

Interactive Example Candidate Responses

Paper 5 (May/June 2016), Question 2

Cambridge International AS & A Level

Biology 9700

In order to help us develop the highest quality resources, we are undertaking a continuous programme of review; not only to measure the success of our resources but also to highlight areas for improvement and to identify new development needs.

We invite you to complete our survey by visiting the website below. Your comments on the quality and relevance of our resources are very important to us.

www.surveymonkey.co.uk/r/GL6ZNJB

Would you like to become a Cambridge International consultant and help us develop support materials?

Please follow the link below to register your interest.

www.cambridgeinternational.org/cambridge-for/teachers/teacherconsultants/

Copyright © UCLES 2018

Cambridge Assessment International Education is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which itself is a department of the University of Cambridge.

UCLES retains the copyright on all its publications. Registered Centres are permitted to copy material from this booklet for their own internal use. However, we cannot give permission to Centres to photocopy any material that is acknowledged to a third party, even for internal use within a Centre.

- 2 Medical researchers carried out an investigation into the effect of smoking in a country. A group of male volunteers had their peak expiratory flow rate (PEFR) measured as shown in Fig. 2.1.



Fig. 2.1

PEFR measures the maximum speed of airflow through the bronchi during breathing out in dm^3 per minute ($\text{dm}^3 \text{min}^{-1}$). Peak flow readings are lower when the airways are constricted.

The volunteers were grouped according to the number of packets of cigarettes that they smoked per year. Each packet contains 20 cigarettes.

Table 2.1 shows the results of the investigation.

Table 2.1

group	1	2	3	4	5
number of packets of cigarettes smoked per year	0	1–50	51–100	101–150	151–230
mean number of packets smoked per group $\pm s$	0	30.61 ± 10.47	73.80 ± 16.52	127.27 ± 9.66	189.22 ± 27.51
mean age of volunteers $\pm s$ /years	26.42 ± 5.61	22.82 ± 3.28	26.66 ± 3.59	28.90 ± 4.20	36.22 ± 3.21
mean PEFR $\pm s$ / $\text{dm}^3 \text{min}^{-1}$	513.43 ± 87.58	494.70 ± 79.22	443.33 ± 45.14	350.90 ± 32.38	300.00 ± 46.90
number of volunteers tested	64	14	15	12	8

s = standard deviation

Your
Mark

2(a)

2(b)

2(c)(i)

2(c)(ii)

Q2	Mark scheme	
	Expected answer	Extra guidance
2(a)	<p>any 3 from:</p> <ul style="list-style-type: none"> 1 body mass / weight ; 2 number of volunteers in each group ; 3 age of volunteers ; 4 no factor affecting air flow / lung capacity ; 5 (physical) fitness of volunteers ; 6 (type of) cigarette smoked ; 7 PEFR device / apparatus used ; 8 PEFR test done when volunteers are sitting down / standing up ; 9 time of day the PEFR test performed ; 10 ethnicity / race ; 	<p>I diet / sex / alcohol consumption / medication / drugs / range of number of packets of cigarettes ;</p> <p>A same number in each age group</p> <p>A asthma, CF, COPD, TB, lung cancer</p> <p>A disease affecting the lungs / breathing</p> <p>A living at altitude</p> <p>A minimum time since last cigarette</p> <p>I passive smoking</p> <p>A in terms of nicotine / tar / filter / brand</p> <p>A not after exercise / at rest</p> <p>[max3]</p>
2(b)	<p>any 3 from:</p> <p>support (max 2)</p> <p>conclusion 1 (an increase in the number of packets smoked decreases the PEFR measurement)</p> <p>1 the <u>mean</u> PEFR decreases as the <u>mean</u> number of packets / cigarettes smoked increase ;</p> <p>2 compare data from two PEFR and a trend on smoking</p> <p>or</p> <p>compare data from two number of packets smoked and a trend in PEFR ;</p> <p>3 highest no. of packets / cigarettes smoked has the lowest mean PEFR ;</p>	<p>answers must either include both 'means' or link relevant data for any two groups (age or PEFR and number of packets smoked) from Table 2.1 / comparisons of age with PEFR</p> <p>must link PEFR values to the amount smoked / number of packets (not just quote from the table)</p> <p>e.g. (mean) PEFR decreases from 513.43 to 300.00 with increase in packets / cigarettes smoked</p> <p>e.g. (mean) PEFR decreases as the (mean) number packets increase from 0 to 189.22</p> <p>A non-smokers / group 1 has the highest <u>mean</u> PEFR</p>

- (a) State three variables which should have been standardised in this investigation.

