

**QUESTIONSHEET 1**

- (a) place known mass of food in burning chamber;  
switch on oxygen supply and filter pump;  
note initial temperature of water;  
burn food to ash;  
keep stirring the water;  
measure the final temperature; 4
- (b)  $7.5 \times 4.18 \text{ J}$  raises the temperature of 1g of water through  $7.5^\circ\text{C}$ ;  
 $7.5 \times 4.18 \times 500 \text{ J}$  raises the temperature of 500 g of water through  $7.5^\circ\text{C}$ ;  
 $15.675 \text{ kJ}$  are produced; 3
- TOTAL 7**
- 

**QUESTIONSHEET 2**

- (a) A;  
since has received lowest power centrifugation;  
nucleus is the largest organelle (so sediments first); 3
- (b) (i) B;  
cytochrome oxidase is the main electron carrier in mitochondria; 2
- (ii) C;  
ribosomes made of RNA; 2
- (c) plant;  
ribulose biphosphate carboxylase found only in chloroplasts; 2
- (d) organelles have different masses/densities;  
heaviest/densest/organelles separate first/at low speeds/lighter/less dense organelles require higher speed; 2
- TOTAL 11**
- 

**QUESTIONSHEET 3**

- (a) (i) phototropism to light;  
hydrotropism to water;  
chemotropism to chemicals;  
thigmotropism/haptotropism to contact/touch; max 3
- (ii) a tropism is a growth movement/response towards or away from an external stimulus;  
a nasty is a non-directional movement in response to an external stimulus;  
which may be caused either by turgor changes or by growth; 3
- (b) pin germinating seeds to cork base of klinostat;  
keep moist by having damp filter paper around them;  
set drum to horizontal position;  
set motor to make drum rotate;  
4 or 5 revolutions per hour/run for several hours;  
radicles/plumules thus receive equal gravity on all sides and grow straight/horizontal;  
switch off motor so drum no longer rotates;  
after a few hours radicles grow down and plumules up; max 5
- TOTAL 11**

**QUESTIONSHEET 4**

- (a) (i) magnification is the number of times the image produced (by the microscope) is larger than the object being viewed;  
resolving power is the ability of the microscope to separate detail/separate dots which are minute distances apart; **2**

(ii)

	Limit of magnification	Limit of resolution
light microscope	1500 times ;	200 $\mu\text{m}$ ;
electron microscope	$5 \times 10^6$ times ;	1 $\mu\text{m}$ ;

[4]

(b)

Feature	Visible in	
	Light microscope	electron microscope
mitochondria	✓	✓
ribosomes	✗	✓
viruses	✗	✓
bacteria	✓	✓
lysosomes	✗	✓
hydrogen atoms	✗	✗

6

- (c) TEM passes electrons through thin sections/layers/viruses to see internal structure;  
SEM reflects electrons off surface to see surface/3D structure;

2

**TOTAL 14**

**QUESTIONSHEET 5**

- (a) (i) place tip of (pasteur) pipette containing suspension at edge of cover slip (by counting chamber) to allow suspension to be drawn into counting area (by capillary attraction);  
being careful not to get fluid into the grooves; **max 2**
- (ii) turn on light and adjust mirror/open iris diaphragm;  
place counting chamber on stage and centralise;  
find grid under low power/x10 objective using coarse adjustment;  
adjust condensor height until bulb/filament is in focus with grid, then lower it slightly/adjust to critical illumination;  
(only give this mark if it in the correct sequence)  
turn to high power objective/x40 and focus using fine adjustment;  
adjust iris diaphragm to give comfortable light; **max 5**
- (b) (i) number of cells in  $\frac{1}{25} \text{ mm}^2 = 73$  (allow 72 – 74) ;
- $73 \times 25$  (area)  $\times 10$  (depth);  
 $= 18,250 \text{ cells mm}^{-3}$ ; **3**
- (ii)  $18,250 \times 10^5$  (dilution factor)  $\times 10^6$  (to convert to  $\text{dm}^3$ ) ;  
 $18.25 \times 10^{14} \text{ cells dm}^{-3}$ ; **2**
- (iii) only count cells on line once/only count cells on top and right hand side lines in each square/equivalent method; **1**

