Aligned to DBE Revised ATPs

Platinum

Physical Sciences

Navigation pack

FET PHASE
GRADE 12

Platinum

Physical Sciences

Pearson

FET PHASE
GRADE 12

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Dear Teacher

The National State of Disaster due to the COVID-19 pandemic has resulted in the disruption of Education in South Africa and the loss of valuable teaching time and disruption of the school calendar.

As a result of this, the DBE has created and released revised Annual Teaching Plans (ATPs) to assist schools and teachers in ensuring the 2021 school year is completed. The 2021 ATPs are based on the revised ATPs that were developed in 2020. It is important to note that fundamental and core topics are retained in the 2021 ATPs. Some of the strategies that have been used in the process of developing the 2021 DBE ATPs are:

- reduction of content covered in certain topics
- merging of topics
- deleting topics
- revising the assessment guidelines
- reduction in teaching time for certain topics
- resequencing of topics/concepts

At Pearson South Africa, we believe that education is the key to every individuals' success. To ensure that despite the challenges, teachers and learners can meet all the necessary learning outcomes for the year, we have created the Navigation Guide, a free resource to support teachers and learners during this challenging time.

The Navigation Pack aims to summarise and highlight the changes in the 2021 DBE ATP and provide teachers and learners with worksheets that focus on impacted topics in the curriculum.

Due to resequencing of topics, the order of topics in the textbook that is currently used in the classroom may not be aligned to the new sequence of topics in the ATP. Pearson has included page numbers from one of our tried and tested series, Platinum, to guide the teacher and learners as they navigate through the textbook, with the 2021 ATP. The Navigation Pack has a set of assessments based on the Section 4 changes and the revised assessment guidelines.

COVID-19 safety guidelines for teachers and learners

Gatherings at school

Where schools are open for learning, it is up to management to take decisive action to ensure sites are not simultaneously used for other functions such as shelters or treatment units in order to reduce the risk.

Implement social distancing practices that may include:

- A staggered timetable, where teachers and learners do not arrive/leave at the same time for the beginning and end of the school day.
- Cancelling any community meetings/events such as assemblies, cake sales, market day, tuckshop, after-care classes, matric dance, Eisteddfod and other events.
- Cancelling any extra-mural activities such as ballet classes, swimming lessons, sport games, music class and other events that create a crowd gathering.
- Teaching and modelling creating space and avoiding unnecessary touching.
- Limiting movement and interaction between classes.
- Schools with an established feeding scheme plan are to ensure that hygiene and social distancing is always implemented. Teachers and staff members assisting with food distribution are to wear masks, sanitise prior to issuing food items and learners are to stand 1,5m apart in the queue.

Wear a mask at all times.

1. Restrooms/toilets

Hand washing

Washing hands with soap or using alcohol-based hand sanitisers is one of the most important ways to help everybody stay healthy at school. Critical to this is preparing and maintaining handwashing stations with soap and water at the toilet and in each classroom.

Teachers and learners should always wash their hands after:

- eating
- entering the classroom
- using the toilet
- blowing your nose or coughing
- touching tears, mucous, saliva, blood or sweat.

2. Premises and classroom setting

When schools open, classroom settings should be altered in order to promote hygiene, safety and social distancing.

Changed classroom settings may include:

- Cleaning and disinfecting school buildings, classrooms and especially sanitation of facilities at least once a day, particularly surfaces that are touched by many people (railings, lunch tables, sports equipment, door and window handles, toys, teaching and learning tools, etc.).
- Ensuring the proper ventilation and fresh flow of air through classrooms.
- Providing learners with vital information about how to protect themselves by incorporating the importance of hygiene, handwashing and other measures of protecting themselves, into the lessons.
- Promoting best handwashing and hygiene practices and providing hygiene supplies.

- Prepare and maintain handwashing stations with soap and water, and if possible, place alcohol-based hand sanitisers in each classroom, at entrances and exits, and near lunchrooms and toilets.

- Ensure teachers and learners wear a mask at all times.

Social distancing

- Space the learners out in the classroom (or outdoors) – try to keep learners separated by a minimum of 1,5m.

- Create space for learner's desks to be at least 1,5m apart
- Learners should not share cups, eating utensils, or food
- Do not let learners eat items that fall on the floor or chew on pencils or other objects
- Learners are not to exceed 30 per class or 50% of original class size

- Avoid close contact, like shaking hands, hugging or kissing

3. Social behaviour

It is extremely vital during a pandemic that focus is not only directed towards optimal physical health and hygiene but finding ways to facilitate mental health support.

- Treat everybody with respect and empathy – no teasing about COVID-19.
- Encourage kindness towards each other and avoid any stereotyping when talking about the virus.
- Stay home if you have a temperature or are ill.
- Do not touch people who are ill, but be empathetic.

Wear a mask at all times.

How to use this Navigation Pack

Revised DBE Teaching Plan: Comprehensive summary of the CAPS topics according to the revised ATPs.

Navigation Plan: Link to the Platinum series, as well as additional resources in the Navigation Pack.

REVISED DBE ANNUAL TEACHING PLAN				NAVIGATION PLAN	
Themes	**Topic**	**Unit**	**Time**	**Links to Platinum series and Pearson Navigation Pack**	**Page reference**
WAVES, SOUND AND LIGHT	Electromagnetic radiation [9 hrs] *10	The nature of electromagnetic radiation	2 hrs	Plat LB Plat TG	Page 84–90 Page 46–48
		The electromagnetic spectrum	3 hrs		
		The electromagnetic radiation as particle – Photon	4 hrs	Navigation Pack: Targeted Worksheet 1	Page 15
	Consolidation and revision [16 hrs]		16 hrs		
HYDROSPHERE *11					
ASSESSMENT		End of year exam		Navigation Pack: Paper 1 Physics	Page 45
		End of year exam		Navigation Pack: Paper 2 Chemistry	Page 56
TOTAL HOURS = 25					

*10 This topic has been moved from term 1 to term 4. This topic is on pages 84–90 in the Platinum LB, and pages 46–48 in the Platinum teacher's guide book.

*11 The whole topic has been removed.

Assessments for the Term as per the revised ATPs and the Section 4 amendments.

Link to a targeted worksheet in the Navigation Pack, that focus on impacted or challenging topics in the curriculum.

Footnotes provide any additional information.

Link to an exemplar assessment in the Navigation Pack, that was created with Section 4 and curriculum changes in mind.

Navigation Guide

FET PHASE

Physical Sciences

GRADE	NO OF WEEKS	CONTENT, CONCEPTS & SKILLS (WEEKS)	FORMAL ASSESSMENT (WEEKS)
10	40	36	4
11	40	36	4
12	40	29	11

*4 hours teaching time per week, with 40 weeks per grade, means the total teaching time per year is 160 hours

THEME	GRADE 10	GRADE 11	GRADE 12
PHYSICS: MECHANICS	Introduction to vectors and scalars, Motion in one dimension, Energy [32 hours]	Vectors in two dimensions, Newton's Law and Application of Newton's Laws [26 hours]	Momentum and Impulse, Vertical projectile motion in one dimension, Work, Energy and Power [25 hours]
PHYSICS: WAVES, SOUND & LIGHT	Transverse pulses on a string or spring, Transverse waves, Longitudinal waves, Sound, Electromagnetic radiation [17 hours]		Doppler Effect [6 hours]
PHYSICS: ELECTRICITY & MAGNETISM	Magnetism, Electrostatics, Electric circuits [14 hours]	Electrostatics, Electromagnetism, Electric circuits [26 hours]	Electric circuits, Electrodynamics [13 hours]
CHEMISTRY: MATTER & MATERIALS	Revise matter and classification, States of matter and the kinetic molecular theory, Atomic structure, Periodic table, Chemical bonding [24 hours]	Atomic combinations, Intermolecular forces, Ideal gases [21 hours]	Optical phenomena and properties of materials**, Organic chemistry, Organic macromolecules [19 hours]
CHEMISTRY: CHEMICAL CHANGE	Physical and chemical change, Representing chemical change, Reactions in aqueous solutions, Quantitave aspects of chemical change,Stoichiometry [15 hours]	Stoichiometry, Energy and chemical change, Types of reactions [29 hours]	Reaction rate, Chemical Equilibrium, Acids and bases, Electrochemical reactions [27 hours]

**physics content

Term 2

REVISED DBE ANNUAL TEACHING PLAN				NAVIGATION PLAN	
THEMES	**TOPICS**	**UNITS**	**TIME**	**LINKS TO PLATINUM SERIES AND PEARSON NAVIGATION GUIDE**	**PAGE REFERENCE**
MECHANICS	Work, energy and power [7 hrs]	Definition of work	1 hr	• Plat LB • Plat TG	• Page 126–144 • Page 59–63
		Work-Energy Theorem	2 hrs		
		Conservative and non-conservative forces	2 hrs		
		Power	2 hrs		
WAVES, SOUND & LIGHT	Doppler Effect [6 hrs]	Doppler effect with sound and ultrasound	4 hrs	• Plat LB • Plat TG	• Page 152–161 • Page 68–71
		Doppler effect with light	2 hrs		
CHEMICAL CHANGE	Rate and extent of reaction [6 hrs)[1]	Reaction rate and factors affecting the rate	2 hrs	• Plat LB • Plat TG • Navigation Pack: Targeted Worksheet 1	• Page 166–184 • Page 75–82 • Page 16–18
		Measuring reaction rates	2 hrs		
		Mechanism of reaction and catalysis	2 hrs		
	Chemical equilibrium [8 hrs]	Chemical equilibrium and factors affecting equilibrium	2 hrs	• Plat LB • Plat TG	• Page 185–207 • Page 83–91
		Equilibrium constant	2 hrs		
		Le Chatelier's principle and applications	2 hrs		
		Calculations based on Kc values	2 hrs		

