

**QUESTIONSHEET 1**

- a) (i) the internal conditions of the body;  
such as body temperature/blood pH/blood salt concentration/blood osmotic pressure; **2**
- (ii) negative feedback control is when a varying physiological value is returned to its mean value by the controlling mechanism (credit example. eg. sweating to reduce body temperature);  
positive feedback control is when a physiological value is pushed above its mean value by the controlling mechanism (credit example eg. increased uterine contractions in birth); **2**
- (iii) -ve : normal body temperature/blood pressure/blood osmotic pressure/blood pH/ventilation rate/any correct eg;  
+ve : oxytocin release during birth/oxytocin release in suckling/body temperature during fever/any correct eg; **2**
- (iv) the reduction or suppression of a feedback control mechanism when the required physiological value is reached;  
(usually feedback control mechanisms are not completely turned off) **1**
- (b) Amoeba: osmoregulation/water removal by the contractile vacuole;  
Marram grass: water loss from leaves by hinge cells closing stomata/rolling leaf up;  
Human: control of blood pressure/blood osmotic pressure/blood salt and water concentration by ADH mechanism  
/any other valid examples; **3**

**TOTAL 10****QUESTIONSHEET 2**

- (a) thermoreceptors in skin sense surface/shell temperature;  
thermoreceptors in hypothalamus sense core/blood temperature;  
relay nerve impulses to heat gain/heat loss/thermoregulatory centres in hypothalamus; **3**
- (b) baroreceptors sense blood pressure;  
situated in walls of arterial arches/bases of great veins/aortic and carotid bodies;  
relay nerve impulses to vasomotor centre in brain/medulla (to regulate cardiac output/blood pressure); **3**
- (c) glucoreceptors sense blood glucose concentrations;  
situated on cell membranes of alpha and beta cells of the islets of Langerhans;  
if blood glucose concentration rises beta cells stimulated to release insulin to lower it  
/if blood glucose concentration falls alpha cells stimulated to release glucagon to raise it; **3**
- (d) proprioceptors are tension and pressure receptors;  
situated in muscles and tendons/ ligaments/joint capsules;  
send nerve impulses to cerebellum to regulate muscle tone/enable balance/coordinated movements; **3**

**TOTAL 12**

**QUESTIONSHEET 3**

- (a) (i) low/decreasing value as it used up/fasting blood glucose concentration;  
value is not obscured by absorption of glucose from gut to blood; **2**
- (ii) 4.2 millimoles  $\text{dm}^{-3}$ ; (allow range 4.1 to 4.3) **1**
- (b) A-B: glucose being absorbed from gut (into blood stream);  
faster than it is being converted to glycogen;  
and stored in liver/muscles;  
under the influence of insulin; **max 3**
- B-C: glucose absorption from gut to blood is reducing/stopping;  
 $\beta$ -cells release more insulin;  
 $\alpha$ -cells release less glucagon;  
conversion to glycogen for storage is faster than absorption; **max 3**
- TOTAL 9**
- 

**QUESTIONSHEET 4**

- (a) (i) regulators are organisms that regulate or control their physiological values within narrow limits;  
any one of: mammals/birds/flowering plants/specific example of these;  
non regulators do not control their physiological values within narrow limits;  
any one of: cnidarians/algae/specific example of these; **4**  
(most other organisms are regulators for some values and non regulators for other values)
- (ii) exogenous rhythms are those that are related to regular changes in environmental stimuli;  
eg. heart rate /blood pressure; **4**  
endogenous rhythms are those that follow a spontaneous internal cycle;  
eg. core temperature/sleep patterns;
- (b) metabolism out of phase;  
due to crossing time zones;  
thus may need to be awake when body clock thinks it is time to sleep/body clock confused/ref body clock;  
ref. to melatonin; **4**
- TOTAL 12**
- 

**QUESTIONSHEET 5**

negative feedback;  
hypothalamus;  
osmolality/osmotic pressure/sodium ion concentration;  
posterior pituitary body;  
neurosecretion;  
collecting duct;  
water permeable;  
reabsorbed;

**TOTAL 8**

**QUESTIONSHEET 6**

Action	Hormone
Breakdown of glycogen in the liver	glucagon/adrenaline;
Non shivering thermogenesis	adrenaline;
Lowering of blood glucose concentration	insulin;
Acceleration of heart beat	adrenaline/thyroxine;
Reduction of water loss in urine	antidiuretic hormone;
Increase in flow of gastric juice	gastrin;
Increase in antibody release by plasma cells	interleukin;