**TOTAL 13****QUESTIONSHEET 6**

- (a) (i) an association of an enzyme and a transducer;  
which produces an electrical signal when the enzyme transforms its substrate; **2**
- (ii) glucose is oxidised by oxygen;  
yielding gluconic acid and hydrogen peroxide; (allow marks on an equation) **2**
- (iii) glucose absorbed from solution by gel layer/diffuses into gel;  
acted on by glucose oxidase which means an equivalent amount of oxygen is also absorbed into the gel;  
electrode responds to oxygen uptake by generating an electric potential;  
size of electric potential is proportional to oxygen uptake and thus to glucose concentration; **max 3**
- (b) measuring blood glucose concentrations in diabetics/measuring urine glucose in diabetics/monitoring glucose use in fermentations/  
any correct example; **1**

**TOTAL 8**

**QUESTIONSHEET 7**

Use of apparatus	Apparatus
comparing light absorbances	<b>spectrophotometer;</b>
looking at virus structure	<b>electron microscope;</b>
measuring glucose concentrations	<b>glucose oxidase electrode;</b>
measuring stomatal diameter	<b>eyepiece and stage micrometer;</b>
measuring vital capacity	<b>spirometer;</b>
measuring cell population density	<b>haemocytometer;</b>
separating ribosomes from mitochondria	<b><u>ultracentrifuge</u>;</b>
looking at vascular bundles	<b>light microscope;</b>
sampling invertebrates in leaf litter	<b>tulgren funnel;</b>
comparing transpiration rates	<b>potometer;</b>
separating chloroplast pigments	<b>chromatography apparatus;</b>
measuring plant population density	<b>quadrat;</b>
measuring blood pressure	<b>sphygmomanometer;</b>
comparing energy contents of foods	<b>bomb calorimeter;</b>

**TOTAL 14**

**QUESTIONSHEET 8**

- (a) (i) heat/light from the light bulb drives organisms to the bottom (of the litter);  
organisms fall through the perforated shelf into the fixative;  
this kills them while preserving them (in a life like state); **3**
- (ii) same mass of leaf litter in each sample;  
same wattage light bulb;  
light bulb at same distance from top (of litter);  
litter exposed for the same time (period);  
time must be long enough to allow small organisms to move to bottom of litter/at least 1 hour; **max 4**
- (iii) collect at same time of day;  
under similar weather conditions/light intensity;  
take samples within a standard range from the tree/surrounding trees;  
collect samples to the same depth/down to soil level;  
collect several samples from each site/replicates;  
use small quadrats/0.25m<sup>2</sup> quadrats;  
placed using random coordinates/randomly; **max 5**
- (b) use keys to identify each organism;  
sort organisms out into primary consumers, secondary consumers, tertiary consumers/equivalent statements;  
heat each sample of organisms to constant mass;  
this gives the dry mass at each trophic level;  
plot on graph paper in pyramid form;  
area of box represents amount of biomass; **max 4**

**TOTAL 16****QUESTIONSHEET 9**

- (a) (i) lay chromatography paper flat on clean filter paper/paper;  
use capillary tube to place small drops of fruit juice on origin;  
dry each drop with hair dryer (to prevent spreading);  
at least 10 drops to get a concentrated spot;  
hang chromatography paper in jar so that solvent surface is over end of paper but below origin;  
put lid on to make an airtight seal; **max 5**
- (ii) do not touch chromatography paper with fingers since sweat contains amino acids;  
atmosphere in jar must be saturated with the vapour of the solvent (so that the paper does not dry out);  
make sure paper is hanging vertically so that solvent moves straight up/does not carry amino acids to edge of paper; **max 2**
- (b) (i) distance moved by solute;  
divided by the distance moved by the solvent front;  
is a physical constant for each amino acid with a specific solvent; **3**
- (ii) A:  $R_f = \frac{13}{66} = 0.20$ ; arginine; (measure to the centres of spots, allow  $\pm 0.5$  mm)
- D:  $R_f = \frac{38}{66} = 0.56$ ; methionine;
- E:  $R_f = \frac{52}{66} = 0.79$ ; cysteine; **6**
- (iii) run another chromatogram at right angles to the first/two way chromatography;  
using a different solvent; **2**

