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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Environmental Science 6441

ESC7 Written Alternative to Practical Investigation

Mark Scheme

2006 examination – June series

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Environmental Science

June 2006 **ESC7**

Instructions: ; = 1 mark / = alternative response A = accept R = reject

Question 1

(a) Similar soil type/named soil property;
similar width of verge;
[**A** size/area/length/ref. to starting point]
similar aspect/shading;
[**A** access to sunlight]
similar slope angle/gradient/topography/drainage;
similar surrounding land use;
similar management regime eg mowing;
similar background pollution;
similar age of road/age of vegetation; MAX 3

(b) (i) Environmental gradient present/(linear) change in species distribution;
distance short;
more information than a line transect/interrupted belt transect;
comparative comment rejection of random sampling; MAX 3

(ii) Transect at right angles to the road;
details of method of systematic/continuous quadrat sampling;
appropriate size quadrat used ($0.25m^2$ or $1m^2$)/point frame;
identify species;
record plant density/percentage cover/frequency/abundance scale;
[**A** count no. of species]
repeat transects in each location;
calculate index of diversity;
random selection of transect location; MAX 5

(iii) Random quadrat sampling/line transect; 1

(iv) Area studied may not be representative of a whole area/only applies to local area;
only carried out at one point in time;
transect may miss plants with clumped distribution/rare plants;
subjective data recorded (eg % cover);
lack of statistical analysis;
other factors might contribute to differences (eg specially sensitive plants);
[**R** soils/light]
traffic volume/pollution levels not measured;
problems of plant identification;
no replicates done/small quantity of data; MAX 3

(c) Risks:
hit by traffic;
encounters with strangers;
qualified health problems relating to pollution (asthma/breathing difficulties/noise);
[**R** risks associated with general fieldwork]

Risk reduction:
informing adults for safety/work with others;
permission from Highways Agency/local council or similar;
fluorescent jacket/clothing;
work in good weather conditions for best visibility;
carry mobile phone;
avoid bends in road;
work behind barrier/avoid road edge;
avoid busy times;
wear face masks/ear defenders/take asthma inhalers;
warning signs further up road; MAX 4

(d) (i) Weigh dry soil sample;
heat strongly (to burn off organic matter);
cool in dessicator;
repeat to constant mass and reweigh;
calculate %/loss in mass; MAX 4

(ii) Subjective judgement of colour;
statistical analysis unreliable;
ref to imprecision of intervals/log scale; MAX 2

(e) Survey other organisms/insect/lichen surveys;
other soil factors not used in (d);
plant height/growth rates;
measurement of air quality/concentration of pollutants;
chemical analysis of organisms; MAX 2

Total marks = 27

Question 2

(a) (i) Safety/legal reasons; 1

(ii) (High speed) so expect most casualties; 1

(b) (i) $\frac{29}{100} \times 5675 = 1646\ (1645.75)$; 1
[**A** 1645]

(ii) Large population/widespread in UK/slow moving/unseen because of small size/nocturnal habit; 1

(c) Vehicle speed;
traffic intensity;
time of day/year;
awareness/alertness of driver/lighting level of road;
roadside vegetation/habitat type/geographical distribution/surrounding land use;
integration into the landscape/camouflage;
animals dazzled by lights at night;
animal population size/distribution (credit once only in (b (ii) or (c));
migration routes/activity patterns; MAX 4

(d) No births/deaths/migration during process;
no increased vulnerability to predators/disease/climate as a result of marking;
time sufficient to mingle with existing population;
population is sampled randomly irrespective of age, sex, size/all individuals equally available for capture;
not trap happy/trap shy;
mark does not wear off; MAX 3

Total marks = 11

Question 3

(a) (i) Spread of measurements/variation about the mean/measurement of central tendency; 1

(ii) Bar chart;
[**A** box and whisker diagram/histogram (tick+)]
[**R** line graph/scattergraph]
mean plotted accurately;
SD shown eg as a 'stick';
axes labelled with appropriate scale; 4

(iii) Weather conditions (eg rain);
background noise/location noise;
car factors (engine size/age/tyres/make);
[**R** other vehicles]
type of road surface;
position measurement taken relative to speed reduction measure;
actual speed of vehicle;
presence of reflective/absorbing materials; MAX 3

(b) (i) t test/Mann-Whitney *U test*; 1

testing averages/test of significance rather than association or correlation;
correct amount of data (minimum 5 in each dataset);
data continuous;
similar standard deviations;
appropriate ref. to normal distribution;
measured data (t test only); MAX 2

(ii) t test:
difference between means (5.87);
correct calculation of denominators (2.14 + 1.25/3.39);
correct square root calculated (1.84);
correct value for t (3.19);
correct number of degrees of freedom stated (18);
correct critical value (2.88);
[**A** 2.10]

Mann-Whitney *U* test:
ranking of values in combined dataset;
correct ranking of dataset;
correct insertion of figures into formula;
correct value for U_1 (13);
correct value for U_2; (87)
correct critical value stated (23); 6

(iii) Exceeds critical value/highly significant (significant for Mann-Whitney);
possibility of chance = 1 in 100/confidence level 99% /95% for M-W;
[**A** t test at p=0.05/95% confidence level]
reject null hypothesis/accept alternative hypothesis; MAX 2

(c) All traffic calming measures increase noise pollution compared to road with none;
cars slow down when approaching traffic calming device;
increases braking noise/accelerate when device passed;
increases engine noise;
increases friction with road surface;
speed cameras create most noise;
drivers conform to avoid fine/brake sharply (as cameras not seen);
valid comparative comment on road narrowing/road bumps;
awareness of size of differences/ref. to logarithmic scale; MAX 5

(d) Increased exhaust emissions/air pollution;
increased wear and tear on cars/tyres/brakes;
increased fuel use;
aesthetic considerations;
disruption/cost of putting in measures (to taxpayer/local council);
problem of access for emergency vehicles/buses etc.;
driver frustration/annoyance;
economic problems relating to increased congestion;
economic implications of reduction in road accidents (eg reduced healthcare costs/ less time off work);
appropriate comment on economic implications of speed camera fines;
reference of economic or environmental consequences of drivers taking alternative routes to avoid measures; MAX 3

Total marks = 27

Question 4

Quality of Written Communication is assessed in this answer

(a) Least NO_2 in rural locations;
target levels not exceeded;
very low levels found in highlands/remote location;
small traffic volume/little industry;
highest average NO_2 in kerbside locations;
all exceed targets;
average annual concentrations greatest in largest conurbations/named city;
hourly concentrations greatest in largest conurbations/named city; MAX 4

[**A** converse points]

(b) Some areas of country not sampled/sample sites not representative;
few rural/kerbside sites used;
smaller towns should be included;
no information about impact on health/need information on target levels;
no information about other contributors of NO_x in sample areas;
no information on other pollutants/synergistic pollutants emitted by vehicles;
no data on traffic volume; MAX 4

Quality of Written Communication

Mark	Descriptor
2	Material is logically presented in clear, scientific English. Technical terminology has been used effectively and accurately throughout. At least half a page of material is presented.
1	Account is logical and generally presented in clear, scientific English. Technical terminology has been used effectively and is usually accurate. Some minor errors. At least half a page of material is presented
0	The account is generally poorly constructed and often fails to use an appropriate scientific style and terminology to express ideas.

MAX 2

Total marks = 10