1.9 A-Level Biology: Required Practicals and Data Analysis: Test Pack

AQA 7402 · Calculator allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A student calibrates a light microscope using an eyepiece graticule and a stage micrometre scale, then uses the calibration to measure palisade mesophyll cells from a privet leaf.

(a) At x400 magnification, 25 divisions of the stage micrometre scale (each division = 10 micrometres, µm) aligned exactly with 100 eyepiece graticule units (egu). Calculate the value of 1 egu in micrometres at this magnification. **(2)**

(b) Using the same objective lens, a palisade mesophyll cell measures 18 egu across. Calculate its actual width in micrometres. **(1)**

(c) The student repeats the measurement on five different palisade cells, obtaining readings of 16, 18, 17, 19 and 15 egu. Using the calibration from part (a), calculate the mean actual cell width and the standard deviation of the actual widths, using $SD = \sqrt{\text{sum}(x - \text{mean})^2 / (n - 1)}$. Give both answers to 3 significant figures. **(4)**

(Total for Question 1 is 7 marks)

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2 A student investigated the antimicrobial effect of tea tree oil on the growth of a named non-pathogenic bacterium, using paper discs soaked in different concentrations of tea tree oil placed on an agar plate inoculated with a lawn of bacteria, incubated at 25°C for 48 hours.
Tea tree oil concentration (%): 0 (control, distilled water), 25, 50, 75, 100
Diameter of zone of inhibition (mm): 0, 6, 11, 16, 20

(a) State two aseptic technique steps that should be used when inoculating the agar plate, and explain the purpose of one of them. **(2)**

(b) Calculate the area of the zone of inhibition produced by the 100% concentration disc, which has a diameter of 20 mm. Use area = $\pi \times r^2$ and give your answer to 3 significant figures. **(2)**

(c) Explain why the plates were incubated at a maximum of 25°C rather than at 37°C, which would produce faster bacterial growth. **(2)**

(d) Identify the independent variable in this investigation. **(1)**

(Total for Question 2 is 7 marks)

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3 A student dissected a fish head to examine the structure of the gills, as part of a required practical investigating the gas exchange system of a named organism.

(a) State two safety precautions that should be taken when dissecting a fish head. **(2)**

(b) Explain how the structure of the gills, as observed in your dissection, is adapted for efficient gas exchange. **(6)**

(Total for Question 3 is 8 marks)

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Mark scheme · 1.9 A-Level Biology: Required Practicals and Data Analysis: Test Pack

Question 1

(a) 25 x 10 = 250 µm spanned by 100 egu (or equivalent correct method) **M1**

(a) 2.5 µm cao **A1**

(a) Answer: 2.5 µm per egu

(b) 45 µm (ft from (a): 18 x their calibration value) **B1**

(b) Answer: 45 µm

(c) converts all five readings using the calibration factor: 40, 45, 42.5, 47.5, 37.5 µm **M1**

(c) mean = 42.5 µm cao **A1**

(c) sum of squared deviations from the mean = 62.5, divided by (n - 1) = 4, giving variance = 15.625 **M1**

(c) SD = 3.95 µm (awrt 3.95) cao **A1**

(c) Answer: Mean = 42.5 µm; SD = 3.95 µm

Question 2

(a) two valid steps, e.g. flame the neck of the culture bottle/inoculating loop before and after use; work near a Bunsen burner flame; tape (do not fully seal) the lid of the petri dish and incubate upside down **B1**

(a) a correct explanation of the purpose of one of the named steps (e.g. flaming kills/prevents contaminating microorganisms; the rising hot air current above a flame prevents microorganisms from the air settling on the plate; taping rather than sealing allows gas exchange while still restricting entry of unwanted microorganisms) **B1**

(a) Answer: e.g. Flame the inoculating loop before and after use, to kill contaminating microorganisms

(b) r = 10 mm; area = π x 10^2 (correct substitution) **M1**

(b) 314 mm^2 (awrt 314) cao **A1**

(b) Answer: 314 mm^2

(c) 37°C is human body temperature, which favours the growth of microorganisms that could be human pathogens **B1**

(c) incubating at a maximum of 25°C reduces the likelihood of growth of pathogenic species, reducing the risk to students carrying out the practical **B1**

(c) Answer: Reduces the risk of growing human pathogens, which grow best near body temperature (37°C)

(d) concentration of tea tree oil **B1**

(d) Answer: Concentration of tea tree oil

Question 3

(a) any one of: wear appropriate protective clothing (gloves, apron, eye protection); use a dissecting mat/tray; handle scalpels/sharp instruments carefully, cutting away from the body; dispose of biological waste appropriately and wash hands after **B1**

(a) any second, different precaution from the list above **B1**

(a) Answer: Any two of: wear gloves/eye protection, use a dissecting tray, cut away from the body, dispose of waste and wash hands appropriately

(b) **L3** A detailed and coherent explanation linking at least four structural features of the gills to their function in gas exchange, using appropriate scientific terminology throughout. **5-6**

(b) **L2** Some structural features are linked to function, with less detail or minor inaccuracies; reasonably clear overall. **3-4**

(b) **L1** Basic, largely isolated statements about gill structure or function, with limited linkage between the two. **1-2**

(b) **L0** No relevant content. **0**

(b) Indicative content:

- Many thin gill filaments, each covered in numerous secondary lamellae, greatly increase the surface area available for diffusion of gases
- The lamellae have a very thin (often one-cell-thick) epithelium, giving a short diffusion distance/pathway for oxygen and carbon dioxide
- Each lamella has an extensive network of capillaries close to its surface, maintaining a steep concentration gradient for diffusion
- Blood in the capillaries flows in the opposite direction to the flow of water over the gills (counter-current flow/exchange), maintaining a concentration gradient along the entire length of the lamella and maximising oxygen uptake
- Continuous ventilation (movement of water over the gills, e.g. via the mouth and operculum) maintains a concentration gradient of oxygen between the water and the blood
- The gill filaments/lamellae are supported by the surrounding water, allowing them to remain spread out (rather than collapsing, as would happen in air), maximising surface area

(b) Answer: Level 3 response linking at least four features (large surface area, thin epithelium, dense capillary network, counter-current flow, ventilation) to efficient gas exchange

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