**TOTAL 7****QUESTIONSHEET 7**

- (a) (i) so that water content of body is maintained at constant level/no dehydration/ no over dilution;  
so that blood concentration/osmotic pressure/volume/blood pressure can be kept constant; **2**
- (ii) 1: sweat;  
due to temperature rise and so more secretion of sweat to cool body (using latent heat); **2**
- 2: respiration;  
more energy required so faster respiration thus more metabolic water released; **2**  
(exhaled air; more respiration thus more gas exchange thus more water lost by evaporation;)
- (iii) more water loss by increased sweating;  
thus rise in blood concentration sensed by osmoreceptors (in hypothalamus);  
thus ADH secretion stimulated and more water reabsorbed from urine in collecting ducts (to blood); **3**
- (b) osmoreceptors in hypothalamus;  
sense when blood is too concentrated or too dilute;  
if too concentrated ADH release from posterior pituitary is stimulated;  
ADH in blood causes collecting tubule walls to become water permeable;  
so that water is reabsorbed from urine;  
high salt concentration in renal medulla (which results from counter current mechanism) enhances water reabsorption; **max 5**  
(allow converse points about ADH not released as alternative scheme)

**TOTAL 14****QUESTIONSHEET 8**

- (a) Any four of:  
diabetes insipidus is a failure of ADH production/by the posterior pituitary/  
thus excessive diuresis/water loss through urine occurs (resulting in dehydration/death)/  
diabetes mellitus is a failure of the beta cells in the islets (of Langerhans) to produce insulin/  
thus insufficient blood glucose is converted to glycogen and glucose is lost in urine;;; **4**
- (b) homeostasis is the regulation of the internal environment within narrow limits;  
using negative and positive feedback mechanisms;  
haemostasis is the stopping of bleeding after tissue damage;  
enabled by the blood platelets/clotting cascade mechanism; **4**
- (c) diuresis is the loss of water in urine;  
regulated by antidiuretic hormone;  
deamination is the removal of (toxic) amine groups from unwanted amino acids;  
occurs in the liver/ornithine cycle to make urea (for excretion); **4**

**QUESTIONSHEET 9**

- (a) osmoregulation/to control Amoeba's water content; **1**
- (b) collects excess water from cytoplasm using energy from ATP;  
when vacuole is full it bursts at the cell membrane releasing water to exterior; **2**
- (c) water enters Amoeba along concentration gradient between external and internal environments;  
in pure water cytoplasm is most hypertonic to exterior and so most water enters and so vacuole has to work harder;  
as cytoplasm becomes less hypertonic to exterior less water enters and so vacuole works less;  
at 70% seawater cytoplasm is isotonic to sea water and so osmotic entry and loss of water are the same and so vacuole need not operate;  
(IOB recommends that the terms 'water potential' and 'solute potential' are not applied to animals) **4**
- TOTAL 7**
- 

**QUESTIONSHEET 10**

- (a) (i) ascending limb of loop of Henle is always impermeable to water;  
but has a very powerful active transport mechanism for pumping  $\text{Na}^+/\text{Cl}^-$  out of tubule (into interstitial fluid);  
this lowers the concentration as tubular fluid rises up ascending limb;  
 $\text{Na}^+/\text{Cl}^-$  diffuse into descending limb (from higher concentration in surrounding interstitial fluid);  
raising concentration of tubular fluid as it passes down the descending limb; **max 4**
- (ii) maintains a high salt concentration in the medulla/interstitial fluid;  
this enables water reabsorption from the collecting ducts (when ADH is present); **2**
- (iii) maintains blood salt concentration;  
and so helps to maintain blood osmotic pressure/blood pressure; **2**
- (b) ADH: renders the collecting duct walls permeable to water;  
so that water may be reabsorbed or lost thus regulating blood volume/ pressure/concentration; **2**
- Aldosterone: stimulates uptake of  $\text{Na}^+$  by active transport;  
from ascending limb of loop of Henle (thus retains body sodium ions);  
stimulates active secretion of  $\text{K}^+$  ;  
into distal convoluted tubule (thus lowering body potassium ion content); **max 3**
- TOTAL 13**

**QUESTIONSHEET 11**

- |  |   |
|--|---|
| (a) (i) when for instance, blood volume varies above or below its norm;<br>a mechanism is operated to bring the varying value back to the norm;  | 2 |
| (ii) when a mechanism has operated to bring a value back to the norm, the mechanism activity is reduced<br>(but not totally switched off);   | 1 |
| (iii) when a hormone is secreted as a result of nervous stimulation;   | 1 |
| (b) (i) in the midbrain/just behind the pituitary body;  | 1 |
| (ii) to regulate physiological functions in general - such as sleep/body temperature/blood osmolality/any other<br>valid example;  | 1 |
| (c) Any four of:<br>increased blood pressure increases glomerular blood pressure/<br>increases ultrafiltration/<br>thus a larger volume of glomerular filtrate is formed (per unit time)/<br>raised blood pressure inhibits ADH release/<br>thus collecting ducts become impermeable to water/<br>thus no water reabsorbed from urine so urine volume increases;;; | 4 |
| <b>TOTAL 10</b>  |   |
- 

