

**QUESTIONSHEET 1**

(a)

Pig Number	1	2	3	4	5	6	7	8	9	10	11
<b>B- A Weight difference(x)</b>	+	+	+	+	+	+	-	-	-	+	+
	1.5	0.5	3.8	5.2	3.7	1.0	6.0	4.5	3.5	1.1	0.3
<b>x<sup>2</sup></b>	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

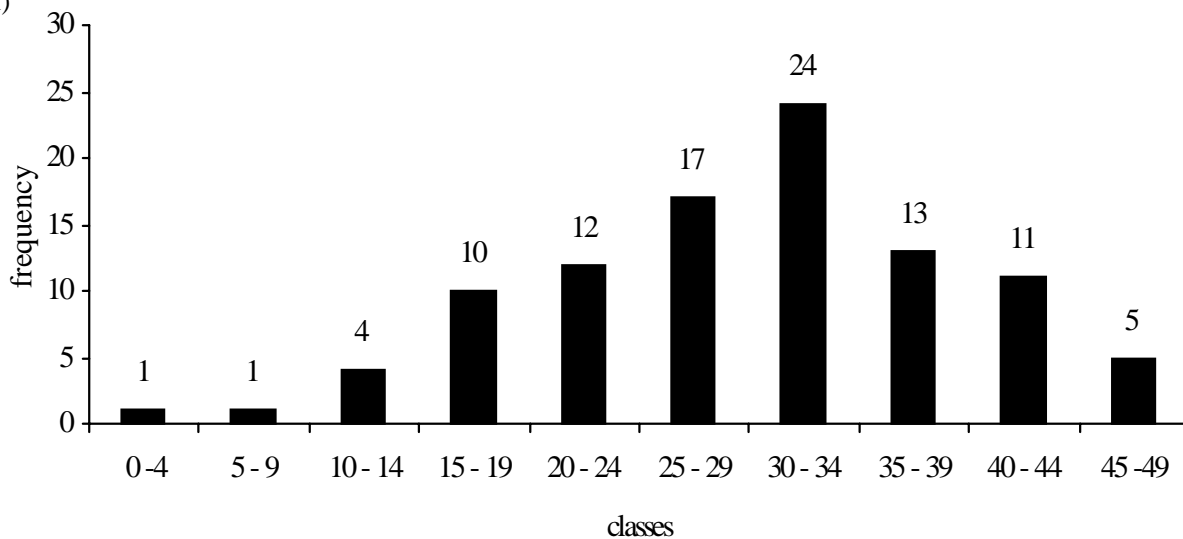
(ii) by injection (since dietary supplement has no significant effect);

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

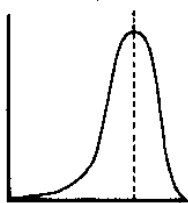
(ii) normal/top hat distribution/slightly skewed to the right;

1

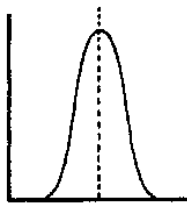
(iii)  $\frac{2890}{98} = 29.49$  ;

2

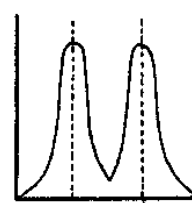
(b) Directional  
(accept other direction)



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 ;    |
- (ii)  $\chi^2 = \frac{(167 - 139.5)^2}{139.5} + \frac{(33 - 60.5)^2}{60.5} + \frac{(112 - 139.5)^2}{139.5} + \frac{(88 - 60.5)^2}{60.5}$   
 $= 5.421 + 12.50 + 5.421 + 12.50$  ; (allow mark here or in correct substitution above)  
 $\chi^2 = 35.84$  ;
- (iii)  $n = 1$ ;
- (iv) accept the hypothesis/effect of nasal breathing is important;  
since calculated value of  $\chi^2$  is much higher than critical value;
- (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;
- TOTAL 15**

