ANSWERS & MARK SCHEMES

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 x 4.18 J raises the temperature of 1g of water through 7.5^{0}C;
7.5 x 4.18 x 500 J raises the temperature of 500 g of water through 7.5^{0}C;
15.675 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 bisphosphate 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 µm ;
electron microscope	5 x 10^6 times ;	1 µm ;

[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 $\frac{1}{25}$ mm^2 = 73 (allow 72 – 74) ;

73 x 25 (area) x 10 (depth);
= 18,250 cells mm^{-3}; **3**

(ii) 18,250 x 10^5 (dilution factor) x 10^6 (to convert to dm^3) ;
18.25 x 10^{14} 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	**spectrophotometer;**
looking at virus structure	**electron microscope;**
measuring glucose concentrations	**glucose oxidase electrode;**
measuring stomatal diameter	**eyepiece and stage micrometer;**
measuring vital capacity	**spirometer;**
measuring cell population density	**haemocytometer;**
separating ribosomes from mitochondria	**<u>ultra</u>centrifuge;**
looking at vascular bundles	**light microscope;**
sampling invertebrates in leaf litter	**tulgren funnel;**
comparing transpiration rates	**potometer;**
separating chloroplast pigments	**chromatography apparatus;**
measuring plant population density	**quadrat;**
measuring blood pressure	**sphygmomanometer;**
comparing energy contents of foods	**bomb calorimeter;**

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^2 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: Rf $= \frac{13}{66} = 0.20$; arginine; (measure to the centres of spots, allow ± 0.5 mm)

D: Rf $= \frac{38}{66} = 0.56$; methionine;

E: Rf $= \frac{52}{66} = 0.79$; 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/cools 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_2 absorption/increase the efficiency of CO_2 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 $RQ_{carb} = 1.0/RQ_{lipid} = 0.7/ RQ_{prot} = 0.9$; **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