**QUESTIONSHEET 12**

- |  |   |
|--|---|
| (a) (i) A = renal artery; B = ureters; C = urethra; D = dorsal aorta;  | 4 |
| (ii) male urethra is much longer (since it extends through the penis);   | 1 |
| (b) 1. removal of toxic waste products from blood/excretion;   |   |
| 2. regulation of blood pH/osmolality/pressure/ref homeostasis of body fluids;  | 2 |
| (c) to prevent urination/micturition until a convenient time/prevents constant dribbling of urine from bladder/keeps<br>bladder closed to reduce infection risk; | 1 |
| <b>TOTAL 8</b>   |   |
- 

**QUESTIONSHEET 13**

- |                             |                |
|-----------------------------|----------------|
| (a) C; (b) B; (c) A; (d) B; | <b>TOTAL 4</b> |
|-----------------------------|----------------|
-

**QUESTIONSHEET 14**

- (a)  $60 \times 120 = 7200 \text{ cm}^3$  or  $7.2 \text{ dm}^3$ ; (units essential) 2
- (b)  $125 \times 60 \times 24 = 180000 \text{ cm}^3$  or  $180 \text{ dm}^3$ ; (units essential) 2
- (c)  $\frac{180}{7.2} = 25$ ; 2
- (d) Any three of:  
 about 80% / much of the water is reabsorbed back to blood/  
 in the proximal convoluted tubule/  
 more water is reabsorbed via the collecting ducts/  
 in the presence of ADH;;; 3
- TOTAL 9**
- 

**QUESTIONSHEET 15**

- (a) (i) A = glomerulus;  
 B = renal/Bowman's capsule;  
 C = proximal/first convoluted tubule;  
 D = descending limb (of loop of Henle);  
 E = ascending limb (of loop of Henle);  
 F = distal/second convoluted tubule;  
 G = collecting duct; 7
- (ii) C is very permeable to water;  
 E is never permeable to water;  
 G is only water permeable if ADH is present; 3
- (b) (i) Any two of:  
 glucose/amino acids/(some) urea;; 2
- (ii) Any two of:  
 hydrogen ions/potassium ions/creatinine/hydrogen carbonate ions/ammonia;; 2
- (c) (i) to achieve a high salt concentration in the medulla of the kidney/ around the collecting ducts;  
 so that water may be reabsorbed osmotically from urine in collecting ducts (in presence of ADH); 2
- (ii) Any two of:  
 ADH release is suppressed when blood volume/pressure is too high/ blood concentration too dilute/  
 ADH increases permeability of collecting ducts to water/  
 thus in absence of ADH water is not reabsorbed;; 2
- TOTAL 18**
-

**QUESTIONSHEET 16**

- (a) ureter carries urine from kidney to bladder;  
urethra carries urine from bladder to exterior;  
ureter lined by a transitional epithelium;  
urethra lined by compound/stratified squamous epithelium; 4
- (b) urinary bladder stores urine until a suitable time for release;  
gall bladder stores bile (from liver) until food enters duodenum;  
urinary bladder situated in pelvis/just ventral to rectum/lined by transitional epithelium;  
gall bladder lies near liver/lined by columnar epithelium; 4
- (c) glomerulus is a knot of capillaries situated in the renal capsule;  
vasa recti form a network of capillaries over the nephron tubules;  
glomerulus is concerned with ultrafiltration/forming glomerular filtrate;  
vasa recti are concerned with exchange of materials between tubular fluid and blood; 4
- (d) afferent arteriole carries blood from renal/arcuate artery branch to glomerulus;  
efferent arteriole carries blood from glomerulus to vasa recti;  
efferent arteriole narrower than afferent arteriole (so that blood pressure in the glomerulus is raised);  
blood in efferent arteriole has reduced urea/glucose/salt/amino acid (or any other valid substance)  
concentrations compared to afferent arteriole blood; 4
- TOTAL 16**
- 

**QUESTIONSHEET 17**

- high; renal artery; glomeruli; renal/Bowman's; ultrafiltration/high pressure; proteins; osmotic pressure;  
urea/uric acid/ammonia or any other; glucose; TOTAL 9
- 

**QUESTIONSHEET 18**

- (a) have many mitochondria to produce much ATP;  
required as energy supply for large amount of active transport carried out (by these cells);  
allowing reabsorption of glucose/some amino acids/ some salts/ some urea;  
microvilli increase surface area available for reabsorption; 4
- (b) podocytes are epithelium/pavement cells;  
which are raised off their basement membrane;  
thus the cavities of the glomerular capillaries and renal capsule are only separated by the basement membranes;  
this increases the efficiency of transport into the capsules of small molecules from the blood plasma/increases the efficiency  
of ultra filtration; 3
- (c) coffee contains caffeine;  
caffeine inhibits the release of ADH;  
thus no water can be reabsorbed by collecting ducts from urine; 3
- TOTAL 10**

