QUESTIONSHEET 1

(a) (i) a population of similar organisms that are capable of interbreeding to form fertile offspring;
they are reproductively isolated from other such populations/cannot interbreed with other species to form fertile offspring; **2**

(ii) an obstacle to interbreeding;
thus limiting gene flow between parts of the gene pool;
thus enabling divergence; **max 2**

(b) (i) Allopatric: speciation due to populations occupying different geographical areas;
thus there is <u>no</u> gene flow between the populations;

Sympatric: speciation where the populations occupy the same geographical locality;
but gene flow is <u>restricted</u> between the populations/demes; **4**

(ii) Prezygotic: prevents fertilisation and the formation of zygotes;

Any two examples:
geographical isolation/
seasonal/mature at different times/
ecological/live in different habitats but in same region/
behavioural/incompatible mating rituals/incompatibility/cannot fertilise due to physiological incompatibility;;

Postzygotic: fertilisation can occur but hybrids are either not formed or are sterile; **4**

TOTAL 12

QUESTIONSHEET 2

(a) prolific breeding/rapid reproduction rate/quick maturing/huge reproductive capacity;
abundant food supply enabling rapid growth/little or no competition for food;
no/few predators to reduce numbers;
could burrow under fences; **max 2**

(b) no natural resistance/immunity to the virus;
rabbit population was dense/animals lived close together in burrows;
thus supported a huge flea population/fleas could easily jump from rabbit to rabbit;
thus the virus was transmitted very easily from rabbit to rabbit; **max 2**

(c) a few rabbits developed resistance/immunity to the virus;
possibly as a result of gene mutation;
these rabbits survived and bred;
passing on the resistance/mutant gene to their offspring;
these also developed immunity to the virus (before it caused symptoms/killed them);
thus resistant rabbits were selected and non-resistant rabbits died; **max 4**

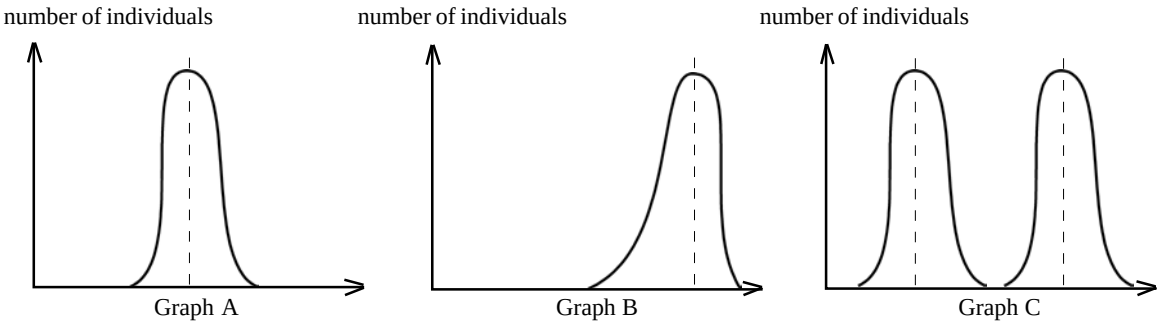
(d) not all rabbits inherit the resistance gene and so some sucumb to the virus;
the virus may have mutated changing its infectivity/pathogenicity; **2**

TOTAL 10

QUESTIONSHEET 3

(a) A = stabilising; B = directional; C = disruptive; **3**

(b)



3 correct graphs;;; 3 correct means;;; **6**

(c) artificial selection practised by humans;
cattle/sheep/pigs or other example;
improved milk/beef yield/improved wool yield/improved hardiness/improved bacon yield/ any other example; **3**

TOTAL 12

QUESTIONSHEET 4

(a) shape of beak; **1**

(b) different diets;
some eat insects some eat seeds/nuts;
beaks become adapted over many generations by variation (mechanisms) and most efficient forms are selected; **3**