**TOTAL 18**

**QUESTIONSHEET 10**

- (a) (i) potometer; 1
- (ii) measures water uptake by the shoot;  
which is almost identical in volume to water loss (by transpiration);  
volume of water actually used/retained by shoot is very small/negligible; max 2
- (iii) shoot must be cut under water (to prevent air entry);  
apparatus should be set up under water (to exclude air);  
apparatus should be completely air tight/no leaks;  
shoot should be in turgid condition;  
if comparing shoots they should have similar surface area; max 3
- (b) (i) stomata open in the light allowing transpiration loss;  
slow increase in transpiration rate up to fan setting 3;  
faster rate increase at higher wind speeds/from setting 3 to 5;  
air movements remove water vapour from around leaves;  
thus increasing diffusion gradient of water out of leaves/through stomata; max 3
- (ii) marram grass is a xerophyte whereas oat is a mesophyte;  
thus marram grass has adaptations to reduce water loss;  
thus its transpiration rate is lower than oat and it does not increase much as wind speed increases;  
ref to sunken stomata in marram grass;  
ref to folded leaves in marram grass;  
ref to thicker cuticle in marram grass/more epidermal hairs/any other valid marram grass feature; max 4
- TOTAL 13**
- 

**QUESTIONSHEET 11**

- (a) (i) fermentation process/microbial metabolism generates a lot of heat;  
water jacket/water flow through jacket removes this heat/cool process down;  
so that enzymes do not become denatured by heat; max 2
- (ii) supplies oxygen for aerobic respiration (of microorganisms);  
thus allowing ATP manufacture;  
so that product can be synthesised/synthesis requires energy/ATP; max 2
- (iii) fermenter is sterilised by steam/by steam under pressure in autoclave;  
inlet allows steam access to inside of fermenter;  
contaminating/dangerous microorganisms are killed; max 2
- (b) (i) in batch fermentation the nutrient medium is inoculated with microorganisms and growth is allowed to  
continue into the decline phase;  
the product is then harvested from the culture;  
for example, beers/ wines/penicillin/any other correct example;  
in continuous fermentation the microorganism growth is maintained in the exponential phase;  
by adding replacement nutrients/oxygen as required;  
products are extracted and separated at regular intervals;  
for example, vinegar/some lagers/citric acid/any other correct example; max 5
- (ii) primary metabolite is made during the exponential/growth phase/is a product of a metabolic process  
that is essential for life of the microorganism;  
for example, alcohol/ethanol production by yeast/acetic acid production by Acetobacter/any other correct example;  
secondary metabolite is made after the growth phase has stopped/is not essential to the life of the microorganism;  
for example, penicillin/quinine/codeine/any other correct example; 4

**TOTAL 15**

**QUESTIONSHEET 12**

- (a) (i) to absorb the carbon dioxide liberated (by the germinating peas); **1**
- (ii) to increase the surface area of potassium hydroxide exposed for CO<sub>2</sub> absorption/increase the efficiency of CO<sub>2</sub> absorption; **1**
- (iii) opened at start of experiment to let manometer levels equalise; **1**
- (b) control temperature using water bath;  
suitable range, at least three temperatures, range 15°C to 50°C;  
suitable time at least 10 minutes for equilibration at each temperature;  
with tap open to level manometer fluid;  
close tap and allow experiment to run for a suitable time/at least 30 minutes;  
measure deflection on manometer which is equivalent to oxygen uptake; **max 5**
- (c) (i) the volume of carbon dioxide liberated by respiration;  
divided by the volume of oxygen used;  
ref to  $RQ_{\text{carb}} = 1.0/RQ_{\text{lipid}} = 0.7/RQ_{\text{prot}} = 0.9$ ; **max 2**
- (ii) perform experiment as in (b) to measure oxygen uptake;  
then repeat again in same way but without potassium hydroxide;  
change in manometer level indicate difference between volume of oxygen used and volume of carbon dioxide liberated;  
thus, since volume of oxygen used has already been measured can calculate volume of carbon dioxide liberated  
(and so can calculate the RQ);  
if manometer level did not move then the RQ would be 1.0; **max 4**

**TOTAL 14**