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Physical science content knowledge of first-year preservice science teacher trainees at colleges of education in South Africa

Howie, Sarah J

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APPENDIX 1

Questionnaire for Physical Science College Lecturers

Identifying problem areas in the STD 10 physical science syllabus for first year physical science candidates entering Colleges of Education.

I am looking into the knowledge of science that first year physical science students have, on entering a college of education for the first time (and I am hoping that this study will result in a Masters degree in Education). An aspect which I must first consider, is to identify the areas in the std 9 and 10 syllabuses, that first year students have problems with. This is why I am asking for your help as practitioners in the colleges, as you have had the first hand experience and are in the best position to identify the problems. Therefore, I really need your help by completing this questionnaire. It is intended that the results of this study, will be made available to all science lecturers at college of education

Please identify the areas in the std 9 and 10 physical science syllabuses that, in your experience, cause the most problems for first year students. Rank the areas in terms of difficulty (that the students experience), by writing a number from 1-15 (1 being the most difficult) next to the topic.

AREAS	RANKING
Bodies in motion	___
Electrostatics	___
The Electric Current	___
Reaction rates and chemical equilibrium	___
Acids and bases	___
Oxidation reduction and electrochemical cells	___
Organic Chemistry	___
Vectors	___
Displacement-time, Velocity-time relationships	___
Light	___
The Atom	___
The Periodic Table	___
Chemical Bonding	___
The Kinetic model of matter and intermolecular forces	___
Inorganic chemistry	___

NAME

COLLEGE

DO YOU LECTURE PTD OR STD OR BOTH?

HOW MANY STUDENTS DO YOU LECTURE (APPROXIMATELY)?

PTD_____ STD_____

GENERAL COMMENTS

THANK-YOU SO MUCH!!!

SJ Howie
January 1995

APPENDIX 2

QUESTIONNAIRE FOR PHYSICAL SCIENCE COLLEGE LECTURERS

Identifying problem areas in the STD 9 and STD 10 physical science syllabus for first year physical science candidates entering Colleges of Education.

Results of questionnaire administered in January 1995 to 36 colleges of education lecturers who had to identify the areas in the std 9 and 10 physical science syllabuses that, in their experience, caused the most problems for first year students. They were asked to rank the areas in terms of difficulty, by writing a number from 1-15 (1 being the most difficult) next to each topic. The results of this questionnaire are as follows:

AREAS		RESULTS	RANKING
1.	Bodies in motion	6.7	7
2.	Electrostatics	8.5	9
3.	The Electric Current	12	14
4.	Reaction rates and chemical equilibrium	5.5	2
5.	Acids and bases	8.9	11
6.	Oxidation reduction and electrochemical cells	4.9	1
7.	Organic Chemistry	7.9	8
8.	Vectors	6.6	6
9.	Displacement-time, Velocity-time relationships	6.3	5
10.	Light	6.7	7
11.	The Atom	10.1	13
12.	The Periodic Table	9.7	12
13.	Chemical Bonding	8.6	10
14.	The Kinetic model of matter and intermolecular forces	5.9	4
15.	Inorganic chemistry	5.8	3

ANALYSIS OF DATA FROM QUESTIONNAIRE

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Lecturer															
A	3	13	12	5	6	11	4	1	2	15	14	7	8	10	9
B	7	12	4	5	10	2	15	8	3	1	13	14	11	9	6
C	9	13	12	1	3	2	8	10	11	14	15	4	7	5	6
D	7	5	9	10	11	4	10	1	6	8	13	12	5	7	8
E	1	5	3	13	12	6	14	2	8	1	7	15	9	10	11
F	9	5	10	7	12	8	10	8	9	6	12	13	22	4	na
G	1	5	1	1	15	10	15	15	15	10	15	10	10	5	15
H	3	2	5	2	4	1	2	6	5	1	2	3	2	2	2
I	2	1	2	1	10	1	0	3	3	4	2	2	1	1	2
J	2	15	14	3	11	6	8	12	4	5	13	9	10	7	1
K	1	8	2	4	8	8	13	5	1	10	10	10	8	6	3
L	3	1	4	na	na	na	na	5	2	6	na	na	na	na	na
M	2	14	3	na	na	5	6	4	1	na	na	15	na	na	na
N	6	5	7	9	10	10	3	8	5	6	8	9	8	11	10
O	15	7	7	1	7	1	7	15	1	1	7	1	7	1	7
P	5	6	3	10	4	15	8	1	14	7	13	9	12	11	2
Q	10	10	1	2	5	2	1	1	12	15	15	5	2	12	5
R	3	14	1	5	4	7	8	6	2	15	11	10	13	12	9
S	2	3	4	na	na	na	na	5	1	6	na	na	na	na	na

T	15	14	6	7	13	4	1	5	na	8	9	10	11	2	3
U	14	9	6	8	7	2	15	3	4	12	11	13	10	5	1
V	3	9	10	4	15	7	11	1	2	5	12	14	6	8	13
W	13	8	7	4	5	6	2	12	9	10	15	14	11	3	1
X	13	9	6	7	11	6	8	7	7	10	6	11	10	6	5
**Y	14	8	4	6	3	2	9	7	5	11	1	13	15	12	10
Z	10	5	3	2	5	1	5	10	10	1	14	12	14	5	2
AA	3	4	12	10	7	4	10	6	7	7	5	8	8	3	4
BB	6	5	10	6	7	6	5	6	6	3	1	3	4	4	2
CC	6	2	9	3	13	4	14	7	8	5	11	15	10	1	12
DD	7	4	3	10	12	13	5	1	6	8	15	14	11	2	9
EE	5	10	10	10	10	5	4	4	6	3	5	8	8	1	10
FF	8	7	1	6	10	2	3	13	9	5	11	12	15	14	4
GG	6	10	10	1	5	1	12	13	3	2	8	10	5	3	1
HH	14	1	3	2	10	4	7	15	11	8	12	9	13	5	6
II	11	6	12	5	8	1	14	13	15	9	7	4	2	10	3
JJ	7	13	10	8	14	5	11	1	6	3	12	15	2	4	9
**KK	11	14	6	1	5	4	15	7	2	10	13	9	3	8	12
No of respondants	35	35	35	35	32	32	33	35	34	34	32	33	32	32	31
Total	235	299	420	179	285	163	262	233	214	230	324	320	275	189	181
Average	**7**	**8.5**	**12**	**5.5**	**8.9**	**4.9**	**7.9**	**6.6**	**6.3**	**6.7**	**10.1**	**9.7**	**8.6**	**5.9**	**5.8**

