

QUESTIONSHEET 1

(a)

Pig Number	1	2	3	4	5	6	7	8	9	10	11
B- A Weight difference(x)	+ 1.5	+ 0.5	+ 3.8	+ 5.2	+ 3.7	+ 1.0	- 6.0	- 4.5	- 3.5	+ 1.1	+ 0.3
x ²	2.25	0.25	14.44	27.04	13.69	1.0	36.0	20.25	12.25	1.21	0.09

1 mark for correct differences (must show negatives);

1 mark for correct squared values;

2

(b) (i) $\bar{x}^2 = 0.0794$; (add B-A, divide by 11, then square)

$\Sigma x^2 = 128.47$; (allow 128.5)

2

(ii) $s^2 = \frac{128.47}{11} - 0.0794 = 11.6$; $s = 3.406$; (allow 3.41)

2

(iii) $t = \frac{0.28\sqrt{11-1}}{3.406}$; = 0.26;

2

(iv) accept the null hypothesis;

calculated value is less than critical value;

2

(c) (i) anaemia is a lack of haemoglobin/red blood cells;

thus ability of blood to transport oxygen/carbon dioxide is impaired;

thus less available energy/ATP for protein synthesis/cellular respiration may be slowed up;

2

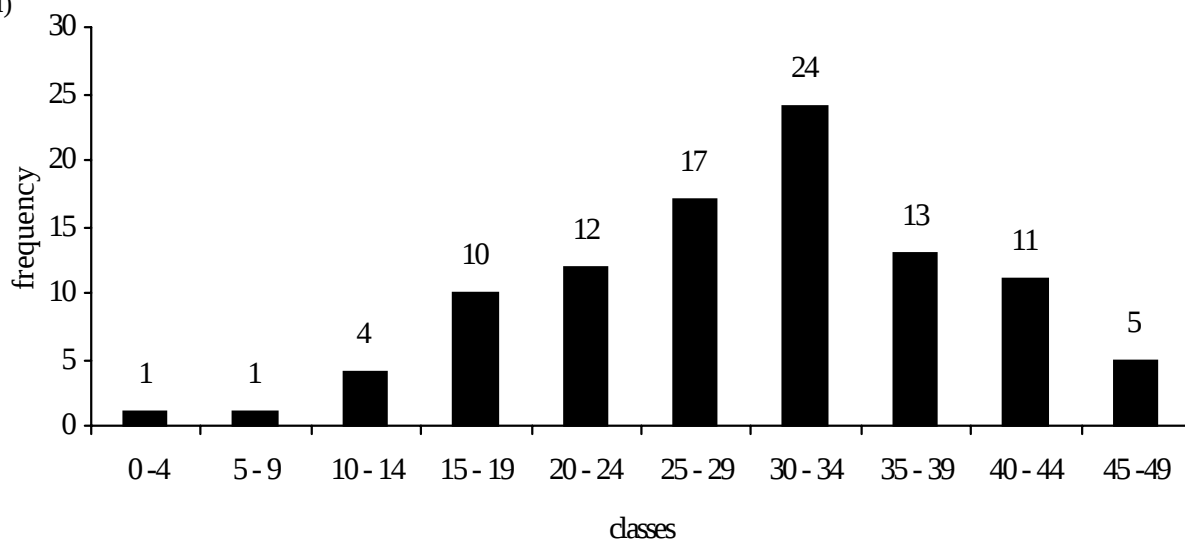
(ii) by injection (since dietary supplement has no significant effect);

1

TOTAL 13

QUESTIONSHEET 2

(a) (i)



Class (5 lbs)	No of pigs
0 - 4	1
5 - 9	1
10 - 14	4
15 - 19	10
20 - 24	12
25 - 29	17
30 - 34	24
35 - 39	13
40 - 44	11
45 - 49	5

correct numbers of pigs written in table;
 axes correctly labelled including class details;
 suitable scale;
 accurate plotting;
 blocks drawn clearly/tidily;

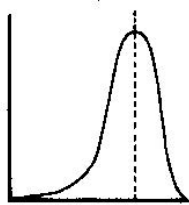
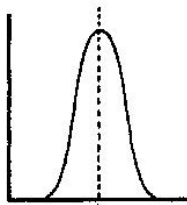
5