1 The content time has been increased from 4 hrs to 6hrs.

Term 2

REVISED DBE ANNUAL TEACHING PLAN				NAVIGATION PLAN	
THEMES	**TOPICS**	**UNITS**	**TIME**	**LINKS TO PLATINUM SERIES AND PEARSON NAVIGATION GUIDE**	**PAGE REFERENCE**
CHEMICAL CHANGE	Acids and bases[2] [9 hrs]	Defining acids and bases according to Arrhenius and Lowry-Brønsted.	1 hr	• Plat LB • Plat TG	• Page 209–242 • Page 93–107
		Concentrated and dilute acids/bases; weak and Strong, acids/bases	1 hr		
		Identify conjugate acid-base pairs for given compounds	1 hrs		
		Acid-base reactions	1 hr		
		Titrations	2 hrs		
		pH and salt hydrolysis	1 hr		
		pH scales and calculation of pH values	1 hr		
		Kw and auto-ionization of water; Compare the Ka and Kb values of strong and weak acids	1 hr		
ASSESSMENT		FORMAL TEST		• Navigation Pack: Term 2 Control test	Page 28–32
TOTAL HOURS = 36					

2 The content time has been increased from 8 hrs to 9 hrs.

REVISED DBE ANNUAL TEACHING PLAN				NAVIGATION PLAN	
THEMES	**TOPICS**	**UNITS**	**TIME**	**LINKS TO PLATINUM SERIES AND PEARSON NAVIGATION PACK**	**PAGE REFERENCE**
ELECTRICITY & MAGNETISM	Electric circuits [7 hrs]	Solve problems involving current, voltage and resistance for series and parallel circuits (maximum four resistors)	3 hrs	• Plat LB • Plat TG	• Page 252–259 • Page 116–121
		Internal resistance	1 hrs		
		Solve circuit problems using $\varepsilon = IR_{ext} + Ir$ or $\varepsilon = V_{load} + V_{int}$, with internal resistance and resistors in series and in parallel (maximum four resistors).	3 hrs		
	Electrodynamics [6 hrs][3]	Generators: Energy conversion, how a generator works, AC and DC generators and their components	1,5 hrs	• Plat LB • Plat TG • Navigation Pack: Targeted Worksheet 2	• Page 262–272 • Page 124–127 • Page 19–20
		Motors: Energy conversion, how a motor works, components of motors.	1,5 hrs		
		Alternating current: AC versus DC, Graphs of voltage and current versus time for AC.	1 hr		
		Define rms. Solve problems using $I_{rms} = \frac{I_{max}}{\sqrt{2}}$, $V_{rms} = \frac{V_{max}}{\sqrt{2}}$, $P_{ave} = I^2 rms_R$, $P_{ave} = \frac{V^2_{rms}}{R}$, $P_{ave} = I_{rms} V_{rms}$ $= ½ I_{max} V_{max}$ (for purely resistive circuit)	2 hrs		

3 The content time has been reduced from 8 hrs to 6 hrs. Careful preparation is paramount to teach all the content. Worksheets can be used during teaching for quicker evaluation.

Term 3

REVISED DBE ANNUAL TEACHING PLAN				NAVIGATION PLAN	
THEMES	**TOPICS**	**UNITS**	**TIME**	**LINKS TO PLATINUM SERIES AND PEARSON NAVIGATION PACK**	**PAGE REFERENCE**
MATTER & MATERIALS	Optical phenomena and properties of materials [6 hrs]	Photoelectric effect and its significance; Threshold frequency and work function	1 hr	• Plat LB • Plat TG	• Page 280–291 • Page 132–134
		Calculations using the photoelectric equation $E = W_o + K_{max}$, where $E = hf$ and $W_o = hf_o$ and $K_{max} = ½ m(v_{max})^2$	2 hrs		
		Effect of intensity and frequency on the photoelectric effect	1 hr		
		Emission and absorption spectra	2 hrs		
CHEMICAL CHANGE	Electrochemical reactions [8 hrs]	Oxidation and Reduction processes; defining all related terminology[4]	1 hr	• Plat LB • Plat TG • Navigation Pack: Targeted Worksheet 3	• Page 296–324 • Page 139–147 • Page 22–23
		Galvanic cells. Processes and redox reactions in galvanic cells	1 hr		
		Calculating emf of a galvanic cell	1 hr		
		Relation of current and potential to rate and equilibrium	1 hr		
		Standard electrode potentials and the hydrogen reference electrode	1 hr		
		Electrolytic cells	1 hr		
		Electrolytic processes and industrial uses.	2 hrs		
PRELIMINARY EXAM		Trial exam	3 hrs	• Navigation Pack: Trial exam Paper 1	• Page 33–40
PRELIMINARY EXAM		Trial exam	3 hrs	• Navigation Pack: Trial exam Paper 2	• Page 41–49
TOTAL HOURS = 27					

4 This topic needs proper explanation to learners. Learners tend to understand what is happening but not using the keywords i.e. reduction, cation, anions, reduction potentials, electromotive force, cathode, anode as part of their answers. A glossary worksheet with a set of terminologies explaining each of those terms can be of help.

Term 4

REVISED DBE ANNUAL TEACHING PLAN				NAVIGATION PLAN	
THEMES	TOPICS	UNITS	TIME	LINKS TO PLATINUM SERIES AND PEARSON NAVIGATION GUIDE	PAGE REFERENCE
ALL TOPICS	CONSOLIDATION AND REVISION [15 hrs]				
		TOTAL HOURS = 15			

Targeted Worksheets

Targeted Worksheet 1

Topic: Reaction rate and factors affecting the rate

TARGETED WORKSHEET	TOPIC IN CAPS
1	Reaction rate and factors affecting the rate
2	Electrodynamics
3	Electrolytic cells

Content summary

The main objective here is for learners to

- gain an understanding of collision theory.
- gain an understanding of the four main factors that affect reaction rate.

Explain to learners the reaction rate.

List the factors which affect the rate of chemical reactions:

- Surface area (solid)
- Concentration (solution),
- Pressure (gas)
- Temperature
- Presence of a catalyst
- Nature of reacting substances

Explain in terms of collision theory how the various factors affect the rate of chemical reactions.

To understand the kinetics of chemical reactions, and the factors that affect kinetics, we should first examine what happens during a reaction on the molecular level. According to the collision theory of reactivity, reactions occur when reactant molecules effectively collide. For an effective collision to occur, the reactant molecules must be oriented in space correctly to facilitate the breaking and forming of bonds and the rearrangement of atoms that result in the formation of product molecules.

Targeted Worksheet 1

Time: 30 minutes

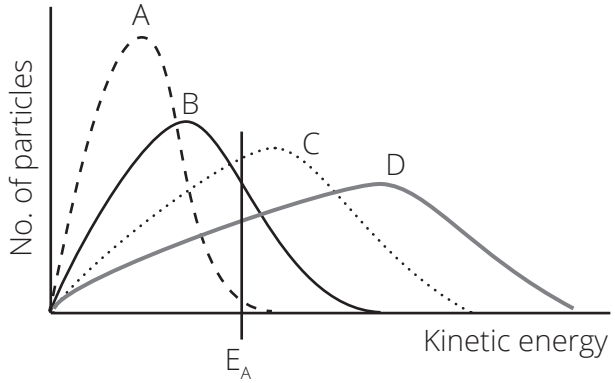
Topic: Reaction rate and factors affecting the rate

Name: **Surname:**

Instructions and information

1. Answer all of the questions.
2. Write your answers on lined paper.
3. Number the questions carefully and follow the instructions.
4. Non-programmable calculators may be used.
5. Round off your answers to TWO decimal places

1. The Boltzmann distribution curves (A, B, C and D) show the number of particles as a function of their kinetic energies for a reaction at four different temperatures.



1.1 What does EA represent? (1)

1.2 Which curve represents the reaction with the greatest number of effective collisions? (1)

1.3 Which curve represents the lowest temperature? (1)

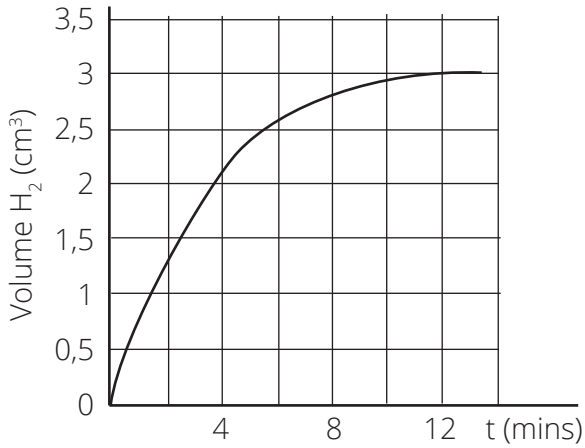
1.4 Which curve represents the reaction with the highest reaction rate? (1)

1.5 Apart from the energy of the effective collisions, what other factor is important for particles to react? (1)

2. Zinc powder is placed in an excess of dilute sulfuric acid. The following reaction takes place:

   $Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$

   The volume of the gas collected is recorded in intervals of 2 minutes and is represented on the graph below.