** is not a college lecturer and was not counted in the total

Name	Code	College of Education	PTD	STD	Comments
Stone, R	A	Good Hope	60	0	Organic Chemistry, last chap std 10 seldom covered in schools. To do STS.....food and clothing - need to teach .....organic chemistry. Mechanics section - application of formula, basic maths skills poor. Students without maths battle with physics problems - this is reflected in exam results - students who do not opt for maths or are weak at maths are usually among those who fail final exam. Understanding of atomic structure and implications to ..... of periodic table poorly understood - rote learning a problem, This obviously has implications to an understanding of reactions in organic chemistry. Chem equilibrium - kinetic theory - not understood - rote learning without understanding.
no name	B				
Baba, K	C	Soweto	60	0	Majority left high school 3+ years ago. Basic concepts not grasped. Very few have had exposure to practical or even laboratory activities
Mashimbye, E	D	Lemana	30	0	First year physical science students appear to facing serious problems during their first encounter with colleges of education. Such problems are related to the background information in science, exposure to hands-on practical activities. Research of this nature has been done at our college and published in the Spectrum magazine.
Ngcingwana, EN	E	Masibulele	25	10	More time is needed on the difficult sections and perhaps more practical work has to be done especially in our area where the students are less exposed to laboratories in high schools.
Mabaza,M	F	Clarkebury	52	0	I do not teach most of these topics at college as the content prescribed is the syllabus for std's 2 to 7.
Mohlala,S	G	Mapulaneng	26	34	The knowledge of science that student entering college have, differ from one group to another. The topics that seems to be difficult for some students coming from a certain area/school may be easier for another group coming from a different place altogether.
Modiba, AJ	H	Kwena-Moloto		12	Some of the aspects marked most difficult are said to be not properly covered as a result of lack of teaching resources and theorising in the teaching of science. Lack of laboratory. Lack of competence, initiative, innovations in some teachers.
Moropa, NP	I	Transvaal< Soshanguve	15	20	STD students are better achievers than PTD students. Because students battle with organic chemistry I get the impression, it is ill-taught (at std 10 level) or not taught at all; as a result, students find it difficult, at first to comprehend STS.
Motsileng, PP	J	Dr CN Phatudi	10	10	Most students show no knowledge of matric science. By incorporating STS, it becomes even worse to find out what they knew before and not.

Mogodi, TK	K	Sekgoscse	60	0	Most of the difficulties experiences by this students (PTD1) are compounded by the factthat they are from schools which are ill-equipped or have no laboratories at all and because of teachers having lower qualifications.
Samuel, TP	L	Kwena-Moloto	10	36	I am ranking the physics part of it, as I am teaching the physics section only.
Du Toit, C	M	Indumiso		30	Before staring each topic Students form groups and mind map their existing/understanding/concepts - which is then reported back to the class - this would be a source of existing knowledge and misconceptions.
Maditsi, MR	N	Sekhukhune		15	The year one student I have to teach for the past four years seems to be able in chemistry than physics. With most physics concepts they know what they are but cannot apply them.
Tyawa, INN	O	Sebokeng	25	27	Some topics I presume become very difficult because students never got a chance of doing them at school. The sort of response I get from students is that they usually do not get time to cover the chemistry section at school.
Tshabalala, MG	P	Esikhawini		80	
Ncube, OM	Q	Ndebele	30	28	Secondary students generaliy dodge particular topics that require extra effort. They leave them till a few weeks to the Matric Examinations and instruct students to do them on their own. Their mathematical background ie relatively poor, contributes immensely.
Nkosi, BJ	R	Tshiya		40	I have based my response on the 2nd year STD since the 1st year is STS and some other lecturers handle that.
Nair, PAP	S	Venda		75	I can only rank the physics topics as I am responsible for Physics part of physical science at the college. For chemistry, my colleague has ranked the topics. My experience for the last 7 years is that those who register of physical science and maths courses at the college are coming with very poor symbols in those subjects in the matric HG/SG exams. The ones with better marks get into universities and those rejected by the universities and technikons. get into the college.
Mpaneng, HS	T	Sekhukhune		50	Most of the 1st year work is STS, so these sections would be clearly tackled in the 2nd year. Maybe, also, students could have lost touch with some aspects/topics.
Msibi, AN	U	Sebokeng	30	35	I think as the teachers are "afraid" of chemicals, some sort of centralised laboratories must be constructed. Because generally the students view chemistry as being more difficult than physics. In short, I would like to point out that the problems in general is LACK OF EXPERIMENTATIONS.
Masiangoako, V	V	Tlhabane		30	Students usually find "quntum"mechanics and mechanics a bit difficult.
Webber, R	W	Daveyton	30		Most students have only E or F on SG for matric. Their knowledge is extremely vague, with many misconceptions.

Mudumela, AKG	X	Makhado	15	20	
**Alfred	Y	Giyani			
Diale, MK	Z	Thabamoopo	40	30	The students generally like sections of calculations ie: solving of problems eg: in mechanics. But when it comes to practical and explanation section they find it very difficult. In chemistry they only know most things which they can just memorise.
Ngobeni, BT	AA	Shingwedzi	40		
Mamapa, SS	BB	Mokopane			
Legodi, KO	CC	Bochum		14	I never taught course 1 physical science at college, so what I've written is based on the problems that I encounter in STD 2 & 3.
Thangwana, MEO	DD	Bochum	43		Most teachers seem to have less interest in physics at high school and other most important factor is that most teachers at our area are under-qualified in maths and science. Most of our schools do not have laboratory, so students do most topics or sections theoretically.
Panicker, K	[illegible]	Venda		25	The chapter interference and diffraction are extremely difficult for std 9 pupils. Chemical equilibrium is difficult for std 10 pupils. Even though organic chemistry is easy for the teacher, it is not enjoyed by students.
Van Wyk, R	[illegible]	Tranvaal	25	40	Some of the topics eg: organic chemistry* was never done at school - therefore they experience it to be very difficult. *and inorganic chemistry, redox reactions.
Sebola, SM	GG	Makhado	20	20	
Kantani, PR	HH	Phatsimang	50		I wish I would have a bridging programme for my student. The students I meet come with G and H and I have to start all over again.
Rasalanavito, M	II	Giyani		55	
Kizito, R	JJ	Mankwe		70	
**Brand, M	KK	Wits			Does not feel able to comment - teaches HDE.

