Grade 12 Biology Model Paper 1

MODEL PAPER

Full marks 75 · 3 hours

Name _____ Class ____ Roll no. ____ Date _____ Marks ____ / 75

Answer every question; where a question has an OR question, answer either one. Time: 3 hours.

A practice paper by Science Playground, made to CDC's Specification Grid 2078, Grade 12 Biology (Bio. 202); not an official CDC or NEB paper. Mark it yourself online: the QR code below opens the paper with its answers.

A full practice run of the NEB Grade 12 Biology paper (Bio. 202): 75 marks in 3 hours, in two parts, Botany (37 marks) and Zoology (38 marks). Each part has three groups: group A is one question of multiple-choice items (5 in Botany, 6 in Zoology), and groups B and C have short-answer questions of 4 marks and long-answer questions of 8 marks, of two to four parts each, with each part's marks shown. Allow about 25 minutes for all the multiple-choice items and 155 minutes for the rest. CDC's paper numbers the questions of each part from 1; here they run straight through, Questions 1–7 in Botany and 8–14 in Zoology, so that every question has its own number. Questions 4 and 11 in group B and Questions 6 and 14 in group C each have an OR question: answer either the question or its OR question, every part from the same one, and mark only the one you answered. Write on paper first, then tap your choice in group A and open each other part's answer to give yourself the marks its scheme allows.

Botany, Group A Multiple choice (Botany) — 5 marks

Question 1 — 5 × 1 = 5

Choose the correct option for each of the following questions.

a. A sal trunk grows thicker year after year, but a maize stem stays almost the same thickness all its life. Why?

(i) Maize has no xylem vessels, only tracheids.

(ii) The vascular bundles of maize are closed: they have no cambium between the xylem and the phloem.

(iii) Maize has no pericycle, so it cannot form lateral roots.

(iv) The epidermis of maize is covered by a thick cuticle that stops it from stretching.

b. Early on a cool, damp morning, drops of water are seen along the leaf margins of a grass. What is this loss of water called?

(i) transpiration (ii) bleeding (iii) guttation (iv) imbibition

c. In an hour, the chloroplasts of a leaf fix 12 molecules of carbon dioxide through the Calvin cycle. How many molecules of ATP does the cycle use for this?

(i) 12 (ii) 18 (iii) 24 (iv) 36

d. Three sets of potted chrysanthemums were grown side by side: set A left whole; set B with the shoot tip cut off; set C with the shoot tip cut off and auxin paste put on the cut stump. After three weeks, only set B had many side branches. What does this show?

(i) Cutting a plant always makes it branch.

(ii) Auxin coming down from the shoot tip keeps the lateral buds from growing.

(iii) Auxin makes lateral buds grow into branches.

(iv) The shoot tip makes cytokinin, which stops the lateral buds.

e. How many cells and how many nuclei are there in the mature embryo sac of a typical flowering plant?

(i) 8 cells and 8 nuclei (ii) 7 cells and 8 nuclei

(iii) 7 cells and 7 nuclei (iv) 8 cells and 7 nuclei

Botany, Group B Short answers (Botany), each on one content area 16 marks

Question 2 4 marks

In the laboratory of her college in Butwal, Anjila looks at two transverse sections of young roots under the microscope.

- **Section P: radial vascular bundles with four xylem strands, the xylem vessels angular; almost no pith in the center.**
- **Section Q: radial vascular bundles with about sixteen xylem strands round a large pith full of starch; most endodermal cells have very thick walls, but a few, opposite the xylem strands, are thin-walled.**

a. What is the Casparian strip? **[1]**

b. Why are a few cells of the endodermis in section Q left thin-walled, and why are they opposite the xylem strands? **[1]**

c. Identify the roots in sections P and Q, giving one reason for each. **[2]**

Question 3 4 marks

In flowering plants, a pollen tube brings two male gametes into the embryo sac, and both of them fuse with something there.

a. What is double fertilization? Name the product of each of its two fusions. **[2]**

b. The cells of the endosperm of a maize grain have 30 chromosomes. Kriti says that the leaf cells of maize must have 30 chromosomes too. Is she right? Work out the number of chromosomes in a leaf cell and in an egg cell of maize. **[2]**

Question 4 4 marks

The four o'clock plant, *Mirabilis jalapa* (मालती), has red, pink and white flowers. A pure red plant (RR) crossed with a pure white one (rr) gives an F_1 that is all pink.

a. A cross of tall and dwarf pea plants gives an F_1 that is all tall, but the cross of red and white four o'clock plants gives one that is all pink. Explain the difference. **[1]**

b. Sujan crosses a pink four o'clock plant with a white one. Work out, with a checkerboard, the genotypes and phenotypes of their offspring, and the ratio in which they appear. **[2]**

c. Sujan's friend says the pink flowers show that the red and white alleles have blended into a new "pink" allele. Which result of a cross shows that this is wrong? **[1]**

OR

At a research farm in Khumaltar, durum wheat (*Triticum durum*, 2n = 28) is crossed with rye (*Secale cereale*, 2n = 14). The hybrid seedlings are treated with colchicine, which doubles their chromosomes, and the new plants are called triticale.

