Mark schemes

1 (a) any **two** from:

accept other logical / reasonable ideas

- other scientists not aware of his work
- chromosomes / DNA / genes not seen / discovered / known

  *do **not** accept there was no interest in genetics*
- other theories accepted at the time
- not considered to be a scientist / not eminent / respected

  allow 'he was just / only a monk'

2

(b) (i) random selection

accept a method of achieving random selection
eg "take a handful"
if number given, minimum 20

1

(ii) any **one** from:

- 1:1 / one to one
- 19:21

  accept any ratio to give correct answer, eg "50:50"
  *do **not** accept 21:19 unqualified*

1

(iii) A + a as gametes from 1st parent

1

a + a as gametes from 2nd parent

allow a alone

1

(offspring / 2nd generation) Aa aa

offspring must be derived from correct gametes

correct identification of yellow (Aa)

other symbols correctly used can gain full marks

1

or

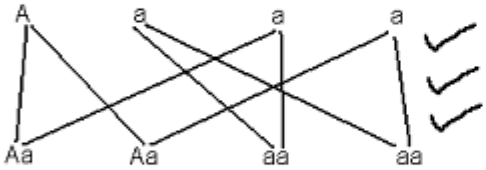
green (aa) (if both given, both must be correct)

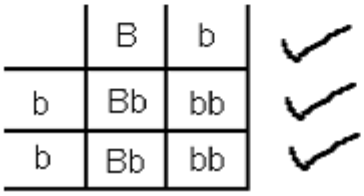
ignore references to previous generations
*if no other marks awarded, both correct parental genotypes given gains **1** mark*

examples of award of first three marks

	a	a
A	Aa	Aa
a	aa	aa

	A	a
A	AA	Aa
a	Aa	aa





	B	b
b	Bb	bb
b	Bb	bb

1

[8]

2 (a) (i) 40 – 42

1

(ii) Palaeocene

1

(iii) bush babies

1

(b) any **two** from:

- religious objections
- insufficient evidence

  allow 'could not prove'
  ignore 'no evidence'
- mechanism of heredity not known

2

[5]

3 (a) (bacteria) produce toxins / poisons

1

(viruses) damage / kills cells **or** toxins released from cell

1

(b) any **two** from:

- viruses live inside cells
- viruses inaccessible to drug
- drug would damage body cells / tissue

2

(c) any **four** from:

- overuse of antibiotics
- bacteria mutate

  *do **not** allow antibiotic causes mutation*
- antibiotics kill non-resistant strains **or** idea of selection
- reduced competition
- resistant bacteria reproduce

4

[8]

4 any **four** from:

*max **two** marks for a Lamarck explanation*

- mutation produced a bird whose bill was crossed
  *do **not** allow birds decide to mutate*
- birds compete for <u>food</u> / <u>seeds</u>
- mutant crossbill able to obtain food faster / easier / more successfully
- selected for **or** more likely to survive
- reproduce / mate / breed / produce offspring

[4]

5 (a) any **two** from:

- streamlined / shape reduces friction / long and thin / smooth surface OWTTE
- fins / flippers / tail / paddle
  *do **not** accept 'arms' or 'legs'*
- structures that push against water

2

(b) (i) any **two** from:

fossil has hind limb / legs / feet
it = minke
accept any valid comparison

fossil has more ribs / bones

fossil has teeth

fossil has curved spine

2

(ii) billion

1

give evidence for

1

[6]

6 (a) wing pattern similar to *Amauris* **1**

birds assume it will have foul taste **1**

(b) mutation / variation produced wing pattern similar to *Amauris*
*do **not** accept breeds with Amauris*
*do **not** accept idea of intentional adaptation* **1**

these butterflies survived **1**

breed / genes passed to next generation **1**

[5]

7 (a) fossils / teeth / bones / skeleton / foot prints
allow cave drawings
*do **not** accept scientists have seen them* **1**

