Grade 11 Biology Model Paper 3

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. **(iii)** The stomata are open only when it is cool, so far less water is lost by transpiration.

b. **(i)** *Shorea robusta* (sal)

c. **(iv)** Cold: its seedlings are killed by frost, and it needs a long, hot growing season

d. **(ii)** Reptiles and amphibians

e. **(iii)** Four cells of 12

f. **(i)** At least 1,500 endemic species of vascular plant, and at least 70% of its natural vegetation already lost

g. **(iv)** Pyrrophyta

h. **(ii)** Changes an organism acquires by using or not using its organs are passed on to its young.

i. **(iii)** Maggots come from eggs laid by flies, not from the meat itself.

j. **(i)** Whales are most closely related to even-toed hoofed mammals such as the hippopotamus.

k. **(iv)** Modern humans arose in Africa and later spread over the rest of the world.

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

Question 2 — 5 marks

a. Any two of these: **[2]**

- The plant body has **no true roots, stems or leaves**: it is a thallus or a small leafy shoot, fixed by **rhizoids**.
- **Vascular tissues** (xylem and phloem) are **absent**.
- The main plant is the **gametophyte**: haploid, independent and green; the diploid **sporophyte** grows on it and depends on it.
- Sexual reproduction is **oogamous**: biflagellate antherozoids from the antheridium swim to the single egg in the flask-shaped archegonium.
- They grow mostly in damp, shady places.

Marking scheme

- One correct feature.
- A second correct feature.

b. *Sphagnum*'s leaves have **large dead cells with holes in their walls**, which fill with water like a **sponge**, so the moss holds a lot of water and keeps the roots **moist** on the journey. **[2]**

Other uses (any one): **packing** glassware and fragile goods (dried moss is light and springy); **peat** for fuel; an absorbent, antiseptic **dressing** for wounds.

Marking scheme

- Its large dead cells with pores hold much water, keeping the roots moist.
- One other use (packing, peat fuel, absorbent dressing).

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c. Like amphibians, they live on **land** but still need **water to breed**: their body is adapted to land (rhizoids, a body many cells thick, tough-walled spores carried by wind), but their antherozoids must **swim** to the egg, so fertilization needs water. **[1]**

Marking scheme

- Land-adapted body, but fertilization needs water (antherozoids swim), as amphibians breed in water.

OR

a. Any two of these: **[2]**

- Their **ovules are naked**, not enclosed in an ovary, and **no fruit** is formed.
- They are **heterosporous**, with microspores and megaspores borne on sporophylls grouped in **cones**, usually unisexual.
- Mostly **evergreen woody** trees and shrubs, with a tap root and secondary growth.
- The xylem has **tracheids but no vessels** (except *Gnetum* and *Ephedra*); the phloem has no companion cells.
- **Pollination** is mostly by **wind**; double fertilization is absent; the food in the seed is the haploid female gametophyte.

Marking scheme

- One correct feature.
- A second correct feature.

b. i. ***Ephedra*** gives the alkaloid **ephedrine**, which opens the airways and is used against **asthma**, coughs, colds and bronchitis. **[2]**

ii. **Resin** tapped from chir pine is distilled into **turpentine** (an oil, used in paints and varnishes) and **rosin** (a solid, used in varnishes, soap, sealing wax, printing ink and on violin bows).

Marking scheme

- *Ephedra*: ephedrine, against asthma.
- Pine resin: turpentine or rosin, with a use.

c. The pollen is carried by **wind**, and the male gametophyte grows a **pollen tube** that carries the male gametes right to the egg, so they don't have to swim in water as fern antherozoids do. **[1]**

Marking scheme

- Wind pollination and a pollen tube carry the male gametes to the egg, so no water is needed.

Question 3 — 5 marks

a. **Phycoerythrin**, a red phycobilin, which masks their chlorophyll. **[1]**

Marking scheme

- Phycoerythrin.

b. **[2]**

- **Sample X**: **Phaeophyceae** (brown algae): chlorophyll *c*, fucoxanthin, laminarin and mannitol.
- **Sample Z**: **Chlorophyceae** (green algae): chlorophylls *a* and *b*, and starch as reserve food.

Marking scheme

- X: Phaeophyceae, with a reason.
- Z: Chlorophyceae, with a reason.

c. The **green algae** (Chlorophyceae). They share with land plants: **[2]**

- the same photosynthetic pigments, **chlorophylls *a* and *b***, with carotenes and xanthophylls;
- the same reserve food, **starch**.

