Grade 11 Biology Model Paper 2

ANSWER KEY

Full marks 75 · 3 hours

Give the marks for the points in the marking scheme; an answer in other words that says the same is right.

A practice paper by Science Playground, made to CDC's Specification Grid 2077, Grade 11 Biology (Bio. 201); not an official CDC or NEB paper.

Group A Multiple choice — 11 marks

Question 1 — 11 × 1 = 11

a. **(iv)** Each chlorine atom freed from them acts as a catalyst, breaking up ozone molecules again and again.

b. **(i)** 1962

c. **(iii)** Protecting red pandas in their own forest in a national park

d. **(i)** Mycology

e. **(iii)** A bacterium

f. **(iv)** Critically Endangered, Endangered and Vulnerable

g. **(iv)** They will fill and empty more slowly, or stop.

h. **(iii)** That amino acids can form from simple gases such as methane, ammonia and hydrogen when energy is supplied

i. **(i)** The fewer the differences, the more recently two species shared a common ancestor.

j. **(iii)** *Homo erectus*

k. **(i)** The founder effect: one of the few founders happened to carry the allele.

Group B Short answers, each on one content area — 40 marks

Question 2 — 5 marks

a. Each dot is a **sorus** (plural sori): a group of **sporangia** on the lower surface of a fertile leaf (sporophyll). **[2]**

Each sorus is covered by a **kidney-shaped** flap, the **indusium**, which protects the young sporangia.

Marking scheme

- Sorus, a group of sporangia.
- Covered by the kidney-shaped indusium.

b. Each spore mother cell divides by **meiosis** into four spores, so $16 \times 4 = 64$ **spores**. **[2]**

The spores are **haploid** (made by meiosis from diploid cells), and since all the spores are alike, *Dryopteris* is **homosporous**.

Marking scheme

- 64 spores (16×4, by meiosis).
- Haploid; homosporous.

c. The **gametophyte**, the small prothallus, must live on damp ground, and **fertilization needs water**: **[1]** the multiflagellate antherozoids must swim in a film of water to the archegonia. Without moisture no new sporophyte can start, so ferns are mostly found where it stays damp.

Marking scheme

- Fertilization needs water (antherozoids swim to the egg) and the delicate prothallus needs moist ground, so ferns are tied to damp places.

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OR

a. [2]

- **Agar**, from *Gelidium* and *Gracilaria*: a jelly for jams and sweets, and the solid **culture medium** for bacteria and plant tissue culture.
- **Carrageenan**, from *Chondrus crispus* (Irish moss): a thickener in ice cream, chocolate milk and toothpaste.

Marking scheme

- Agar, with a use (culture medium, jellies).
- Carrageenan, with a use (thickener in ice cream, toothpaste).

b. The fertilizer makes the **algae** in the pond (green algae, diatoms) grow and multiply. Floating and attached algae are the **primary food** of fish and the small water animals they eat, so with more algae there is more food for the fish, and the harvest grows. [2]

Marking scheme

- The fertilizer makes the algae in the pond grow.
- Algae are the primary food of fish (directly or through small animals), so more fish grow.

c. Gelatin **melted** in warm weather and some bacteria **digested** it, so the medium turned liquid. Agar stays **solid up to about 85 °C**, and almost no bacterium can digest it, so the plates stay firm and the colonies stay separate. [1]

Marking scheme

- Agar stays solid at warm temperatures and bacteria can't digest it, unlike gelatin.

Question 3 — 5 marks

a. **Carolus Linnaeus**, the Swedish naturalist, in *Species Plantarum* (**1753**). [1]

Marking scheme

- Carolus Linnaeus, in *Species Plantarum* (1753).

b. [2]

- The specific epithet starts with a **small letter**: "Tigris" should be "tigris". The generic name starts with a **capital letter**: "solanum" should be "Solanum".
- By hand the two words are **underlined separately**, since italics can't be written: Panthera tigris and Solanum tuberosum.

Marking scheme

- Genus with a capital letter and specific epithet with a small letter: *Panthera tigris*, *Solanum tuberosum*.
- Handwritten names underlined, each word separately.

c. Any two of these: [2]

- **Cell wall:** bacteria have **peptidoglycan** (murein); archaea have none (pseudopeptidoglycan, protein or polysaccharide instead).
- **Membrane lipids:** archaea's are joined to glycerol by **ether** bonds; bacteria's (and eukaryotes') by **ester** bonds.
- **Antibiotics:** bacteria are killed by streptomycin, chloramphenicol and penicillin; archaea are **not affected**, since they lack the bacterial ribosome and wall these act on.
- **rRNA** and other molecules: archaea's rRNA sequences, RNA polymerase and histones are closer to those of eukaryotes than to bacteria's.