(ii) normal/top hat distribution/slightly skewed to the right;

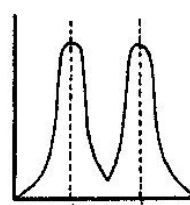
1

(iii) $\frac{2890}{98} = 29.49$;

2

(b) Directional
(accept other direction)Stabilising
(must be narrower than original)

Disruptive



3 correctly drawn curves;;; 3 means;;; 6

TOTAL 14

QUESTIONSHEET 3

(a)(i)

	Correct	Incorrect
Nose closed	139.5 ;	60.5 ;
Nose open	139.5 ;	60.5 ;

4

$$(ii) \chi^2 = \frac{(167 - 139.5)^2}{139.5} + \frac{(33 - 60.5)^2}{60.5} + \frac{(112 - 139.5)^2}{139.5} + \frac{(88 - 60.5)^2}{60.5}$$

$$= 5.421 + 12.50 + 5.421 + 12.50 ; \text{ (allow mark here or in correct substitution above)}$$

$$\chi^2 = 35.84 ;$$

2

(iii) $n = 1$;

1

(iv) accept the hypothesis/effect of nasal breathing is important;
since calculated value of χ^2 is much higher than critical value;

2

(b) (i) mouths should be rinsed out with water before each test;
cinnamon infusion should be of same concentration throughout test/concentrated enough to taste;
test subjects should not have colds/nasal congestion/be the same age/sex;
test subjects should not eat for a few hours prior to the test (so that residual tastes do not interfere with the test); **max 3**

(ii) many substances to be tasted give off volatile chemicals;
which can depolarise/be sensed by/stimulate the olfactory/smell receptors in the nasal mucosa/lining;
thus adding to the effect of the chemical depolarising/stimulating the taste buds on the tongue;

3

TOTAL 15**QUESTIONSHEET 4**

(a) (i)

	Number of plants	
	Green	White
O	49	18
E	50.25;	16.75;

2

$$(ii) \chi^2 = \frac{(49 - 50.25)^2}{50.25} + \frac{(18 - 16.75)^2}{16.75}$$

$$= 0.124 ;$$

(allow the working mark at any correct stage in the calculation)

2

(iii) $n = 1$;

1

(iv) reject the hypothesis/deviation from ratio is not significant;
calculated value of χ^2 is less than critical value (at 0.05 probability level);

2

(b) suitable symbols, eg. G for green, g for white;

P Gg x Gg (no mark)
gametes ♂ ♂ ♂ ♂;
F₁ GG Gg Gg gg ;
 3 green 1 white ;

4

TOTAL 11

QUESTIONSHEET 5

(a)(i)

plant	gold accumulated/mg gold Kg ⁻¹ dry mass		x = b - a	x ²
	no thiocyanate(a)	with thiocyanate(b)		
1	1.01	0.99	-0.02	0.0004
2	1.09	1.09	0	0.0000
3	0.98	1.25	0.27	0.0729
4	0.71	1.34	0.63	0.3969
5	1.15	1.22	0.07	0.0049
6	1.21	1.18	-0.03	0.0009
7	1.18	1.23	0.05	0.0025
8	0.89	1.34	0.45	0.2025
9	1.26	1.21	-0.05	0.0025
10	1.07	0.97	-0.1	0.0100
11	1.30	1.18	-0.12	0.0144
12	1.17	1.23	0.06	0.0036

x values;

$$\sum x = 1.21;$$

$$\bar{x} = \frac{1.21}{12} = 0.101;$$

3

(ii) x² values;

$$\sum x^2 = 1.464;$$

2

(iii) ($\bar{x}$)² = 0.010(2);

1

(iv) $s^2 = \frac{1.464}{12} - 0.010 = 0.112;$

$$s = 0.335;$$

2

(v) $t = \frac{0.101\sqrt{12-1}}{0.335}; = 1.00; \text{ (allow 0.999)}$

2

(b) (i) accept the null hypothesis;

calculated value is less than the critical value (at 0.05 probability level/at all probability levels shown);