~~The age of the males~~
 • The ethnicity of the males.
~~How long they have been smoking for~~
 • In Their condition whilst taking the test, for example everyone should be rested/sitting down.
 The number of hours they do not smoke before the test, for example 24 hours.

[3]

- (b) The medical researchers made two conclusions based on the data shown in Table 2.1.

1. An increase in the number of packets smoked decreases the PEFR measurement.
2. The number of packets smoked increases with age.

State how the results from Table 2.1 support these conclusions and how they do not support these conclusions.

support

For conclusion one, it does support because Group 1's mean PEFR is 713.43, and Group 3's is 443.33 and group 5's is the lowest with 300.00, as the mean number of pack smoked increases

For conclusion 2 it does support because from group 2 to 5 the age increases from 22.82 to 36.22, as the packs smoked also go up

do not support

For conclusion one, it doesn't support, because the standard deviation for Group 1 and 2 overlap significantly. As well as group 2 and 3 (for mean PE).
 For conclusion 2, Group 1's mean age (10 cigarette) is higher than Group 2's mean age (1-50 cigarette)
 $26.42 > 22.82$

Your
Mark

2(a)

2(b)

2(c)(i)

2(c)(ii)

Q2 Mark scheme

	Expected answer	Extra guidance
2(b)	<p>conclusion 2 (the number of packets smoked increases with age)</p> <p>4 as <u>mean</u> age increases the mean number of packets increases ;</p> <p>5 compare data from two age groups and a trend on smoking</p> <p>or</p> <p>compare data from two mean number of packets smoked and a trend on age ;</p> <p>6 oldest volunteers / group 2 smoked the <u>highest</u> mean number of packets ;</p> <p>does not support (max 2)</p> <p>conclusion 1 (an increase in the number of packets smoked decreases</p> <p>the PEFR measurement)</p> <p>7 as the number packets increases</p> <p>and</p> <p>the values / range / standard deviation of PEFR of two of the groups</p> <p>overlap ;</p> <p>conclusion 2 (the number of packets smoked increases with age)</p> <p>8 values / range/ standard deviation of the ages (for each group) overlap</p> <p>or</p> <p>there are no distinct age groups / age groups overlap ;</p> <p>9 group 2 smoke more packets than group 1 but (mean) age is lower ;</p>	<p>must link age values to the amount smoked / number of packets (not just quote from the table)</p> <p>must not use group 1 data here (26.42 and 0)</p> <p>e.g. (mean) number of packets increases from 30.61 to 189.22 with an increase in age</p> <p>e.g. (mean) age increases from 22.82 to 36.22 as the (mean) number of packets smoked increases</p> <p>A the youngest smokers / group 2 smoked the <u>least</u> <u>mean</u> number of packets</p> <p>A the <u>largest</u> <u>mean</u> number of packets was smoked by the <u>oldest</u> people</p> <p>e.g. overlap between: group 1 / non-smokers and group 2</p> <p>group 1 / non-smokers and group 3</p> <p>group 2 and group 3</p> <p>group 4 and group 5</p> <p>A individuals in groups 1, 2, 3 and 4 all have a similar / same age</p>

[max3]

- (c) (i) State a null hypothesis for a statistical test to find out whether the data in Table 2.1 supports the conclusion that:

An increase in the number of packets smoked decreases the PEFR measurement.

There is no significant relationship between
increase in number of
the number of packets smoked and decrease
in PEFR measurement. [1]

- (ii) State two ways in which the data for group 5 is less trustworthy compared with the data for the other groups.