(b) only (some) bones remain / soft parts have decayed
accept 'no-one has ever seen one'
allow no photos, no pictures, no drawings **1**

(c) any **two** from:

- hunted by human
- (new) predator
  allow more predators
- (new) competitor
- (new) disease
- environment changed / named environmental change
  allow natural disaster
- prey extinct / loss of food supply
  ignore not enough food

2

[4]

8 (a) (i) viruses live inside cells

1

viruses inaccessible to antibiotic
allow drug / antibiotic (if used) would (have to) kill cell

1

(ii) mutation
ignore mutation caused by antibiotic

1

natural selection **or** no longer recognised by antibiotics
accept description of natural selection

1

(b) (stimulate) antibody production
ignore antitoxin

1

(by) white cells

1

<u>rapidly</u> produce antibody on re-infection
ignore antibodies remain in blood

1

[7]

9 (a) antibiotics diffuse / pass (into agar)

*do **not** allow into dish*

1

kill / prevent growth of bacteria or destroy cell wall / bacteria

accept bacteria are dead

1

(b) it / higher concentration kills more bacteria **or** causes less growth

*do **not** accept anything referring to size of circle*

1

levels off (at 6 units)

accept above 4 units

1

(c) **Quality of written communication**:
for correct sequencing or linking of ideas or points

this mark can only be awarded for a plausible attempt (not necessarily biologically correct) to link a precaution to a purpose

Q ✓ or Q ✗

1

<u>Loop flamed</u>

to sterilise it / kill unwanted microorganisms

*accept so no bacteria present do **not** accept to clean it*

1

<u>Lid taped</u>

prevent bacteria getting in / out **or** prevent someone touching bacteria

accept microorganisms/fungi for bacteria
*do **not** accept viruses or germs*

1

<u>25°C</u>

prevents / reduces <u>growth</u> of / reproduction

1

harmful bacteria / microorganisms or pathogens

1

(d) any **two** from:

- to avoid over-use of antibiotics **or** use no / less / low concentration antibiotics
- select antibiotic that is most effective
- finish the course
- don't give or use for animals
- develop new antibiotics **or** alternatives

2

[11]

10 any **five** from:

- genetic variation exists in a population **or**
  variation caused by mutation / change in gene / in DNA
- larger voles have smaller $\frac{\text{S.A.}}{\text{Vol.}}$
  or have more fat
  'they' accept as larger voles
- larger voles lose less heat / are better insulated **or** more energy stored
- larger voles survive
- larger voles breed
- larger voles pass on (beneficial) gene / allele / mutation / DNA
  ignore characteristic

[5]

11 **Quality of written communication**

*for correct use of at least **two** scientific terms eg mutation, resistant (**not** just 'antibiotic-resistant', **not** 'immune') / selection / natural selection / survival / reproduction / gene / allele / DNA*

1

any **two** from:

mutation occurs in bacteria or change in DNA / gene occurs

cancel if mutation 'caused by' antibiotic

(when antibiotic used) only resistant bacteria survive **or** non-resistant bacteria are killed **or** reference to 'natural selection'

resistant bacteria pass on the gene / allele

allow pass on the mutation
*do **not** accept just 'pass on resistance'*

2

[3]

12 (a) (i) dark form lives in the industrialised/ densely populated areas
or
dark form lives to the East/downwind/North East of industrialised are

1

(ii) more pollution/discolouration in those areas
or
pollution blown by prevailing winds

1

(b) a **change** to the genetic material/DNA/chromosomes/genes in an organism

*do **not** accept fault. error*

1

(c) <u>survival in polluted areas:</u>

one mark for each mark point to a maximum of 4

(pollution) lichen/trees/buildings become(s) blackened

credit an answer given in terms of survival in polluted areas or non-survival in other areas

(camouflage) black formed camouflaged / more difficult to see

(predation) not preyed upon eaten by thrushes

(survival) survive to breed

<u>or non survival</u>

(no pollution) lichen/trees/buildings remain(s)pale/non-blackened

(no camouflage) black formed not camouflaged / easier to see

(predation) preyed upon/eaten by thrushes

(survival) do not survive to breed

4

[7]