Red and brown algae have different pigments (phycoerythrin; chlorophyll *c* and fucoxanthin) and store different foods (floridean starch; laminarin and mannitol). A cellulose wall is no evidence here, since red and brown algae have one too.

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Marking scheme

- Green algae (Chlorophyceae).
- Two shared characters with land plants: chlorophylls *a* and *b*, and starch as reserve food.

Question 4 — 5 marks

a. An **exotic** species is one brought into a new place by people; the potato is grown where it is planted and causes no harm. An **invasive alien species** is an exotic species that **spreads on its own** and **harms** the local environment, economy or health, as *Mikania* smothers trees and grassland, even in Chitwan's rhino habitat. **[2]**

Features that help invaders (any one): fast growth and reproduction; tolerance of many conditions; **few natural predators and diseases** in the new place; aggressive competition for light, water and space; efficient dispersal.

Marking scheme

- Exotic means brought in by people; invasive means also spreading on its own and causing harm.
- One feature of invaders (fast growth, no enemies, wide tolerance, competition, dispersal).

b. **Water hyacinth** (jalkumbhi), *Eichhornia crassipes* (now *Pontederia crassipes*). Its mats **block the light and oxygen** from the water below, so the fish and water plants there suffer. **[1]**

Marking scheme

- Water hyacinth, which blocks light and oxygen from the water beneath.

c. It is **biological control**, bringing in the invader's natural enemy from its home; *Mikania* spreads in Nepal partly because it left its enemies behind. But the insect must first be **tested** to show that it will attack **nothing else**, or it could become an invader itself. **[2]**

If it passes, it may work better than **herbicide**, which would also harm native plants and the environment over the large area of the park, while the insect keeps working by itself as long as *Mikania* is there.

Marking scheme

- Must first be tested to attack nothing but *Mikania*, or it could become a new invader.
- Better than herbicide: it targets only the invader, without poisoning native species, and keeps working.

Question 5 — 5 marks

a. Any two of these: **[2]**

- They are **photosynthetic** prokaryotes, with **chlorophyll *a*** and the phycobilins phycocyanin and phycoerythrin, on thylakoids, with **no chloroplasts**; they split water and give off **oxygen**.
- They have no membrane-bound organelles; their circular DNA lies in a **nucleoid** without histones.
- The cell wall is of **peptidoglycan**, with a mucilage sheath.
- They have **no flagella**.
- Some filamentous ones have **heterocysts**, where nitrogen is fixed.
- They reproduce by fission, hormogonia and akinetes; **no sexual reproduction**.

Marking scheme

- One correct feature.
- A second correct feature.

b. *Anabaena* living in *Azolla*'s leaves **fixes nitrogen** from the air in its **heterocysts**, large thick-walled pale cells that shut out oxygen, which would destroy the enzyme nitrogenase. The fixed nitrogen feeds the fern, and when *Azolla* dies or is worked into the mud it releases it to the soil as **green manure**, so the rice gets more nitrogen and grows better. **[2]**

Marking scheme

- *Anabaena* fixes atmospheric nitrogen in its heterocysts.

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- The nitrogen reaches the rice (green manure), so it grows better.

c. They are **bacteria**, prokaryotes: they have **no nucleus**, no chloroplasts or other membrane-bound organelles, 70S ribosomes and a **peptidoglycan** wall, while all true algae are eukaryotes. **[1]**

Marking scheme

- They are prokaryotes (no nucleus or chloroplasts, peptidoglycan wall), while algae are eukaryotes.

Question 6 — 5 marks

a. The adaptations of animals that **dig and live underground** in burrows (Latin *fossor*, digger), such as moles, mole-rats, pangolins and earthworms. **[1]**

Marking scheme

- Adaptations for digging and living underground in burrows.

b.
- **Tiny hidden eyes and no outer ears:** underground there is little light, and large eyes or ears would only **fill with soil**; it finds its way by touch and smell instead.
- **Broad, clawed front feet turned outward:** they work like **shovels**, digging the soil and pushing it sideways and back as it tunnels. **[2]**

Marking scheme

- Small hidden eyes and no outer ears: soil can't get in; little use for sight in the dark.
- Broad, clawed forefeet: shovels for digging and pushing soil aside.

c.
- A **bird's** wing has stiff **flight feathers** on a forelimb whose hand bones are **reduced and fused** into a firm frame.
- A **bat's** wing is a thin, elastic sheet of **skin**, the **patagium**, stretched between four enormously **long finger bones** and from the arm to the side of the body, the hindleg and often the tail. **[2]**

Because a bat's fingers still move, it can **change the shape of its wing** in flight, which makes it very agile.