Number of volunteers tested is less.
It has the largest standard deviation in
the mean number of packs smoked. 127.51
[2]

[Total: 9]

Your
Mark

2(a)

2(b)

2(c)(i)

2(c)(ii)

Q2	Mark scheme	
	Expected answer	Extra guidance
2(c)(i)	there is no <u>significant</u> relationship / correlation between the decrease in the PEFR and the increase in the number of packets of cigarettes smoked or there is no <u>significant</u> decrease in the PEFR as the number of packets smoked increases or the increase in the number of packets smoked does not <u>significantly</u> decrease the PEFR ;	A there is no significant relationship / correlation between the increase in the number of packets of cigarettes smoked and the decrease in the PEFR [max1]
2(c)(ii)	<i>any 2 from:</i> number of volunteers small (est.); great(est) range in number of packets of cigarettes smoked (151–230) ; larg(est) standard deviation for number of packets of cigarettes ;	A has a range of 80 instead of 50 [max2] Total: [9]

- 2 Medical researchers carried out an investigation into the effect of smoking in a country. A group of male volunteers had their peak expiratory flow rate (PEFR) measured as shown in Fig. 2.1.



Fig. 2.1

PEFR measures the maximum speed of airflow through the bronchi during breathing out in dm^3 per minute ($\text{dm}^3 \text{min}^{-1}$). Peak flow readings are lower when the airways are constricted.

The volunteers were grouped according to the number of packets of cigarettes that they smoked per year. Each packet contains 20 cigarettes.

Table 2.1 shows the results of the investigation.

Table 2.1

group	1	2	3	4	5
number of packets of cigarettes smoked per year	0	1–50	51–100	101–150	151–230
mean number of packets smoked per group $\pm s$	0	30.61 ± 10.47	73.80 ± 16.52	127.27 ± 9.66	189.22 ± 27.51
mean age of volunteers $\pm s$ /years	26.42 ± 5.61	22.82 ± 3.28	26.66 ± 3.59	28.90 ± 4.20	36.22 ± 3.21
mean PEFR $\pm s$ / $\text{dm}^3 \text{min}^{-1}$	513.43 ± 87.58	494.70 ± 79.22	443.33 ± 45.14	350.90 ± 32.38	300.00 ± 46.90
number of volunteers tested	64	14	15	12	8

s = standard deviation

50.25 317.62 346.90.

Your
Mark

2(a)

2(b)

2(c)(i)

2(c)(ii)

Q2	Mark scheme	
	Expected answer	Extra guidance
2(a)	<p>any 3 from:</p> <ul style="list-style-type: none"> 1 body mass / weight ; 2 number of volunteers in each group ; 3 age of volunteers ; 4 no factor affecting air flow / lung capacity ; 5 (physical) fitness of volunteers ; 6 (type of) cigarette smoked ; 7 PEFR device / apparatus used ; 8 PEFR test done when volunteers are sitting down / standing up ; 9 time of day the PEFR test performed ; 10 ethnicity / race ; 	<p>I diet / sex / alcohol consumption / medication / drugs / range of number of packets of cigarettes ;</p> <p>A same number in each age group</p> <p>A asthma, CF, COPD, TB, lung cancer</p> <p>A disease affecting the lungs / breathing</p> <p>A living at altitude</p> <p>A minimum time since last cigarette</p> <p>I passive smoking</p> <p>A in terms of nicotine / tar / filter / brand</p> <p>A not after exercise / at rest</p> <p>[max3]</p>
2(b)	<p>any 3 from:</p> <p>support (max 2)</p> <p>conclusion 1 (an increase in the number of packets smoked decreases the PEFR measurement)</p> <p>1 the mean PEFR decreases as the mean number of packets / cigarettes smoked increase ;</p> <p>2 compare data from two PEFR and a trend on smoking</p> <p>or</p> <p>compare data from two number of packets smoked and a trend in PEFR ;</p> <p>3 highest no. of packets / cigarettes smoked has the lowest mean PEFR ;</p>	<p>answers must either include both 'means' or link relevant data for any two groups (age or PEFR and number of packets smoked) from Table 2.1 / comparisons of age with PEFR</p> <p>must link PEFR values to the amount smoked / number of packets (not just quote from the table)</p> <p>e.g. (mean) PEFR decreases from 513.43 to 300.00 with increase in packets / cigarettes smoked</p> <p>e.g. (mean) PEFR decreases as the (mean) number packets increase from 0 to 189.22</p> <p>A non-smokers / group 1 has the highest mean PEFR</p>

(a) State three variables which should have been standardised in this investigation.