13 (a) long neck or legs

1

(b) change in environment **or** reaching for food **or** stretching led to **more use** of neck (and legs) [1]

use led to **increased** size **or** characteristic acquired during lifetime [1]

this characteristic was passed to offspring [1]

3

(c) phenotypic changes do not affect genotype **or** genes [1]

acquired characteristics are not passed to offspring **or** the offspring were born with tails **or** inheritance has to be genetic [1]

2

(d) **one** mark awarded for each of the following general points:

variation exists in all populations **or** mutation occurred [1]

or if written specific to giraffes:

*all giraffes are different **or** reference to short necked giraffes[1]*

4

some individuals will have an advantage in certain areas **or** will be better adapted **or** there is survival of fittest [1]

*taller giraffes **or** those with longer necks will have an advantage in being able to reach high vegetation **or** there is survival of fittest [1]*

advantaged individuals breed more **or**
are more successful [1]

*these giraffes will breed more **or** will be more successful [1]*

the genes **or** units of heredity **or** DNA
of these individuals are passed on [1] (look for idea of genetic
information being passed on)

*the genes **or** units of heredity **or** DNA of these giraffes are passed on [1]*

[10]

14 (i) (sweet) peas

1

(ii) homozygous parents crossed [1]

heterozygous (F1) offspring crossed [1]

recognition of yellow dominant over green [1]

recognition that results support 3:1 **or**
0.75 to 0.25 ratio

*up to **4** marks awarded for an understanding of the monohybrid cross and the expected outcome*

4

[5]

15 natural variation in amount of body hair;
in cold environment, (having genes) which produce long hair is an advantage;
because hair insulates; OWTTE
such animals more likely to survive;
and pass these genes onto succeeding generations

each for 1 mark

[5]

16 3 of e.g.
new predators
new diseases
new competitors
environmental changes (initiated by Man)

each for 1 mark

[3]

17 (a) (i) bones [and feathers]

1

for 1 mark

(ii) hard parts do not decay

for 1 mark each

2

(iii) has feathers

for 1 mark

1

(b) (i) all of kind have died out

for 1 mark

1

(ii) e.g. change of habitat

for 1 mark

1

(iii) named extinct organism, e.g. Dinosaur

1

for 1 mark

[7]

18 (a) mutation

for 1 mark

1

(b) fall,
idea that resistant beetles more likely to survive to breed,
∴ their offspring more likely to appear in the next generation

for 1 mark each

3

(c) inbreeding between resistant brothers and sister,
will produce some individuals with 2 copies of the resistance allele,
if 2 of these individuals breed all their offspring will be resistant

for 1 mark each

3

[7]

19 (a) (i) D

for 1 mark

1

(ii) D Y (*both*) or C X (*both*) or B W (*both*)

for 1 mark

1

(b) *N.B. answers must relate to fossils <u>providing evidence</u>*
show types of animals / plants that <u>no longer exist</u> / named ref eg dinosaur
show <u>changes</u> in types *(of animals / plants)*
similar fossils found in rocks of similar age
reference to sequence of change
or example
e.g. horse / limb

any two for 1 mark each

2

[4]

20 (a) greater proportion of dark moths survive in polluted woods
Greater proportion of pale moths survive in unpolluted woods
% survival on underside of branch is greater in both situations

each for 1 mark

3

(b) *ideas that (please indicate in body of answer by √1, √2, √3)*
1. different sorts of moths / pale and dark moths
2. ideal of differential survival in different habitats
3. this is evidence for natural selection / survival of the fittest
or idea that feature likely to be passed on

each for 1 mark

3

[6]

21 (a) 550 – 650

for one mark

1

(b) skulls
preserved as fossils / measure skull volume

for 1 mark each

2

(c) range of brain size / bigger brains arose by mutation
more with large brains more likely to survive
because more intelligent / survival advantage described
their genes passed to next generation / offspring inherited large brains

any three for 1 mark each

3

[6]

