**1.** (a) Genus; 1

(b) (i) Prefer / more likely to mate with male of same species; 1

(ii) Appropriate / species-specific courtship by male / courtship not recognised;

chemical attraction / pheromones;

compatible genitalia; max 2

(iii) (Geographical) isolation;

mutations / genetic differences;

selection;
(isolation lead to) reproductive isolation / populations no longer able to mate; 3

**[7]**

**2.** (i) Order; 1

(ii) Correct sequence: 1

| Sequence |
|---|
| 1 |
| 6 |
| 2 |
| 3 |
| 4 |
| 5 |

**[2]**

**3.** (a) *Any two from:*
(Group of) organisms able to interbreed / reproduce / have offspring;
Giving <u>fertile</u> offspring / which are <u>fertile</u>; 2 max

(b) *In sequence:*
1. Kingdom
2. Phylum
3. Class
4. Order
5. Family
6. Genus; 1

(c) No nucleus / no membrane-bound organelles / named e.g. / no mitochondria / don't divide by mitosis / divide by binary fission / 70S ribosomes / smaller ribosomes / circular DNA / only one 'chromosome' / have plasmids / has murein cell wall;
*Accept have (slime) capsule / have fimbriae / pili*
*Ignore references to 'no chloroplasts'* 1

**[4]**

**4.** (a) (i) 0.24 : 1, 1

(ii) Mammals more active / higher metabolic rate;
Respiration provides heat;
To maintain body temperature / for endotherms / warm-blooded; 2

(b) R = C – (F+P) / R = C – F – P; *[Accept: transposed F and P]* 1

(c) Diet of primary consumer contains more cellulose / more indigestible material;
OR Diet of secondary consumers protein rich / more digestible material;
OR Primary consumers lose more (energy) in faeces; 1

**[5]**

**5.** (a) (Absorption of) light; 1

(b) Inner membrane/cristae/stalked particles of mitochondria; 1

(c) Plantae (plants) / Protoctista / prokaryotes;
Processes are photosynthesis and respiration /
plants/algae/(some) protoctistans/prokaryotes photosynthesise/have chlorophyll; 2

**[4]**

**6.** (a) (i) there are no fertile hybrids found in the overlapping regions; 1

(ii) even if mating took place, there would be no fertile hybrids/ different chromosome number/gene pool/evolutionary history/many morphological/biochemical/serological differences; 1

(b) (i)

| | |
|---|---|
| Kingdom | **Animalia/Animals** |
| Phylum | Chordata |
| **Class** | Mammalia |
| **Order** | Xenarthra |
| **Family** | Dasypodidae |
| Genus | ***Dasypus*** |
| Species | ***(D.) novemcinctus*** |
| 1 mark per correct column | |

2

(ii) Family, as all three belong to different genera; 1

**[5]**

**7.** (i) Population is the total number of organisms/individuals of a species/tigers in an area (at a given time); 1

(ii) (Deforestation involves) habitat destruction/ destruction of niches;

Some prey animals move out or die / fewer suitable prey for tiger/ less food for tiger; Reduces tiger population if prey biomass falls below 600 (tonnes per $km^2$); 3

**[4]**

**8.** (i) Increase in biomass
time; 1

(ii) Approximately 10% of energy passed (from phytoplankton to zooplankton) ;

Energy lost as heat/in respiration/in excretory products/ to decomposers; 2

*<u>not</u> urine/movement*

**[3]**

**9.** (a) group of organisms with similar features;
can (interbreed to) produce fertile offspring; 2

(b) directional selection;
*any TWO from*
selection against one extreme / for one extreme;
against broadest beaks in B and narrowest beaks in **A** / for narrowest in **B** and broadest in **A**;
whole distribution / range / mean / mode / median is shifted towards favoured extreme; 3 max

**[5]**

**10.** (i) Taxon **A** - there is more than one level/taxon below it / genus only has species /only has one level / taxon above it;