- the mean age of the volunteers, with same standard deviation.
 - the number of volunteers tested in each group
 - the interval within the number of packets of cigarettes smoked per year
- [3]

Your
Mark

2(a)

2(b)

2(c)(i)

2(c)(ii)

(b) The medical researchers made two conclusions based on the data shown in Table 2.1.

1. An increase in the number of packets smoked decreases the PEFR measurement.
2. The number of packets smoked increases with age.

State how the results from Table 2.1 support these conclusions and how they do not support these conclusions.

support

for statement 1, the mean PEFR decreases as the number of packets smoked increases from 513 to 300.
for statement 2, the mean number of packet smoked increase with mean age increases, from 26.42 to 36.22.

do not support → The overlapping of standard deviation is too large

for statement 1, for example group 4, and 5, group 4 PEFR is in range 317.62 – 382.28 while in group 5 PEFR range is 253.1 – 346.90, so some volunteer in who smokes more packets have higher PEFR than the who smoke fewer packets. [3]

- For statement 2, comparing group 3 and 4, people with age about 30 (26.06+3.39) smoke fewer packets than those who age is about 25 in group 4.

Q2 Mark scheme

	Expected answer	Extra guidance
2(b)	<p>conclusion 2 (the number of packets smoked increases with age)</p> <p>4 as <u>mean</u> age increases the mean number of packets increases ;</p> <p>5 compare data from two age groups and a trend on smoking</p> <p>or</p> <p>compare data from two mean number of packets smoked and a trend on age ;</p> <p>6 oldest volunteers / group 5 smoked the <u>highest</u> mean number of packets ;</p> <p>does not support (max 2)</p> <p>conclusion 1 (an increase in the number of packets smoked decreases the PEFR measurement)</p> <p>7 as the number packets increases</p> <p>and</p> <p>the values / range / standard deviation of PEFR of two of the groups</p> <p>overlap ;</p> <p>conclusion 2 (the number of packets smoked increases with age)</p> <p>8 values / range/ standard deviation of the ages (for each group) overlap</p> <p>or</p> <p>there are no distinct age groups / age groups overlap ;</p> <p>9 group 2 smoke more packets than group 1 but (mean) age is lower ;</p>	<p>must link age values to the amount smoked / number of packets (not just quote from the table)</p> <p>must not use group 1 data here (26.42 and 0)</p> <p>e.g. (mean) number of packets increases from 30.61 to 189.22 with an increase in age</p> <p>e.g. (mean) age increases from 22.82 to 36.22 as the (mean) number of packets smoked increases</p> <p>A the youngest smokers / group 2 smoked the least <u>mean</u> number of packets</p> <p>A the <u>largest mean</u> number of packets was smoked by the oldest people</p> <p>e.g. overlap between: group 1 / non-smokers and group 2</p> <p>group 1 / non-smokers and group 3</p> <p>group 2 and group 3</p> <p>group 4 and group 5</p> <p>A individuals in groups 1, 2, 3 and 4 all have a similar / same age</p> <p>[max3]</p>

- (c) (i) State a ~~null hypothesis~~ for a statistical test to find out whether the data in Table 2.1 supports the conclusion that:

An increase in the number of packets smoked decreases the PEFR measurement.

there is no significant ^{Correlation} difference
between increases in the number of packets smoked
and decrease in PEFR measurement. [1]

- (ii) State two ways in which the data for group 5 is less trustworthy compared with the data for the other groups.

the interval for number of packets
of cigarettes smoked per year is not the
same as the other group.
~~the standard deviation of mean number~~
the number of volunteers in Group 5 [2]
is the smallest.