Marking scheme

- Bird: feathers on fused hand bones; bat: a skin patagium stretched over long fingers.
- The bat moves its fingers to change the wing's shape, so it is very agile.

Question 7 — 5 marks

a.
- **Like plants:** it has **chloroplasts** with chlorophyll, and makes its own food by **photosynthesis** in light (it is autotrophic).
- **Like animals:** it has **no cell wall**, only a flexible **pellicle**, so it can bend and squirm; it **swims** with a flagellum, and can take in food from its surroundings in the dark. **[2]**

Marking scheme

- Two plant-like features (chloroplasts with chlorophyll, photosynthesis in light).
- Two animal-like features (no cell wall/pellicle, swims with a flagellum, takes in food in the dark).

b. It is the **eyespot** (stigma), which is **sensitive to light**; it helps the cell swim **towards light**, where it can photosynthesize. **[1]**

Marking scheme

- The light-sensitive eyespot (stigma), which helps it swim towards light.

c. *Euglena* fits **neither** kingdom: it photosynthesizes like a plant but swims and lacks a cell wall like an animal, and in the dark it feeds like an animal (**mixotrophic**). Forcing it into one kingdom would hide half of what it is. **[2]**

So it was placed, with the other simple **unicellular eukaryotes** that aren't plants, animals or fungi, in **Protista**, one of Whittaker's five kingdoms (1969).

Marking scheme

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- *Euglena* has features of both plants and animals (mixotrophic), so fits neither kingdom.
- Hence a kingdom for unicellular eukaryotes that aren't plants, animals or fungi: Protista.

OR

a. Setae are made of **chitin**. **[2]**

They are absent on the **first** segment, the **last** segment, and the **three segments of the clitellum** (14–16); every other segment has a ring of them.

Marking scheme

- Made of chitin.
- Absent on the first, the last and the clitellar segments.

b. It becomes **longer and thinner**. Each segment is a closed bag of coelomic fluid, which can't be squeezed smaller, so as it gets thinner the fluid makes it longer (a **hydrostatic skeleton**). **[1]**

Marking scheme

- Longer and thinner, because the fluid inside can't be compressed (hydrostatic skeleton).

c. The worm crawls by waves of muscle contraction: thin segments reach forward while short, fat segments hold still, their **setae** sticking out to **grip** the surface. **[2]**

On rough blotting paper the setae get a grip, so the fat segments stay put and the worm moves ahead. On smooth **glass** the setae can't grip, so the back slips backwards as much as the front slides forwards, and the worm hardly moves.

Marking scheme

- Fat segments are anchored by setae gripping the surface while thin ones reach forward.
- On glass the setae can't grip, so the anchored segments slip and the worm stays in place.

Question 8 — 5 marks

a. i. **Rohu fish: a chordate.** It has a dorsal hollow nerve cord (brain and spinal cord), a notochord in the embryo replaced by the vertebral column, and gill slits in the pharynx for life. **[3]**

ii. **Earthworm: not a chordate.** Its nerve cord is **solid, double and ventral**, it has no notochord and no pharyngeal gill slits.

iii. **Lancelet: a chordate.** It keeps all three for life: a notochord, a dorsal hollow nerve cord above it, and gill slits in the pharynx.

Marking scheme

- Rohu: chordate, with a reason.
- Earthworm: not a chordate (solid, ventral nerve cord, no notochord or gill slits).
- Lancelet: chordate, all three characters for life.

b. She is **wrong**: a chordate has the three characters **at some stage** of its life, at least in the embryo. **[2]**

- Her **notochord** formed in the embryo and was **replaced by the vertebral column**; a trace survives as the soft center of each disc between her vertebrae.
- Her **pharyngeal gill slits** appeared in the embryo and closed up, parts becoming the middle ear canal and some glands. She also has a dorsal hollow nerve cord, her brain and spinal cord, all her life.

Marking scheme

- Wrong: the characters need be present only at some stage (the embryo).
- Notochord replaced by the backbone (trace in the discs), gill slits close in the embryo; dorsal hollow nerve cord kept.

