

M1. (a)

- appropriate scales (> halfway along each axis)
- all points correctly plotted to better than $\frac{1}{2}$ a square
- lines carefully drawn

(allow point to point in this case)

N.B.

- no mark available for labelling axes
- *allow* either orientation
for 1 mark each

3

(b) (i) *ideas that*

- energy transferred faster in 100m race
(not more energy transferred)
- carbon dioxide produced faster during 1500m race
for 1 mark each

(allow more carbon dioxide produced)

correct reference to twice / half as fast in either / both cases
for 1 further mark

3

(ii)

- respiration during 100m race (mainly) anaerobic
- respiration during 1500m race aerobic
- aerobic respiration produces carbon dioxide
- anaerobic respiration doesn't produce carbon dioxide
/ produces lactic acid
any two for 1 mark each

2

(c) *ideas that*

- there is an oxygen debt / more than normal oxygen needed
- lactic acid needs to be oxidised / combined with oxygen
for 1 mark each

2

[10]

M2. (a)

- caused by a recessive* gene / allele
(allow non / not dominant)
- both parents heterozygous / carry the gene / allele
for 1 mark each

offspring needs two recessive genes to have / inherit disease
for 2 marks

or

- $Nn \times Nn$
- $NN \quad Nn \quad Nn \quad nn$
for 1 mark each

nn identified as having the disease*
for 2 marks

4

(b) any reference to DNA
gains 1 mark

but
different genes means difference in DNA
gains 2 marks

idea of
 different codes / instructions for making proteins
or
 different (order of) amino acids (in proteins)
for 1 mark

3

[7]

M3. *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

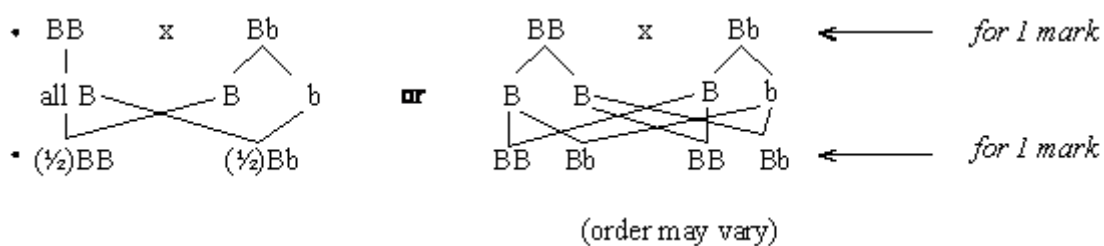
- homing instinct
for 1 mark each

survive to breed
gains 1 mark

but
 pass on genes to offspring
gains 2 marks

[4]

M4. (a) First Generation



or as matrix

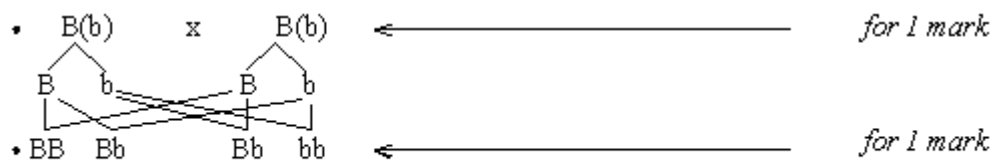
	B	b
B	BB	Bb
b	Bb	bb

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



() = 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 than 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]

- (gene) in DNA (i.e. mention of DNA)
- (DNA) contains bases
- (bases) code for amino acids (in protein)
- (amino acids) in correct order
- to make the (spider) protein
any four for 1 mark each

(No credit for double helix, **pairs** of bases - but no penalty)

[4]

M6.

(a) alleles in parents

Bb

Bb

alleles in sperms/eggs (*)

B

b

B

b

alleles in children (*)

BB

Bb

bB

bb

hair colour

black

black

black

red

(*) NB ecf

Allow other letters if a clear key

each line correct for 1 mark each

4

(b) evens/50:50/equal/half (e.c.f. from cross below)

for 1 mark

parents

J Smart

M Jones

Bb

bb

children

Bb Bb

bb bb

*(ecf)

black

red

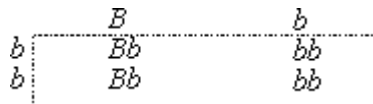
each line correct for 1 mark each

3

J Smart must be BB or Bb

M Jones must be bb or from (a)

Credit cross shown in a matrix:



for 2 marks

Bb identified as black hair

bb identified as red hair

or

2 red : 2 black

for 1 mark

1

[8]