22 (a) mud

1

decayed

1

skeleton

1

rock

1

(b) idea that living things have changed (over time)

*do **not** allow 'dating'*
*do **not** credit 'evolved'*
allow 'compare the skeleton'

1

[5]

23 (a) **Quality of written communication**
The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme

idea of mutation ***or*** variation

*do **not** allow 'bacteria get used to antibiotics' **or** idea that antibiotics change the bacteria **or** 'bacteria become immune' **or** references to adaptation or evolution*

1

(resistant cells) survive antibiotic

1

(resistant cells) breed

1

(b) **EITHER** (yes)

keep animals disease free (1) so grow faster (1 mark) **or** live longer

OR (no)

resistant bacteria may develop (1)
risk to human **or** animal health (1)

allow bacteria become resistant / immune

2

[5]

24 idea of variation
Darwin's theory based on range of variation in organisms

accept some (birds) have long legs and some have short legs
do not credit inherited characteristics
mention of genes etc – neutral

1

idea of acquisition
Lamarck's based on characteristics **or** long legs acquired during lifetime

e.g. legs stretch during lifetime
*do **not** credit grow*

1

idea of survival of fittest
Darwin's theory based on survival of organisms with beneficial variation

accept reference to survival of the fittest
accept ones with longer legs will survive

1

idea of inheritance
Lamarck's based on inheritance of acquired characteristics

accept reverse point that Darwin recognised that acquired characteristics are not inherited

*do **not** credit reference to other animals*
e.g. giraffes

1

[4]

25 (a) agilisaurus / camarasaurus / ornitholestes

1

(b) eorapter

allow lagosuchus

1

(c) lagusuchus (it) walks on hind limbs / two limbs / alamosaurus has longer neck / lagusuchus has back legs longer than front but alamosaurus has the reverse

1

(d) (i) alamosaurus

1

(ii) increased

1

(e) from hard parts / bones / imprints
e.g. footprints / parts replaced by other materials / conditions for decay absent or example

buried is neutral

1

(f) simple

1

billion

1

[8]

26 (a) any **three** from:

factor for colour has two forms

accept gene for factor and allele for form

yellow dominant since all first generation yellow

accept F1 for first generation

green recessive since reappears in second generation

accept F2 for second generation

3

(b) (i) genes

accept alleles / genetic

1

(ii) nucleus

accept chromosomes / DNA

1

[5]

27 (a) (reject)

if support then zero marks

any **two** from:

giraffe spend almost all of the dry season feeding from low bushes

only in the wet season do they feed from tall trees, when new leaves are plentiful

females spend over 50 % of their time feeding with their necks horizontal

both sexes feed faster and most often with their necks bent

2

(b) any **two** from:

mutations produce male giraffes with longer necks

either

male giraffes with longer neck more likely to win fight / more likely to mate with female

or

females prefer long necks / more likely to mate with long necked male

their genes more likely to pass to next generation

accept long necks inherited or offspring have long necks

2

[4]

28 any **four** from

dark were better adapted to survive **or**
dark ones can hide in dirty environment

*dark is the survival of the fittest **or** they are better camouflaged*

those which survive breed

they are able to pass on their genes

light ones more easy to see on smoky surfaces (so get eaten)

birds can see light ones more easily

as environment becomes cleaner or less smoky light ones hide easier

those which survive breed **or** increase the population

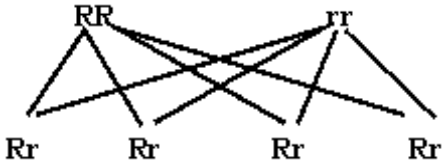
accept the converse argument

[4]

29 (a) white

1

(b)