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Question 9 — 5 marks

a. They lived through the **cold of the ice ages** in Europe and Asia, and a short, stocky body **keeps heat in** (less surface for its bulk). **[1]**

Marking scheme

- A short, stocky body kept in heat in the ice-age cold.

b. *Homo neanderthalensis* (Neanderthal man), with Mousterian tools. Modern humans have a high forehead, small brow ridges and a chin. **[1]**

Marking scheme

- *Homo neanderthalensis.*

c. **[3]**

- **Not our direct ancestors:** modern humans arose in **Africa** (fossils about 300,000 years old), while Neanderthals lived in **Europe and western Asia** from about 400,000 to 40,000 years ago. They were a separate line living at the same time, not a stage that turned into us.
- **They did die out**, about **40,000 years ago**, soon after modern humans reached Europe (competition, small scattered populations and the ice-age climate probably all played a part).
- **But they left something in us:** modern humans **interbred** with them, and about **1–2%** of the DNA of everyone whose ancestors lived outside Africa is Neanderthal, as Svante Pääbo showed by reading Neanderthal DNA. So neither student is fully right.

Marking scheme

- Not our ancestors: a separate line in Europe and Asia while *H. sapiens* arose in Africa.
- They died out about 40,000 years ago after modern humans arrived.
- Yet interbreeding left 1–2% Neanderthal DNA in people outside Africa, so neither claim is fully right.

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

Question 10 — 8 marks

a. **[2]**

$$\text{Ebr} \ \oplus \ ♂ \ K_{2+2} \ C_4 \ A_{2+4} \ \underline{G}_{(2)}$$

The fruit is a **siliqua** (a long, thin pod; a short, broad one is a silicula).

Marking scheme

- Floral formula: ⊕ ♂ K2+2 C4 A2+4 G(2) superior.
- Fruit: siliqua.

b. i. **Cruciform corolla**: four free petals, each with a narrow claw and a broad limb, spread like a **cross**. **[3]**

ii. **Tetradynamous stamens**: six stamens in two whorls, the outer **two short** and the inner **four long**.

iii. **Parietal placentation with a replum**: the ovary of two joined carpels is one-chambered at first and becomes **two-chambered** by a **false septum**, the replum; the ovules are borne on the ovary's **wall** where the carpels join.

Marking scheme

- Cruciform: four clawed petals like a cross.
- Tetradynamous: two short outer and four long inner stamens.
- Parietal: ovules on the wall; the replum is a false septum making the ovary two-chambered.

c. The friend is **wrong**: the plant belongs to **Brassicaceae**. Being a vegetable says nothing about the family; the flower and fruit do. **[3]**

- **Petals:** four free petals in a cross (cruciform); Solanaceae has five petals joined in a tube.

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- **Stamens:** six, tetradynamous; Solanaceae has five stamens fixed on the petals (epipetalous).
- **Fruit:** a siliqua splitting from below into two valves, leaving the seeds on the replum; Solanaceae has a berry or capsule.

Marking scheme

- Petals: cruciform four (vs five joined in Solanaceae).
- Stamens: tetradynamous six (vs five epipetalous).
- Fruit: siliqua with replum (vs berry or capsule), so Brassicaceae.

OR

a. **R. H. Whittaker**, in **1969**. The kingdoms are **Monera, Protista, Fungi, Plantae and Animalia**. **[2]**

Marking scheme

- Whittaker, 1969.
- Monera, Protista, Fungi, Plantae, Animalia.

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

- **Complexity of the cell**: prokaryotic (no nucleus) or eukaryotic.
- **Complexity of the body**: unicellular or multicellular.
- **Mode of nutrition**: autotrophic or heterotrophic, and among heterotrophs, absorbing food (fungi) or taking it in (animals).
- **Ecological role**: producer, consumer or decomposer.
- **Phylogenetic relationship**: which groups share a common ancestor.

Marking scheme

- One criterion explained.
- A second criterion explained.
- A third criterion explained.

c. **[3]**

- **Mushroom: Fungi.** Eukaryotic and multicellular, with no photosynthetic pigment; it **absorbs** its food from dead matter as a **decomposer**.
- ***Spirogyra*: Plantae.** It is an alga, but a **multicellular** eukaryote (a filament of many cells) that makes its own food by photosynthesis; Whittaker placed the many-celled algae with the plants and only the one-celled ones in Protista.
- ***Nostoc*: Monera.** A cyanobacterium: **prokaryotic**, with no nucleus, though it photosynthesizes and forms filaments.