2

(ii) use same strain/seed batch/similar Brassica seedlings;

mine waste material should have identical gold contents to begin with;

use a standard concentration of thiocyanate;

grow under similar conditions of temperature/humidity/water availability;

max 2

TOTAL 14

QUESTIONSHEET 6

(a) the colours of the seeds produced are not in the ratio 5:4:4:2 ;

1

(b)

Colour of flower	Red	White	Yellow	Pink
Working	$\frac{5 \times 60}{15}$	$\frac{4 \times 60}{15}$	$\frac{4 \times 60}{15}$	$\frac{2 \times 60}{15}$
Expected numbers	20	16	16	8

correct working ;

correct answers;

2

(c) $\chi^2 = \frac{(15-20)^2}{20} + \frac{(20-16)^2}{16} + \frac{(10-16)^2}{16} + \frac{(15-8)^2}{8}$; (allow for any correct stage of working)

$$\chi^2 = 10.625;$$

2

(d) 3:

1

(e) accept the null hypothesis/colours are not distributed in stated ratio;
calculated value of χ^2 is more than the critical value;

2

(f) heterozygous;
blending inheritance/incomplete dominance;
allele for red interacts with allele for white (producing pink);

max 2

TOTAL 10**QUESTIONSHEET 7**

(a) 70% of dandruff sufferers will be able to clear up their dandruff with one application of the shampoo;

1

(b) $200 - (6.156 + 26.46 + 72.03 + 33.614)$;
= 61.74 ;

2

(c) $\chi^2 = \frac{(15-6.156)^2}{6.156} + \frac{(24-26.46)^2}{26.46} + \frac{(57-61.74)^2}{61.74} + \frac{(75-72.03)^2}{72.03} + \frac{(29-33.614)^2}{33.614}$;
(allow working mark at any correct stage of calculation)

$$= (12.706 + 0.229 + 0.364 + 0.122 + 0.633) = 14.054 ;$$

2

(d) 4; (column 0 has to be amalgamated with column 1)

1

(e) accept the hypothesis/the manufacturers claim is correct;
since calculated value of χ^2 is higher than the critical value;

2

TOTAL 8

QUESTIONSHEET 8

(a) the mean height of year 8 pupils at the teacher's school is less than 1.53 metres;

1

(b)(i)

Pupil Number	1	2	3	4	5	6	7	8	9	10
Height difference/m	- 0.03	+ 0.04	- 0.04	- 0.07	0	+ 0.09	0	- 0.02	+ 0.04	- 0.09

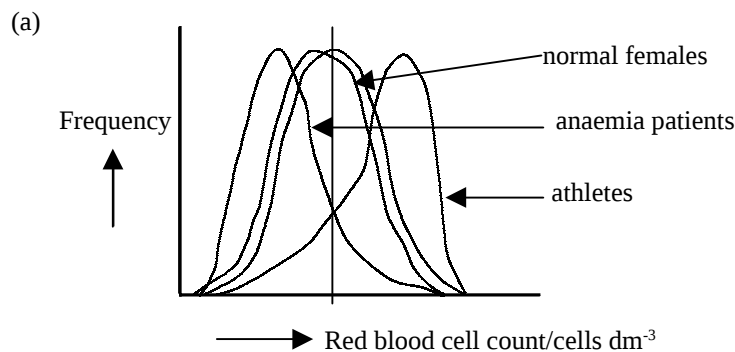
1 mark for + or - signs; 1 mark for figures;

2(ii) $\sum x = -0.08$; $\bar{x} = -0.008$; $\bar{x}^2 = 0.000064$; $\sum x^2 = 0.0272$;**4**(iii) $s^2 = \frac{0.0272}{10} - 0.000064 = 0.002656$; $s = 0.0515363$;**2**(iv) $t = \frac{0.008\sqrt{10-1}}{0.0515363}$; $= 0.466$;**2**