Use the graph to write down the following:

2.1 How long the reaction lasts. (1)

2.2 The volume of hydrogen gas collected after 2 minutes. (1)

2.3 How long (in minutes) it takes for 50% of the reaction to occur. (1)

2.4 For which time interval is the reaction rate the fastest? Choose from: 0–4 minutes. 2–6 minutes; 6–10 minutes. Give a reason for your answer in terms of the collision theory. (3)

2.5 Calculate the average reaction rate in cm^3 per second for the 2–6 minute time interval of the reaction. (3)

2.6 The experiment is now repeated using zinc granules instead of zinc powder. It is found that the rate of reaction changes. Will the reaction rate increase or decrease? Use the collision theory to explain this finding. (4)

2.7 How would a higher concentration of acid affect the following? (Write down only *increases*, *decreases* or *remains the same*.)

a) the volume of hydrogen gas collected per unit time (1)

b) the total volume of hydrogen gas produced (1)

c) the time for the reaction to reach completion. (1)

Total: [21]

Targeted Worksheet 2

Time: 30 minutes

Topic: Electrodynamics

Content summary

Electrodynamics relies heavily on models and hand rules and learners should practice and demonstrate their usage of the various hand rules throughout the series. Practice and demonstration will allow learners to better understand the visual aspect of this section.

Use ideas from the lessons such as:

- Drawings.
- Physical apparatus where possible.
- Real electrical motors, magnets and wires.

In a nutshell, make sure that the learners are practicing, drawing and explaining as many examples as possible.

Targeted Worksheet 2

Time: 30 minutes

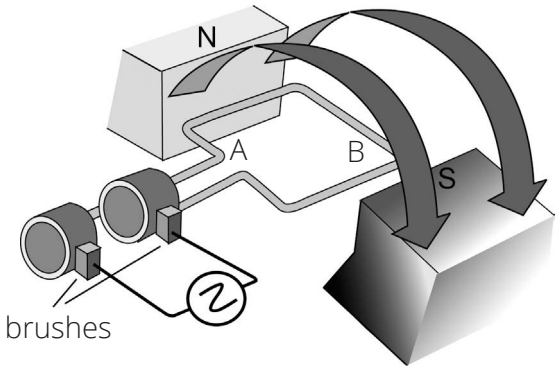
Topic: Electrodynamics

Name: **Surname:**

Instructions and information

1. Answer all the questions.
2. Write your answers on lined paper.
3. Number the questions carefully and follow the instructions.
4. Non-programmable calculators may be used.
5. Round off your answers to TWO decimal places.

1. The basic components of a simple generator are shown in the diagram.



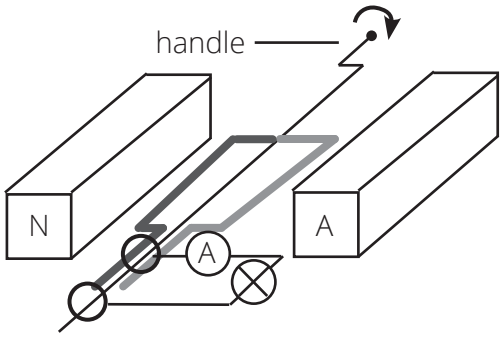
1.1 What type of current does this generator produce? (1)

1.2 What is the function of the brushes? (1)

1.3 As the coil turns in the direction shown, a current flows through the coil. Give a brief explanation for this flow of current. (2)

1.4 What is the direction of the current flow in the part of the coil labelled AB as it moves downwards as shown? From A to B or from B to A? (1)

2. Learners are investigating factors which affect the current induced in an alternator. They have a hand-operated alternator consisting of a handle, which rotates an armature of conducting coils as shown in the diagram. The armature is placed between two opposite magnetic poles. The alternator is connected to a sensitive ammeter and a small globe.



2.1 Apart from the components already mentioned, name TWO other components which are vital components of this alternator. (2)

2.2 As the handle is turned the globe flickers and the ammeter needle fluctuates from left to right. Give the reason for this. (1)

The table shows the results of the learners' investigations:

Rotation of armature (cycles per second)	Distance between the magnetude poles (m)	Maximum ammeter reading (A)
6	0,2	0,21
8	0,2	0,28
10	0,2	0,35

2.3 In the investigation, the learners investigate the speed of the rotation of the armature on the induced current.

2.3.1 Write down an investigative question for this investigation. (2)

2.3.2 With regards to the alternator, give TWO factors that the learners should keep constant so that they can consider the investigation as fair. (2)

2.4 In one of the trials, the maximum current passing through the light bulb is 0,35 A and the average power dissipated in the light bulb is 1,5 W.

2.4.1 Calculate the rms current which passes through the light bulb. (3)

2.4.2 Calculate the rms voltage which is induced across the light bulb. (3)

Total: [18]

Targeted Worksheet 3

Time: 30 minutes

Topic: Electrolytic cells

Content summary

In this topic, make sure that learners are familiar with all the concepts needed to explain electrolysis. The concepts that are common to all electrochemical cells, galvanic and electrolytic, are:

- An electrochemical cell always contains two electrodes and at least one electrolyte.
- In an electrochemical cell, oxidation occurs at the anode and reduction occurs at the cathode.
- In an operating electrochemical cell, anions migrate towards the anode, and cations migrate toward the cathode.
- In an operating electrochemical cell, electrons always move from the anode (where electrons are lost through oxidation) to the cathode (where electrons are gained through reduction).
- Standard cell potential difference can be predicted from a table of reduction potentials.

Targeted Worksheet 3

Time: 30 minutes

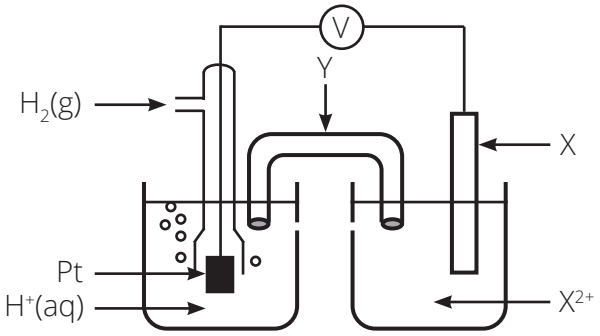
Topic: Electrolytic cells

Name: **Surname:**

Instructions and information

1. Answer all the questions.
2. Write your answers on lined paper.
3. Number the questions carefully and follow the instructions.
4. Non-programmable calculators may be used.
5. Round off your answers to TWO decimal places.

1. A standard electrochemical cell is set up using a standard hydrogen half-cell and a $X|X^{2+}$ half-cell as shown. The voltmeter initially registers –0,27 V.



1.1 Identify metal X. (1)

1.2 Write down the half-reaction that takes place at the cathode of this cell. (2)

1.3 The $X|X^{2+}$ half-cell is now replaced by a $Cu|Cu^{2+}$ half-cell.

a) What would the reading on the voltmeter now be? (1)

b) Is the hydrogen half-cell now the anode or the cathode? (1)

1.4 With time the reading on the voltmeter gradually decreases and eventually becomes zero. Briefly explain this statement. (2)

2. The given cell notation represents a nickel-cerium galvanic cell set up under standard conditions: $Ni(s) / Ni^{2+}(aq) \,||\, Ce^{3+}(aq) / Ce(s)$

A voltmeter is connected to the external circuit. When the cell is in operation under standard conditions, the reading on the voltmeter is 2,23 V.

2.1 At what temperature should this cell operate to give the voltmeter reading? (1)

2.2 In which direction do the electrons move through the voltmeter: From the Ni HALF-CELL to the Ce HALF-CELL, or from the Ce HALF-CELL to the Ni HALF-CELL? (1)

2.3 Calculate the standard electrode potential of the Ce^{3+}/Ce half-cell. (4)

2.4 Write down the balanced net ionic equation for the reaction which takes place in this cell. (3)

2.5 Will an increase in the concentration of the electrolyte in the cerium half-cell INCREASE, DECREASE or HAVE NO EFFECT ON the emf? Explain your answer. (4)

Total: [20]

Targeted Worksheet 1 Answers

Time: 30 minutes

Topic: Reaction rate and factors affecting the rate

1.1 The activation energy/the minimum energy required for particles to collide effectively. ✓ (1)

1.2 D ✓ (1)

1.3 A ✓ (1)

1.4 D ✓ (1)

1.5 Correct orientation of particles when colliding✓ (1)

2.1 10 minutes ✓ (1)

2.2 1 cm^3 ✓ (1)

2.3 3 minutes ✓ (1)

2.4 0–4 minutes ✓Initially there are a lot of reacting particles✓ ∴ more effective collisions ✓ (3)

2.5 Reaction rate

$= \frac{2,5 - 1}{240}$ ✓✓ $= 6,25 \times 10^{-3}$ c,^{3}.s^{-1} ✓ (3)

2.6 Decrease; ✓ the surface area of zinc granules is smaller ✓∴ less reacting particles per unit volume ✓ exposed ∴ less effective collisions per unit time ✓ ∴ a lower reaction rate. (4)

2.7 a) increase ✓ (1)

b) remain the same ✓ (1)

c) decrease ✓ (1)

Total: [21]

Targeted Worksheet 2 Answers

Time: 30 minutes

Topic: Electrodynamics

1.1 alternating current ✓ (1)

1.2 They keep the split rings in contact with the circuit. ✓ (1)

1.3 As the coil moves through the magnetic field there is a change in ✓ the magnetic flux linkage ✓ relative to the coil inducing an emf. (2)

1.4 B to A ✓ (1)

2.1 slip rings ✓ and brushes ✓ (2)

2.2 an alternating current ✓ is generated. (1)

2.3.1 Will the current induced be higher ✓ if the armature is rotated faster ✓ in the magnetic field? OR Will the current increase as speed of rotation increases? (2)

2.3.2 The number of coils on the armature ✓ the strength of the magnetic field ✓ (2)

2.4.1 $I_{rms} = \frac{I_{max}}{\sqrt{2}}$ ✓

$= \frac{0,35}{\sqrt{2}}$ ✓

$= 0,25$ A ✓ (3)

2.4.2 $P_{av} = V_{rms}I_{rms}$ ✓

$1,5 = V_{rms}0,25$ ✓

$V_{rms} = 6$ V ✓ (3)

