EVOLUTION
ANSWERS & MARK SCHEMES

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**
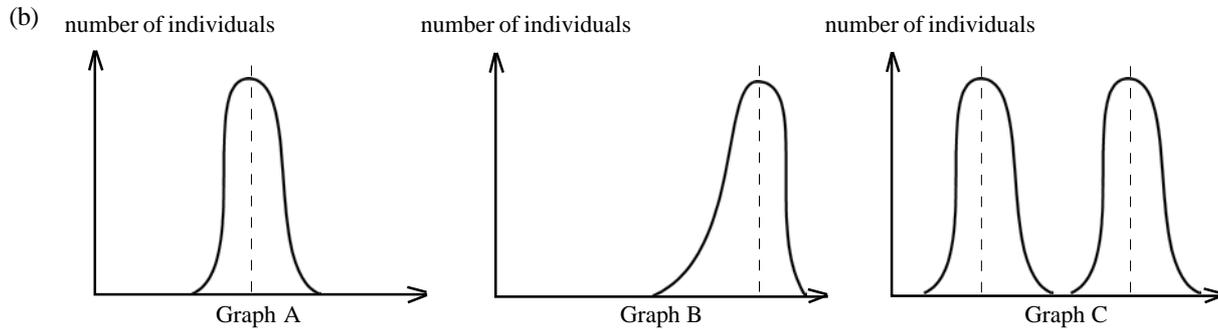
   TOTAL 12

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)

number of individuals   number of individuals   number of individuals

Graph A   Graph B   Graph C

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**

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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

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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

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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) $= \dfrac{105}{300} = 0.35$;
since $p + q = 1$, then (tt) which is $q^2 = 0.35$, thus $q = 0.59$;
thus $p = 1 - 0.59 = 0.41$;
thus $2pq$ (Tt) $= 2 \times 0.41 \times 0.59 = 0.48$ or 48%;   **4**

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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

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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

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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