** comments noted but not incorporated in analyzing answers with regard to ranking.

APPENDIX 3

ANALYSIS OF EXPERTS'S COMMENTS ON SCIENCE QUESTIONS

QUESTION CODE	EXPERTS INITIALS	EXPERT CODE	WORDING OF QUESTIONS a = simple b = ambiguous c = appropriate d = difficult e = incomprehensible	DIFFICULTY INDEX a = easy b = fair c = difficult	LEVEL OF THINKING TESTED BY THE QUESTION a = understanding of terminology b = understanding of fact and principle c = ability to explain/illustrate d = ability to calculate e = ability to predict f = ability to recommend appropriate action g = ability to make an evaluative judgement	SUITABILITY OF QUESTION FOR THE TOPIC a = poor b = satisfactory c = good

			A	B	C	D	E	A	B	C	A	B	C	D	E	F	G	A	B	C

APPENDIX 4

Name of College.....

Course.....

Student Number.....

Date.....

Test Number.....

TEST PAPER
FOR FIRST YEAR SCIENCE STUDENTS
AT COLLEGES OF EDUCATION

return to
Sarah Howie
c/o HSRC
Group Education
Private Bag X41
Pretoria
0001

April 21, 1996

COLLEGE OF EDUCATION
SCIENCE TEST PAPER

[O1]

1. A zinc spoon is used to stir a copper sulphate solution for a long time.

1.1.1. Does the temperature of solution increase, decrease or remain the same? (1)

1.1.2. Give a reason for your answer in 1.1. (1)

1.2. Name the precipitate which forms. (2)

1.3 Describe the colour change taking place in the solution. (2)

1.4. Why can the reaction taking place be considered to be a redox reaction? (2)

1.5 Which substance acts as an oxidising agent in the reaction? (2)

1.6. What happens to the mass of the spoon? (2)

Total (8)

May 9, 1996

[O5]

2. A copper-zinc electrochemical cell is set up and an ammeter connected in the external circuit shows that the cell is delivering current.

2.1. Write down the equation for the half-reaction which occurs at the cathode. (2)

2.2. In which direction do electrons move in the external circuit? (2)

2.3. Will the mass of the copper plate increase or decrease? (2)

2.4. Name a suitable salt solution which could be used in the zinc half-cell. (2)

2.5. How does the concentration of the solution in the zinc half cell change? (2)

Total (10)

[O11]

3. The net reaction for a zinc-lead electrochemical cell is
$Zn + Pb^{2+} - Zn^{2+} + Pb$

Answer the following questions:

3.1. Is this reaction spontaneous? Give a reason for the answer. (4)

3.2. Write down the anode half-cell reaction. (3)

Total (7)

[O12]

4. An electrochemical cell has the following cell notation:

$Al(s) / Al^{3+}(aq) // M^{2+}(aq) / M(s)$

If the E.M.F. of the cell under standard conditions is 2,00V,

4.1.1. determine, using the REDOX tables provided, what element M is. (Clearly show how you determine this element). (6)

4.1.2. Give the correct half reactions and the complete overall reaction when the cell delivers current. (3)

4.1.3. A salt bridge is an essential component of any cell. Briefly explain the purpose of the salt bridge. (3)

4.2. Propane belongs to a homologous series and it is highly flammable.

4.2.1. Name the homologous series to which propane belongs. (2)

Total (14)

[O15]

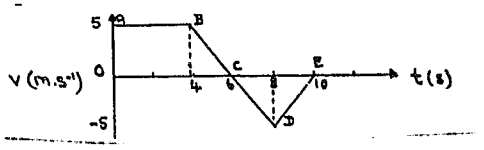
5. In which reaction is Fe^{2+} being oxidised?

A Fe - $Fe^{2+} + 2e^-$
B $Fe^{2+} + 2e^-$ - Fe
C Fe^{2+} - $Fe^{3+} + e^-$
D $Fe^{3+} + e^-$ - Fe^{2-} (3)

Total (3)

[V4]

6. The graph represents the velocity of a body moving horizontally towards the east.



Calculate the magnitude and direction of the displacement of the body after it has been in motion for 10s.
(Use the graph. Do not use the equations of motion.) (7)

Total (7)

[V19]

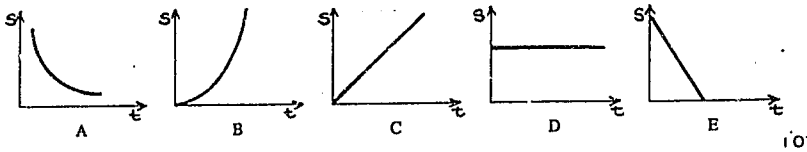
7. A car of mass M is moving along a straight level road at a certain velocity. The driver then applies the brakes and the car decelerates uniformly coming to a stop after travelling a distance S. A second car of mass 2M is moving under similar conditions at the same velocity. If the second car brakes with the same retarding force as the first car in what distance will the second car stop?

A. 4S B. 2S C. S
D. 1/2S E. 1/4S (4)

Total (4)

[V24]

8. A steel ball rolls down an incline of constant slope. Which one of the following graphs describes the relationship between the displacement (s) and the time (t) correctly?
(Friction is negligible.) (3)



Total (3)

[V26]

9. A traffic patrol car stops at a red robot along a straight road. A truck, maintaining a constant velocity of 9 $m.s^{-1}$ passes the patrol car and goes through the red robot . The robot only turns greens 10 seconds later and at this instant the patrol car accelerates uniformly at 2 $m.s^{-2}$ and chases the truck.

9.1 Calculate the time the patrol car took, from the moment it left the robot, to overtake the truck. (14)

[HINT: at the moment of overtaking both vehicles have travelled the same distance from the robot.]

9.2. Calculate how far both vehicles were from the robot at the moment of overtaking. (4)

[V33]

10. Which one the following statements is false?

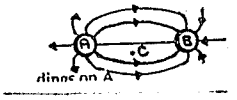
An object can have, at some stage of its motion:

A constant speed, even though its velocity is changing,
B constant acceleration, even though its velocity is changing,
C constant velocity, even though its speed is changing,
D zero velocity, even though its acceleration is not zero. ( )

Total ( )

[E2]

11. The diagram shows the electric field between two point charges A and B.



11.1. State the nature of the charges carried by A and B. (2)

11.2. In what direction will a positive test charge placed at point C move? (2)

Total (4)

[E5]

12. A potential of 1000V exists between two parallel vertical metal plates 0,01m apart in a vacuum.



12.1 Sketch the electric field pattern between the plates. (3)

12.2. Calculate the work done by the electric field on a positive charge of $8x10^{-19}C$ that moves from the positive plate to the negative plate. (3)

12.3 Determine the magnitude of the electric force acting on the positive charge. (3)

Total (9)

[E14]

13. When two identical positively charged point charges are a certain distance apart they repel each other with a force of 1×10^{-3}N.