Marking scheme

- One real difference between archaea and bacteria (wall, membrane lipids, antibiotics or rRNA).
- A second real difference.

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Question 4 — 5 marks

a. [2]

- **Forest:** a few large trees support many thousands of insects that eat them, so the producers' bar is **narrower** than the herbivores' above it, while the carnivores' bars narrow again: the pyramid is **spindle-shaped**.
- **Parasitic chain:** each level is **more numerous** than the one it lives on (one tree, many birds, thousands of lice), so every bar is wider than the one below: the pyramid is **inverted**.

Marking scheme

- Forest: few large producers support many herbivores, then fewer carnivores: spindle-shaped.
- Parasitic chain: every level more numerous than the one below: inverted.

b. Each step passes on about 10%: chital receive $50{,}000 \times 0.1 = 5{,}000$ kJ, and tigers $5{,}000 \times 0.1 = \mathbf{500\ kJ}$. [1]

Marking scheme

- 500 kJ ($50{,}000 \rightarrow 5{,}000 \rightarrow 500$).

c. With no snakes to eat them, the **rats** would multiply; more rats would eat more **rice** and the farmer's harvest would fall (animals that ate snakes, such as some birds of prey, would also lose food). His idea is **wrong**: the snakes are part of the food web and keep the rats in check, so they protect his crop. [2]

Marking scheme

- Without snakes, rats increase and eat more rice (the web is upset).
- So the idea is harmful: snakes control the rats and help the farmer.

Question 5 — 5 marks

a. [2]

- **Like non-living things** (any two): they can be **crystallized** and stored like chemicals; outside a cell they are **inert**; they have **no metabolism** (no respiration, nutrition or excretion); they are acellular, with no ribosomes or enzyme systems of their own.
- **Like living things** (any two): they **multiply** inside a living host cell; they carry **genes** (DNA or RNA); they undergo **mutation**; they are **infectious** and host specific.

Marking scheme

- Two non-living characters (e.g. crystallized, inert outside cells, no metabolism).
- Two living characters (e.g. multiply in host cells, have nucleic acid, mutate).

b. The phage's **tail fibers** grip the bacterium's surface. The tip of the tail, carrying the enzyme **lysozyme**, makes a hole in the peptidoglycan **cell wall**; the **sheath contracts** and pushes the hollow tail tube through, and the DNA is **injected** into the cell like a syringe. [2]

Inside, the phage's genes take over the cell, which makes copies of the phage until it **bursts** (lyses), releasing about 100–200 new phages: the **lytic cycle**.

Marking scheme

- Tail fibers attach; lysozyme makes a hole in the wall; the sheath contracts and the DNA is injected.
- Phage genes make the cell produce new phages, and the cell bursts (lytic cycle), freeing them.

c. Flu is caused by a **virus**. Antibiotics such as penicillin and streptomycin work by stopping the making of a **bacterial cell wall** or by blocking **bacterial ribosomes**; a virus has neither (it uses the host cell's machinery), so the antibiotic has nothing to act on. [1]

Marking scheme

- Antibiotics act on bacterial walls or ribosomes, which viruses lack, so they don't affect the flu virus.

Question 6 — 5 marks

a. Because they **persist** in the environment for a long time: they are **non-biodegradable** and hard to break down. [1]

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Marking scheme

- They persist for a long time and are hard to break down (non-biodegradable).

b. [2]

$$\frac{25}{0.00005} = 500{,}000 \text{ times}$$

This is **biomagnification**. DDT dissolves in **fat**, not water, and is not broken down, so it is **stored** in the bodies of the organisms that take it in. Each animal eats **many** of the level below over its life and keeps their DDT, so the concentration grows at every step up the chain.

Marking scheme

- 500,000 times.
- Biomagnification: DDT is fat-soluble and not broken down, so it is stored and builds up as each level eats many of the one below.

c. The family is caught in the **pesticide treadmill**. In the caterpillar population a few have genes that let them survive the spray; they breed and pass the genes on, so each spraying leaves more **resistant** caterpillars. The spray also kills the caterpillars' natural **enemies** (spiders, wasps, ladybird beetles), so the pests rebound faster, and more spraying follows. [2]

Better ways (any two, as in **integrated pest management**): crop rotation; biological control (*Trichogramma* wasps, *Bacillus thuringiensis*); biopesticides such as neem; hand-picking, nets and sticky traps; resistant varieties; spraying only when the pests are many enough to do real harm.