M7. (a) idea

- unbanded dominant/plain **or** banded recessive
- because banded appears in young/
- parents heterozygous/*Bb*
- offspring

BB	}	
<i>Bb</i>	}	credit response consistent with parents even if not both heterozygous
<i>Bb</i>	}	
<i>bb</i>	}	

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]

##

- (a) *idea*
O₂ increases
CO₂ decreases
for 1 mark each

2

- (b) (i)
- | | | |
|------------------|------------------|--------------------|
| <u>reduced</u> | <u>unchanged</u> | <u>increased</u> |
| digestive system | brain | skin |
| bone | | muscles |
| | | heart and arteries |

*All (6) correct gains 4
5 correct gains 3
4 correct gains 2
2/3 correct gains 1*

Correct wording not needed if unambiguous. No mark if organ repeated.

4

- (ii) more/higher/quicker/faster
gains 1 mark
- but**
7500 more/from 5,000 to 12,500 more
gains 2 marks
- but**
7500 cm³/min more
gains 3 marks
- or 2½ times more

3

[9]

##

- (a) + light = + photosynthesis
+ light = + photosynthesis to a limit
limit depends on temp/CO₂ levels
+ CO₂ = + photosynthesis
+ temp = + photosynthesis
each for 1 mark

5

- (b) need to raise optimum levels
when one other raised
to get max/economic yield
each for 1 mark

2

[7]

##

- (a) both axes labelled
both axes appropriate scale
plotting 7 correct
good attempt at line graph
each for 1 mark

4

- (b) more fertiliser added more yield increased
gains 1 mark

but

yield increases with fertiliser up to maximum
gains 2 marks

yield **increase** slows down above 125/150 kg/ha
either for 1 further mark

(do **not** allow yield falls)
maximum yield with 175 kg/ha

3

[7]

- M11.** (a) 23 1
- (b) chromosome nucleus gene cell
 2 3 1 4 1
- (c) (i) any **one** from
 (cells which are bigger) take up more space
 (cells) have to get bigger **or** mature to divide 1
- (ii) chromosomes duplicate **or**
 make exact copies of self
 accept forms pairs of chromatids 1
- nuclei divide
 accept chromatids or
 chromosomes separate 1
- identical (daughter) cells formed
 accept for example, skin cells make
 more skin cells or cells are clones 1
- (d) any **two** from
 Differentiation mark
 babies need **or** are made of different types of cells **or** cells that have
 different functions
 accept different cells are needed
 for different organs

Division or specialisation mark

as fertilised egg starts to divide each cell specialises to form a part of the body
*accept specialised cells make
different parts of the body*

Growth mark
specialised cells undergo mitosis to grow further cells
*accept cells divide or reproduce
to form identical cells*

2

[8]

M12. (a) diatoms photosynthesise **or** are producers

1

the amount of growth depends upon the energy **or** light they get
*accept more light means more growth
or they multiply more in more light
do not accept they need light*

1

(b) (i) eaten by small fish
do not accept eaten by fish

1

minerals **or** nitrate **or** phosphates
or nutrients **or** food supply used up
or reduced

1

(ii) any **two** from
gets colder
light decreases
end of their life span **or** die
accept more being eaten than being formed

eaten by small fish
*do not accept a decrease in nitrates
or phosphates*

1

- (c) increased minerals **or** nitrates **or** phosphates 1
- any **one** from
- due to death **or** decay of diatoms **or** fish
do not accept death of large fish 1
- influx of minerals in an ocean current
*do not accept extraneous pollution **or** dumping by a ship* 1

[8]

- M13.** (a) to transfer / provide / give release energy
***or** production of ATP / adenosine triphosphate (molecules)*
accept to give heat 1
- (b) (i) $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$
accept any other
n : 6n : 6n : 6n ratio
do not credit if any other changes have been made 1
- (ii) glucose
do not credit sugar / sucrose 1
- (c) (i) any **two** from
 large surface
 thin (surface)
 moist (surface)
 (with a good) blood supply 2
- (ii) carbon dioxide
accept water vapour
do not credit just water 1

(d) (i) anaerobic (respiration)

1

(ii) any **three** from

in mitochondria

glucose decomposes / breaks down / reacts

or glucose → lactic acid for (2) marks

to give lactic acid

or breathing hard

or lactic acid → CO₂ + water

causing pain

(leaving an) oxygen debt

(quick) source of energy

(but) less efficient than aerobic respiration

accept less efficient than with oxygen

3

[10]

M14. (i)