13.1. Make a free hand sketch to show the pattern of the electric field formed by the two charges. (5)

13.2. The point charges are now moved 3mm closer to each other and this time repel each other with a force of 4×10^{-3}N.

a. How far apart were the charges originally? (4)

b. What was the magnitude of each charge? (7)

Total (16)

[E21]

14. A small sphere with a charge of $+5 \times 10^{-9}$C experiences an electrostatic force of 2×10^{-8}N to the right when placed at a point in a uniform electric field.

14.1. Calculate the magnitude of the electric field strength at this point. (4)

14.2. What is the direction of this electric field? (2)

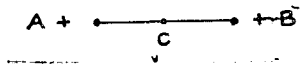
14.3. If an electron is placed in the same field, will the electrostatic force on this electron be greater or less than the electrostatic force on the sphere? (2)

14.4. In which direction will the electron move? (2)

Total (10)

E26

15. A and B in the diagram represent two positive point charges of the same magnitude.



15.1 Draw a neat pencil sketch of the electric field due to the point charges A and B. (3)

15.2. If A = +6nC and B = +6nC and the distance AB = 20mm, calculate the magnitude of the force A exerts on B. (6)

15.3. A positive point charge lies midway between A and B. Explain whether it would experience any resultant force. (2)

Total (11)

[P5]

16. Explain the difference between the covalent radius and Van der Waals radius. (3)

Total (3)

[P6]

17. Point out briefly why positive ions are always smaller and negative ions are always greater than the corresponding atom. Is energy absorbed or liberated during the formation of these ions? Name the kind of energy in each case. (4)

Total (4)

[P11]

18. The first kind of ionisation energy of magnesium is 734 $kJ.mol^{-1}$. Calculate the energy of an electron found in the 3s-orbital of the magnesium atom. [$-1,22 \times 10^{-21}$J] (3)

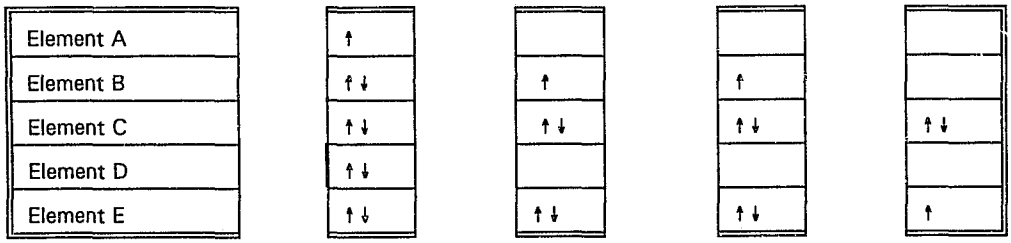
Total ( )

[P15]

19. Compare the first ionisation energy of metals and nonmetals. Use the concepts of atomic radius and nuclear charge to explain the difference. (3)

Total (3)

20. The following seven questions refer to the elements marked A,B,C,D,E, the valence electron structures of which are indicated below:



[NOTE: All these elements appear in the same period in the periodic table.

a) Which element will definitely be a gas at room temperature? (1)

b) Which element will be found in Group IV of the periodic table? (1)

c) Which element(s) will most probably be metal(s)? (1)

d) The negative ion of which element will have the same electron structure as element C? (1)

e) The negative ion of which element will have the same electron structure as element A? (1)

f) Which element(s) appear(s) in the s-block of elements in the periodic table? (1)

g) Which element(s) appear(s) in the p-block of elements in the periodic table? (1)

Total (7)

Total = 190 marks

DATA SHEET FOR CHEMISTRY

STANDARD REDUCTION POTENTIALS OF A NUMBER OF HALF-REACTIONS

Half-reaction			
Oxidising agent		Reducing agent	E°(volts)
$Li^+ + e^-$	⇌	Li	-3,04
$K^+ + e^-$	⇌	K	-2,92
$Ba^{2+} + 2e^-$	⇌	Ba	-2,90
$Ca^{2+} + 2e^-$	⇌	Ca	-2,87
$Na^+ + e^-$	⇌	Na	-2,71
$Mg^{2+} + 2e^-$	⇌	Mg	-2,37
$A\ell^{3+} + 3e^-$	⇌	$A\ell$	-1,66
$Mn^{2+} + 2e^-$	⇌	Mn	-1,18
$2H_2O + 2e^-$	⇌	$H_2(g) + 2OH^-$	-0,83
$Zn^{2+} + 2e^-$	⇌	Zn	-0,76
$Cr^{2+} + 2e^-$	⇌	Cr	-0,74
$Cr^{3+} + 3e^-$	⇌	Cr	-0,74
$Fe^{2+} + 2e^-$	⇌	Fe	-0,44
$Cr^{3+} + e^-$	⇌	Cr^{2+}	-0,41
$Cd^{2+} + 2e^-$	⇌	Cd	-0,40
$Co^{2+} + 2e^-$	⇌	Co	-0,28
$Ni^{2+} + 2e^-$	⇌	Ni	-0,25
$Sn^{2+} + 2e^-$	⇌	Sn	-0,14
$Pb^{2+} + 2e^-$	⇌	Pb	-0,13
$Fe^{3+} + 3e^-$	⇌	Fe	-0,04
$2H^+ + 2e^-$	⇌	$H_2(g)$	0,00
$S + 2H^+ + 2e^-$	⇌	$H_2S(g)$	+0,14
$Sn^{4+} + 2e^-$	⇌	Sn^{2+}	+0,15
$SO_4^{2-} + 4H^+ + 2e^-$	⇌	$SO_2(g) + 2H_2O$	+0,17
$Cu^{2+} + 2e^-$	⇌	Cu	+0,34
$2H_2O + O_2 + 4e^-$	⇌	$4OH^-$	+0,40
$SO_2 + 4H^+ + 4e^-$	⇌	$S + 2H_2O$	+0,45
$I_2 + 2e^-$	⇌	$2I^-$	+0,54
$O_2(g) + 2H^+ + 2e^-$	⇌	H_2O_2	+0,68
$Fe^{3+} + e^-$	⇌	Fe^{2+}	+0,77
$NO_3^- + 2H^+ + e^-$	⇌	$NO_2(g) + H_2O$	+0,78
$Hg^{2+} + 2e^-$	⇌	$Hg(\ell)$	+0,78
$Ag^+ + e^-$	⇌	Ag	+0,80
$NO_3^- + 4H^+ + 3e^-$	⇌	$NO(g) + 2H_2O$	+0,96
$Br_2(\ell) + 2e^-$	⇌	$2Br^-$	+1,06
$O_2(g) + 4H^+ + 4e^-$	⇌	$2H_2O$	+1,23
$MnO_2 + 4H^+ + 2e^-$	⇌	$Mn^{2+} + 2H_2O$	+1,28
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	⇌	$2Cr^{3+} + 7H_2O$	+1,33
$C\ell_2(g) + 2e^-$	⇌	$2C\ell^-$	+1,36
$MnO_4^- + 8H^+ + 5e^-$	⇌	$Mn^{2+} + 4H_2O$	+1,52
$Co^{3+} + e^-$	⇌	Co^{2+}	+1,82
$F_2(g) + 2e^-$	⇌	$2F^-$	+2,87

Increasing oxidising ability ↓

Increasing reducing ability ↑

APPENDIX 5

NAME OF COLLEGE:.....