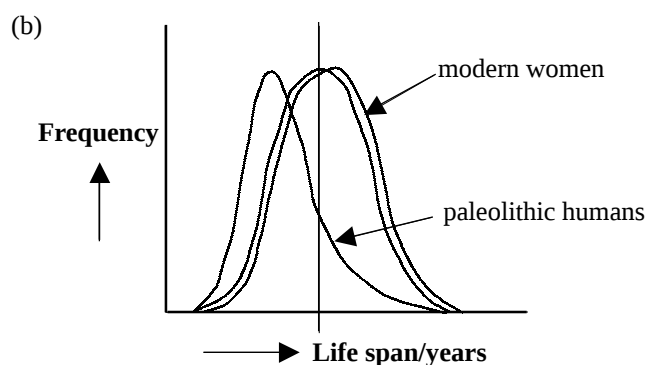
(v) 9;

1(c) reject the hypothesis/the teacher is not correct;
calculated value is less than the critical value;**2****TOTAL 14**

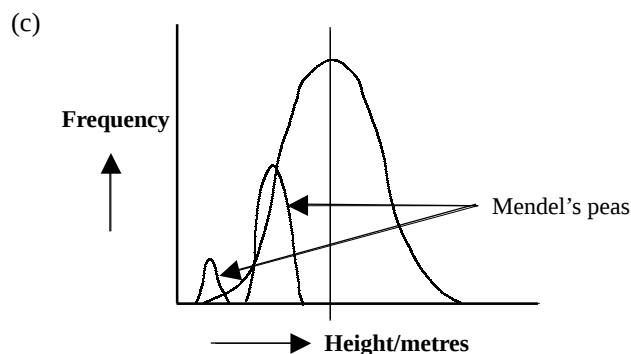
QUESTIONSHEET 9



- (i) correct graph;
women have lower red cell counts than men (so normal distribution lies to the left of men); 2
- (ii) correct graph;
anaemic patients have fewer red cells than normal (so distribution skewed to the left);
due to deficiency of iron/folic acid/vit B₁₂/cyanocobalamin/erythropoietin/due to kidney disease; 3
- (iii) correct graph;
red cell count has increased due to low oxygen tension (so distribution skewed to the right);
ref to low oxygen tension stimulating erythropoietin release which stimulates red cell formation/mitosis in red bone marrow; 3



- (i) correct graph;
women tend to live longer than men (so normal distribution lies to the right of men); 2
- (ii) correct graph;
paleolithic humans tended to die young/by the age of 25 (accept any reasonable value);
due to lack of food/no health care/no medical care/killed by wild animals/any reasonable suggestion; 3



- correct graph;
shows discontinuous variation/bimodal distribution;
tall and short peas in the ratio of three to one/ref to monohybrid inheritance; 3

TOTAL 16

QUESTIONSHEET 10

- (a) (i) the inherited characteristics do not behave in a Mendelian manner;

1

(ii)

Phenotype	Observed	Expected	(O – E)	(O – E) ²
Grey winged	180	145;	35	1225
Black vestigial	52	16;	36	1296
Grey vestigial	14	48;	-34	1156
Black wild	12	48;	-36	1296

(O - E) all correct;

(O - E)² all correct;**6**

$$(iii) \chi^2 = \frac{1225}{145} + \frac{1296}{16} + \frac{1156}{48} + \frac{1296}{48} ;$$

$$= (8.45 + 81 + 24.08 + 27) = 140.53 ;$$

(allow the working mark at any correct stage in the calculation)

2

- (iv) 3;

1

- (v) reject the null hypothesis/results are not a Mendelian ratio;
-
- calculated value is more than the critical value;

2

- (b) the characteristics are linked;

grey to winged and black to vestigial wings;

alleles on the same (homologous pair of) chromosomes;

ref to recombinants produced by chiasma formation/crossover;

max 3**TOTAL 15**

QUESTIONSHEET 11

(a) dandelion and ribwort do not tend to grow in association with each other in the meadow;

1

(b) (i)

		Dandelion		row total
		present	absent	
Ribwort	present	O 88 E 86.8;	O 52 E 53.2;	140
	absent	O 36 E 37.2;	O 24 E 22.8;	60
column total		124	76	200 (grand total)