[Total: 9]

Your
Mark

2(a)

2(b)

2(c)(i)

2(c)(ii)

Q2	Mark scheme	
	Expected answer	Extra guidance
2(c)(i)	there is no <u>significant</u> relationship / correlation between the decrease in the PEFR and the increase in the number of packets of cigarettes smoked or there is no <u>significant</u> decrease in the PEFR as the number of packets smoked increases or the increase in the number of packets smoked does not <u>significantly</u> decrease the PEFR ;	A there is no significant relationship / correlation between the increase in the number of packets of cigarettes smoked and the decrease in the PEFR [max1]
2(c)(ii)	any 2 from: number of volunteers small (est.); great(est) range in number of packets of cigarettes smoked (151–230) ; larg(est) standard deviation for number of packets of cigarettes ;	A has a range of 80 instead of 50 [max2] Total: [9]

- 2 Medical researchers carried out an investigation into the effect of smoking in a country. A group of male volunteers had their peak expiratory flow rate (PEFR) measured as shown in Fig. 2.1.



Fig. 2.1

PEFR measures the maximum speed of airflow through the bronchi during breathing out in dm^3 per minute ($\text{dm}^3 \text{min}^{-1}$). Peak flow readings are lower when the airways are constricted.

The volunteers were grouped according to the number of packets of cigarettes that they smoked per year. Each packet contains 20 cigarettes.

Table 2.1 shows the results of the investigation.

Table 2.1

group	1	2	3	4	5
number of packets of cigarettes smoked per year	0	1–50	51–100	101–150	151–230
mean number of packets smoked per group $\pm s$	0	30.61 ± 10.47	73.80 ± 16.52	127.27 ± 9.66	189.22 ± 27.51
mean age of volunteers $\pm s$ /years	26.42 ± 5.61	22.82 ± 3.28	26.66 ± 3.59	28.90 ± 4.20	36.22 ± 3.21
mean PEFR $\pm s$ / $\text{dm}^3 \text{min}^{-1}$	513.43 ± 87.58	494.70 ± 79.22	443.33 ± 45.14	350.90 ± 32.38	300.00 ± 46.90
number of volunteers tested	64	14	15	12	8

s = standard deviation

Your
Mark

2(a)

2(b)

2(c)(i)

2(c)(ii)

Q2	Mark scheme	
	Expected answer	Extra guidance
2(a)	<p>any 3 from:</p> <ul style="list-style-type: none"> 1 body mass / weight ; 2 number of volunteers in each group ; 3 age of volunteers ; 4 no factor affecting air flow / lung capacity ; 5 (physical) fitness of volunteers ; 6 (type of) cigarette smoked ; 7 PEFR device / apparatus used ; 8 PEFR test done when volunteers are sitting down / standing up ; 9 time of day the PEFR test performed ; 10 ethnicity / race ; 	<p>I diet / sex / alcohol consumption / medication / drugs / range of number of packets of cigarettes ; A same number in each age group A asthma, CF, COPD, TB, lung cancer A disease affecting the lungs / breathing A living at altitude A minimum time since last cigarette I passive smoking A in terms of nicotine / tar / filter / brand A not after exercise / at rest</p> <p>[max3]</p>
2(b)	<p>any 3 from:</p> <p>support (max 2)</p> <p>conclusion 1 (an increase in the number of packets smoked decreases the PEFR measurement)</p> <ul style="list-style-type: none"> 1 the <u>mean</u> PEFR decreases as the <u>mean</u> number of packets / cigarettes smoked increase ; 2 compare data from two PEFR and a trend on smoking <p>or</p> <ul style="list-style-type: none"> compare data from two number of packets smoked and a trend in PEFR ; 3 highest no. of packets / cigarettes smoked has the lowest mean PEFR ; 	<p>answers must either include both 'means' or link relevant data for any two groups (age or PEFR and number of packets smoked) from Table 2.1 / comparisons of age with PEFR</p> <p>must link PEFR values to the amount smoked / number of packets (not just quote from the table)</p> <p>e.g. (mean) PEFR decreases from 513.43 to 300.00 with increase in packets / cigarettes smoked</p> <p>e.g. (mean) PEFR decreases as the (mean) number packets increase from 0 to 189.22</p> <p>A non-smokers / group 1 has the highest <u>mean</u> PEFR</p>

(a) State three variables which should have been standardised in this investigation.

- The number of volunteers tested should be same in all groups.

- The number of packets of ~~cig~~ cigarettes smoked per year in all groups should be the same

- Use uncertainty instead of standard deviation.

[3]

(b) The medical researchers made two conclusions based on the data shown in Table 2.1.