**QUESTIONSHEET 19**

- (a) the regulation of the internal environment within narrow limits;  
thus making it independent of the external environment; 2
- (b) (i) Any three of:  
in freshwater, water enters the Amoeba by osmosis/  
this water is collected into the contractile vacuole and expelled/  
by an active/energy requiring process/thus maintains the osmotic concentration of Amoeba's cytoplasm/prevents bursting;;; 3
- (ii) desert animals must conserve water since little is available;  
long loop of Henle means more salt is pumped out of loop into medulla of kidney;  
thus allows more water to be reabsorbed from collecting ducts (if ADH is present); 3  
(reject more water would be reabsorbed through the loop of Henle - it is impermeable to water)
- (iii) insect are small and mainly land animals/thus tend to lose water through their relatively large surface areas;  
uric acid is virtually insoluble in water;  
thus insect Malpighian tubules produce it to enable excretion of solid urine/so preventing water loss; 3
- (c) (i) diabetes insipidus; 1
- (ii) failure to synthesise ADH in the posterior pituitary gland; 1
- TOTAL 13**

**QUESTIONSHEET 20**

Feature	GF	Urine
Contains glucose	✓	✗
Does not contain amino acids	✗	✗
Has a pH of 3.5	✗	✗
Same composition of blood	✗	✗
Never contains protein	✓	✓

; (about 2 g of amino acids are  
excreted per day as amino acids)

**TOTAL 5****QUESTIONSHEET 21**

- (a) by blood buffering systems;  
such as haemoglobin/phosphate/ hydrogen carbonate/protein buffering systems; 2
- by control of ventilation/inspiration and expiration rate;  
which regulates the H<sup>+</sup> and HCO<sub>3</sub><sup>-</sup> concentrations in blood plasma; 2
- (b) many hydrogen ions pass from plasma to glomerular filtrate during ultrafiltration (thus raising blood pH);  
hydrogen ions are actively secreted from blood into the distal convoluted tubules (also raising blood pH);  
but this lowers pH of tubular fluid;  
around pH 4.8 the active transport pumps can no longer force more H<sup>+</sup> into the tubule;  
therefore distal tubule cells also actively secrete ammonia/NH<sub>3</sub> into tubule;  
this combines with H<sup>+</sup> and Cl<sup>-</sup> to make ammonium chloride (credit equation);  
buffering the urine pH (to pH 6.0); max 5

**TOTAL 9**



**QUESTIONSHEET 22**

- (a) (i) volume smaller/has passed through a filter; **1**
- (ii) more water is reabsorbed in collecting duct (in the presence of ADH); **1**
- (b) (i) blood urea passes freely from A to B during glomerular filtration;  
higher concentration at C due to water reabsorption reducing the volume of tubular fluid in proximal convoluted tubule;  
even more water reabsorption in F causes further concentration of urea in urine; **3**
- (ii) from C to D as tubular fluid passes down into higher salt concentrations of medulla, salt diffuses into the tubule raising the concentration;  
from D to E active transport pumps salt out of tubule into surrounding interstitial fluid;  
thus concentration of salt falls in tubular fluid from D to E: **3**
- (iii) proteins are large molecules/high molecular weight;  
cannot cross membranes separating glomerular blood and capsule fluid/substances with a molecular weight greater than 65,000 cannot cross filter; **2**
- (iv) all glucose actively reabsorbed in proximal convoluted tubule; **1**
- TOTAL 11**

**QUESTIONSHEET 23**

- (a) (i) false;  
the kidneys are concerned with the regulation of blood and other body fluids, (this results in urine formation);  
the kidneys are concerned with excretion of toxic metabolic waste products, (this also results in urine formation); **3**
- (ii) false;  
on a hot day more water is lost from blood by sweating;  
thus blood volume falls/blood concentration rises and ADH release is stimulated causing water reabsorption from urine in collecting ducts; **3**
- (iii) true;  
uric acid is insoluble and so does not poison the embryo in the closed environment of the egg;  
also can be excreted as solid urine thus conserving water; **3**
- (b) (i) Any three of:  
dialysis is the separation of large molecules from small molecules/  
across a differentially permeable membrane/  
principle used in kidney machine/haemodialysis/peritoneal dialysis/  
to remove toxic waste products from patient with kidney failure;;; **3**
- (ii) in incurable/irreversible kidney damage/patients on long term dialysis;  
when a kidney becomes available, usually from a recently dead donor/car accident victim;  
tissue antigens/ref HLA antigens of donor kidney and recipient must be close matching to avoid rejection problems; **3**
- TOTAL 15**