Unit 5 · Plant Hormones

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

K · 4.5

1. IAA
2. polar
3. parthenocarpic
4. bakanae
5. bolting
6. adenine
7. Richmond–Lang
8. ethylene
9. abscisic acid

Each carries 0.5 mark.

2 Label the diagram

K · 2.5

1. aleurone layer
2. embryo
3. endosperm (starch)
4. seed coat
5. scutellum (cotyledon)

Each carries 0.5 mark.

3 Multiple choice

i. **c.** immature seeds — K · 1

Reproductive parts hold more gibberellin than vegetative parts, and **immature seeds** are the richest of all.

ii. **b.** it is a gas and acts mostly at or near the place where it is made, not at a distant site — U · 1

A hormone, by the classical definition, is carried from where it is made to a **distant** site. **Ethylene** is a **gas** that diffuses out of the tissue that makes it and acts there or close by (a ripe fruit ripens its neighbors through the air). Plants make it themselves, and in tiny amounts, so it is still a plant hormone.

iii. **b.** auxin from the block makes the cells on that side grow longer than those on the other side — U · 1

Auxin diffuses down from the block into the cells **on that side only**, and makes them **elongate**. That side grows longer than the other, so the stump **curves away** from the block. The test is done in the dark, so light plays no part; a plain block does nothing, which shows it isn't the weight.

iv. **b.** it couldn't make enough gibberellin — A · 1

Adding the hormone **cured** the dwarfism, so the plant could respond to gibberellin; it was short because it **made too little** of it. (A plant whose cells couldn't respond, like the Green Revolution wheats, stays short even when sprayed.)

v. **b.** low auxin, high cytokinin — A · 1

Auxin keeps lateral buds dormant, and **cytokinin** makes them grow. So **low auxin and high cytokinin** releases them.

4 Short answers

a. MARKING SCHEME — K · 2

- ✓ Organic compounds, not nutrients, that change growth in low concentrations (natural or synthetic).
- ✓ Two synthetic ones (e.g. NAA and 2,4-D).

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b. MARKING SCHEME U · 2

✓ A synthetic auxin that at high concentration kills broad-leaved (dicot) weeds.
✓ Cereals and grasses (monocots) such as wheat are much less affected.

c. MARKING SCHEME A · 2

✓ Pineapple: NAA (auxin) sprayed for uniform flowering.
✓ Cuttings: bases dipped in IBA or NAA rooting powder.

d. MARKING SCHEME U · 3

✓ Definition: the apical bud keeps the lateral buds below it dormant.
✓ Auxin from the apex suppresses them (shown by decapitation and auxin paste).
✓ Cytokinin makes lateral buds grow; the auxin : cytokinin balance decides.

5 Long answers

a. ANSWER U · 4

In 1926–1928 **Frits Went** worked with the **coleoptiles** of oat, *Avena sativa*:

1. He cut off coleoptile tips and stood them on an **agar block** for an hour or two; the growth substance diffused into the agar.
2. He cut the tip off another coleoptile and put the block on **one side** of the stump, in the **dark**.
3. The stump **bent away** from the block: the cells under it grew longer. A plain agar block caused no bending.
4. The **angle of bending** grew with the amount of substance in the block, so it could **measure** auxin: the first bioassay.

It showed that a growth substance (auxin) made in the tip **moves down** and makes the cells below it **elongate**.

MARKING SCHEME

✓ Tips stood on agar, which takes up the substance.
✓ Block placed on one side of a decapitated stump, in the dark; a plain block as control.
✓ The stump bends away from the block, by an angle that measures the amount.
✓ Conclusion: a substance from the tip moves down and makes cells elongate.

b. ANSWER U · 4

Any four:

- **Internode elongation**: stems grow much longer; genetic dwarfs of pea and maize grow to normal height.
- **Bolting and flowering**: rosette plants such as cabbage and henbane bolt and flower even under short days.
- **Breaking dormancy** of buds and potato tubers; light-sensitive seeds (lettuce) germinate in the dark.
- **Parthenocarpy and fruit growth**: seedless fruits, even in apple and pear; larger seedless grapes.
- α-**amylase** in germinating cereal grains: the aleurone layer makes the enzyme that digests the endosperm's starch.
- Little effect on roots; they inhibit rooting of cuttings.

MARKING SCHEME

✓ A first correct effect (e.g. internode elongation, curing genetic dwarfism).
✓ A second (e.g. bolting).
✓ A third (e.g. breaking dormancy).
✓ A fourth (e.g. α-amylase in the aleurone, or parthenocarpy).

6 Think

ANSWER

First keep the callus growing on a medium with **about equal auxin and cytokinin**, so it stays undifferentiated and grows into enough tissue, cut into pieces.

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Then move the pieces to a medium with **high cytokinin and low auxin**, which makes them form **shoot buds**.
Finally move the shoots to a medium with **high auxin and low cytokinin**, which makes them form **roots**; the rooted plantlets can be planted out. (Skoog and Miller's tobacco callus, 1957.)

MARKING SCHEME

- ✓ Balanced auxin and cytokinin keep the callus growing as callus.
- ✓ High cytokinin : auxin makes shoot buds.
- ✓ High auxin : cytokinin then roots the shoots.

7 Activity: Rooting cuttings

(not marked)

WHAT STUDENTS SHOULD FIND

The treated cuttings root **sooner and more heavily**; the untreated ones later, or not at all. All roots form at the **lower end**, near the buried node, because auxin moves **down** the cutting (polar transport) and collects at its base.

Marks by level	Knowledge	Understanding	Application	Higher ability	Total
Marks	10	15	4	3	**32**

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