ANSWERS & MARK SCHEMES

QUESTIONSHEET 1

Effect	Auxins	Gibberellins	
Promote cell enlargement	✓	✓	;
Break bud dormancy	✗	✓	;
Promote ripening of fruit	✗	✗	;
Inhibit lateral growth	✓	✓	;
Promote root formation in cuttings	✓	✗	;
Promote fruit growth	✓	✓	;
Stimulate stomatal opening	✗	✗	;

TOTAL 7

QUESTIONSHEET 2

(a) (i) coleoptile bending to left;
taller than in B; **2**

(ii) tip is secreting auxin;
diffuses down into the agar gel; **2**

(iii) right hand side of coleoptile receives auxin/more auxin than left hand side;
thus cells on right hand side exhibit greater elongation causing bending to left; **2**

(b) (auxin) loosens the rigid cellulose framework/cellulose microfibrils of the cell wall;
osmotic uptake of water then enables swelling/elongation; **2**

TOTAL 8

QUESTIONSHEET 3

Name of growth substance	Site of production	One main effect
abscisic acid;	leaves/stems/ fruits/seeds;	
	ripening fruits;	promotes fruit ripening;
auxin;	stem/root tips;	
gibberellin;	embryo/in seeds/buds/ young leaves/root tips;	
cytokinins;	fruits/seeds;	

TOTAL 10

QUESTIONSHEET 4

(a) (i) all caused greater elongation than the control;
GA only had a small increase in (cell) elongation compared with the control group;
IAA only had a much larger effect on stimulating (cell) elongation, especially over the first 30 hours;
IAA + GA had the greatest effect, especially over the first 24 hours/increase over three times greater than in control;
max 3

(ii) when one substance enhances the effects of another substance;
gibberellic acid enhances the effect of auxin on (cell) elongation/vica versa; **2**

(iii) seedlings may not be identical/seedlings may receive slightly different quantities of growth substance/
cutting (the internodes) may interfere with their growth; **1**

(b) auxins stimulate cell elongation;
cytokinins stimulate cell division/mitosis; **2**

(c) to encourage fruit setting;
to cause the development of seedless fruits/induce parthenocarpy;
to stimulate amylase production to promote 'malting' in the brewing industry; **max 2**

TOTAL 10

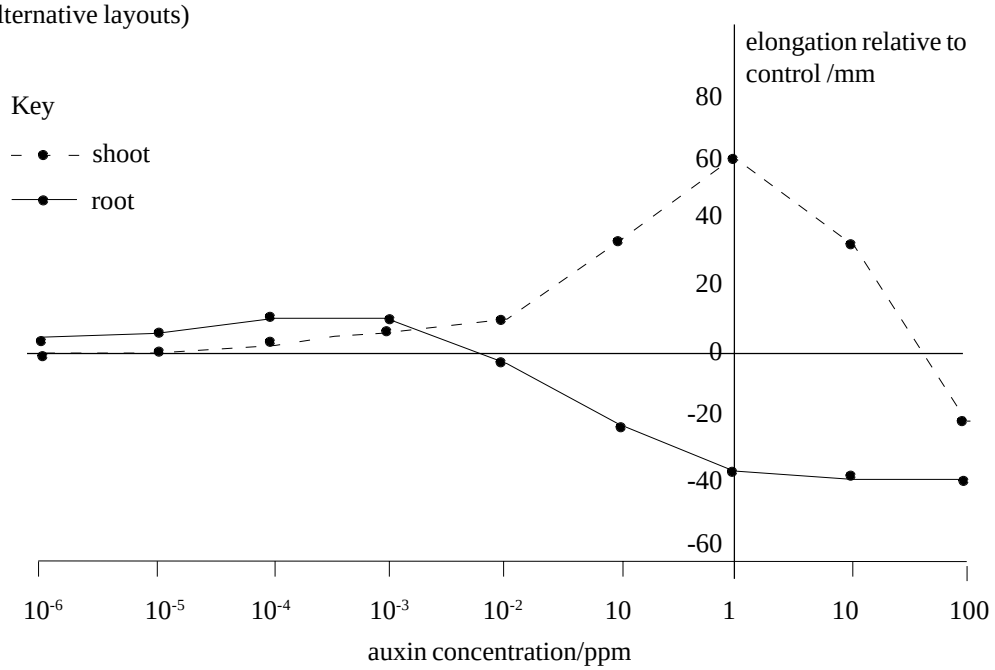
QUESTIONSHEET 5

1. ethene;
2. cytokinin;
3. auxin;
4. abscisic acid;
5. abscisic acid;
6. auxin/gibberellin;
7. cytokinin;
8. auxin;
9. gibberellin;
10. gibberellin;