Total: [18]

Targeted Worksheet 3 Answers

Time: 30 minutes

Topic: Electrolytic cells

1.1 Ni/Nickel ✓ (1)

1.2 $2H^+ + 2e^- \rightarrow H_2$ ✓✓ (2)

1.3 a) 0,34 V ✓ (1)

b) anode ✓ (1)

1.4 When the rate of the chemical reaction between the half-cells starts to decrease, electron transfer rate will decrease, and the cell potential also decreases. ✓ When the chemical reaction in the cell stops, the concentrations of the reactants and products are constant, and equilibrium has been reached. ✓ (2)

2.1 298 K/25 °C ✓ (1)

2.2 Ni to Ce ✓ (1)

2.3 $E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ ✓

2,23 ✓ $= E^{\theta}_{cathode} - (-0,27)$ ✓

$E^{\theta}_{cathode} = 1,96$ V ✓ (4)

2.4 $3Ni + 2Ce^{3+} \rightarrow 3Ni^{2+} + 2Ce$ ✓: reactants; ✓: products; ✓: balanced (3)

2.5 INCREASE✓; Increasing the electrolyte concentration in the Ce half-cell favours the forward reaction ✓ to counteract the increased Ce^{3+} concentration, ✓ thus electrons will be released/transferred at a much faster rate ✓ and the emf will thus increase. (4)

Total: [20]

Exemplar Assessments

Exemplar Assessments

Time: 2 hours

Term 2 Control Test

Name: **Surname:**

Instructions and information

This question paper consists of TWO sections A and B.

SECTION A: PHYSICS [20 Marks]

SECTION B: CHEMISTRY [30 Marks]

1. Answer ALL questions in both sections.
2. Number the answers correctly according to the numbering system used in this question paper.
3. Leave ONE line between two sub questions, for example between QUESTION 2.1 and QUESTION 2.2.
4. You may use a non-programmable calculator.
5. You may use appropriate mathematical instruments.
6. Show ALL formulae and substitutions in ALL calculations.
7. Round off your final numerical answers to TWO decimal places.
8. Give brief motivations, discussions, et cetera where required.
9. Write neatly and legibly.

SECTION A: CHEMISTRY

Question 1

Multiple-choice questions: Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write down only the letter (A – D) next to the question number (1.1 – 1.4). (i.e. 1.5 E)

1.1 The rate of a chemical reaction can be expressed in ...

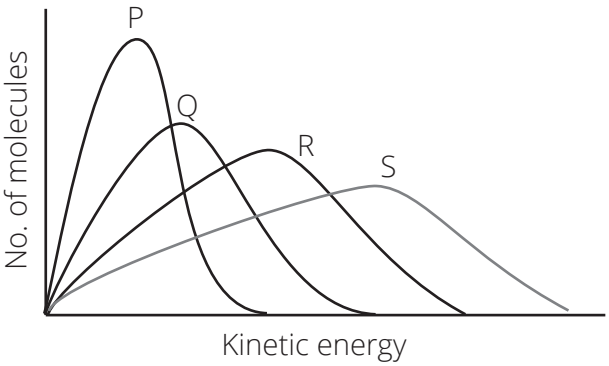
A grams per mole

B energy consumed per mole

C volume of gas formed per unit time.

D moles of product formed per litre of solution. (2)

1.2 The graphs below represent the molecular distribution for a reaction at different temperatures.



Which ONE of the graphs above represents the reaction at the highest temperature?

A P

B Q

C R

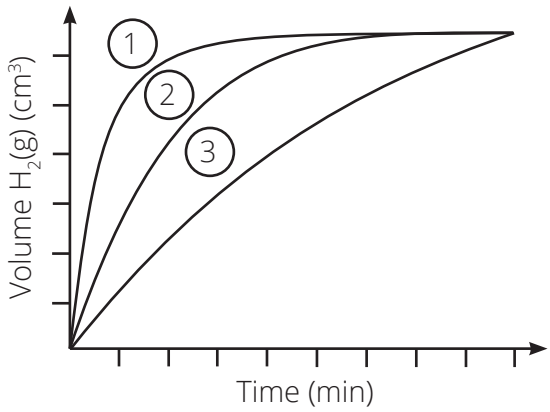
D S (2)

[4]

Question 2

2.1 List two factors that can affect the rate of a chemical reaction. (2)

2.2 Zinc pieces were reacted with excess hydrochloric acid. The graph below shows the volume of hydrogen produced for three different experiments.

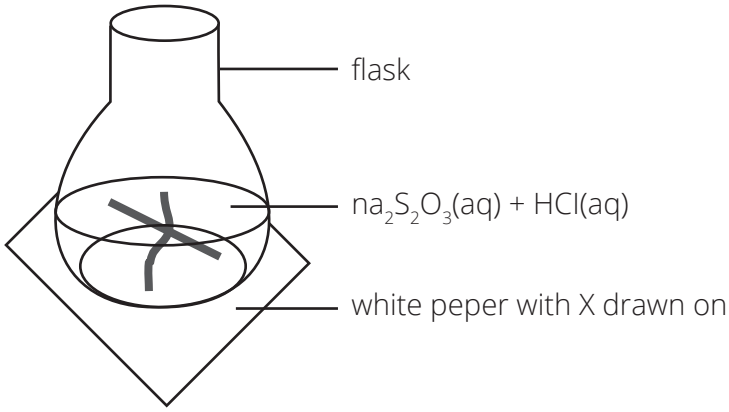


2.2.1 Which experiment has the highest rate of reaction? (1)

2.2.2 Suggest two changes to the experiment that could change the graphs from 1 to 2 or 3 (2)

2.3 A learner investigates the rate of a reaction using the apparatus in the diagram below. He mixes solutions of sodium thiosulfate and hydrochloric acid together, which react according to the equation:

$Na_2S_2O_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + S(s) + H_2O(l) + SO_2(g)$



The learner repeats the experiment a number of times under varied conditions.

2.3.1 Suggest a way the learner can compare the rates of the various reactions. (2)

He investigates the effect of varying the temperature of the liquids, he conducts the experiment at: 10°C, 40°C and at 60°C.

2.3.2 State which rate you think will be fastest. (1)

2.3.3 Explain your answer to 2.3.2 in terms of collision theory. (3)

2.3.4 Name the other variables that the learner must keep constant to investigate the effects of temperature on rate. (2)

2.3.5 Explain how dissolving less sodium thiosulfate into solution will affect the rate of reaction. (3)

[16]

Total Section A: [20]

SECTION B: PHYSICS

Question 1

Multiple-choice questions: Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write down only the letter (A – D) next to the question number (1.1 – 1.4). (i.e. 1.5 E)

1.1 A cyclist rides past a stationary car whose alarm is sounding. Which of the following statements is FALSE?

A The frequency that the alarm emits remains unchanged

B The cyclist hears a change in pitch from high to low as he passes the car

C The cyclist hears a change in pitch from low to high as he passes the car

D The Doppler effect will be apparent, as it is the listener moving relative to the sound source. (2)

1.2 Which one of the following is the main principle applied when measuring the rate of blood flow or the heartbeat of a foetus in the womb?

A Diffraction

B Doppler effect

C Huygens' principle

D Photoelectric effect (2)

1.3 If the net work done on a moving object is negative, the following may be concluded:

A The object is accelerating down a slope.

B The object has zero kinetic energy.

C The object experiences a decrease in kinetic energy.

D The object is falling vertically downwards. (2)

1.4 A cyclist free-wheeling down an inclined road has to apply brakes for 8 s to maintain a constant velocity of 10 $m \cdot s^{-1}$. The force exerted by the brakes is 80 N. The power dissipated by the brakes of the bicycle is:

A 8 W

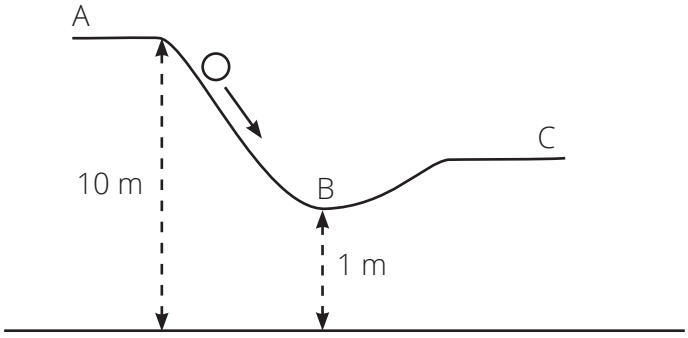
B 10 W

C 100 W

D 800 W (2)

1.5 A 0,1 kg ball rolls down a smooth, frictionless slope from A to C as shown in the diagram below.

At B, the lowest point of the slope, the ball has a kinetic energy of 12 J.



The total mechanical energy of the ball is:

A 9,8 J

B 12 J

C 12,98 J

D 21,8 J (2)

[10]

Question 2

Commercial aeroplanes are installed with a flight recorder, called a 'black box', which uses the principle of the Doppler effect. In the event of an aeroplane crash, the black box sends out ultrasonic signals, so that the location of the crash site of the aeroplane can be determined. The black box of an aeroplane that crashed into the sea lies on the seabed, 200 m deep. It sends out a constant signal of 23 kHz. A search and rescue ship, sailing at a speed of 25 $m \cdot s^{-1}$, picks up the signal of the black box and records this signal to be 23 390 Hz.