R	r	
R	RR	Rr
r	rR	rr

a cross over diagram is also acceptable 1 mark for the separation of alleles to form the two axes (gametes)

1 mark for the four combinations

2

(ii) 25 or 1 in 4 or 1:3

accept ¼ do not credit 1 to 4

1

[3]

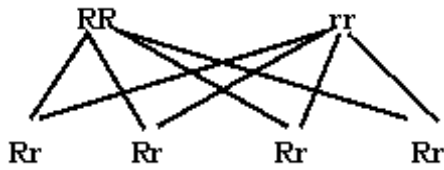
- M15.** (a) **A A a a**
Aa allele correctly separated 1
- B b B b**
*Bb allele arranged to form four different pairings
all four pairings must be correct for the second mark* 1
- (b) **A A**
*the two cells the same as the parent
cell*
- a a**
- B B**
- b b**
1 mark for each cell 2
- (c) (i) 46
accept 23 pairs 1
- (ii) 23
accept half if c(i) 1
- (iii) 46
accept save as c(i) 1

[7]

M16. (a) white

1

(b)



or a Punnett square

1 mark for parents and separation of genes
1 mark correct set of four pairs, **rR**

	R	R
r	rR	rR
r	rR	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 F₁ 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]

M17.

(a) respiration

reject start respiring / respire only at night

1

no photosynthesis because no light

1

(b) photosynthesis rate greater than respiration rate

reject no respiration / photosynthesis only 1
photosynthesis since light 1

[4]

M18. carbon dioxide concentration 1

since atmospheric concentration very low / value give e.g. 0.03%
allow carbon dioxide used up 1

temperature high
allow if light chosen as a factor 1

light intensity high
allow if temperature chosen as a factor 1

[4]

M19. (a) any **two** from 2

- copies of chromosomes made
- cell divides twice **or** 4 cells formed
- each gamete / cell now has single set of chromosomes
*allow chromosome number halved /
cells haploid / cells n*

(b) any **two** from

- sex cells / gametes fuse / fertilisation

- offspring receive genes or chromosomes or alleles from both parents / DNA
- alleles in a pair may vary

2

(c) (i) new form of gene
allow change in genetic material / DNA / chromosomes / gene

1

(ii) (no)

any **two** from

- some neutral
- exemplified
e.g. extra digit
- some increase chances of survival / reference to natural selection or evolution
- exemplified
e.g. example of disease resistance

2

[7]

M20. (a) low in winter / named months /when the days are short
accept increases in spring / Dec – June

1

high in summer / named month(s) / (when days are long
decreases in autumn / June – December

1

reasonable quantitative statement

accept any reasonable calculated / translated quantitative statement
higher in summer than in winter for 2 marks
comparative statements may be worth 2 marks
but
8/11 times higher in summer than in

winter for 3 marks

1

- (b) no artificial light given in summer / light only given in winter
since natural light greatly exceeds minimum / 600 J (required to produce tomatoes)
accept day length if linked to light energy

OR

light only given in winter

as natural light less than the minimum needed (to grow them) or 600 J

OR

for 2 marks:
percentage increase in growth from artificial] light only significant in winter

2

[5]

M21. (a) gametes A **or** a A **or** a

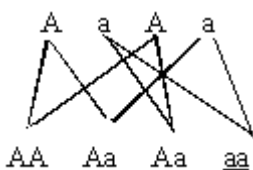
1

F₁ genotypes correctly derived

1

albino identified

OR



gametes – 1

*F₁ genotypes corresponding to 'lines' – 1
lines must be correct*

Albino (aa) identified – 1 (lower case)

1

OR

	A	a
A	AA	Aa
a	Aa	aa

gametes – 1
 boxes all correct – 1
 albino (aa) identified – 1

(b) $\frac{1}{2}$ / half / 50% evens / 1 in 2

do **not** credit 1 to 2 or 50/50

1

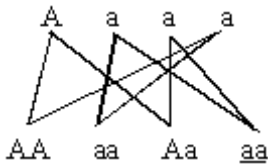
gametes A **or** a a **or** a or one
 parent heterozygous, one parent
 homozygous recessive

1

F₁ genotypes correctly derived

OR

(R) (S)



gametes correctly identified – 1
 F₁ genotypes correctly derived – 1

OR

(R)

	A	a
(S) a	Aa	aa
a	Aa	aa

gametes correctly derived – 1
 F₁ genotypes correctly derived – 1

1

[6]

M22. (i) DNA (accept RNA)
for one mark

1

(ii) DNA carries coded information
which controls the order of amino acids
in proteins

for 1 mark each

3

[4]