Marking scheme

- Resistance builds up by selection, and natural enemies are killed: the pesticide treadmill.
- Two sound alternatives (IPM: rotation, biological control, neem, traps, resistant varieties, spraying only when needed).

Question 7 — 5 marks

a. [2]

- **Primary (definitive) host:** the female *Anopheles* mosquito, in which the **sexual** phase passes (gametes form and fuse in its stomach).
- **Secondary (intermediate) host: man**, in whom the **asexual** phase (schizogony in the liver and red blood cells) passes.

Marking scheme

- Primary host: female *Anopheles*, the sexual phase.
- Secondary host: man, the asexual phase.

b. In *P. vivax* one **erythrocytic cycle** takes **48 hours**. Each time a generation of schizonts in the red blood cells bursts together, releasing merozoites and hemozoin into the blood, the body reacts with an attack of fever, so the attacks come every 48 hours (tertian malaria). [1]

Marking scheme

- The erythrocytic cycle takes 48 hours, and the fever comes when the red blood cells burst together at its end.

c. [2]

- **Falciparum is more urgent:** *P. falciparum* is the **most dangerous** species (malignant malaria): it causes nearly all malaria deaths, and the fever may be almost continuous, so it must be treated at once.
- **Vivax needs an extra medicine:** *P. vivax* leaves **hypnozoites** resting in the liver, which can wake weeks or months later and cause a **relapse**. Chloroquine clears only the blood, so **primaquine** is also given to kill the hypnozoites. *P. falciparum* makes no hypnozoites, so it doesn't relapse.

Marking scheme

- Falciparum is the most dangerous (malignant, most deaths), so urgent.
- Vivax has hypnozoites in the liver that cause relapse, so primaquine is added; falciparum has none.

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OR

a. [2]

- **Cutaneous** respiration (through the skin);
- **Bucco-pharyngeal** respiration (through the lining of the mouth and pharynx);
- **Pulmonary** respiration (through the lungs).

Marking scheme

- Cutaneous and bucco-pharyngeal respiration.
- Pulmonary respiration.

b. [1] It breathes only through its **skin** (cutaneous respiration), which is enough during hibernation when it needs little oxygen. The skin is **thin, moist** (kept slimy by mucous glands) and **full of blood capillaries**, so oxygen dissolves in its water film and diffuses into the blood.

Marking scheme

- Through the skin, which is thin, moist and richly supplied with capillaries.

c. [2] Oxygen can pass through the frog's skin only when it **dissolves in the thin film of water** on it. In a dry, sunny box the skin **dries out**, so it can no longer take in oxygen or give out **carbon dioxide**, most of which a frog loses through its skin even when the lungs are working. The lungs alone can't keep up, and the drying skin also loses water from the body, so the frog dies.

Marking scheme

- Gases must dissolve in a moist film to pass through the skin; dried skin can't exchange O_2 and CO_2.
- The skin normally removes most of the CO_2 (and the frog loses water), so lungs alone can't keep it alive.

Question 8 — 5 marks

a. [3]

- *Hydra*: phylum **Coelenterata** (Cnidaria); a soft, sac-like body with a ring of **tentacles** round the mouth, and radial symmetry.
- **Starfish**: phylum **Echinodermata**; a **spiny skin** and **five arms** in a ring (five-part radial symmetry), with tube feet beneath.
- **Cockroach**: phylum **Arthropoda**; **jointed legs** and a hard **chitin exoskeleton**, the body in segments.

Marking scheme

- *Hydra*: Coelenterata, with a reason (tentacles round the mouth, sac-like body).
- Starfish: Echinodermata, with a reason (spiny skin, five arms).
- Cockroach: Arthropoda, with a reason (jointed legs, chitin exoskeleton).

b. [2] Any two of these:

- The starfish's **larva is bilaterally symmetrical**; only the adult becomes radial again, so echinoderms come from bilateral ancestors.
- The starfish is **triploblastic**, with three germ layers; *Hydra* is **diploblastic** (ectoderm and endoderm with jelly-like mesoglea between).
- The starfish has a true **coelom** (it is an enterocoelomate) and an organ-system grade of body; *Hydra* has no coelom, only tissues.
- The starfish has an **endoskeleton** of calcareous ossicles from the mesoderm; *Hydra* has none.