2.1 Under what condition is the Doppler effect observed? (2)

2.2 Is the ship moving TOWARDS or AWAY FROM the location of the black box? (1)

2.3 Explain your answer to question 2.2. (3)

2.4 Calculate the speed of sound in seawater. (5)

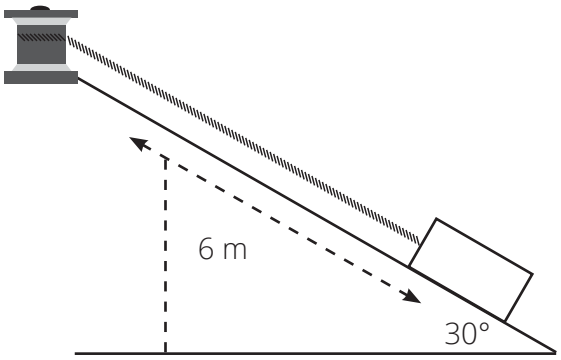
[11]

Question 3

A winch pulls a crate of mass 30 kg from rest up a slope inclined at 30° to the horizontal by applying a constant force of 300 N. A frictional force of 20 N acts on the crate as it moves upslope.

3.1 Draw a labelled free-body diagram to show *all* the forces acting on the crate during its motion. (5)

3.2 Use the work-energy theorem to calculate the speed of the crate after it has moved 6 m up the slope. (4)



[9]

Total Section B: [30]

Total: [50]

Exemplar Assessments

Time: 3 hours

Trial Exam Paper 1

Name: **Surname:**

Instructions and information

1. This question paper consists of TEN questions. Answer ALL questions
2. Number the answers correctly according to the numbering system used in this question paper.
3. Leave ONE line between two sub questions, for example between QUESTION 2.1 and QUESTION 2.2.
4. You may use a non-programmable calculator.
5. You may use appropriate mathematical instruments.
6. Show ALL formulae and substitutions in ALL calculations.
7. Round off your final numerical answers to TWO decimal places.
8. Give brief motivations, discussions, et cetera where required.
9. Write neatly and legibly.

Question 1

Multiple-choice questions: Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write down only the letter (A – D) next to the question number (1.1 – 1.4). (i.e. 1.5 E)

1.1 The gravitational acceleration experienced by an object falling towards the earth is dependent on …

A the object's mass

B the object's mass and the distance that the object falls

C the relative mass of the earth and the mass of the object

D the mass and the radius of the earth (2)

1.2 The electrostatic force between two charged objects will …

A double if the distance between them is halved

B double if the charges on each object is doubled

C increase four times if the distance between them is doubled

D decrease four times if the charge on each of them is halved (2)

1.3 A line emission spectrum is …

A a spectrum consisting of lines corresponding to the energy of released electrons

B a continuous spectrum of only specific wavelengths

C a spectrum consisting of frequencies which correspond to the energies of the photons released when a low pressure gas is energised

D a spectrum corresponding to the wavelengths of the colour that the gas absorbs when the ground state electrons become excited (2)

1.4 Bats fly out of a cave over a sound detector. The detector picks up the change in the ultrasounds emitted by the bats to be from 65 kHz to 28 kHz. The actual frequency of the sound made by the bats is most likely to be:

A 28 kHz

B 47 kHz

C 65 kHz

D 93 kHz (2)

1.5 Light of wavelength 680 nm, coming from a receding distant galaxy, is observed from Earth. The frequency of this light as observed from Earth will most likely be:

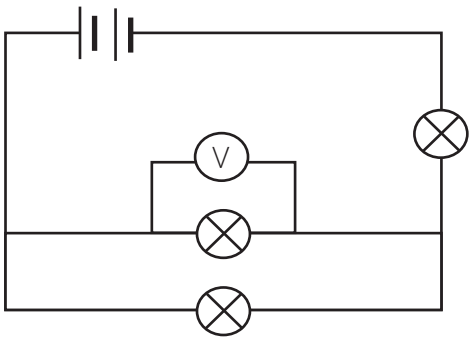
A $4{,}51 \times 10^{14}$ Hz

B $4{,}41 \times 10^{5}$ Hz

C $4{,}29 \times 10^{14}$ Hz

D $4{,}41 \times 10^{14}$ Hz (2)

1.6 The circuit given consists of three identical light bulbs. The emf of the battery is 12 V and it has negligible internal resistance.



When the circuit is in operation, the reading on the voltmeter will be ...

A 2 V

B 4 V

C 6 V

D 8 V (2)

1.7 Some generators use a split-ring commutator, while others use slip rings. Which combination applies to generators that use a split-ring commutator?

A voltage varies between +V and 0 V; current varies between +1 and –1 A

B voltage varies between +V and 0 V; current varies between +1 and 0 A

C voltage varies between +V and –V; current varies between +1 and 0 A

D voltage varies between +V and –V; current varies between +1 and –1 A (2)

1.8 The dark lines in an absorption spectrum correspond to ...

A the frequencies of the photoelectrons released by a cold gas

B the frequencies of the light passing through a cold gas

C the frequencies of white light which are absorbed by a cold gas

D the frequencies of the photons emitted by a cold gas (2)

1.9 The Doppler effect will not be observed when the source ...

i and the observer are moving in the same direction at the same speed.

ii is moving towards the observer who is accelerating towards it.

iii is stationary and the observer is accelerating towards it.

iv and the observer are both stationary.

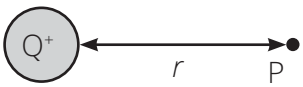
A i only

B ii and iii

C i and iv

D iv only (2)

1.10 P is a point in the electric field of positively charged Q. P is a distance *r* away from Q. The electric field at P is ...



A directed towards the left

B stronger at a distance of ½ r from Q

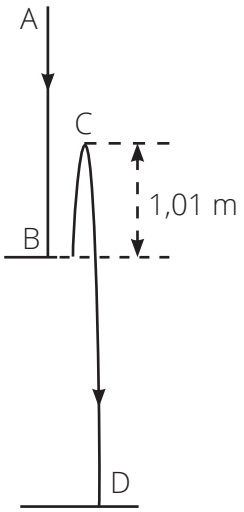
C the same magnitude as at any other distance from Q

D 0 $N \cdot C^{-1}$ because P is not a charge (2)

[20]

Question 2

A ball is dropped at point A and undergoes free fall. It strikes a table's edge at B, bounces vertically upwards to C and then falls past the table's edge. It strikes the ground at D. Choose DOWNWARDS as the POSITIVE direction. Ignore the effects of air friction.



2.1 What is meant by *free* fall? (2)

2.2 The ball strikes the table's edge at B with a velocity of 5 m·s^{-1}.

2.2.1 Prove by calculation that the ball falls for 0,51 s from when it is released at A to when it strikes the table at B. (3)

2.2.2 Calculate the distance between A and B. (4)

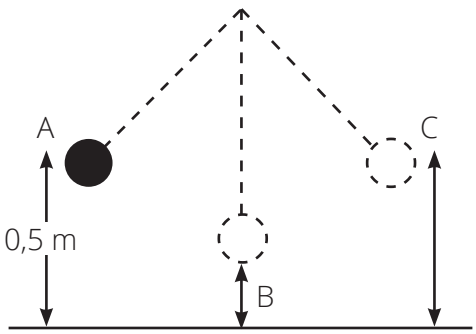
2.3 Give a reason why the ball does not rise up to point A after striking the table's edge at B. (2)

2.4 The total time taken for the ball to move from A to D is 2 s. Draw a position-time graph for the motion of the ball from point A to point D. Use point A as the zero reference point and DOWNWARDS as positive. Write down all known and calculated values for position and time on the relevant axes. (5)

[16]

Question 3

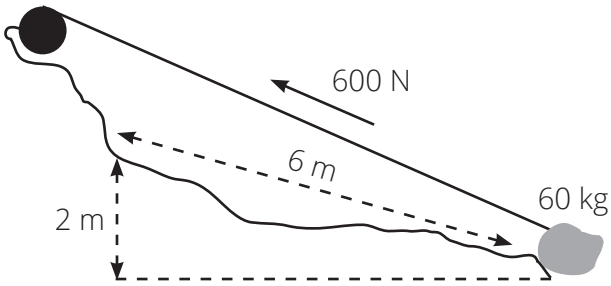
3.1 A pendulum consists of a light inextensible string, to which a 50 g bob is attached. The bob is released from point A which is 0,5 m above the ground. It swings to and fro between points A and C. At B, its lowest point of the motion, it has a velocity of 2,8 m·s^{-1}. All effects of friction are negligible.



3.1.1 Which conservation law is applicable for the motion of this pendulum? (2)

3.1.2 Calculate the height of the bob above the ground when its velocity is 2,8 m·s^{-1}. (4)

3.2 A winch is used to pull a 60 kg rock 6 m up a rough, uneven incline. The winch applies a constant force *F* of 600 N on the rock and the work done by friction is 240 J.



3.2.1 Draw a labelled free-body diagram showing all the forces that do work on the rock. (3)

3.2.2 Show by calculation that the work done by the winch is 3 600 J. (2)

3.2.3 Use the work-energy theorem to calculate the magnitude of the velocity of the rock when it has been pulled 6 m along the slope and is at a vertical height of 2 m above the starting point. (5)

3.2.4 Calculate the power dissipated in the winch if it took 10 s for it to pull the rock for 6 m. (3)

[19]

Question 4

Jaryd is playing snooker and positions his cue so that the white ball is lined up with the black ball. He strikes the white ball with the tip of his cue, sending it towards the stationary black ball with a velocity of 0,5 $m \cdot s^{-1}$. The white ball strikes the black ball with a force of 1,2 N and the white ball undergoes a change in momentum of – 0,24 $kg \cdot m \cdot s^{-1}$. The mass of the white ball is 0,6 kg and the mass of the black ball is 0,8 kg. Ignore all effects of friction for this question.