M23. parental genotypes both correct – both Bb
gamete genotypes all correct B and b B and b
genotype of bb offspring correctly related to gametes
bb offspring identified as small bolls

for 1 mark each

[4]

M24. (a) (i) carbon dioxide / CO₂ (reject CO)

(ii) oxygen / O₂/ O (water vapour neutral)

for 1 mark each

2

(b) (provides) energy
for one mark

1

- (c) starch insoluble therefore water not taken in by osmosis
or
sugar is soluble / has small molecules may diffuse out therefore lost
(ignore ref. to cells bursting)

or
starch has large molecules
cannot diffuse therefore retained
for 1 mark each

3

[6]

- M25.** pancreas produces lipase
which breaks down / digests fats into fatty acids and glycerol
liver produces bile / hydrogen carbonate
which neutralises acids / makes alkaline
provides optimum / best / most effective pH for lipase / enzyme action
bile emulsifies fats / description
increasing the surface area for lipase / enzyme to act on
any five for 1 mark each
(digestion is in stomach / liver / pancreas – penalise only once)

[5]

- M26.** (a) (i) sexual / sex
(ii) egg / gamete / sex cell / ovum *(reject ovule)*
for 1 mark each

2

- (b) (i) meiosis / reduction
(ii) mitosis / somatic

for 1 mark each

2

- (c) twice as many (*reject answers based on 23 / 46 chromosomes*)
for one mark

1

- (d) (i) information / genes / DNA passed from parents
(chromosomes neutral)
for one mark

1

- (ii) genes / genetic information / chromosomes from two parents
alleles may be different
environmental effect / named may have been mutation
any two for 1 mark each

2

[8]

- M27.** (i) increase in CO₂ concentration leads to increase in volume of air inhaled
increase of % carbon dioxide has little effect over most of range / large
increase when % carbon dioxide > 5.6 %
each for 1 mark

2

- (ii) *idea that*
depth of breathing changes at low % carbon dioxide, increase in % CO₂
results in volume of each breath increasing without increase / little increase
in number of breaths
each for 1 mark

2

[4]

- M28.** (a) (i) mitosis
for 1 mark 1
- (ii) 1
fertilised egg cell has 1 albino gene from father splits to produce
identical cells / produced by mitosis
each for 1 mark 3
- (b) (i) less protection from UV light / UV radiation
for 1 mark 1
- (ii) ideas of uncontrolled multiplication of mutated cells reject fast /
rapid cell division cells invade of other parts / cells transported in blood
each for 1 mark 2
- [7]**

- M29.** (a) digested / broken down / made soluble by protease enzyme
in stomach in small intestine / from stomach / from pancreas
into amino acids
amino acids / small molecules absorbed into blood
any four for 1 mark each 4
- (b) *ideas that*
lipase / enzyme works best in alkaline / neutral conditions
acid denatures or inactivates enzyme / inhibits enzyme activity
bile emulsifies fat / bile produces larger surface area of fats / bile alkaline
for enzyme to work on / which increase activity of enzymes
any three for 1 mark each 3
- [7]**

M30. (a) 21.5 – 22 **and** 27 – 27.5
for 1 mark

1

(b) *ideas of*
limiting factor / shortage of
e.g. light / carbon dioxide / water / chlorophyll
each for 1 mark
(allow 1 for 'maximum / optimum rate of enzyme activity if no
reference to limiting factors) (ignore denaturation)

2

(c) 21.5 – 22° C
(allow **first** figure from answer to (i) so that no
'double-penalty but only if this first answer is 20 or greater)

maximum rate of photosynthesis / highest / fastest
but related to flat part of curve

most economical heating / cheapest related to heating
must relate to the temperature the candidate has given
each for 1 mark

3

[6]

M31. (i) DNA
for 1 mark

1

(ii) contains the code for manufacturing the protein,
as order of bases,
which determine the order in which amino acids are
assembled into protein
for 1 mark each

3

[4]

##

(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]

M33. (i) the higher the rate of oxygen consumption, the shorter the
time taken to complete
for 1 mark 1

(ii) the faster oxygen is taken into the blood,
the faster energy can be released in the muscles,
and the faster the athlete can run
for 1 mark each 3

[4]

M34. genotype of parent A Nn
gametes N n n n
young genotypes and phenotypes all correct
for 1 mark each

[3]

M35. genotype of parent A Nn
gametes N n n n
young genotypes and phenotypes all correct
for 1 mark each

[3]