TOTAL 10

QUESTIONSHEET 6

(a) axes (auxin on X axis, elongation on Y axis);
suitable scale (at least half of graph paper and easy to use);
accurate plotting;
points joined with ruler (IOB recommendations);
curves labelled/key;
(accept alternative layouts) **5**



(b) root elongation stimulated most at low auxin concentration/around 10^{-4}ppm;
root elongation inhibited above 10^{-2}ppm/at higher auxin concentrations;
shoot elongation stimulated best at high auxin concentratioon/1 ppm;
not stimulated at low auxin concentrations/below 10^{-5}ppm;
inhibited at concentrations of 100ppm; **max 4**

(c) (plantains are broad leaved whereas) grasses are narrow leaved;
thus plantains tend to absorb more auxin than grasses and so plantains affected more;
inhibit root growth whilst causing 'bolting'/overgrowth of shoots which die; **3**

TOTAL 12

QUESTIONSHEET 7

(a) cause increased root growth in low concentrations;
stimulate shoot growth in higher concentrations;
inhibit root growth in high concentrations;
low concentrations have no effect on shoot growth/very high concentrations inhibit shoot growth; **max 3**

(b) (i) could cause inhibition of root growth;
since would accumulate inside the cells;
causes rapid cell elongation so that stems grow too quickly;
but no extra lignified tissue in plant stem;
thus stem collapses/loss of too much water through extra leaves; **max 3**

(ii) auxins are absorbed through the plant surface;
broad leaved plants absorb relatively more auxin than narrow leaved plants;
thus broad leaved plants are subjected to a concentration which inhibits root growth/causes shoots to bolt (or eqivalent);
narrow leaved plants are only subjected to a concentration which does not adversely affect root or shoot growth;
max 3

(c) different types of protein have different amino acid sequences;
and thus have different secondary and tertiary structures/3D structures;
and so produce different shaped channels; **max 2**

TOTAL 11

QUESTIONSHEET 8

(a) (i) auxin secreted by tip of stem;
diffuses down to elongation zone;
causes elongation of cells by modifying their cellulose walls, allowing osmotic expansion;
cytokinin may stimulate apical cell division; **max 3**

(ii) gibberellic acid is produced in presence of Le allele;
acts synergistically with auxin/enhances the effect of auxin thus causing taller growth; **2**

(b) environmental factors also influence growth;
such as light intensity/light duration/light wavelength/temperature/water availability/nitrate availability/
any other valid example; **2**

(c) (i) auxin promotes apical dominance/inhibits lateral growth;
this affect is enhanced in the presence of gibberellin/synergism; **2**

(ii) cut off the apical buds so that lateral buds grow;
add cytokinin which stimulates lateral growth/inhibits apical dominance by auxin; **max 1**

TOTAL 10

QUESTIONSHEET 9

(a) (i) slow transportation in plants + rapid transportation in animals;
transported by diffusion/in phloem + transported in blood;
synthesised in many cell sites + synthesised in specific endocrine glands;
slow acting/sustained effect + usually fast acting/short term effect; **max 3**

(ii) ripe bananas produce (large quantities of gaseous) ethene;
ethene stimulates ripening; **2**

(b) (i) when the presence of one substance enhances the effects of another substance;
gibberellins enhance the effect of auxins in causing shoot growth; **2**

(ii) when the presence of one substance inhibits the effects of another substance;
cytokinins/ethene break bud dormancy whereas abscisic acid promotes bud dormancy/any other valid example; **2**

(c) (i) the presence/growth of the apical bud suppresses the growth of axillary buds; **1**

(ii) auxin promotes apical dominance and inhibits lateral growth;
gibberellin acts synergistically with auxin to increase apical dominance/suppress lateral growth;
cytokinins inhibit apical dominance/enhance lateral growth; **max 2**