COURSE .....

STUDENT NUMBER.....

DATE.....

TEST NUMBER.....

YEAR OF MATRICULATION.....

QUESTIONNAIRE
FOR FIRST YEAR SCIENCE STUDENTS
AT COLLEGES OF EDUCATION
1996

return to
Sarah Howie
c/o HSRC
Group Education
Private Bag X41
Pretoria
0001

General guidelines for completing the questionnaire

The answers to the questions in this questionnaire will be used for a project looking at initial teacher training. Your class is one of a few selected classes participating in the study. Your contribution is very important to me as it forms part of my postgraduate university studies.

As you glance through this questionnaire, you will find some questions asking you for facts, whilst others are seeking your opinion. Please answer all of these questions as completely, honestly and as clearly as possible.

Do not write in the shaded blocks.

Write a tick in the box which indicates your answer. If you are asked to specify your answer, please write this out in full.

Thank you for helping me by participating in this project.

Sarah Howie
April 1996

1. When were you born? __/__/____ (day/month/year)	
2. Are you male or female? (M = male and F = female)	
3. What is your home language?	
Northern Sotho	
Southern Sotho	
Tswana	
Xhosa	
English	
Zulu	
Venda	
Afrikaans	
Swazi	
Ndebele	
Shangaan	
4. Was the area where you grew up:	
the centre of a city.....	
the edge/outskirts of a city/town...	
a small town in a rural area.....	
a rural village.....	
other (specify)	

5. Do you know what education your parents received? (M = mother and F = father)	M	F
i. primary school		
ii. secondary school up to std 7		
iii. secondary school up to std 10 (did not finish)		
iv. Matriculated (finished std 10)		
v. completed technical/vocational education after school		
vi. attended university (did not complete)		
vi. attended university and completed degree		
vii. attended a college of education		
viii. attended a technikon		
ix. Not sure		

6. Where was your school situated?					
in a rural area		in a village		in a rural town	
in the centre of a city		the outskirts of a city			

7. What did your parents want you to do after finishing school?					
get a job		technikon		college of education	
apprenticeship		university		technical college	
other, (specify)					

8. What advice did your teachers give?					
technikon		full time employment		university	
college of education		apprenticeship		technical college	
other		they did not advise			

9. Was teaching/attending a college of education your first choice?	yes	no

If not what was? (indicate your first, second, third choice etc)	order from 1-6
technikon	
fulltime employment	
university	
artisan/apprenticeship	
technical training	
other	

10. In your community, how would you regard the status of the following occupations? Please order them from 1 to 12 (1 being regarded the highest and 12 the lowest).	order from 1-12
lawyer	
fireman	
doctor	
engineer	
plumber	
primary school teacher	
nurse	
technician	
train driver	
accountant	
secondary school teacher	

11. Indicate the subjects you studied for matric; at what grade (higher/standard grade); and the symbol you achieved?

Subject	Higher Grade	Standard Grade	Lower Grade	Symbol
accountancy				
Afrikaans				
agriculture				
biblical studies				
biology				
business economics				
economics				
English				
geography				
history				
Latin				
mathematics				
science				
other language (specify)				
other subject(specify)				

12. During your matric year, how much time did you spend on each of the following activities?	never	0-1hr	1-2 hrs	2-5hrs	more than 5hrs
playing sport					
doing chores around the house					
reading a book for fun					
doing science homework					
part-time paid job					
watching television					
going to movies					
studying or doing other homework					
spending time with friends					

13a. How did you used to get to school?					
walking		bicycle		train	
bus		car		school bus	
taxi/minibus		motorbike		other	

13b. How long did it take you to travel to school?	

14. During your schooling, where did you live?					
house		flat		school hostel	
informal settlement		other			

15. Did you have a quiet place to study in, when you in matric?	yes		no	

16. Did your school have the following facilities?					
library		soccer/rugby/hockey field/s		netball/tennis courts	
swimming pool		computer room		science laboratories	

17. Were you ever prevented from attending school by the following:	never	yes	number of days
problems with transport			
strikes by teacher			
strikes by pupils			
weather			
political unrest			
damaged school buildings			
other			

18. How many pupils were in your class (not standard) in matric?	

19. Mark the words below which best describe your feelings about science at school?					
easy		fun		difficult	
enjoyable		boring		exciting	
dull		challenging			

20. In your opinion what does it take to do well in science?					
lots of studying		natural ability		lots of memorising	
luck					

21. What do you think makes science enjoyable?					
more practical work and experiments		teacher		videos	
visits to companies		more relevance		more exploration on your own	
taking part in competitions		other			

22. How confident are you that you understand the following areas in science?
Indicate if you are confident of understanding the area or not (x).

AREAS	not at all confident	a little confident	confident	very confident
Bodies in motion				
Electrostatics				
The Electric Current				
Reaction rates and chemical equilibrium				
Acids and bases				
Oxidation reduction and electrochemical cell				
Organic Chemistry				
Vectors				
Displacement-time, Velocity-time relationships				
Light				
The Atom				
The Periodic Table				
Chemical Bonding				
The Kinetic model of matter and intermolecular forces				
Inorganic chemistry				

write your answer below

23. If there were areas which you were not confident in, how are you going to improve your knowledge/gain confidence so that you are able to teach these areas after you qualify?	

24. What courses are offered by this college?	
JPTD	
SPTD	
STD	
HDE	
BPRIMED	

25. What subjects have you chosen to study?	
English	
Home Language	
Afrikaans	
Mathematics	
Science	
Geography	
History	
Biology	
Economics	
Computers	
other	
compulsory courses, no selection	

26. What made you select this college to study at?	
college's reputation	
teacher/s	
parents	
friends	
other (specify)	

27. How many years do you think it will take to get your diploma?					
minimum time		1 year over the minimum time		2 years over the minimum time	
longer					

28. When you qualify, how long do you expect to teach for?					
1 year		2-4 years		5 years	
10 years		15 years		20 years	
more than 20 years					

1996-4-21 / 12:21

NAME OF COLLEGE:.....