a. Why is the hybrid of wheat and rye sterile before its chromosomes are doubled? **[1]**

b. How many chromosomes are there in a gamete of each parent, in a cell of the hybrid, and in a cell of triticale? **[2]**

c. Is triticale an autopolyploid or an allopolyploid? Why is it called a new species rather than a variety of wheat? **[1]**

Question 5 — 4 marks

A laboratory in Ilam wants thousands of plants of a high-yielding variety of large cardamom (अलैंची), all exactly like one mother plant, and grows them by micropropagation from its shoot tips.

a. Define totipotency. **[1]**

b. The laboratory has many shoots growing on the medium and now wants them to form roots. What change should it make to the medium? **[1]**

c. Two hundred plantlets were taken straight from the jars and planted in an open field, and most of them wilted and died within days. Another batch, kept for some weeks in a humid greenhouse first, did well. Explain why. **[2]**

Botany, Group C — Long answers (Botany), each on one content area — 16 marks

Question 6 — 8 marks

Pratik puts germinating seeds of gram in two flasks: flask X with plenty of air, and flask Y with its air replaced by nitrogen.

a. Where in the cell does glycolysis take place? **[1]**

b. Describe the Krebs cycle in brief. **[3]**

c. Taking each $NADH_2$ as giving 3 ATP and each $FADH_2$ 2 ATP in the electron transport chain, calculate the ATP that the Krebs cycle yields from one molecule of glucose. **[2]**

d. The seeds in flask Y get only 2 ATP from each glucose. The Krebs cycle itself uses no oxygen, so why does it stop in flask Y? **[2]**

OR

Sushma grows chrysanthemum (*godawari*) and radish in her garden in Kathmandu. There the day lasts about 10 hours in late December and about 14 hours in late June.

a. Define photoperiodism. **[1]**

b. Explain how short-day, long-day and day-neutral plants differ in their response to the photoperiod, with one example of each. **[3]**

c. The short-day cocklebur (*Xanthium*) flowers whenever its day is shorter than about 15½ hours, and the long-day henbane (*Hyoscyamus*) whenever its day is longer than about 11 hours. Which of the two could flower in Kathmandu in late December, and which in late June? **[2]**

d. A cocklebur plant is kept on long days, so it would not flower. In one plant, a single leaf is covered each evening to give it long nights, and the whole plant flowers. In another, all the leaves are removed and only the bare shoot tip gets short days, and it does not flower. Explain what these results show. **[2]**

Question 7 — 8 marks

In a study published in 2010, 3.9% of the boys tested in schools of the Kathmandu Valley had a color vision defect, and none of the girls. Red–green color blindness is caused by a recessive allele on the X chromosome. Write the normal allele as X^C and the color-blindness allele as X^c.

a. Why is color blindness far commoner in boys than in girls? **[2]**

b. Sandhya has normal vision, but her father is color-blind. She marries Abhishek, who has normal vision. Work out, with a checkerboard, the genotypes of their possible children, and state what share of their sons and of their daughters would be color-blind. **[3]**

c. A color-blind girl is born to a couple. Her mother, Sheetal, says the girl's father must be color-blind, and that she herself must be either color-blind or a carrier. Is she right? Explain, and say what the girl's sons would be. **[3]**

Zoology, Group A Multiple choice (Zoology) 6 marks

Question 8 6 × 1 = 6

Choose the correct option for each of the following questions.

a. Which vaccine is given to every baby in Nepal at birth to protect against tuberculosis?

(i) MR (ii) BCG (iii) OPV (iv) DPT

b. The lining of the urinary bladder stretches a great deal as the bladder fills, without tearing or leaking. Which epithelium makes this possible?

(i) simple squamous epithelium
(ii) keratinized stratified squamous epithelium
(iii) transitional epithelium
(iv) ciliated columnar epithelium

c. Which cells of the gastric glands secrete pepsinogen?

(i) chief (peptic) cells (ii) parietal (oxyntic) cells
(iii) goblet cells (iv) Kupffer cells

d. Why is the wall of the left ventricle about three times as thick as that of the right ventricle?

(i) The left ventricle holds much more blood.
(ii) The left ventricle pumps blood through the whole body, against far more resistance than the lungs give.
(iii) The left ventricle receives deoxygenated blood, which is thicker.
(iv) The left ventricle contracts before the right ventricle.

e. Sabina's kidneys form filtrate at 125 mL a minute, and she passes urine at 1 mL a minute. About what share of the filtrate is reabsorbed?

(i) 1.25% (ii) 80% (iii) 98.8% (iv) 99.2%

f. A retired teacher in Gorkha has always seen well. Now, past 45, he has to hold his newspaper at arm's length to read it, though he sees distant hills as clearly as ever. Which is the best explanation?

(i) His eyeball has grown too long, so images form in front of the retina.
(ii) His lens has lost its elasticity, so it can no longer become rounder to focus on near objects.
(iii) His cornea has become unevenly curved.
(iv) His lens has become cloudy, so less light reaches the retina.