TOTAL 12

QUESTIONSHEET 10

(a) positive phototropism is when shoots grow towards unilateral light;
plants/seedlings in a room tend to grow towards the windows/any correct example;
phototaxism is when a complete organism moves towards the light;
Chlamydomonas/Euglena swimming towards the light/any correct example; **4**

(b) etiolation is when a plant grows very tall/spindly and lacks chlorophyll;
caused by being in continuous darkness/too much auxin activity;
abscission is leaf fall (in deciduous trees);
stimulated by abscisic acid; **4**

(c) long day plants are stimulated to flower by dark periods shorter than a critical length;
Potato/Henbane (need darkness shorter than a 13 hour length)/any correct example;
short day plants are stimulated to flower by dark periods longer than a critical length;
Cocklebur/Tobacco (need dark periods longer than about 9 hours)/any correct example; **4**

(d) (pale blue) plant pigment involved in photoperiodism/flowering/onset of germination;
reference to two forms/P_R and P_{FR}/P_{660} and P_{730};
parthenocarpy is the production of seedless fruits/fruit formation in absence of pollination;
parthenocarpy is promoted by auxin and gibberellin; **4**

TOTAL 16

QUESTIONSHEET 11

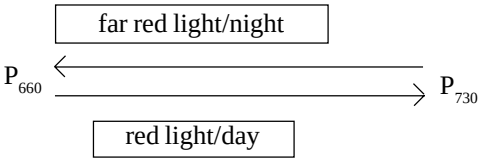
IAA/indole acetic acid; apical; elongation; tropic/growth responses; light; gravity/water; adventitious; lateral; fruit; parthenocarpy; tips; diffuses;

TOTAL 12

QUESTIONSHEET 12

(a) (i) phytochrome; **1**

(ii)



arrows;
labels; **2**

(b) short day plants;
require a dark period longer than a critical length; **2**

(c) Any two of: temperature change/humidity/soil water availability/light intensity;; **2**

TOTAL 7

QUESTIONSHEET 13

(a) (i) tips intact and so auxin is present;
auxin stimulates apical dominance and suppresses axillary growth;
thus no change seen in axillary growth/slight growth only; **3**

(ii) tips removed and so no auxin produced;
thus no inhibitory action on axillary growth;
thus axillary shoot lengths increase considerably/by approx 115mm more than C/by approx. 130 mm; **3**

(iii) no auxin present so no inhibition of axillary growth;
cytokinins stimulate axillary growth by increasing mitotic rate;
thus shoots increase in length by the largest amount/by approx 160mm more than C/by approx. 168 mm; **3**

(b) (i) no lateral growth/less lateral growth than in A; **1**

(ii) apical bud exerts apical dominance/suppresses lateral growth;
produces auxins which inhibit axillary growth; **2**

(c) Any two of: use similar/same batch of plants/similar ages/apply same quantity of hormone to each plant/
constant temperature/constant all round light intensity/equal watering/any other valid precaution;; **2**

(d) (i) cut off lateral shoots leaving apical buds intact; **1**

(ii) cut off apical shoots to stimulate axillary buds to grow; **1**

TOTAL 16

QUESTIONSHEET 14

promotes seed dormancy;
thus seeds will not germinate until conditions become suitable; **2**

promotes leaf fall/abscission;
thus no water loss by transpiration when soil water may be unavailable/frozen; **2**

promotes bud dormancy;
so that growth does not occur during unfavourable conditions; **2**

inhibits stem growth;
particularly during drought/waterlogging, thus increasing survival chances; **2**

promotes closing of stomata;
particularly during water shortage/wilting, thus increasing survival chances; **2**

TOTAL 10

QUESTIONSHEET 15

(a) abscisic acid inhibits germination until washed out of the seed/overridden by gibberellin;
gibberellins break dormancy by stimulating enzyme synthesis (in the aleurone layer);
enzymes enable mobilisation of starch/oil reserves/proteins (in the endosperm);
cytokinins stimulate cell division in the embryo (allowing growth);
auxins and gibberellins act together to produce cell elongation in the plumules/shoots and radicles/roots; **5**

(b) auxins help fruit setting and fruit growth;
effect enhanced in the presence of gibberellin/ref. synergism of auxin and gibberellin;
auxins and gibberellins can also induce parthenocarpy/fruit setting without pollination;
this results in the production of seedless fruit/grapes/oranges;
cytokinins also promote fruit growth/ethene induces ripening; **5**

