

**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**

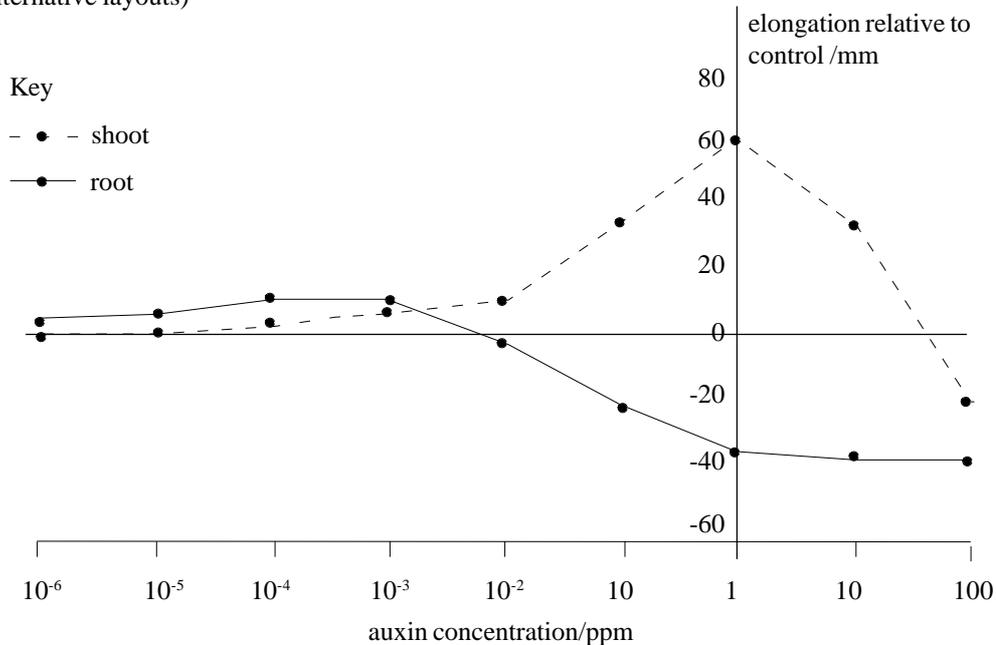
**TOTAL 10****QUESTIONSHEET 5**

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 concentration/1 ppm;  
 not stimulated at low auxin concentrations/below  $10^{-5}$  ppm;  
 inhibited at concentrations of 100 ppm;

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 equivalent);  
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;  
phototaxis 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; 2  
labels;
- (b) short day plants; 2  
require a dark period longer than a critical length;
- (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
	<b>TOTAL 10</b>

**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 parthenocarp/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
	<b>TOTAL 15</b>

**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°C; 2
- (b) (i) A: auxin concentration must be adjusted to 3 mg dm<sup>-3</sup>;  
kinin concentration must be adjusted to 0.2 mg dm<sup>-3</sup>;
- B: auxin concentration must be reduced to 0.03 mg dm<sup>-3</sup>;  
kinin concentration must be raised to 1 mg dm<sup>-3</sup>;
- C: auxin concentration must be raised to 3 mg dm<sup>-3</sup>;  
kinin concentration must be reduced to 0.02 mg dm<sup>-3</sup>; 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  $\pm 5$  either way) 1
- (ii) 390 - 410 nm; 640 - 700 nm; (allow  $\pm 5$  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**