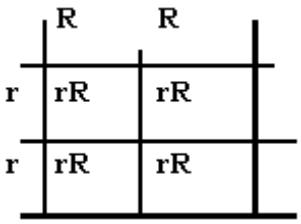


or a Punnett square

1 mark for parents and separation of genes

1 mark correct set of four pairs, ***rR***

1



1

all are red **or** R is red **or** Rr are red

1 mark for explanation of colour

1

(c) any **two** from

accept allele for gene

to stop cross pollination

credit so they could not breed with other flowers ***or*** *colours*

to control the gene pool **or** prevent other genes getting in

credit characteristics ***or*** *factors*

do not accept to use the same genes again

to see which genes were present

credit factors

to test if F_1 **or** they contained any genes for white **or** recessive genes

credit a suitable Punnett square

referenced to white

*credit to see if there was variation in the genes **or** to see if he got any white flowers*

do not accept for a fair test

2

(d) white

1

(e)

the term gene may be in place of allele

the situation mark

red is dominant so masks any white alleles **or** could be heterozygous

credit some (may) have both alleles

credit you do not know if a white allele is there

the consequence marks

1

EITHER

if a recessive **or** white allele is present there is a chance of a white flower

credit if white alleles are there the recessive can show

OR

chance of white flower could be 1 in 4 if all red flowers contain a dominant and a recessive allele

1

[9]

30 fossils

gains 1 mark

but
extinct

gains 2 marks

fossils
rocks/coal

each for 1 mark

[4]

31 extinct (NOT fossils)
fossils
bones
rocks

each for 1 mark

[4]

32 (a) idea

- unbanded dominant/plain **or** banded recessive
- because banded appears in young/
- parents heterozygous/Bb
- offspring BB } Bb } Bb } bb } credit response consistent with parents even if not both heterozygous

  Accept any clear and consistently used notation
- identify BB, Bb as plain
- identify bb as banded
- ratio 3:1 unbanded/banded (stated or clearly implied
- matches 35:12 results e.g. all the outcomes clearly identified as banded/unbanded)

  for 1 mark each

7

(b) *idea*

- many genes control [accept "continuous variation"]
- many alleles for a gene/large genepool
- snails can inherit lots of different combinations
- mutation (gives rise to many alleles)
  allow selection allows alleles to be passed on unless [very]disadvantageous or if advantageous

any 4 for 1 mark each

[Also credit, for 1 mark each, up to 2 causes of mutation, e.g. mistakes in cell division, radiation]

4

[11]

33 *idea*

- banded snails camouflaged/less easily seen
- fewer banded eaten [by birds]
- more banded survive to breed
- more genes for banded passed on
  or more banded snails in population

for 1 mark each

N.B.
Accept reverse of all above for plain snails
*All 4 marks may be gained by a relatively short response

[4]

34 (a) (i) *ideas that*

- remains of animal/plant of specific organism
- (from) many years ago/thousands or millions of years
- found in rocks/covered by sediments

for 1 mark each
Mark (a) as a whole to a total of 5 marks.

3

(ii) *ideas that*

- hard parts/bones/shells/skeletons
  link required
- don't decay

or

- no decay
  link required
- conditions needed absent/no oxygen/no water

or

- parts replaced by rock mineral chemicals;
  Do not accept 'materials' or 'substances'.
- as they decay
  Accept 'hard' or 'soft' parts for 1 mark each

2

(b) *idea*

died out/none left/died off

Do not accept 'died' alone
for 1 mark

1

[6]

35 (a) *ideas that*

- birds reached islands by flying
- some variation between these birds
- flight not needed to escape predators
- flight uses energy
- flight could result in death by drowning
- so non-flying birds <u>favoured by</u> natural selection
  or <u>better chance</u> to survive and breed
- so larger birds at an advantage
- any six for 1 mark each

6

(b) *idea*

- large number of genes per characteristic
- large range of alleles/large gene pool

(credit for these points not to be given if they are made in (a))

- mutation(s)

(credit idea of inheritance and environment as the two factors with 1 mark)

any two for 1 mark each

2

[8]

36 (a) *idea about*

- environment change / habitat drier / climate change
- couldn't escape from predators / ref to predators / killed / eaten

