Cambridge AS & A Level · Biology 9700

Biology 9700 formulas and definitions: A2

All 62 formulas, facts and definitions to learn, by syllabus topic. Formulas the exam gives you are left out.

Read online at **pastopic.com/cambridge/biology-9700/formulas**; each topic heading links to its full note.

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A Level

12 Energy and respiration

$\mathrm{ATP} + \mathrm{H_2O} \rightarrow \mathrm{ADP} + \mathrm{P_i}$, releasing 30.5 kJ mol^{-1}

$$\mathrm{RQ} = \frac{\mathrm{CO_2\ given\ out}}{\mathrm{O_2\ taken\ in}}$$

RQ: carbohydrate 1.0, protein about 0.8, lipid 0.7; above 1.0 means some anaerobic respiration

Energy values: carbohydrate and protein about 17 kJ g^{-1}, lipid about 37–39 kJ g^{-1}

Respirometer: volume $= \pi r^2 \times$ distance; $\mathrm{RQ} = \dfrac{x - y}{x}$

Redox indicator: rate $= \dfrac{1}{\mathrm{time}}$

$$\text{Efficiency} = \frac{\text{energy captured in ATP}}{\text{energy released by the substrate}} \times 100$$

Glycolysis per glucose: 2 ATP used, 4 made (net 2), 2 reduced NAD, 2 pyruvate

Link reaction per pyruvate: 1 CO_2, 1 reduced NAD, 1 acetyl CoA

Krebs cycle per turn (two per glucose): 2 CO_2, 3 reduced NAD, 1 reduced FAD, 1 ATP

Without oxygen: net 2 ATP per glucose (glycolysis only)

13 Photosynthesis

$$6\,\mathrm{CO_2} + 6\,\mathrm{H_2O} \rightarrow \mathrm{C_6H_{12}O_6} + 6\,\mathrm{O_2}$$

Photolysis: $2\,\mathrm{H_2O} \rightarrow \mathrm{O_2} + 4\,\mathrm{H^+} + 4\,\mathrm{e^-}$ (in PS II, by the oxygen-evolving complex)

$\mathrm{RuBP\ (5C)} + \mathrm{CO_2} \xrightarrow{\text{rubisco}} \text{unstable 6C} \rightarrow 2\,\mathrm{GP\ (3C)}$

$\mathrm{GP} \xrightarrow{\text{ATP, reduced NADP}} \mathrm{TP}$; $\mathrm{TP} \xrightarrow{\text{ATP}} \mathrm{RuBP}$

Per 3 CO_2: 3 RuBP → 6 GP → 6 TP; 5 TP → 3 RuBP; 1 TP leaves

$$R_f = \frac{\text{distance moved by pigment from origin}}{\text{distance moved by solvent from origin}}$$

Gross rate of photosynthesis = net rate + rate of respiration

Light intensity $\propto \frac{1}{d^2}$ (d = distance from lamp)

Rate $= \frac{\text{amount}}{\text{time}}$; redox indicator rate $= \frac{1}{t}$

Percentage change $= \frac{\text{new} - \text{original}}{\text{original}} \times 100$

Mean increase per unit $= \frac{\text{change in rate}}{\text{change in } x}$

14 Homeostasis

Percentage change $= \frac{\text{new} - \text{original}}{\text{original}} \times 100$ (a fall gives a negative value: state it as a decrease)

Percentage reabsorbed $= \frac{\text{volume filtered} - \text{volume in urine}}{\text{volume filtered}} \times 100$

Rate of change $= \frac{\text{change in quantity}}{\text{time taken}}$, with units such as pmol dm^{-3} min^{-1}

"How many times" $= \frac{\text{later value}}{\text{earlier value}}$ (no units)

cm^3 min^{-1} to dm^3 per day: $\times 60 \times 24 \div 1000$

$\text{glucose} + O_2 \xrightarrow{\text{glucose oxidase}} \text{gluconic acid} + H_2O_2$

$H_2O_2 + \text{chromogen} \xrightarrow{\text{peroxidase}} \text{coloured oxidised chromogen} + H_2O$

$\text{ATP} \xrightarrow{\text{adenylyl cyclase}} \text{cAMP}$ (the second messenger)

Useful values: GFR about 125 cm^3 min^{-1} (180 dm^3 a day); filter cut-off about 68 000–70 000 relative molecular mass; blood glucose about 4–6 mmol dm^{-3}; core temperature about 37 °C

15 Control and coordination

Resting potential about -70 mV; inside negative

Na^+/K^+ pump: 3 Na^+ out, 2 K^+ in, uses ATP

Depolarisation: Na^+ in; repolarisation: K^+ out (voltage-gated channels, no ATP)

Speed $= \frac{\text{distance}}{\text{time}}$, so time $= \frac{\text{distance}}{\text{speed}}$

Maximum impulse frequency $= \frac{1}{\text{refractory period}}$

Percentage change $= \frac{\text{new} - \text{original}}{\text{original}} \times 100$

Sarcomere = A band + I band; H zone = sarcomere $- 2\times$ actin filament length

On contraction: A band same; I band, H zone and sarcomere shorter

Ca^{2+} roles: vesicle release at synapses; binding troponin in muscle

ATP roles in muscle: detach myosin head, recock it, pump Ca^{2+} into the SR

16 Inheritance

Degrees of freedom = number of classes -1

Expected number = total $\times$ that class's fraction of the ratio

χ^2 below the critical value: difference not significant, due to chance

Haploid $= n$, diploid $= 2n$; chromatids at the start of meiosis $= 2 \times 2n$

Combinations of chromosomes from random orientation $= 2^n$

$Aa \times Aa$: genotypes $1:2:1$; phenotypes $3:1$ (dominance) or $1:2:1$ (codominance)

$Aa \times aa$ (test cross): $1:1$

$AaBb \times AaBb$, unlinked: $9:3:3:1$; test cross $AaBb \times aabb$: $1:1:1:1$

$X^HX^h \times X^HY$: all daughters unaffected, half of sons affected

17 Selection and evolution

Degrees of freedom for the t-test $= n_1 + n_2 - 2$

$t >$ critical value at $p = 0.05$: significant difference

$q = \sqrt{\text{frequency of the recessive phenotype}}$, then $p = 1 - q$

Number of heterozygotes $= 2pq \times$ population size

18 Classification, biodiversity and conservation

D near 1: high diversity; near 0: low diversity

Correlation value (ignoring sign) $>$ critical value at $p = 0.05$: significant, reject the null hypothesis

Mean rate of change $= \dfrac{\text{change in value}}{\text{time taken}}$

Percentage change $= \dfrac{\text{new} - \text{original}}{\text{original}} \times 100$

19 Genetic technology

Copies after PCR $= N_0 \times 2^n$, for N_0 starting copies and n cycles

Reaching the same amount k cycles later means 2^k times less DNA at the start

Part of a total $= \text{total} \times \dfrac{\text{percentage}}{100}$

Percentage change $= \dfrac{\text{new} - \text{original}}{\text{original}} \times 100$