Marking scheme

- Mushroom: Fungi (eukaryotic, absorptive decomposer).
- *Spirogyra*: Plantae (multicellular, photosynthetic; only one-celled algae go in Protista).
- *Nostoc*: Monera (prokaryotic).

Question 11 — 8 marks

a. **[3]**

- It has **two membranes**: a smooth **outer membrane**, and an **inner membrane** folded into **cristae**, which greatly increase its surface for respiration. Between them is the **intermembrane space**.
- Inside the inner membrane is the **matrix**, a dense fluid with the enzymes of the **Krebs cycle**, **70S ribosomes** and the mitochondrion's own circular **DNA**.
- On the matrix side of the inner membrane stand thousands of **F_1 particles** (oxysomes), each a head, stalk and base: the enzyme **ATP synthase**, where ATP is made.

Marking scheme

- Two membranes, the inner folded into cristae, with the intermembrane space.
- The matrix with Krebs-cycle enzymes, 70S ribosomes and DNA.

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- F_1 particles (oxysomes, ATP synthase) on the inner membrane.

b.
- **Liver cell:** it is very **active** (making and breaking down many substances), so it needs much ATP; mitochondria are most numerous in active cells. **[3]**
- **Sperm:** the mitochondria form its **middle piece**, at the base of the tail, where they release the energy for **swimming**: mitochondria sit where the energy is needed.
- **Red blood cell:** a mature mammalian red blood cell **loses its mitochondria** as it matures, so it respires **without oxygen**, never using the oxygen it carries.

Marking scheme
- Liver: very active cell, needs much ATP.
- Sperm: middle piece, energy for the tail's swimming.
- Mature red blood cell: loses its mitochondria, respires anaerobically.

c. **No**: they are **semi-autonomous**. Their own DNA is small: in humans a ring of 16,569 base pairs with 37 genes, only **13 for proteins**. **[2]**

A mitochondrion needs **more than 1,000 proteins**; most are coded by the **nucleus**, made on ribosomes in the cytoplasm and imported. So it can copy its DNA, make some proteins and divide on its own, but depends on the nucleus for most of what it is.

Marking scheme
- No: they are semi-autonomous; their DNA codes only a few proteins (13 in humans).
- Most of their proteins (over 1,000) come from nuclear genes, made in the cytoplasm and imported.

Question 12 — 8 marks

a. The **embrace** in which the male frog climbs onto the female's back and clasps her firmly with his forelimbs, just behind her front legs, while she lays her eggs. **[1]**

Marking scheme
- The male clasping the female from behind with his forelimbs during egg laying.

b. From each testis, 10–12 fine **vasa efferentia** run into the **kidney**, opening into **Bidder's canal**; **transverse collecting tubules** carry the sperms across the kidney to the **longitudinal collecting tubule** and into the duct, which leads to the **cloaca**. **[2]**

Since the duct carries **both urine and sperms**, it is called the **urinogenital duct** (Wolffian duct). A female's eggs never pass through the kidney.

Marking scheme
- Testis → vasa efferentia → Bidder's canal and collecting tubules in the kidney → duct → cloaca.
- The duct carries both urine and sperms, hence urinogenital.

c.
- **Male:** a swollen, rough **nuptial pad** at the base of the first finger of each hand; working **vocal sacs**, puffed out when he croaks; a yellow color (brought on by testosterone). **[2]**
- **Female:** a **bulging belly**, the ovaries swollen with eggs filling much of the body cavity; no nuptial pads or vocal sacs.

Marking scheme
- Two male features (nuptial pads, vocal sacs, yellow color).
- Two female features (bulging belly, no nuptial pads or vocal sacs).

d.
- **Amplexus** holds the male right on the female's back, his nuptial pads keeping his grip for hours. As she lays her eggs into the water, he sheds his **milt** (sperm-filled fluid) over them at once, so the sperms meet the eggs before they drift away: fertilization is **external**, in the water. **[3]**
- The eggs come out in a mass, coated with **albumen jelly** that swells in water, holding the eggs together and protecting them while they are fertilized and develop.

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- The jelly is added by the glands of the **oviduct** as the eggs pass down it; an egg just ovulated into the body cavity has only its **vitelline membrane**.

Marking scheme

- Amplexus keeps the male in place, so his milt falls on the eggs as they are laid: external fertilization.
- The albumen jelly swells in water, holding the eggs in a mass and protecting them.
- The jelly is added in the oviduct, so an egg in the body cavity has only its vitelline membrane.

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