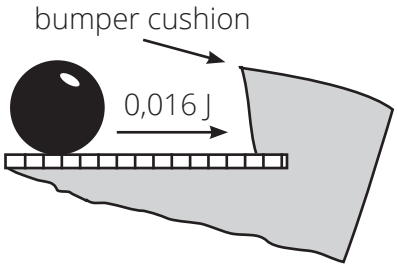
4.1 Give ONE word for 'change in momentum'. (1)

4.2 Write down Newton's second law of motion in terms of momentum. (2)

4.3 Calculate the time that the white ball is in contact with the black ball. (4)

4.4 After striking the black ball, the velocity of the white ball is 0,1 $m \cdot s^{-1}$ to the right. Use the principle of conservation of linear momentum to calculate the velocity of the black ball after the white ball has struck it. (4)

4.5 After being struck, the black ball moves a distance over the felt surface of the snooker table, before colliding elastically with the bumper cushions on the side of the snooker table. The black ball strikes the bumper cushions with a kinetic energy of 0,016 J.



4.5.1 What is meant by the term *collides elastically*? (1)

4.5.2 Determine the velocity of the black ball after it rebounds off the bumper cushions. (5)

[17]

Question 5

5.1 Define *power* in terms of energy and give a definition of the unit for power. (4)

5.2 A 60 kg boy, starting from rest, runs up a flight of stairs in 4,5 s. He reaches a velocity of 2 $m \cdot s^{-1}$ at the top of the stairs where he is 5 m directly above ground level. Determine the power needed to reach the top of the stairs. Ignore the effects of friction. (6)

[10]

Question 6

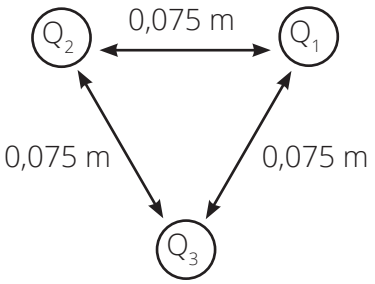
A polystyrene sphere (Q_1) carrying a charge of +2,5 nC is placed in the electric field of another positively charged sphere (Q_2). The electric field experienced by Q_1 is 4 000 $N \cdot C^{-1}$ towards the right.

6.1 Define the term *electric field* at a point. (2)

6.2 Calculate the force that sphere Q_1 will experience due to the electrical field in which it is placed. (4)

6.3 If Q_2 and Q_1 are 0,075 m away from each other, calculate the charge on Q_2. (5)

6.4 A third sphere (Q_3), which is negatively charged, is placed in a position such that the spheres are equidistant from one another as shown in the diagram.



Draw a vector diagram representing all the forces acting on this third sphere (Q_3), as well as the net force which it will experience. Ignore all gravitational forces. (3)

[14]

Question 7

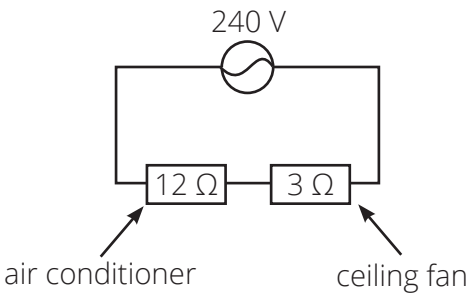
7.1 Electrical power supply plants produce a certain type of electricity, which is transported across the country to homes and industries.

7.1.1 Name the type of electrical machine that is used to produce the electricity supplied by electrical power supply plants. (2)

7.1.2 Give the structural difference between an electrical machine which produces alternating current and an electrical machine that produces direct current. (2)

7.1.3 State the energy conversion that takes place when electricity is produced in an electrical power supply plant. (1)

7.2 An air conditioner (with a resistance of 12 Ω) and a ceiling fan (with a resistance of 3 Ω) are connected in series. They are plugged into the 240 V electrical supply of an office building. The maximum current which the supply can deliver is 22,63 A. The diagram shows a simplified version of this circuit.



7.2.1 Show that the root mean square current delivered by the electrical source is 16 A. (2)

7.2.2 Calculate the V_{rms} across the ceiling fan. (4)

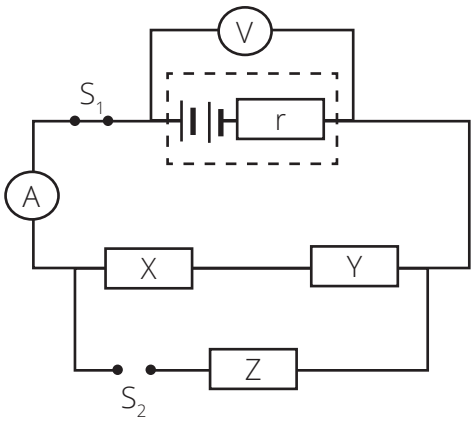
7.2.3 Calculate the average power dissipated by the ceiling fan. (4)

7.2.4 The average power drawn by the air conditioner is 3,072 W. Give a reason why the ceiling fan draws less power than the air conditioner. (2)

[17]

Question 8

The circuit diagram represents a parallel network of identical resistors, X, Y and Z, connected to an ammeter. The battery has an internal resistance of 0,4 Ω.



8.1 When switch S_1 is OPEN, the voltmeter reads 12 V. State what this reading represents. (1)

8.2 Switch S1 is now CLOSED. Give a reason for a drop in the voltmeter reading. (1)

Switch S_2 is now also CLOSED and the voltmeter reading is 11,4 V.

8.3 Calculate the reading on the ammeter. (4)

8.4 Calculate resistance of each resistor. (6)

Switch S_2 is OPENED again while switch S_1 remains closed.

8.5 State how each of the following will be affected. Write down only INCREASES, DECREASES or REMAINS THE SAME.

8.5.1 the reading on the ammeter (1)

8.5.2 the reading on the voltmeter (1)

[14]

Question 9

The data below was obtained during an investigation into the relationship between the velocities of a moving sound source and the frequencies detected by stationary listener for each velocity. The effect of wind was ignored in this investigation. Take the speed of sound in air as 340 $m \cdot s^{-1}$.

Experiment number	1	2	3	4
Velocity of the sound source ($m \cdot s^{-1}$)	0	10	20	30
Frequency (Hz) of the sound detected by the stationary listener	900	874	850	827

9.1 Write down the dependent variable for this investigation. (1)

9.2 State the Doppler effect in words. (2)

9.3 Was the sound source moving TOWARDS or AWAY FROM the listener? Give a reason for your answer. (2)

9.4 Use the information in the table to calculate the speed of sound during the investigation. (5)

9.5 The spectral lines of a distant star are shifted towards the longer wavelengths of light. Is the star moving TOWARDS or AWAY FROM the earth? (1)

[11]

Question 10

10. A metal surface is irradiated with light of wavelength 600 nm, causing the ejection of electrons.

10.1 Calculate the frequency of the light. (3)

10.2 Calculate the amount of energy that is transferred to the electrons of the metal from the incident light. (3)

10.3 If the work function of the metal is $1,2 \times 10^{-19}$ J, calculate the amount of kinetic energy that the ejected electrons possess. (3)

10.4 In a photocell, the electrons require $5,5 \times 10^{-19}$ J of energy to overcome the forces of attraction within the metal. Determine the minimum wavelength of the radiation that would provide sufficient energy for the electrons to break free from the metal. (3)

[12]

Total: [150]

Exemplar Assessments

Time: 2 hours

Trial Exam Paper 2

Name: **Surname:**

Instructions and information

1. This question paper consists of EIGHT questions
2. Answer ALL questions.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Leave ONE line between two sub questions, for example between QUESTION 2.1 and QUESTION 2.2.
5. You may use a non-programmable calculator.
6. You may use appropriate mathematical instruments.
7. Show ALL formulae and substitutions in ALL calculations.
8. Round off your final numerical answers to TWO decimal places.
9. Give brief motivations, discussions, et cetera where required.
10. Write neatly and legibly.

Question 1

Multiple-choice questions: Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write down only the letter (A – D) next to the question number (1.1 – 1.4). (i.e. 1.5 E)

1.1 The stronger the intermolecular forces between the molecules of a liquid organic compound, the ...

A higher the boiling point and the lower the vapour pressure

B lower the boiling point and the higher the vapour pressure

C lower the boiling point and the lower the vapour pressure

D higher the boiling point and the higher the vapour pressure (2)

1.2 Which ONE of the following organic compounds will decolourise bromine water immediately after the bromine water has been added to it?

A propene

B propane

C propanal

D propanone (2)

1.3 An electrolytic cell is used to extract copper from its ore. Which ONE of the following regarding this cell is TRUE?

A the copper ore is the cathode

B it uses a direct current source

C the electrolyte may be a solution of any metal salt

D pure copper forms at the positive electrode (2)

1.4 The molecular formula C_3H_7OH can represent ...

A only a primary alcohol

B only a tertiary alcohol

C only a secondary and primary alcohol

D a primary, a secondary and a tertiary alcohol (2)

1.5 Which of the following will reduce Sn^{2+} to Sn?

A Zn

B Ag

C Hg

D Pb (2)

1.6 The potential energy of the limestone is 93 kJ. When heated the limestone decomposes. This decomposition reaction requires 207 kJ of activation energy and when the products form, 28 kJ of energy is released.