COURSE .....

STUDENT NUMBER.....

DATE.....

TEST NUMBER.....

YEAR OF MATRICULATION.....

QUESTIONNAIRE
FOR FIRST YEAR SCIENCE STUDENTS
AT COLLEGES OF EDUCATION
1996

return to
Sarah Howie
c/o HSRC
Group Education
Private Bag X41
Pretoria
0001

General guidelines for completing the questionnaire

The answers to the questions in this questionnaire will be used for a project looking at initial teacher training. Your class is one of a few selected classes participating in the study. Your contribution is very important to me as it forms part of my postgraduate university studies.

As you glance through this questionnaire, you will find some questions asking you for facts, whilst others are seeking your opinion. Please answer all of these questions as completely, honestly and as clearly as possible.

Do not write in the shaded blocks.

Write a tick in the box which indicates your answer. If you are asked to specify your answer, please write this out in full.

Thank you for helping me by participating in this project.

Sarah Howie
April 1996

1. When were you born? __/__/___ (day/month/year)	
2. Are you male or female? (M = male and F = female)	
3. What is your home language?	
Northern Sotho	
Southern Sotho	
Tswana	
Xhosa	
English	
Zulu	
Venda	
Afrikaans	
Swazi	
Ndebele	
Shangaan	
4. Was the area where you grew up:	
the centre of a city.....	
the edge/outskirts of a city/town...	
a small town in a rural area.....	
a rural village.....	
other (specify)	

5. Do you know what education your parents received? (M = mother and F = father)	M	F
i. primary school		
ii. secondary school up to std 7		
iii. secondary school up to std 10 (did not finish)		
iv. Matriculated (finished std 10)		
v. completed technical/vocational education after school		
vi. attended university (did not complete)		
vi. attended university and completed degree		
vii. attended a college of education		
viii. attended a technikon		
ix. Not sure		

6. Where was your school situated?					
rural area		in a village		in a rural town	
in the centre of a city		the outskirts of a city			

9, 1996

7. What did your parents want you to do after finishing school?					
get a job		technikon		college of education	
apprenticeship		university		technical college	
other, (specify)					

8. What advice did your teachers give?					
technikon		full time employment		university	
college of education		apprenticeship		technical college	
other		they did not advise			

9. Was teaching/attending a college of education your first choice?	yes	no

If not what was? (indicate your first, second, third choice etc)	order from 1-6
technikon	
fulltime employment	
university	
artisan/apprenticeship	
technical training	
other	

10. In your community, how would you regard the status of the following occupations? Please order them from 1 to 12 (1 being regarded the highest and 12 the lowest).	order from 1-12
lawyer	
fireman	
doctor	
engineer	
plumber	
primary school teacher	
nurse	
technician	
train driver	
accountant	
secondary school teacher	

11. Indicate the subjects you studied for matric; at what grade (higher/standard grade); and the symbol you achieved?

Subject	Higher Grade	Standard Grade	Lower Grade	Symbol
accountancy				
Afrikaans				
agriculture				
biblical studies				
biology				
business economics				
economics				
English				
geography				
history				
Latin				
mathematics				
science				
other language (specify)				
other subject(specify)				

12. During your matric year, how much time did you spend on each of the following activities?	never	0-1hr	1-2 hrs	2-5hrs	more than 5hrs
playing sport					
doing chores around the house					
reading a book for fun					
doing science homework					
part-time paid job					
watching television					
going to movies					
studying or doing other homework					
spending time with friends					

13a. How did you used to get to school?

walking		bicycle		train	
bus		car		school bus	
taxi/minibus		motorbike		other	

13b. How long did it take you to travel to school?

14. During your schooling, where did you live?

house		flat		school hostel	
informal settlement		other			

15. Did you have a quiet place to study in, when you in matric?		yes		no	

16. Did your school have the following facilities?

library		soccer/rugby/hockey field/s		netball/tennis courts	
swimming pool		computer room		science laboratories	

17. Were you ever prevented from attending school by the following:	never	yes	number of days
problems with transport			
strikes by teacher			
strikes by pupils			
weather			
political unrest			
damaged school buildings			
other			

18. How many pupils were in your class (not standard) in matric?

19. Mark the words below which best describe your feelings about science at school?

easy		fun		difficult	
enjoyable		boring		exciting	
dull		challenging			

20. In your opinion what does it take to do well in science?					
lots of studying		natural ability		lots of memorising	
luck					

21. What do you think makes science enjoyable?					
more practical work and experiments		teacher		videos	
visits to companies		more relevance		more exploration on your own	
taking part in competitions		other			

22. How confident are you that you understand the following areas in science?
Indicate if you are confident of understanding the area or not (x).

AREAS	not at all confident	a little confident	confident	very confident
Bodies in motion				
Electrostatics				
The Electric Current				
Reaction rates and chemical equilibrium				
Acids and bases				
Oxidation reduction and electrochemical cell				
Organic Chemistry				
Vectors				
Displacement-time, Velocity-time relationships				
Light				
The Atom				
The Periodic Table				
Chemical Bonding				
The Kinetic model of matter and intermolecular forces				
Inorganic chemistry				

write your answer below

23. If there were areas which you were not confident in, how are you going to improve your knowledge/gain confidence so that you are able to teach these areas after you qualify?	

24. What courses are offered by this college?	
JPTD	
SPTD	
STD	
HDE	
BPRIMED	

25. What subjects have you chosen to study?	
English	
Home Language	
Afrikaans	
Mathematics	
Science	
Geography	
History	
Biology	
Economics	
Computers	
other	
compulsory courses, no selection	

26. What made you select this college to study at?	
college's reputation	
teacher/s	
parents	
friends	
other (specify)	

27. How many years do you think it will take to get your diploma?					
minimum time		1 year over the minimum time		2 years over the minimum time	
longer					

28. When you qualify, how long do you expect to teach for?					
1 year		2-4 years		5 years	
10 years		15 years		20 years	
more than 20 years					

1996-4-21 / 12:21

APPENDIX 6

NAME OF COLLEGE:.....

COURSE .....

NAME.....

PRESERVICE SCIENCE STUDENTS AT COLLEGES OF EDUCATION QUESTIONNAIRE FOR LECTURERS 1996

return to
Sarah Howie
c/o HSRC
Group Education
Private Bag X41
Pretoria
0001

General guidelines for completing the questionnaire

The answers to the questions in this questionnaire will be used for a project looking at initial teacher training. Your class is one of a few selected classes participating in the study. Your contribution is very important to me as it forms part of my postgraduate university studies.

