Unit 9 · Gymnosperms

ANSWER KEY · FOR TEACHERS

Full marks 32

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

1 Key words

1. gymnosperm → **g.** a seed plant whose seeds are not enclosed in an ovary — K · 4
2. dwarf shoot → **d.** a branch of limited growth, a few millimeters long, that bears the needles
3. pollen chamber → **e.** the space at the top of the nucellus where the pollen lies
4. microsporophyll → **f.** a scale of the male cone bearing two pollen sacs
5. ovuliferous scale → **b.** a scale of the female cone bearing two ovules
6. pollination drop → **j.** sticky fluid from the micropyle that catches pollen
7. mycorrhizal root → **a.** a short, branched root living with a fungus
8. polyembryony → **i.** one ovule starting several embryos

Each carries 0.5 mark.

2 Label the diagram

K · 3

1. wing
2. seed coat
3. cotyledons
4. embryo
5. food store (female gametophyte)
6. radicle

Each carries 0.5 mark.

3 Multiple choice

i. **b.** three — K · 1

The number is fixed for a species: **three** in chir pine, five in blue pine, two in Scots pine.

ii. **d.** four — K · 1

Four: two prothallial cells, one antheridial (generative) cell and one tube cell.

iii. **c.** the food store around the embryo — U · 1

The food store is the **female gametophyte**, grown from a haploid megaspore. The embryo grew from the zygote (2n); the seed coat (from the integument) and the wing (from the scale) are tissues of the parent sporophyte (2n).

iv. **c.** seeds, and a pollen tube that carries the male gametes — U · 1

Ferns also have vascular tissue and a dominant sporophyte. **Seeds** and the **pollen tube** first appear in the gymnosperms; double fertilization is found only in flowering plants.

v. **c.** *Ephedra* — A · 1

Ephedra yields **ephedrine**, which opens the airways. *Taxus* gives the anti-cancer drug taxol; *Cycas* gives sago and gum; *Araucaria* gives tannin.

4 Short answers

a. MARKING SCHEME — K · 2

- ✓ Ovules and seeds lie exposed on a scale or leaf.
- ✓ No ovary encloses them, so no fruit is formed.

b. MARKING SCHEME — U · 2

- ✓ Any one feature (winged, light pollen; huge numbers; pollination drop; scales parting).
- ✓ A second feature.

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c. MARKING SCHEME U · 2

- ✓ One correct difference (size and grouping, or position on the tree).
- ✓ A second correct difference (microsporophylls with pollen sacs against bract and ovuliferous scales with ovules).

d. MARKING SCHEME A · 3

- ✓ Water in frozen soil can't be absorbed, so water must be saved.
- ✓ Narrow needle and thick cuticle cut water loss through the surface.
- ✓ Sunken stomata lose less water vapor (xerophytic adaptation).

5 Long answer

a. ANSWER U · 4

Wind carries pollen to the young female cone, whose scales part; a **pollination drop** from the micropyle catches the grains and, as it dries, draws them into the **pollen chamber**. The pollen lies inactive for months.

Next spring the **tube cell** grows into a **pollen tube** through the nucellus; the antheridial cell gives a stalk cell and a body cell, and the body cell divides into **two non-motile male gametes**.

The female gametophyte forms **two to four archegonia** at its micropylar end, each with a large egg and a short neck without neck canal cells.

About a year after pollination the pollen tube releases the male nuclei near the egg; **one fuses with the egg** to form the diploid **zygote**, the other degenerates. No water is needed.

MARKING SCHEME

- ✓ Wind pollination; the pollination drop draws pollen into the pollen chamber.
- ✓ The pollen tube grows; the body cell gives two non-motile male gametes.
- ✓ Two to four archegonia with large eggs form in the female gametophyte.
- ✓ One male nucleus fuses with the egg (zygote) about a year after pollination; no water needed.

b. ANSWER A · 4

Any four, each with its plant:

- **Resin** from chir pine, distilled into turpentine and rosin (paints, varnish, soap).
- **Timber** (softwood) from pines (salla) and deodar for building, doors, windows, furniture, paper pulp.
- **Ephedrine** from *Ephedra*, against asthma and coughs; **taxol** from yew (*Taxus*), against cancer.
- **Food**: sago from cycads, chilgoza pine seeds as nuts, *Ginkgo* seeds.
- **Ornamental**: *Cycas*, *Araucaria*, *Thuja*, junipers.
- **Tannin** from the bark of *Araucaria*; gum from *Cycas*.

MARKING SCHEME

- ✓ A first use with its plant.
- ✓ A second use with its plant.
- ✓ A third use with its plant.
- ✓ A fourth use with its plant.

6 Think

ANSWER HA · 3

Pollen released from the lower branches is carried away by the wind and usually **blows past the tree's own female cones**, so the female cones are pollinated from other trees (cross-pollination).

But wind carries pollen at random: **almost all the grains land nowhere useful**.

So the tree must make a **great many** pollen grains (billions; the yellow film on ponds in spring), a large cost in material.

MARKING SCHEME

- ✓ The tree's own pollen usually blows past its own female cones, so pollen comes from other trees.
- ✓ Wind is random: most pollen lands nowhere useful.
- ✓ So the tree must make huge amounts of pollen.

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7 Activity: Count the needles

(not marked)

WHAT STUDENTS SHOULD FIND

The number is fixed for a species: **three** in chir pine, **five** in blue pine (two in Scots pine). A deodar has no spurs of a fixed number: its short shoots carry tufts of many needles (it isn't a *Pinus*). Brown, papery **scale leaves** wrap the base of each dwarf shoot. A three-needle pine's needle is a wedge, a third of a circle; a five-needle pine's a fifth: together the needles of a spur fit into a cylinder, as they did in the bud.

Marks by level	Knowledge	Understanding	Application	Higher ability	Total
Marks	11	10	8	3	**32**

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