(c) ancestors from South American landmass/Ecuador blown by storms/winds;
or carried on driftwood; **2**

(d) new variations would arise due to meiosis/fertilisation;
(and) due to continued mutation;
most successful variations would survive better (than less suitable adaptations);
ref to many different niches on the island to which the birds might become adapted; **4**

(e) that they are now separate species;
due to reproductive isolation; **2**

(f) bill shape/bird song/mating dances or ritual movements;; (any two) **2**

TOTAL 14

QUESTIONSHEET 5

(a) cross pollination can only occur within the gene pool of a species;
cannot bring in new genes because of reproductive isolation between different species; **2**

(b) some alleles express multiple effects in the phenotype;
for example 'mottled colour' in mice and a 'defect in copper absorption' are controlled by the same allele/any other valid example;
effect of a particular genotype may be modified by different environmental influences; **max 2**

(c) even in self fertilisation gametes vary because of meiosis;
variation introduced due to random assortment/chiasmata;
mutation may produce variation; **max 2**

(d) DNA replication must be accurate enough to give genetic stability;
but a low level of inaccuracy allows mutation;
and so gives variation allowing evolutionary potential/development; **3**

TOTAL 9

QUESTIONSHEET 6

(i) B; (ii) D; (iii) A; (iv) G; (v) C; (vi) F; (vii) I; (viii) E; (ix) J; (x) H; **10**

TOTAL 10

QUESTIONSHEET 7

(a) (i) the relative proportions of the alleles of a gene present in the population;
can be measured by geneticists and monitored for changes; **2**

(ii) mutation;
migration;
natural selection; **3**

(b) in a large randomly-mating population there is a fixed relationship between gene and genotype frequencies;
in the absence of mutation, migration and natural selection;
these frequencies remain constant from generation to generation; **3**

(c) proportion of non tasters (tt) = $\frac{105}{300}$ = 0.35;
since p + q = l, then (tt) which is $q^2 = 0.35$, thus q = 0.59;
thus p = 1 - 0.59 = 0.41;
thus 2pq (Tt) = 2 x 0.41 x 0.59 = 0.48 or 48%; **4**

TOTAL 12

QUESTIONSHEET 8

(a) (i) differential rates of reproduction in nature;
leading to an increase in frequency of some genes/genotypes and a decrease in others; **2**

(ii) the ability of a species to reproduce new offspring;
far more offspring are generally produced than can survive (due to limitations in environmental provisions or to predation); **2**

(iii) variations which are inherited from generation to generation;
which if they give advantage will also give survival value; **2**

(iv) organisms which are capable of interbreeding to form fertile offspring;
not separated from other members of the species by reproductive isolation/breeding barriers; **2**

(b) far more offspring are produced than can be supported by the environment;
thus there will be a struggle for survival and the best adapted will survive to reproduce more of the same/
the least adapted will die out; **2**

(c) gene flow might be restricted by organisms being sexually mature at different times;
or by failing to mate by having different mating rituals;
or by a geographical barrier;
or by physiological incompatibility/or by living in different ecological niches/any other valid example; **4**

TOTAL 14

QUESTIONSHEET 9

(a) populations/islands X and Y are relatively close/not geographically isolated;
thus birds can still come into contact and breed together;
no chance for any mutations to become genetically isolated/no chance for demes to become established;
so little divergence occurs between X and Y/still reproductively compatible;
population Y probably arose from population X because of prevailing winds;
chromosomes of hybrids will still pair in meiosis (so gametes can form); **max 4**

(b) populations/islands Y and Z are geographically isolated;
thus will not normally interbreed;
thus mutations/genetic variation in the two populations will occur independently;
thus become isolated by post-zygotic isolation/chromosomes of Y differ from those
of Z/will not pair in meiosis (to form gametes);
Z probably arose from Y as blown by winds rather than originating from X;
not diverged sufficiently to have different courtship rituals/behavioural patterns;
some Y may still be blown to Z allowing occasional interbreeding (although this has now become ineffective); **max 5**