As you glance through this questionnaire, you will find some questions asking you for facts, whilst others are seeking your opinion. Please answer all of these questions as completely, honestly and as clearly as possible.

Do not write in the shaded blocks.

Write a tick in the box which indicates your answer. If you are asked to specify your answer, please write this out in full.

Thank you for participating in this project and for helping me.

Sarah Howie

1. When were you born? __/__/____ (day/month/year)							
2. Are you male or female? (M = male and F = female)							
3. What is your home language?							
Northern Sotho							
Southern Sotho							
Tswana							
Xhosa							
English							
Zulu							
Venda							
Afrikaans							
Swazi							
Ndebele							
Shangaan							
other (specify)							
How many years have you lectured at this college of education?							
Where did you obtain your qualifications?							
technikon		university		technical college			
college of education (3 year course)		college of education (4 year course)					
How many years did you *teach at school level?*		Primary school		Secondary school			
What qualifications do you have?							
matric		BEd		Technikon diploma			
teaching diploma		doctorate		BA			
master's degree		higher diploma of education		BSc			
Was lecturing at a college of education your first choice?						yes	no
If not where would you prefer to work?						order from 1-6	

10. From the following list of occupations, select in order of the status of the occupation in your community/society:	order from 1-12
lawyer	
fireman	
doctor	
engineer	
college lecturer	
plumber	
primary school teacher	
nurse	
technician	
train driver	
accountant	
secondary school teacher	

How many students are specialising in Science in the first year at this college?			
In your experience, do first year students arrive at the college with a sufficient knowledge of science?			

19. Mark the words below which best describe your feelings about science taught at secondary school?

easy		fun		difficult	
enjoyable		boring		exciting	
dull		challenging			

20. In your opinion what does it take to do well in science?

lots of studying		natural ability		lots of memorising	
luck					

21. What do you think makes science enjoyable?

more practical work and experiments		teacher		videos	
visits to companies		more relevance		more exploration on your own	
taking part in competitions		other			

22. Rank the following topics from 1 - 15 in order that you feel the students have the most difficulty with. (1 = most difficult and 15 = easiest).

AREAS	Ranking 1-15
Bodies in motion	
Electrostatics	
The Electric Current	
Reaction rates and chemical equilibrium	
Acids and bases	
Oxidation reduction and electrochemical cell	
Organic Chemistry	
Vectors	
Displacement-time, Velocity-time relationships	
Light	
The Atom	
The Periodic Table	
Chemical Bonding	
The Kinetic model of matter and intermolecular forces	
Inorganic chemistry	

24. What courses does your college offer?

JPTD	
SPTD	
STD	
HDE	
BPRIMED	

25. What courses do you lecture?

How long do you expect to lecture for?

1 year		2-4 years		5 years	
10 years		15 years		20 years	
more than 20 years					

Which of the following topics have been taught to your class this year?

AREAS	not taught at all	part of the topic taught	large part of topic taught	topic completed	
Bodies in motion					
Electrostatics					
The Electric Current					
Reaction rates and chemical equilibrium					
Acids and bases					
Oxidation reduction and electrochemical cell					
Organic Chemistry					
Vectors					
Displacement-time, Velocity-time relationships					
Light					
The Atom					
The Periodic Table					
Chemical Bonding					
The Kinetic model of matter and intermolecular forces					
Inorganic chemistry					

APPENDIX 7

REMAINING SCIENCE QUESTIONS AFTER FIRST ELIMINATION

QUESTION CODE	EXPERTS INITIALS	EXPERT CODE	WORDING OF QUESTIONS a = simple b = ambiguous c = appropriate d = difficult e = incomprehensible					DIFFICULTY INDEX a = easy b = fair c = difficult			LEVEL OF THINKING TESTED BY THE QUESTION a = understanding of terminology b = understanding of fact and principle c = ability to explain/illustrate d = ability to calculate e = ability to predict f = ability to recommend appropriate action g = ability to make an evaluative judgement							SUITABILITY OF QUESTION FOR THE TOPIC a = poor b = satisfactory c = good		
			A	B	C	D	E	A	B	C	A	B	C	D	E	F	G	A	B	C
O1	TZ,DM	E2			2				2			2								2
O5	TZ,DM	E2	1		1			2				1								2
O7	CQ	E3			1				1		1	1		1	1		1			1
O8	TZ,DM	E2			1	1		1		1	1						1		1	1
O11	TZ,DM	E2			2				2		1	1				1			1	1
O12	CQ	E3			1				1		1	1	1	1	1					1
O13	CQ	E3			1			1			1	1							1	
O14	JW,MR	E1			1M	M		M		1	M	1 M	1						M	
O15	TZ,DM	E2	1		1			1	1			2							1	1
O16	JW,MR	E1	1			M		M			M	1 M					1		1	
O20	TZ,DM	E2				1	1		1	1					1	1	1		1	1
O23	CQ	E3			1			1			1	1		1					1	

REMAINING SCIENCE QUESTIONS AFTER FIRST ELIMINATION

QUESTION CODE	EXPERTS INITIALS	EXPERT CODE	WORDING OF QUESTIONS a = simple b = ambiguous c = appropriate d = difficult e = incomprehensible					DIFFICULTY INDEX a = easy b = fair c = difficult			LEVEL OF THINKING TESTED BY THE QUESTION a = understanding of terminology b = understanding of fact and principle c = ability to explain/illustrate d = ability to calculate e = ability to predict f = ability to recommend appropriate action g = ability to make an evaluative judgement							SUITABILITY OF QUESTION FOR THE TOPIC a = poor b = satisfactory c = good		
			A	B	C	D	E	A	B	C	A	B	C	D	E	F	G	A	B	C
V3	TZ,DM	E2	1		1			1	1		1	1	1							1
V4	JW,TZ,DM,CQ,MR	E1-E3	2		2M	M		1	3M		1	3	M	3					1 M	3
V6	JW,MR	E1			1	M			1M		1	1 M							1	M
V7	TZ,DM	E2			1	1				1						1	1		2	
V10	TZ,DM	E2	1		1			1	1		1	1							1	1