(c) auxin inhibits abscission/leaf fall;
unless the process has already started when it promotes it;
abscisic acid promotes leaf fall;
particularly when the plant is stressed by drought;
when its effects override those of auxin/ref. antagonism of auxin and abscisic acid; **5**

TOTAL 15

QUESTIONSHEET 16

(i) synthetic auxin/IAA;
delays ageing/senescence/abscission/fall (of fruit); **2**

(ii) following imbibition/uptake of water, gibberellins are released;
gibberellins stimulate enzyme/amylase synthesis/transcription;
amylase converts starch to sugars;
sugars provide energy for seedling;
gibberellins normally produced by embryo; **max 3**

(iii) apical dominance;
shoot tip inhibits growth of laterals below it;
by releasing auxin which suppresses lateral buds;
encourages height growth rather than width/encourages growth towards light;
tip removal removes inhibiting effect of auxin; **max 3**

TOTAL 8

QUESTIONSHEET 17

(a) (i) any tissue/part of plant used to start a culture;
should be healthy/must be living tissue/not dead xylem/sclerenchyma; **2**

(ii) callus is made up of undifferentiated plant cells;
all cells could undergo mitosis/differentiate into any tissue; **2**

(iii) to prevent fungal/microbial growth/contamination;
nutrients in growth medium would provide an ideal substrate for fungal/microbial growth; **2**

(iv) carbon source/suitable sugar/sucrose;
major mineral salts/nitrates/phosphates;
trace elements;
vitamins/thiamine/nicotinamide;
hormones/auxin/kinin;
water; **max 4**

(v) light;
suitable temperature/room temperature/26^{0}C; **2**

(b) (i) A: auxin concentration must be adjusted to 3 mg dm^{-3};
kinin concentration must be adjusted to 0.2 mg dm^{-3};

B: auxin concentration must be reduced to 0.03 mg dm^{-3};
kinin concentration must be raised to 1 mg dm^{-3};

C: auxin concentration must be raised to 3 mg dm^{-3};
kinin concentration must be reduced to 0.02 mg dm^{-3}; **6**

(ii) kinins stimulate rate/frequency of mitosis in the presence of auxins;
synergistic effect; **2**

TOTAL 20

QUESTIONSHEET 18

(a) test group of stems had tips covered with foil;
control group of stems without foil/with tips uncovered;
exposed to unilateral light for several hours;
control group grew towards light, test group grew straight up;
test group then covered with foil around elongation zone with tips uncovered;
when exposed to unilateral light, grew towards light; **max 4**

(b) ref to use of mica/plastic/metal strips;
inserted into stem from side just beneath tip;
to penetrate about half way into stem;
one set of stems with mica inserted on dark side of stem and one set with mica inserted on light side of stem;
control group of stems with no mica;
when exposed to unilateral light stems with mica on the light side and the controls bent towards the light, those with mica on the dark side grew straight up; **max 4**

(c) select flowers of same age/from newly opened buds;
place freshly cut flowers in solutions of different salicylate concentrations;
over a range from a trace of salicylate up to a dilute solution;
have a control group in water with no salicylate;
keep solutions topped up with water not with more solution;
measure time until floral parts start to fall/wither; **max 4**

TOTAL 12

QUESTIONSHEET 19

(a) (i) 410 - 640 nm; (allow ± 5 either way) **1**

(ii) 390 - 410 nm; 640 - 700 nm; (allow ± 5 either way) **2**

(b) the last wavelength provided determines the effect/the wavelengths negate each other/
pigment exists in two inter-convertible forms; **1**

(c) plant will not flower;
until it has passed through cold season/winter;
protects flowers/prevents flowering in autumn/wrong season; **max 2**

TOTAL 6

QUESTIONSHEET 20

(a) usually shown graphically;
measures the effectiveness of different wavelengths in stimulating a process/named process; **2**

(b) red light/650-670 nm most effective (in inducing flowering);
photoperiod pigment differs from chlorophyll;
since it only has one high activity peak but chlorophyll has two; **max 2**

(c) same pigment in both types of plant;
must operate differently in the two types of plant; **2**

TOTAL 6