Zoology, Group B Short answers (Zoology), each on one content area 16 marks

Question 9 4 marks

Shristi studies three prepared slides of epithelial tissue: slide P, a single layer of thin, flat cells fitting edge to edge, from the wall of an alveolus; slide Q, many layers of cells, the top ones flat, dead and full of keratin, from the skin of the palm; slide R, a single layer of tall cells with an oval nucleus near the base and a dense fringe of microvilli on the free surface.

a. Define epithelial tissue. **[1]**

b. Why is the wall of an alveolus made of simple squamous epithelium, while the skin of the palm has keratinized stratified squamous epithelium? **[2]**

c. Identify the epithelium of slide R and name one organ it lines. **[1]**

Question 10 — 4 marks

A frog's body cells have 26 chromosomes (2n = 26). In its testes and ovaries, gametes are made by meiosis.

a. Why does one primary oocyte give only one ovum, while one primary spermatocyte gives four sperms? **[1]**

b. In a frog, 50 primary spermatocytes and 50 primary oocytes complete gametogenesis. How many sperms and how many ova are formed, and how many chromosomes does each have? **[2]**

c. Nischal says that the eggs a female frog lays in a pond are mature ova. Is he right? Give a reason. **[1]**

Question 11 — 4 marks

Prakriti stubs her toe on a stone. She feels the touch at once, but the burning pain comes about a second later. Thick myelinated fibers conduct impulses at about 100 m/s, and thin unmyelinated fibers, which carry burning pain, at about 1 m/s.

a. What is a synapse? **[1]**

b. The nerve fibers from Prakriti's toe to her spinal cord are about 1 m long. Calculate how long an impulse takes to travel this distance along each kind of fiber. **[2]**

c. How does myelin make a fiber conduct so much faster? **[1]**

OR

A health camp in a hill district far from the sea finds many older villagers with a swelling in the front of the neck, a goiter, while their grandchildren, who have grown up eating iodized salt, have none.

a. Name the two hormones made by the follicular cells of the thyroid gland. **[1]**

b. Explain how a lack of iodine in the diet makes the thyroid gland swell. **[2]**

c. Why was goiter common in mountain regions far from the sea, and why has iodized salt made it rare there? **[1]**

Question 12 — 4 marks

In a year, a municipality of 40,000 people recorded 720 live births and 280 deaths. Nepal as a whole had a birth rate of about 19 and a death rate of about 7 per 1,000 people a year in 2025, yet the UN estimates that its total population hardly grew that year.

a. Why does a population with a large share of young people go on growing for many years, even after each family has become small? **[1]**

b. Calculate the rate of natural increase of the municipality, per 1,000 people a year. **[1]**

c. Nepal's natural increase was about 12 per 1,000 in 2025. Explain why its population hardly grew, and give one effect of this on the country. **[2]**

Zoology, Group C — Long answers (Zoology), each on one content area — 16 marks

Question 13 — 8 marks

In a monsoon outbreak in the Kathmandu Valley, Rohan's neighbor suddenly passes pale, watery "rice-water" stools, nearly a liter an hour, without pain. Within hours her eyes are sunken, her mouth dry and she passes almost no urine. A stool test confirms cholera.

a. Name the organism that causes cholera. **[1]**

b. Explain how cholera causes such watery diarrhea, and why it can kill within hours. **[3]**

c. No packets of ORS (Jeevan Jal) are at hand. Following WHO's home recipe of 6 level teaspoons of sugar and half a level teaspoon of salt in 1 liter of clean water, how much of each should Rohan dissolve to make 2 liters? Why must he measure the salt carefully? **[2]**

d. The toxin is still pouring salt and water into her gut, yet drinking ORS can save her life. Explain why ORS works in cholera. **[2]**

Question 14 — 8 marks

Pemba, a Sherpa guide, climbs from Kathmandu to the summit of Everest. The air at sea level has a pressure of 760 mmHg, at Kathmandu about 640 mmHg and on the summit about 253 mmHg, and it is 21% oxygen everywhere.

a. Explain how air is drawn into the lungs during inspiration. **[2]**

b. At rest in Kathmandu, Pemba's heart pumps 5 L of blood a minute, each 100 mL of arterial blood carries 20 mL of oxygen, and his body uses 250 mL of oxygen a minute. Calculate how much oxygen his blood delivers each minute, and what percentage of it his body takes up. **[2]**

c. Explain why a climber becomes breathless near the summit, although the air there is still 21% oxygen, and why many Sherpas cope with great heights better than lowlanders do. **[4]**

OR

At rest, Ishaan's heart beats 72 times a minute and pumps 70 mL of blood from each ventricle at every beat. In the last minutes of a football match his heart rate rises to 150 a minute and his stroke volume to 100 mL.

a. Explain how each heartbeat starts and how the impulse spreads through the heart. **[2]**

b. Calculate Ishaan's cardiac output at rest and during the match. How many times his resting output is it during the match? **[2]**

c. At rest each of Ishaan's ventricular systoles lasts about 0.3 s; at 150 beats a minute it shortens only to about 0.25 s. Work out how long his ventricles have to relax and fill in each cycle at rest and during the match, and explain why a heart beating ever faster would at last pump less blood, not more. **[4]**