



UNIVERSITY
OF
JOHANNESBURG

FACULTY OF SCIENCE

DEPARTMENT OF APPLIED CHEMISTRY
NATIONAL DIPLOMA: ANALYTICAL CHEMISTRY (4 YEARS)

MODULE CET3AMP
 MATERIALS PROCESSING SCIENCE

CAMPUS DFC

JULY EXAMINATION

DATE: /07/2018

SESSION: 11:30 – 13:30

ASSESSORS

DR M MAMO/PROF K PILLAY

INTERNAL MODERATOR
EXTERNAL MODERATOR

DR R MOUTLOUALI
PROF LM CELE

DURATION 2 HOURS

MARKS 120

NUMBER OF PAGES: 6 PAGES AND 1 ANNEXURE

INSTRUCTIONS: CALCULATORS ARE PERMITTED (ONLY ONE PER STUDENT).

REQUIREMENTS 2 x EXAMINATION BOOKLETS

INSTRUCTIONS:

ANSWER SECTIONS A AND B IN ONE ANSWER BOOKLET AND SECTION C IN THE OTHER ANSWER BOOKLET.

SECTION A; GREEN CHEMISTRY**QUESTION 1**

1.1 Explain the following concept from the green chemistry point of view and give appropriate examples where possible. (1.5 × 4 = 6)

- 1.1.1 Maximize atom economy.
- 1.1.2 Avoid chemical derivatives.
- 1.1.3 Use catalysts, not stoichiometric reagents.
- 1.1.4 Increase energy efficiency.

1.2 Benzoic acid can be synthesized following the two reaction routes as shown below:



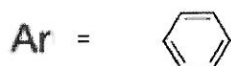
Reaction route 1



Reaction route 2



Where



QUESTION 1(CONTINUED)

- 1.2.1 Compare the two reaction routes from the green chemistry point of view. (6)
- 1.2.2 Calculate the atom efficiency for the two reaction routes. (3)
- 1.3 Explain the advantages and disadvantages of wind power in the environment. (8)
- 1.4 Explain the advantages and disadvantages of the polymer electrolyte membrane fuel cells and Molten carbonate fuel cells. (5 × 2 = 10)
- 1.5 Reactions in the solid state have tremendous advantages and as well as disadvantageous. State the advantages and disadvantages of a solid-state reaction. (5)
- 1.6 Explain the importance of recycling waste materials. (2)
- [40]**
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SECTION B: NANOMATERIALS CHEMISTRY**QUESTION 2**

- 2.1 Define the following terms:
- 2.1.1 Nanomaterials. (1)
- 2.1.2 Nanoparticles. (1)
- 2.2 Explain the following methods of synthesis of nanomaterials and state the advantages and disadvantages of the methods:
- 2.2.1 Solid – state phase synthesis. (4)
- 2.2.2 Sol-gel reaction. (4)
- 2.3 Distinguish between physical vapor deposition and chemical vapor deposition in the synthesis of nanomaterials. (8)
- 2.4 Briefly explain the following methods of nanomaterials synthesis:
- 2.4.1 Electrodeposition. (2)
- 2.4.4 Vacuum arc deposition. (2)
- 2.5 Explain the use of the following techniques in nanomaterials characterisation:
- 2.5.1 Raman spectroscopy. (4)
- 2.5.2 Atomic force microscopy. (4)
- 2.5.3 Transmission Electron Microscopy (TEM/HRTEM). (4)
- 2.6 State three different techniques for the measurement of particle size and particle size distribution. (3)
- 2.7 In the textile industry, either natural or synthetic fabric can be incorporated with nano-sized particles. This process is called nanofinishing. Discuss the incorporation of nano materials in the fabrics. (3)

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SECTION C: WATER QUALITY**QUESTION 3**