The potential energy of the products formed and the heat of the reaction ΔH respectively are:

A E_p = 272 kJ ; ΔH = 179 kJ

B E_p = 28 kJ ; ΔH = 114 kJ

C E_p = 300 kJ ; ΔH = - 179 kJ

D E_p = 272 kJ ; ΔH = - 114 kJ (2)

1.7 Which one of the following represents the products formed during the hydrolysis of ammonium nitrate?

A NH^{+4}(aq) and NO^{-3}(aq)

B NH_3(aq) and H_3O^+(aq)

C HNO_3(aq) and OH^-(aq)

D NO^{-3}(aq) and H_3O^+(aq) (2)

1.8 Which one of the following is a correct description for a 0,1 mol·dm^{-3} sulfuric acid solution?

A Concentrated strong acid

B Concentrated weak acid

C Dilute weak acid

D Dilute strong acid (2)

1.9 An Arrhenius acid is a substance that ...

A Donates a proton

B Accepts a proton

C Produces H^+ in an aqueous solution

D Produces OH^- in an aqueous solution (2)

1.10 Which of the following organic compounds does the molecular formula C_5H_{12} represent?

i pentane

ii 2-methylbutane

iii 2-pentene

A i and ii

B i only

C ii only

D ii and iii (2)

[20]

Question 2

The letters A to H in the given table represent different organic compounds.

A CH_3COOH	B H H O H | | || | H — C — C — C — C — H | | | H H H	C $(-CH_2-CH_2-)_n$	D CH_3 H H | | | H — C — C — C — H | | | CH_3 H H
E 2.3-dichloropropene	F $CH_3CH_2CH_2OH$	G butanal	H CH_3 H H | | | H — C — C — C — H | CH_3

2.1 Write down the:

2.1.1 name of the homologous series to which compound A belongs. (1)

2.1.2 letter of an unsaturated hydrocarbon. (1)

2.1.3 STRUCTURAL FORMULA of a monomer of compound C. (2)

2.1.4 letters of the two compounds that are FUNCTIONAL ISOMERS. (2)

2.1.5 STRUCTURAL FORMULA of compound E. (3)

2.2 Write down the IUPAC name of:

2.2.1 compound B (2)

2.2.2 compound H. (3)

2.3 Compound F represents an alcohol.

2.3.1 Classify this alcohol as PRIMARY, SECONDARY or TERTIARY. (1)

2.3.2 Write down the IUPAC name of this alcohol. (2)

2.4 Esters form when two organic substances react with one another in the presence of sulfuric acid.

2.4.1 Write down the letters of TWO substances in the table that can be used to make an ester. (2)

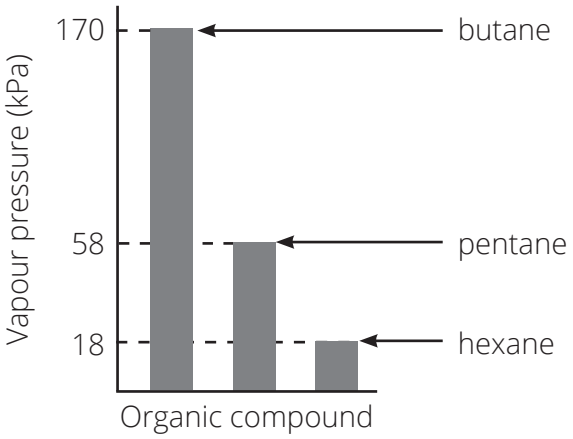
2.4.2 Write down the IUPAC name of the ester that forms when these two substances react during esterification. (2)

2.4.3 What role does the sulfuric acid play in the esterification reaction? (1)

[22]

Question 3

A chemist investigates the physical properties of three different organic compounds. The graph shows the trend in the vapour pressure of the three compounds. The questions below refer to the three compounds that he investigates.



3.1 Define the term vapour pressure. (2)

3.2 To which homologous series do the compounds belong? (1)

3.3 Write down an investigative question for this investigation. (2)

3.4 Apart from environmental conditions, what factor must be kept constant during this investigation? (1)

3.5 Fully explain, in terms of structure and intermolecular forces, the trend in the vapour pressure as illustrated by the graph. (4)

3.6 Are these three substances that the chemist is investigating structural isomers: answer YES or NO. Give a reason for your answer. (2)

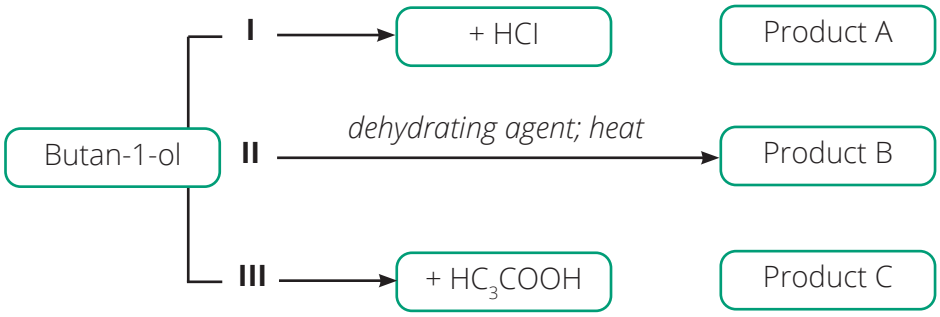
3.7 Write down the molecular formula of the compound that would have the lowest boiling point of the three compounds investigated. (2)

[14]

Question 4

Butan-1-ol undergoes three different types of reactions (**I**, **II** and **III**) to form the main organic products A, B and C.

The three reactions are represented in the flow diagram below.



4.1 Consider reaction I: When butan-1-ol reacts with hydrogen chloride, product A, a haloalkane, is one of the products that form.

Write down the following:

4.1.1 The name of this type of reaction (addition, elimination or substitution). (1)

4.1.2 The IUPAC name of the haloalkane formed. (2)

4.1.3 The formula of the other product that also forms. (1)

4.2 Reaction II is an elimination reaction that takes place in the presence of a dehydrating agent and heat.

4.2.1 Name the dehydrating agent used. (1)

4.2.2 Using structural formulae, write down a balanced equation for reaction I (4)

4.2.3 Write down the IUPAC name of product B. (2)

4.3 Product C forms during reaction III when butan-1-ol reacts with CH_3COOH in the presence of H_2SO_4 and heat.

4.3.1 To which homologous series does product C belong? (1)

4.3.2 Write down the IUPAC name of product C. (2)

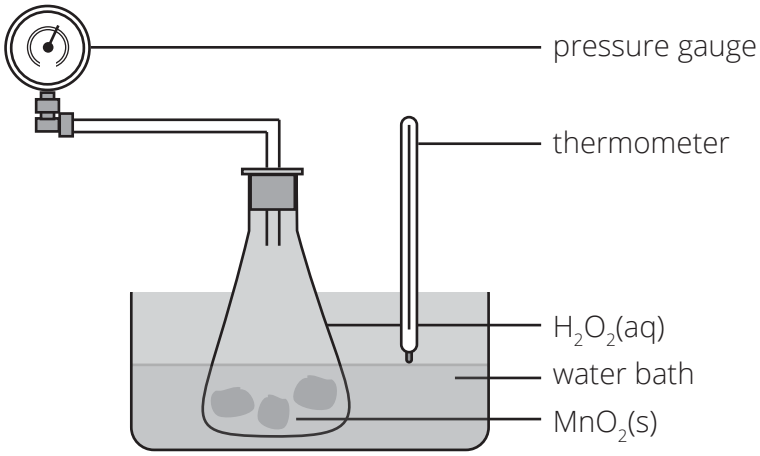
[14]

Question 5

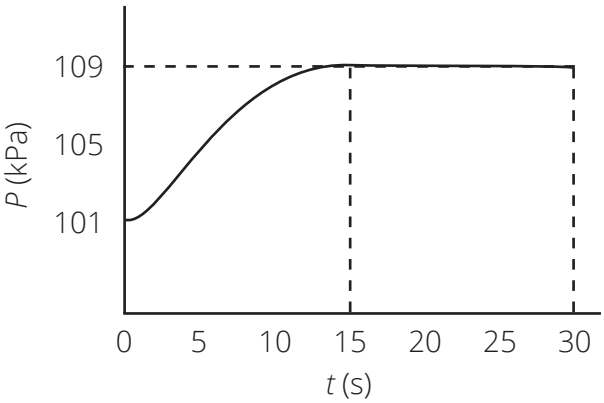
Oxygen gas can be prepared in a laboratory by the decomposition of a solution of hydrogen peroxide in the presence of a manganese dioxide catalyst. The following equation represents this reaction:

$$2H_2O_2(aq) \xrightarrow[MnO_2(s)]{} 2H_2O(l) + O_2(g) \quad \Delta H < 0$$

Chemistry learners are investigating the rate of the decomposition of hydrogen peroxide. They place a flask of a hydrogen peroxide solution in a water bath which is kept at a constant temperature of 60 °C. They then add manganese dioxide crystals, and immediately connect the pressure gauge and take a reading on the gauge.



They observe bubbles starting to form in the solution and notice that the reading on the pressure gauge starts to increase. They take the reading on the pressure gauge every few seconds. Their readings are represented on the graph below:



5.1 Why is the initial reading on the pressure gauge not 0 kPa? (1)

5.2 How long did it take for the hydrogen peroxide to completely decompose? (1)

5.3 Calculate the average reaction rate (in $kPa \cdot s^{-1}$) of this reaction. (3)

5.4 The students repeat the experiment by:

i) Experiment 2: using a higher concentration of hydrogen peroxide solution.

ii) Experiment 3: decreasing the temperature in the water bath to room temperature.

iii) Experiment 4: not adding the manganese dioxide.

