the plants daily for the extent of staining and record the observations.
[Note: The no. of plants, frequency & period of observation may deviate from the recommended]
6. The darker the stain of the root, the higher the rate of respiration in the mitochondria of root cells indicating a higher level of activity of mitochondria.