1. An increase in the number of packets smoked decreases the PEFR measurement.

2. The number of packets smoked increases with age.

State how the results from Table 2.1 support these conclusions and how they do not support these conclusions.

support

- At ~~g~~ from group 3 to 5, does sup as the number of packets smoked increases, the mean age of volunteers also increases.

- from group 1 to 5, mean PEFR decrease from 513.43 to 300.00 as number of smoked ~~in~~ ^{cigarettes} increase.

do not support

- from group 1 to 2, mean age of volunteers decreases as number of packets smoked increases.

[3]

Your
Mark

2(a)

2(b)

2(c)(i)

2(c)(ii)

Q2 Mark scheme

Q2	Expected answer	Extra guidance
2(b)	<p>conclusion 2 (the number of packets smoked increases with age)</p> <p>4 as <u>mean</u> age increases the mean number of packets increases ;</p> <p>5 compare data from two age groups and a trend on smoking</p> <p>or</p> <p>compare data from two mean number of packets smoked and a trend on age ;</p> <p>6 oldest volunteers / group 5 smoked the <u>highest</u> mean number of packets ;</p> <p>does not support (max 2)</p> <p>conclusion 1 (an increase in the number of packets smoked decreases</p> <p>the PEFR measurement)</p> <p>7 as the number packets increases</p> <p>and</p> <p>the values / range / standard deviation of PEFR of two of the groups</p> <p>overlap ;</p> <p>conclusion 2 (the number of packets smoked increases with age)</p> <p>8 values / range/ standard deviation of the ages (for each group) overlap</p> <p>or</p> <p>there are no distinct age groups / age groups overlap ;</p> <p>9 group 2 smoke more packets than group 1 but (mean) age is lower ;</p>	<p>must link age values to the amount smoked / number of packets (not just quote from the table)</p> <p>must not use group 1 data here (26.42 and 0)</p> <p>e.g. (mean) number of packets increases from 30.61 to 189.22 with an increase in age</p> <p>e.g. (mean) age increases from 22.82 to 36.22 as the (mean) number of packets smoked increases</p> <p>A the youngest smokers / group 2 smoked the least <u>mean</u> number of packets</p> <p>A the <u>largest mean</u> number of packets was smoked by the oldest people</p> <p>e.g. overlap between: group 1 / non-smokers and group 2</p> <p>group 1 / non-smokers and group 3</p> <p>group 2 and group 3</p> <p>group 4 and group 5</p> <p>A individuals in groups 1, 2, 3 and 4 all have a similar / same age</p> <p>[max3]</p>

- (c) (i) State a null hypothesis for a statistical test to find out whether the data in Table 2.1 supports the conclusion that:

An increase in the number of packets smoked decreases the PEFR measurement.

Number of packets smoked and PEFR measurement
is related and inverse to one another.
[1]

- (ii) State two ways in which the data for group 5 is less trustworthy compared with the data for the other groups.

- Mean age of volunteers is above 30 where
as the other groups are below 30.
- Number of volunteers tested is the least amongst
all other groups.
[2]

[Total: 9]

Your
Mark

2(a)

2(b)

2(c)(i)

2(c)(ii)

Q2	Mark scheme	
	Expected answer	Extra guidance
2(c)(i)	there is no <u>significant</u> relationship / correlation between the decrease in the PEFR and the increase in the number of packets of cigarettes smoked or there is no <u>significant</u> decrease in the PEFR as the number of packets smoked increases or the increase in the number of packets smoked does not <u>significantly</u> decrease the PEFR ;	A there is no significant relationship / correlation between the increase in the number of packets of cigarettes smoked and the decrease in the PEFR [max1]
2(c)(ii)	any 2 from: number of volunteers small (est.); great(est) range in number of packets of cigarettes smoked (151–230) ; larg(est) standard deviation for number of packets of cigarettes ;	A has a range of 80 instead of 50 [max2] Total: [9]

Cambridge Assessment International Education
The Triangle Building, Shaftesbury Road, Cambridge, CB2 8EA, United Kingdom
t: +44 1223 553554 f: +44 1223 553558
e: info@cambridgeinternational.org www.cambridgeinternational.org

Copyright © UCLES March 2018