(ii) Taxon **C** - there is more than one level/taxon above it / phylum only has kingdom / only has one level taxon above it; 2

**[2]**

**11.** hierarchy / groups within groups / KPCOFGS;
no overlap;
common structures / similar characteristics;
reflecting evolutionary history;
binominal nomenclature / example;
definition of a species; 4

**[4]**

**12.** evolutionary;
*Panthera;*
species;
fertile;
family;
kingdom; 6

**[6]**

**13.** phylogenetic (classification);
based on evolutionary links;
hierarchy/ start with species grouped into Genus, Species with close common ancestry;
then into larger groups/examples of representing more and more distant common ancestry;
Genus, Family, Order, Class, Phylum;
in same Kingdom, so must be related/from common ancestor; 3

**[3]**

**14.** (a) Phylum,
Order,
Genus;
*Any 2 score 1, all three gain 2 marks* 2

(b) F. serratus and F. spiralis;
Highest % value (for non-self);
The more closely related they are, the more similar their DNA;
Explanation of value / complementarity in terms of joining strands; 3 max
(*Special case: if spiralis / spiralis given, then max 1 possible if complementarity explained*)

**[5]**

**15.** (a) *Oryctolagus, Helix, Trichonympha*; (reject if specific names included)
(not insisting on generic capitals) *any two for 1 mark* 1

(b) Animals, Protoctists, Prokaryotes;; (accept Latin equivalents)
*any two for one mark, all three for both* 2

(c) that (they are) fertile; 1

**[4]**

**16.** (i) (populations) isolated/in different areas;
no interbreeding (between populations)/gene exchange/flow;
variation in each (population); (*accept example of variation*)
due to mutation/meiosis; (*accept reference to types of mutation*)
each population adapting to its own/different environment;
through natural selection;
producing differential survival;
producing changes in allele/phenotype frequencies;
producing reproductive isolation; 4 max

(ii) breed together salamanders from different areas;
if fertile offspring, then still same species; 2

(iii) phenotype depends on genotype and environment;
different local environments can produce variation;
different selection pressures;
mutations producing new alleles;
meiosis produces new combinations of alleles/example;
random fusion of gametes / sexual reproduction 4 max

**[10]**

**17.** (a) phylum, class, family, genus; 1

(b) (i) presence of a nucleus / membrane bound organelles /
named organelles only 80S ribosomes / lacks a cell wall; 1

(ii) lacks a cell wall / no chitin / is motile / has one nucleus / no hyphae; 1
(*do not credit it has a nucleus*)

(*credit only one answer relating to a lack of cell wall; if more than one answer is given in* (*i*) *and / or* (*ii*), *incorrect answers negate*)

(c) (i) more recent common ancestor / DNA in common; 1

(ii) mutation;
there is variation;
genes (coding) for protein / cytochrome c with different structures;
EITHER
individuals with a modified cytochrome c have a selective advantage / are selected for;
these individuals are more likely to survive to have offspring / have more offspring;
(*must link a comparison of survival to reproduction*)
gene / allele frequency changes over generations / time;
OR
changed structure does not affect protein function;
these structural differences accumulate over time; 4 max

**[8]**
**QWC 1**

**18.** (a) (i) Order, Family, Genus.
(*all correct = 2 marks; 2 correct = 1 mark*) 2

(ii) 3 concentric circles in Carnivora, labelled Felidae, Panthera and L; 1

(b) (i) large groups split into smaller groups (which do not overlap); 1

(ii) (phylogenetic) based on evolutionary history;
shows ancestry of groups / points of divergence;
example, e.g. reptiles and birds separated after mammals / reptiles and birds more closely related than mammals;
(hierarchical) based on shared characteristics (seen today); 3 max

**[7]**

**19.** (a) large groups are divided into smaller groups; (*not just 'hierarchical'*)
members of a group have features in common;
based on anatomy/fossils/embryology/DNA/specific aspect of cell biology /homologous structures;;