(b) population/island X is geographically isolated from population Z;
by ocean and island Y;
thus mutations/genetic variation in the two populations has continued independently;
they are now reproductively isolated because their courting/mating behaviours differ;
incompatible mating rituals/courtship dances/plumage colours/breeding times;
this is pre-zygotic isolation;
ref to chromosomes of X will no longer match with those of Z even if they could mate; **max 5**

TOTAL 14

QUESTIONSHEET 10

(a) (i) (from the distribution map it is clear that) the populations are isolated on different islands/groups of islands;
even though they are not separated by huge distances/may not like flying over water/psychological barrier to crossing water;
gene mutations/genetic variation may cause different plumage patterns/colours;
which are selected for/of survival/camouflage value on different islands;
since interbreeding is restricted these variations can become established;
but if they do interbreed chromosomes can still pair in meiosis so gametes can be made (by offspring)/not reproductively isolated;
also courtship rituals are still compatible/not behaviourally isolated; **max 5**

(ii) continued restriction on interbreeding/isolation;
continued mutation/genetic variation;
this must be selected for and become established;
until behavioural/mating rituals become incompatible/behavioural isolation;
and chromosomes become so different that meiosis cannot occur in any hybrids;
since pairing/synapsis of chromosomes cannot occur; **max 4**

(a) prezygotic isolation operates before fertilisation occurs/prevents fertilisation;
for example, geographic/behavioural/ecological/seasonal/incompatible gametes;
postzygotic isolation operates after fertilisation;
for example, hybrid sterility/hybrid inviability or premature death; **4**

TOTAL 13

QUESTIONSHEET 11

gene;
sympatric;
allopatric;
geographical;
pre-zygotic;
seasonal;
ecological;
post-zygotic;
inviable; sterile; (these two points can be given either way round)

TOTAL 10

QUESTIONSHEET 12

(a) ref to use of warfarin as rat poison/its action as an anticoagulant resulting in bleeding;
interferes with action of vitamin K;
mutation of normal gene to mutant gene which gave warfarin resistance;
the mutant resistant gene acted as a dominant;
thus both homozygotes and heterozygotes could survive exposure to warfarin;
allowed rapid spread of the resistant strain of rats/alleles (throughout Britain); **max 4**

(b) original population of moths were white with black specks;
camouflaged against predation (by birds) on bark of silver birch trees;
silver birch bark became darker during the industrial revolution due to pollutants/soot;
occasional black mutants appeared in the population/ref gene mutation to give melanic form;
these were better camouflaged (on the polluted bark) than the normal/white forms;
thus the white forms were predated on and the black forms survived to breed;
thus the black/melanic forms were selected for (and the population of moths became melanic); **max 4**

(c) influenza virus has a very high mutation rate;
due to base changes in its RNA/in one or more of its 8 genes/pieces of RNA;
these change the nature of the surface antigens/neuramidase/haemagglutinin;
(every few months) small genetic changes occur causing small antigenic changes/antigenic **drift**/producing new **strains** of influenza;
(every few years) much larger genetic changes occur causing major antigenic change/antigenic **shift**/producing new **species/ subtypes** of influenza;
ref antigenic drift produces epidemics/antigenic shift produces pandemics;
antibodies against one strain of influenza are unlikely to protect against new strains/species of influenza; **max 4**

(d) only hard parts/bones/exoskeletons/plant cell walls stand a chance of fossilisation;
most dead organisms just rot away/decay/may be eaten;
conditions for fossilisation are relatively rare;
body needs to be buried in anaerobic conditions to prevent decay;
suitable example/peat/ river mud/silt/sand;
and where petrification/impregnation with inorganic salts can occur;
most fossils are still buried/hidden in rocks/sections of the fossil record may be destroyed by earthquakes/weathering;
max 4

TOTAL 16