**QUESTIONSHEET 4**

- (a) (i)
- |   | Number of plants |        |
|---|------------------|--------|
|   | Green            | White  |
| O | 49               | 18     |
| E | 50.25;           | 16.75; |
- (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)
- (iii)  $n = 1$ ;
- (iv) reject the hypothesis/deviation from ratio is not significant;  
calculated value of  $\chi^2$  is less than critical value (at 0.05 probability level);
- (b) suitable symbols, eg. G for green, g for white;
- P                      Gg x Gg (no mark)  
 gametes    (G) (g)      (G) (g);  
 F<sub>1</sub>              (GG Gg Gg) gg ;
- 3 green      1 white ;
- TOTAL 11**

**QUESTIONSHEET 5**

(a)(i)

plant	gold accumulated/mg gold Kg <sup>-1</sup> dry mass		x = b - a	x <sup>2</sup>
	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) x<sup>2</sup> 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  $\chi^2$  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  $\chi^2$  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 10**

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

1

(ii)

Phenotype	Observed	Expected	(O – E)	(O – E) <sup>2</sup>
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)<sup>2</sup> 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 <b>86.8;</b>	O 52 E <b>53.2;</b>	140
	absent	O 36 E <b>37.2;</b>	O 24 E <b>22.8;</b>	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;

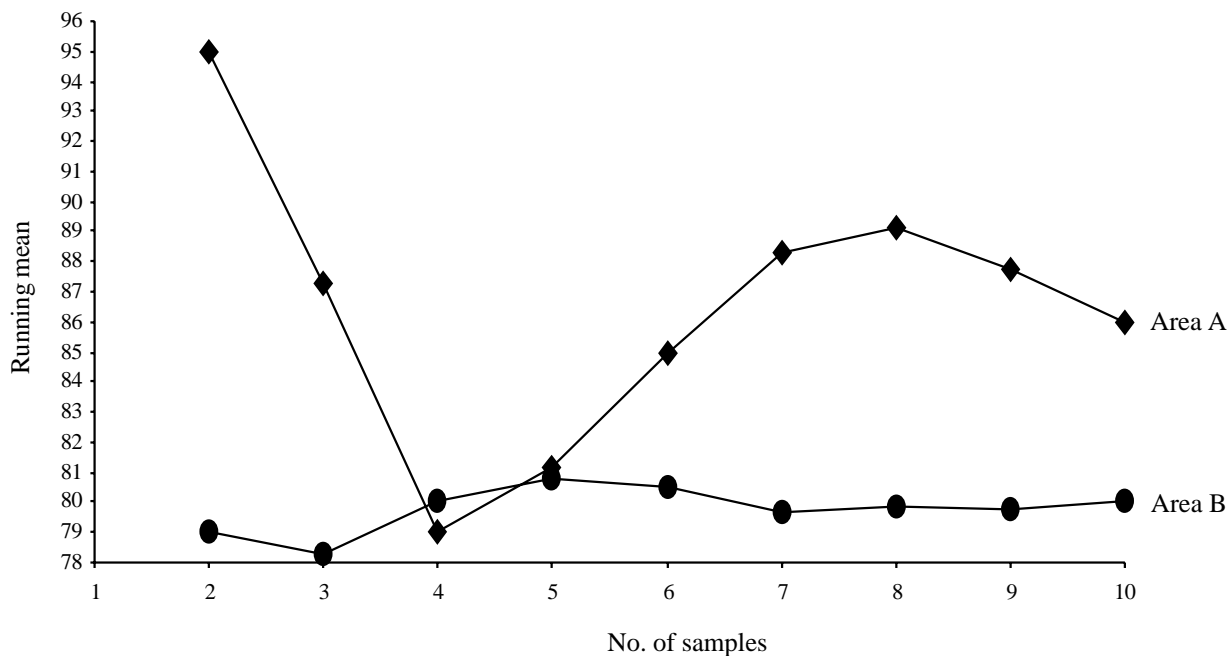
2

**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)  $\chi^2$  ;  
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)  $\chi^2$  ;  
used to test association between factors/light intensity and bluebell distribution; **2**

**TOTAL 16**(Current syllabuses only specify t-test and  $\chi^2$  test for possible exam use)