*(any two for 2 marks)*
reflects evolutionary history; 3 max

(b) fungi and animals; 1

(c) (insects and fungi) have common ancestor;
they diverged a long time ago / before others referred to in phylogenetic tree; 2

(d) those with similar sequences put in same groups/ are more closely related;
the greater difference in amino acid sequence the longer ago the groups diverged; 2

(e) A - present in all (eukaryotic) species or organisms / quantifiable;
D - extinct species not considered/no timing of events available /only limited number of amino acid sequences /can't include prokaryotic species 2

**[10]**

**20.** (a) phylum, class, order;
species, *Acinonyx jubatus;* 2

(b) larger groups containing smaller groups; 1

(c) (i) do not interbreed to produce fertile offspring / different DNA / different niches; 1

(ii) fossil record;
evolutionary history/phylogeny;
biochemical differences e.g. DNA/proteins/cytochromes;
homologous features / named feature;
karyotype / number and form of chromosomes; 2
*(discount any example credited in (i))*

**[6]**

**21.** (a) Kingdom, class, family, genus; 1

(b) (i) (Human)
Fish
Rhesus monkey
Horse; 1

(ii) As aminals closely related, more amino acids in sequence; 1

(c) The more similar the DNA, the more similar the base sequences;
The greater the number of hydrogen bonds/bonds between base pairs;
More energy/heat needed to separate strands; 3

***Q*** *Correct terminology of base, base pair and hydrogen bond must be used as specified in scheme.*

**[6]**

**22.** (a) (Similar) individuals/organisms that reproduce/ interbreed;
To produce fertile offspring; 2

***Q*** *Do not credit "viable" offspring. The context required here is fertile.*

(b) (i) Species **A** has extra element/missing from species B/scissor wings; 1

(ii) Similar sequence/(most of the) same elements in the courtship; 1

(c) Female recognises own species sound;
Responds to that sound only/courtship sequence continues; 2

**[6]**

**23.** (a) Kingdom/phylum/class; 1

(b) (i) 6; 1

(ii) Family; 1

(iii) The two species of *Mirounga* shared a common ancestor more recently than they did with *Monarchus tropicalis*; 1

(c) Difference in DNA/base sequence/alleles/genes; 1

(d) (i) Genetic bottleneck linked to low genetic diversity/smaller gene pool;

Reference to very low seal population/population in 1910/under 100 seals/caused by hunting; 2

*Must refer to data provided for second mark*

(ii) New colonies formed by small number (of seals)/ small number of founders;

Founders have different/fewer alleles/genes / have smaller gene pool; 2

**[9]**

**24.** (a) 1 Large surface area provided by lamellae/filaments;

***Q*** *Candidates are required to refer to lamellae or filaments. Do not penalise for confusion between two*

2 Increases diffusion/makes diffusion efficient;

3 Thin epithelium/distance between water and blood;

4 Water and blood flow in opposite directions/countercurrent;

5 (Point 4) maintains concentration gradient (along gill)/equilibrium not reached;

*5 Not enough to say gives steep concentration gradient*

6 As water always next to blood with lower concentration of oxygen;

7 Circulation replaces blood saturated with oxygen;

8 Ventilation replaces water (as oxygen removed); 6 max

*6-8 Accept answers relating to carbon dioxide*

(b) Mixing of air and water (at surface);

Air has higher concentration of oxygen than water;

Diffusion into water;

Plants/seaweeds near surface/in light;

Produce oxygen by photosynthesis; 2 max

(c) Not much oxygen near sea bed;

Toadfish haemoglobin (nearly) saturated/loads readily at /has higher affinity for oxygen at low partial pressure (of oxygen); 2

(d) (i) The chimpanzee and the bonobo are more closely related (than to the gorilla);

They have identical amino acids/one of the amino acids is different in the gorilla; 2

(ii) (Chimpanzee) orang-utan;

Amino acids different so bases different;

Few hydrogen bonds; 3

**[15]**