REMAINING SCIENCE QUESTIONS AFTER FIRST ELIMINATION

QUESTION CODE	EXPERTS INITIALS	EXPERT CODE	WORDING OF QUESTIONS a = simple b = ambiguous c = appropriate d = difficult e = incomprehensible					DIFFICULTY INDEX a = easy b = fair c = difficult			LEVEL OF THINKING TESTED BY THE QUESTION a = understanding of terminology b = understanding of fact and principle c = ability to explain/illustrate d = ability to calculate e = ability to predict f = ability to recommend appropriate action g = ability to make an evaluative judgement							SUITABILITY OF QUESTION FOR THE TOPIC a = poor b = satisfactory c = good		
			A	B	C	D	E	A	B	C	A	B	C	D	E	F	G	A	B	C
V19	JW,MR	E1			1	M			1M			M	1	1 M						1 M
V24	JW,TZ,D M,CQ,MR	E1-E3	2		1M				3M	1M	2	3 M			2		1		2 M	2
V25	TZ,DM	E2	1		1			1	1		2									1
V26	JW,MR	E1			1M				1	M	1	M		1 M	M		1		1	M
V29	CQ	E3			1					1	1	1								1
V31	JW,MR	E1			1	M			1M		1	M					1		1 M	
V33	TZ,DM	E2	1			1		1	1		2	1								2
V34	CQ	E3			1				1		1	1							1	
V40	CQ	E3			1				1		1	1								1

REMAINING SCIENCE QUESTIONS AFTER FIRST ELIMINATION

QUESTION CODE	EXPERTS INITIALS	EXPERT CODE	WORDING OF QUESTIONS a = simple b = ambiguous c = appropriate d = difficult e = incomprehensible					DIFFICULTY INDEX a = easy b = fair c = difficult			LEVEL OF THINKING TESTED BY THE QUESTION a = understanding of terminology b = understanding of fact and principle c = ability to explain/illustrate d = ability to calculate e = ability to predict f = ability to recommend appropriate action g = ability to make an evaluative judgement							SUITABILITY OF QUESTION FOR THE TOPIC a = poor b = satisfactory c = good		
			A	B	C	D	E	A	B	C	A	B	C	D	E	F	G	A	B	C
E1	JW,MR	E1			1	M			1	M		M		1 M	1				1	
E2	TZ,DM	E2			2				2			1		1	1		1			2
E3	CQ	E3			1				1		1	1	1	1					1	
E4	JW,MR	E1			1	M				1		1		1	1		1			1
E5	TZ,DM	E2			1	1			1	1		1		1		1	1		1	1
E7	TZ,DM	E2	1		1				2					1	1	1				2
E9	CQ	E3	1			1		1		1	1	1 M		1 M					1 M	
E14	JW,MR	E1			1	M			1	M		1 M		1 M	1				1 M	
E15	TZ,DM	E2			2				2					1		1				2
E16	CQ	E3			1				1		1	1			1					1

REMAINING SCIENCE QUESTIONS AFTER FIRST ELIMINATION

QUESTION CODE	EXPERTS INITIALS	EXPERT CODE	WORDING OF QUESTIONS a = simple b = ambiguous c = appropriate d = difficult e = incomprehensible					DIFFICULTY INDEX a = easy b = fair c = difficult			LEVEL OF THINKING TESTED BY THE QUESTION a = understanding of terminology b = understanding of fact and principle c = ability to explain/illustrate d = ability to calculate e = ability to predict f = ability to recommend appropriate action g = ability to make an evaluative judgement							SUITABILITY OF QUESTION FOR THE TOPIC a = poor b = satisfactory c = good		
			A	B	C	D	E	A	B	C	A	B	C	D	E	F	G	A	B	C
P5	JW,MR	E1	1		M				M	1	1	1 M	1 M						1 M	
P6	TZ,DM	E2	1		1				1	1		1				1			1	1
P8	TZ,DM	E2	1		1			1	1		1		1						2	
P10	TZ,DM	E2	1		1			1	1		1			2					1	1
P11	JW,MR	E1	1		M				1	M			M	1 M	M				1 M	
P12	CQ	E3			1			1			1	1							1	
P13	CQ	E3	1					1			1	1	1						1	
P14	CQ	E3	1					1			1	1							1	
P15	CQ	E3			1				1		1	1	1						1	
P19	CQ	E3	1					1			1								1	
P21	CQ	E3				1			1		1	1							1	
P22	CQ	E3			1				1		1	1			1					1

REMAINING SCIENCE QUESTIONS AFTER FIRST ELIMINATION

QUESTION CODE	EXPERTS INITIALS	EXPERT CODE	WORDING OF QUESTIONS a = simple b = ambiguous c = appropriate d = difficult e = incomprehensible					DIFFICULTY INDEX a = easy b = fair c = difficult			LEVEL OF THINKING TESTED BY THE QUESTION a = understanding of terminology b = understanding of fact and principle c = ability to explain/illustrate d = ability to calculate e = ability to predict f = ability to recommend appropriate action g = ability to make an evaluative judgement							SUITABILITY OF QUESTION FOR THE TOPIC a = poor b = satisfactory c = good		
			A	B	C	D	E	A	B	C	A	B	C	D	E	F	G	A	B	C
E18	TZ,DM	E2			1	1			2						1	1			2	
E19	CQ	E3	1						1		1	1								1
E20	TZ,DM	E2			1	1			1	1	1	1	1	1			1		1	1
E21	JW,MR	E1			1	M				1M	1	M		1 M	1 M		1		1 M	
E26	JW,MR	E1, E3			2M			1	1M		2	2 M	1 M	2 M			1		2 M	
P2	TZ,DM	E2			1	1			1	1			1				1		1	1
P4	TZ,DM	E2	1					1					1				1		1	1

REMAINING SCIENCE QUESTIONS AFTER FIRST ELIMINATION

QUESTION CODE	EXPERTS INITIALS	EXPERT CODE	WORDING OF QUESTIONS a = simple b = ambiguous c = appropriate d = difficult e = incomprehensible					DIFFICULTY INDEX a = easy b = fair c = difficult			LEVEL OF THINKING TESTED BY THE QUESTION a = understanding of terminology b = understanding of fact and principle c = ability to explain/illustrate d = ability to calculate e = ability to predict f = ability to recommend appropriate action g = ability to make an evaluative judgement							SUITABILITY OF QUESTION FOR THE TOPIC a = poor b = satisfactory c = good		
			A	B	C	D	E	A	B	C	A	B	C	D	E	F	G	A	B	C
E1	JW,MR	E1			1	M			1	M		M		1 M	1				1	
E2	TZ,DM	E2			2				2			1		1	1		1			2
E3	CQ	E3			1				1		1	1	1	1					1	
E4	JW,MR	E1			1	M				1		1		1	1		1			1
E5	TZ,DM	E2			1	1			1	1		1		1		1	1		1	1
E7	TZ,DM	E2	1		1				2					1	1	1				2
E9	CQ	E3	1			1		1		1	1	1 M		1 M					1 M	
E14	JW,MR	E1			1	M			1	M		1 M		1 M	1				1 M	
E15	TZ,DM	E2			2				2					1		1				2
E16	CQ	E3			1				1		1	1			1					1

Author Howie S J
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