4

$$(ii) \chi^2 = \frac{(88-86.8)^2}{86.8} + \frac{(52-53.2)^2}{53.2} + \frac{(36-37.2)^2}{37.2} + \frac{(24-22.8)^2}{22.8} ;$$

$$= (0.0166 + 0.0271 + 0.0387 + 0.0632)$$

$$= 0.1456 ;$$

2

(iii) 1;

1

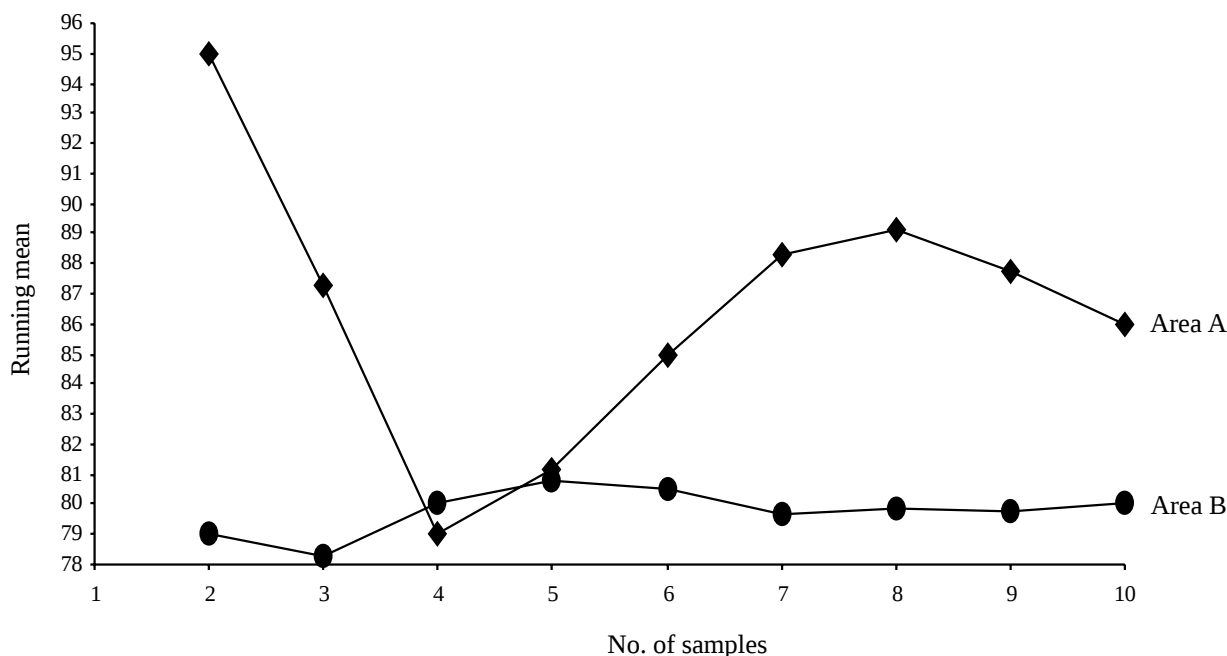
(iv) accept the null hypothesis/there is no association between the two plants;
calculated value is smaller than the critical value;

2**TOTAL 10**

QUESTIONSHEET 12

- (a) (i) correct labelled axes;
 suitable scale;
 accurate plotting;
 points joined with a straight line; (IOB recommendations)
 curves labelled;

5



- (ii) area A;
 the data is much more variable in A (than in B);
 thus A would need many samples to get an accurate estimation of the mean/only a few samples in B would give an accurate estimation of the mean; 3
- (iii) the time available for the investigation;
 the time required to obtain each sample;
 the ease with which each sample can be collected/many small plants more difficult to count than a few large plants;
 how much damage/disturbance the sampling may cause/trampling/crushing of delicate/rare plants; max 2
- (b) (i) χ^2 ;
 used to test 'goodness of fit' of genetical data to Mendelian/linkage/expected ratios; 2
- (ii) t-test;
 used to test the significance of differences in the means of two (or more) sets of data; 2
- (iii) χ^2 ;
 used to test association between factors/light intensity and bluebell distribution; 2

TOTAL 16(Current syllabuses only specify t-test and χ^2 test for possible exam use)