Marking scheme

- One sound piece of evidence (bilateral larva, triploblastic, coelom, endoskeleton).
- A second sound piece of evidence.

Question 9 — 5 marks

a. [1] **Vestigial organs** are organs that are **reduced** and do little or none of the work they do in related animals, but that were **fully working** in the ancestors.

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Marking scheme

- Reduced organs that have lost their main job, but work in related animals (or worked in the ancestors).

b. The **vermiform appendix**. With the cecum it is large and working in plant-eating mammals (a rabbit's is huge), holding bacteria that digest cellulose; its small, reduced form in humans points to **descent from ancestors** that ate far more tough plant food. **[1]**

Marking scheme

- The vermiform appendix; it works in related plant-eating mammals, showing common descent.

c.

- **Reptile features: teeth** in its jaws, a long **bony tail**, three free **clawed fingers** on each wing, no keel on the breastbone. **[3]**
- **Bird features: feathers** (long flight feathers), **wings** (forelimbs shaped for flight), a **wishbone** (furcula).
- **Why strong evidence:** Darwin's theory predicted that if birds came from reptiles, there should once have been animals **in between**. *Archaeopteryx*, a **connecting link** (a transitional fossil) about 150 million years old, was exactly such a creature, found soon after the prediction was made.

Marking scheme

- Two reptile features (teeth, bony tail, clawed fingers).
- Two bird features (feathers, wings, wishbone).
- A transitional fossil of the kind evolution predicted, linking reptiles and birds.

Group C Long answers, each on one content area — 24 marks

Question 10 — 8 marks

a. Any two: **sporangiospores** (in sporangia, the usual way), **chlamydospores** (thick-walled resting spores), **oidia** (in a sugary liquid). **[2]**

Marking scheme

- One asexual structure (e.g. sporangiospores).
- A second (e.g. chlamydospores, oidia).

b.

1. Hyphae of two **different mating types**, the **+ and − strains**, grow close together and put out club-shaped swellings towards each other, the **progametangia**. **[3]**
2. Their tips meet, and a septum forms near each tip, dividing it into a basal **suspensor** and a terminal **gametangium**.
3. The wall between the two gametangia dissolves, and their multinucleate contents **fuse** to form the zygote, whose nuclei fuse in + and − pairs; the zygote swells and secretes a thick, warty, dark wall: the **zygospore**, held between the two suspensors.

Marking scheme

- • and − strains put out progametangia that meet.
- A septum cuts off a gametangium from a suspensor in each.
- The gametangia fuse; nuclei fuse in pairs; a thick-walled zygospore forms between the suspensors.

c. Lichens are very **sensitive to air pollution**, especially to **sulphur dioxide**. They absorb water and whatever it carries **straight through their surface**, have **no way of getting rid of poisons**, and live for many years, so pollution builds up in them. **[3]**

As the air gets dirtier, first the **shrubby (fruticose)** kinds such as *Usnea* disappear, then the **leafy (foliose)**, and only a few **crusts (crustose)** survive. So the roadside air is **polluted**, while Shivapuri's air is **clean**.

So lichens are **bioindicators**: the kinds on the trees show how clean the air is without any instrument.

Marking scheme

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- Lichens are sensitive to air pollution (SO_2): they absorb through the whole surface, can't remove poisons, and live long.
- Fruticose go first, then foliose; only crustose in the worst air, so the road is polluted and Shivapuri clean.
- They are bioindicators of air quality.

OR

a. **[2]**

$$\text{Ebr} \oplus \male\female K_{(5)} \overbrace{C_{(5)} A_5} \underline{G}_{(2)}$$

The tomato's fruit is a **berry**.

Marking scheme

- Floral formula: $\oplus$ ♂♀ K(5) C(5) A5 (epipetalous) G(2) superior.
- Fruit: a berry.

b. i. **Epipetalous stamens**: the five stamens are **attached to the petals** (on the corolla tube), alternating with them. **[3]**

ii. **Persistent calyx**: the joined sepals **stay on** after flowering and remain on the fruit, as the green cap of a brinjal.

iii. **Oblique ovary with axile placentation**: the ovary of two joined carpels has two chambers, its septum set at a **slant** (about 45°) to the flower's front-to-back line, and the ovules are borne on large swollen placentas on the **central axis** where the septum meets the middle.