[Do not allow "died"]

- because feet not adapted to run on dry ground
- couldn't compete (with Merychippus) / more difficult to get food

[Use v + x = x principle]

any two for 1 mark each

2

(b) (i) fossil remains / from the bones

for 1 mark

1

(ii) (known) age of rock **or** any reason for knowing the age of the rock
eg by the rock layers by RA dating (not C-dating)

for 1 mark

1

(c) *idea that*
(present day) horses / species evolved / adapted / developed <u>from earlier species</u>/ <u>horses</u>

- over a long period of time / millions of years
- via many / gradual changes
- which gave a survival advantage /passed on genes / characteristics

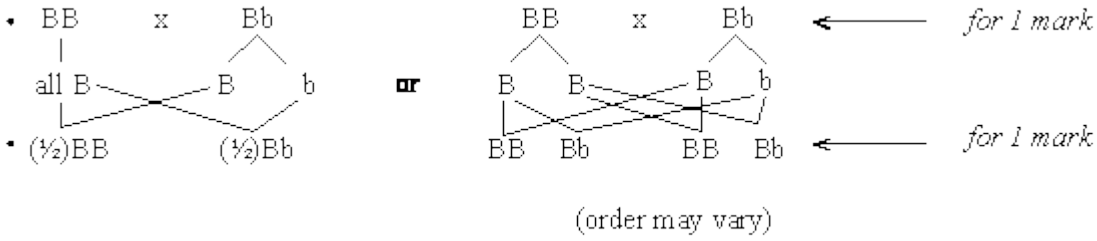
any three for 1 mark each

[First bullet point answer is required before marks can be awarded for others]

3

[7]

37 (a) <u>First Generation</u>



<u>or</u> as matrix

	B	B
B	BB	BB
b	Bb	Bb

1 mark for correct column and row headings
1 mark for correct outcomes

allow one mark for being able to produce a correct genetic cross
(even if from an incorrect starting point)

Second generation

for 1 mark

for 1 mark

( ) = picking out this idea gets both marks

or as a matrix

	B	b
B	BB	Bb
b	Bb	bb

1 mark for correct column and row headings

1 mark for correct outcomes

4

(b)

- green colour gives an advantage/camouflage
- more green flies dm black flies survive to breed*
- pass on their genes to the next generation
- (* but implied by 3rd bullet point)

for 1 mark each

3

[7]

38 (a) (i) (too) cold / all moisture / water frozen / no moisture / no warmth / conditions for decay are absent.

for 1 mark

(*No* oxygen is neutral)
(*Do not accept* frozen or ice has preserved them)

1

(ii)

- (bacteria have) no oxygen / air (because dead fish covered in mud)
  (No moisture x)
  (No moisture and no oxygen or warmth x)
- bones / hard parts do not decay easily

idea that

- material of fish replaced by minerals

any two for 1 mark each

2

(b) *ideas that*

- mammoths lived at the same time as humans / there was man in these times
- mammoths lived in the same place as humans
- humans hunted mammoths / ate mammoths / were carnivorous / for fur etc
- reference to later use of more advanced weapons
- humans needed to protect themselves from mammoths
- humans used flints / weapons / tools

any two for 1 mark each

2

(c) *idea that*

- environment changed / became too cold / became too warm /
  vegetation changed / humans destroyed environment
- (new) predator / humans killed them
- new disease
- new competitor / type of elephant
- shortage of food / no food / ran out of prey
- mammoths reproduced too slowly
- mammoths didn't adapt to changes

any two for 1 mark each

2

[7]

39 *idea that*

- variations / mutations / differences in genes / alleles (in wild salmon population)
- adapted to own river
- any appropriate difference between rivers

  e.g. flow rate, waterfalls, pH, temperature, food supply, disease predators, competitors
- homing instinct

  for 1 mark each

survive to breed

gains 1 mark

but
pass on genes to offspring

gains 2 marks

[4]