- 3.1 Explain the following terms:
- 3.1.1 Wastewater. (2)
- 3.1.2 Pollutant. (2)
- 3.1.3 Chemical Oxygen Demand. (2)
- 3.2 South Africa is one of many countries that is plagued with the problem of acid mine drainage. Discuss the origin of acid mine drainage and explain why this has become such a problematic wastewater in South Africa. (9)
- 3.3 Describe three sources of pathogens in the environment. (10)
- 3.4 Name two methods that are commonly used for the measurement of dissolved oxygen in water. In your opinion which is the more user-friendly method and why? (5)
- 3.5 Although Nanotechnology for water treatment has been well-researched, it has not been successfully implemented practically. Critically discuss this statement highlighting some of the disadvantages of practically implementing nanotechnology for water treatment and proposing possible solutions to these challenges. (10)
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UNIVERSITY OF JOHANNESBURG

Department of Applied Chemistry

1	H	1.0079	2	He	4.0026
Atomic Number			Atomic Weight		

3	Li	6.941	4	Be	9.0122
11	Na	22.990	12	Mg	24.305
19	K	39.098	20	Ca	40.078
37	Rb	85.47	38	Sr	87.62
55	Cs	132.91	56	Ba	137.33
87	Fr	(223)	88	Ra	226.03
21	Sc	44.956	22	Ti	47.88
39	Y	88.906	40	Zr	91.224
57	La	138.91	72	Hf	178.49
89	Ac	227.03	73	Ta	180.95
23	V	50.942	24	Cr	51.996
41	Nb	92.906	42	Mo	95.94
59	Yb	173.05	74	W	183.85
87	Fr	(223)	75	Re	186.2
25	Mn	54.938	26	Fe	55.847
43	Tc	(98)	44	Ru	101.07
55	Cs	132.91	72	Hf	178.49
87	Fr	(223)	73	Ta	180.95
27	Co	58.933	28	Ni	58.69
45	Rh	102.91	46	Pd	106.42
57	La	138.91	72	Hf	178.49
89	Ac	227.03	73	Ta	180.95
29	Cu	63.546	30	Zn	65.39
47	Ag	107.87	48	Cd	112.41
59	Yb	173.05	74	W	183.85
87	Fr	(223)	75	Re	186.2
31	Ga	69.723	32	Ge	72.61
49	In	114.82	50	Sn	118.71
81	Tl	204.38	82	Pb	207.2
33	As	74.922	34	Se	78.96
51	Sb	121.75	52	Te	127.60
83	Bi	208.98	84	Po	(209)
35	Br	79.904	36	Kr	83.80
53	I	126.90	54	Xe	131.29
85	At	(210)	86	Rn	(222)
5	B	10.811	6	C	12.011
13	Al	26.982	14	Si	28.086
31	Ga	69.723	32	Ge	72.61
49	In	114.82	50	Sn	118.71
81	Tl	204.38	82	Pb	207.2
7	N	14.007	8	O	15.999
15	P	30.974	16	S	32.064
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51	Sb	121.75	52	Te	127.60
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9	F	18.998	10	Ne	20.179
17	Cl	35.453	18	Ar	39.948
35	Br	79.904	36	Kr	83.80
53	I	126.90	54	Xe	131.29
85	At	(210)	86	Rn	(222)
58	Ce	140.12	59	Pr	140.91
90	Th	232.04	91	Pa	231.04
60	Nd	144.24	61	Pm	146.92
62	Sm	150.36	63	Eu	151.97
64	Gd	157.25	65	Tb	158.93
66	Dy	162.50	67	Ho	164.93
68	Er	167.26	69	Tm	168.93
70	Yb	173.04	71	Lu	174.97
90	Th	232.04	91	Pa	231.04
92	U	238.03	93	Np	237.05
94	Pu	(244)	95	Am	(243)
96	Cm	(247)	97	Bk	247
98	Cf	(251)	99	Es	(252)
100	Fm	(257)	101	Md	(258)
102	No	(259)	103	Lr	(260)