Marking scheme

- Epipetalous: stamens fixed to the petals.
- Persistent calyx: sepals stay on the fruit.
- Oblique bilocular ovary, ovules on swollen placentas on the central axis.

c. The claim is **wrong**: belonging to one family means sharing the plan of the flower and fruit, not being safe to eat. *Datura*'s seeds are **poisonous** and can kill, even though the tomato is a food. **[3]**

- **Useful** (any one): vegetables (potato, tomato, brinjal); chillies; medicines such as atropine from *Atropa* and drugs for motion sickness from *Datura* and *Hyoscyamus*.
- **Harmful** (any one): tobacco (*Nicotiana tabacum*), the leading cause of preventable death; the poisonous seeds of *Datura*.

Marking scheme

- The neighbor is wrong: one family shares floral characters, not edibility; *Datura* seeds are poisonous.
- One useful product (vegetables, chillies, atropine).
- One harmful product (tobacco, *Datura* poison).

Question 11 — 8 marks

a. Any three of these: **[3]**

- They are **proteins** (mostly globular), some needing a metal ion or a coenzyme.
- They are **specific**: each acts on one substrate or one kind of bond.
- They are very **efficient**: a small amount acts on a huge amount of substrate.
- They **speed up** reactions by **lowering the activation energy**, without changing the equilibrium, and are not used up.
- They are **denatured** by heat, the wrong pH and heavy metals.

Marking scheme

- One correct characteristic.
- A second correct characteristic.

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- A third correct characteristic.

b. [3]

- It works fastest at **37 °C** (3 minutes), the **optimum** temperature, our body temperature.
- At **10 °C** the molecules move slowly, so the enzyme and starch meet less often and the reaction is **slow**; the enzyme is not harmed.
- At **70 °C** the heat **denatures** the enzyme: its protein shape changes, its **active site** no longer fits starch, so the starch is never broken down.

Marking scheme

- Fastest at 37 °C, the optimum.
- At 10 °C slow molecular movement, fewer meetings, slow reaction (enzyme not destroyed).
- At 70 °C the enzyme is denatured: the active site loses its shape.

c. [2]

- **The 10 °C tube** works normally again (in about 3 minutes): cold only **slowed** the enzyme, without changing its shape, so warming it brings back its activity.
- **The 70 °C tube** still does **not** digest the starch: heat **denatured** the enzyme, and its shape (and active site) doesn't return on cooling.

Marking scheme

- 10 °C tube: works again, as cold only slows the enzyme.
- 70 °C tube: still no digestion, as denaturing is permanent.

Question 12 — 8 marks

a. One earthworm has **both male and female** reproductive organs (it is monoecious). [1]

Marking scheme

- Both male and female organs in one worm.

b. The earthworm is **protandrous**: its **male organs ripen first**, before its own eggs are ready. So its own sperm can't fertilize its own eggs. Two worms therefore **mate and exchange sperm** (cross-fertilization), and each stores the partner's sperm in its spermathecae until its eggs ripen. [2]

Marking scheme

- Protandry: the male organs ripen before the eggs, so self-fertilization can't happen.
- So two worms exchange sperm (cross-fertilization), stored in the spermathecae.

c. The worms lie with their ventral surfaces together, heads pointing opposite ways. The **male apertures on segment 18** of each worm lie against the **spermathecal pores (in the grooves 5/6 to 8/9, segments 6 to 9)** of the other. [2]

Sperm and prostatic fluid pass each way, from the male apertures of each worm into the spermathecae of the other.

Marking scheme

- Segment 18 (male apertures) of each against segments 6–9 (spermathecal pores) of the other.
- Sperm with prostatic fluid pass both ways into the spermathecae.

d. [3]

- The **cocoon-forming glands** of the clitellum (segments 14–16) pour out a band that hardens round it, and the **albumen glands** fill it with albumen, food for the young.
- The worm **backs out**, so the band slides **forwards**. It passes the **female aperture on segment 14**, where the worm's own unfertilized **eggs** are laid into it, then the **spermathecal pores (segments 9 to 6)**, where the **partner's sperm** stored there are poured in. The band slips off the front end and closes into a cocoon, where fertilization takes place (external).
- The band moves **forwards** from the clitellum and **never passes segment 18**, behind it, where the worm's own male apertures are, so only the stored sperm of the partner reach the eggs.

Marking scheme

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- Clitellum secretes the band and albumen; the worm backs out so it slides forward.
- Eggs enter at segment 14, then the partner's sperm at segments 9–6; fertilization inside the cocoon.
- The band never passes segment 18, so the worm's own sperm don't reach the eggs.

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