5.4.1 By referring to the collision theory, explain what would happen to the rate of the reaction in Experiment 3. (3)

5.4.2 Redraw the given graph and label it Exp. 1. On the same axes draw graphs to represent: Experiment 2, Experiment 3 and Experiment 4. Clearly label each line according to the experiment number: Exp. 2, Exp. 3 and Exp. 4. (5)

5.5 Would grinding the manganese dioxide crystals to a finer powder INCREASE, DECREASE or HAVE NO EFFECT ON the reaction rate? Explain your answer in terms of the collision theory. (4)

5.6 The concentration of the hydrogen peroxide solution that the learners use for this investigation is 0,85 mol·dm^{-3} and they initially place 75 ml of this solution into the flask. Calculate the mass of the oxygen gas produced after 20 s. (6)

[23]

Question 6

The Haber process for the manufacture of ammonia is a good example of an industrial process which applies Le Chatelier's principle. Favourable conditions for the production of ammonia are relatively low temperatures and high pressures. The equation for the Haber process is as follows:

$N2(g) + 3H2(g) \rightleftharpoons 2NH_3(g)$ $\Delta H = -92{,}2$ kJ·mol^{-1}

When this reaction takes place in a closed system, it reaches a state of dynamic equilibrium at approximately 450 °C.

6.1 Explain the term *dynamic equilibrium*. (2)

6.2 Consider the following extract from a Grade 12 Physical Sciences textbook:

> "The purpose of the Haber process is to produce ammonia, thus the temperature must be maintained at a low enough level to ensure that the forward reaction takes place. However, temperatures lower than 300 °C are not favourable to the industry"

Discuss the above extract in terms of Le Chatelier's principle and rate of reaction. (3)

6.3 Would increasing the pressure by decreasing the volume result in an INCREASE or a DECREASE in the yield of ammonia? Use Le Chatelier's principle to explain your answer. (4)

6.4 Consider the equilibrium constant (K_c) values for the Haber process at different temperatures in the given table.

Temperature (°C)	**100**	**200**	**300**	**400**	**500**
K_c values	$6{,}8 \times 10^{2}$	$2{,}4 \times 10^{1}$	$4{,}4 \times 10^{-1}$	$2{,}3 \times 10^{-3}$	$5{,}6 \times 10^{-4}$

6.4.1 What happens to the value of the equilibrium constant as the temperature increases? Write down INCREASES, DECREASES, REMAINS THE SAME. (1)

6.4.2 Which reaction (forward or reverse) is being favoured when the temperature is above 300 °C? Explain your answer by referring to the K_c values. (3)

6.4.3 Initially, 14 moles of hydrogen gas and *x* moles of nitrogen gas are placed in a closed, empty 10 dm^3 reaction vessel. When equilibrium is reached at 300 °C, it is found that 8 moles of the hydrogen gas are present in the reaction vessel. Calculate the initial number of moles of nitrogen gas, *x*, originally placed in the vessel. (7)

[20]

Question 7

7.1 500 ml of a 0,5 mol·dm^{-3} standard solution of oxalic acid, $(COOH)_2$ is required for a titration reaction.

7.1.1 Calculate the mass of oxalic acid that must be used to prepare this standard solution. (4)

7.1.2 Oxalic acid is a diprotic acid. Explain the meaning of diprotic. (2)

7.1.3 Write the equation for the reaction of oxalic acid with water. (3)

7.2 A standard solution of KOH has a concentration of 5×10^{-3} mol·dm^{-3}.

7.2.1 Calculate the pH of the solution. (5)

In a titration, 27 cm^3 of the KOH solution reacts with 24 cm^3 of a H_2SO_4 solution to reach the end point. The balanced equation for the reaction is:

$2KOH + H_2SO_4 \rightarrow K_2SO_4 + 2H_2O$

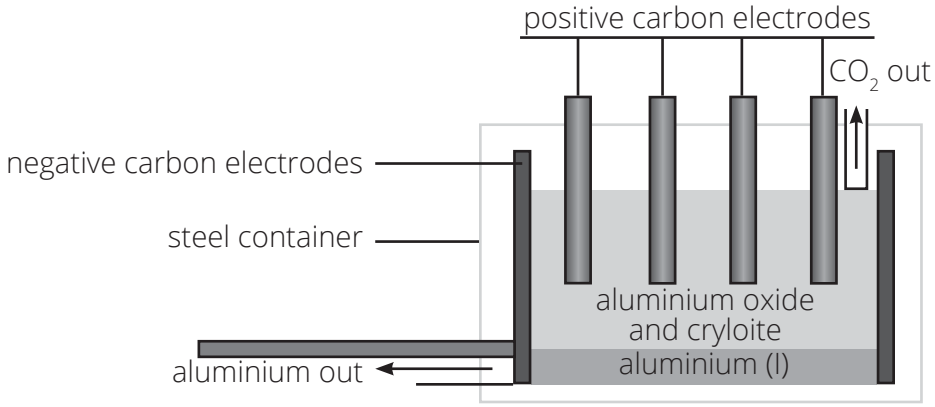
7.2.2 Name a suitable indicator to use. (1)

7.2.3 Calculate the concentration of the acid. (4)

[19]

Question 8

8.1 The diagram shows a cell for the production of aluminium from Al_2O_3.



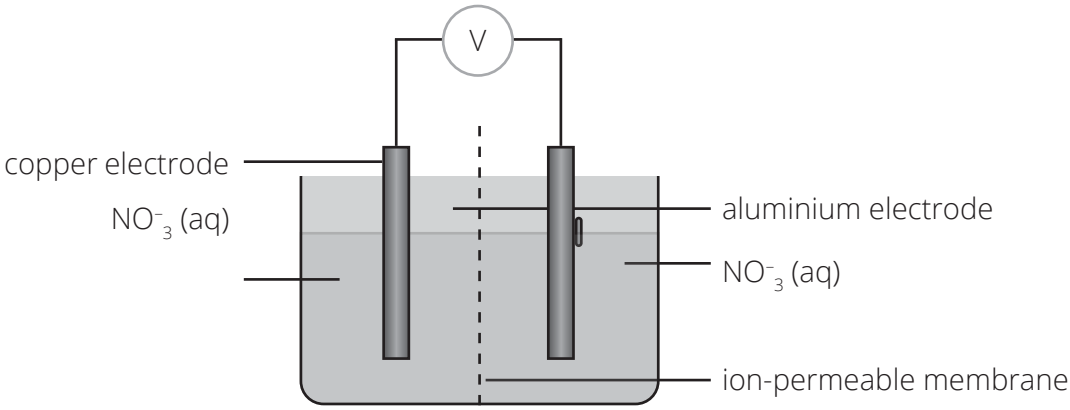
8.1.1 Name this type of electrochemical cell. (1)

8.1.2 Identify the anode in the cell. (1)

8.1.3 Write down the formula of the substance that is reduced. (1)

8.1.4 Write the oxidation half-reaction. (2)

8.2 A chemistry student sets up an aluminium-copper galvanic cell in the laboratory. Each half cell consists of a metal electrode immersed in a nitrate solution of its ions. The two half-cells are separated by an ion-permeable membrane which allows the passage of ions to maintain electrical neutrality as shown in the diagram below.



8.2.1 Give the energy conversion that takes place in this cell. (1)

8.2.2 The reading on the voltmeter is 1,98 V. Use a calculation to show that, when the reading was taken, this cell was not operating under standard conditions. (4)

8.2.3 Write down the FORMULA of the ions that pass through the ion-permeable membrane from the anode to the cathode. (1)

8.2.4 Write down the half-reaction taking place in the copper half-cell. (2)

8.2.5 Write down the balanced equation for the net (overall) redox reaction that takes place in this cell when it is operating. (3)

8.2.6 How will the reading on the voltmeter be affected if the concentration of the copper nitrate solution were to be increased? Write down only INCREASES, DECREASES or NO EFFECT. (2)

[18]

Total: [150]

Exemplar Assessments

Time: 2 hours

Term 2 Control Test

MEMORANDUM

SECTION A: CHEMISTRY

1.1 C✓✓ (2)

1.2 D✓✓ (2)

[4]

2.1 Nature of reactants; surface area; concentration of reactants; pressure; temperature; catalyst (Any two) ✓✓ (2)

2.2.1 Experiment 1 ✓ (1)

2.2.2 Larger zinc pieces would reduce the rate. ✓ More dilute acid would also reduce the rate. ✓ (We cannot say less zinc because it is the limiting reagent and had to be present in the same amount (moles) in each experiment. (2)

2.3.1 He can time how long it takes for the X on the page to become obscured by the liquid. ✓ The solution will turn opaque and light yellow, as a sulphur precipitate is f ormed as a product. ✓ OR:

He could also put the reaction vessel on a scale and measure the loss of mass as a function of time ✓ as sulphur dioxide gas is a product and is free to escape the flask. ✓ (any one) (2)

2.3.2 The higher temperature (60 °C) will have the fastest rate ✓ (1)

2.3.3 Higher temperature, higher average kinetic energy of the particles, ✓ more particles have enough energy for effective collisions, ✓ more effective collisions, higher rate of reaction. (3)

2.3.4 Concentrations of the acid ✓ and the sodium thiosulfate and the volumes added together. ✓ (2)

2.3.5 It would lower the rate of reaction by lowering the concentration ✓ of one of the reactants, causing fewer collisions between reactants. ✓ The X will take longer to become invisible. ✓ (3)

[16]

Total Section A: [20]

SECTION B: PHYSICS

1.1 C✓✓ (2)

1.2 B✓✓ (2)

1.3 C✓✓ (2)

1.4 D✓✓ (2)

1.5 C✓✓ (2)

[10]

2.1 The listener and/or the sound source ✓ must be moving relative to the medium through which the sound is travelling. ✓ (2)

2.2 towards ✓ (1)

2.3 The frequency picked up by the ship is higher than the actual frequency of the signal. ✓ This means that the distance between the wave fronts is decreasing ✓ as the ship moves towards the emitted waves. The ship thus perceives more waves arriving per second, ✓ accounting for the higher detected frequency. (3)

2.4 $f_L = [\frac{v \pm v_L}{v \pm v_s}] f_s$

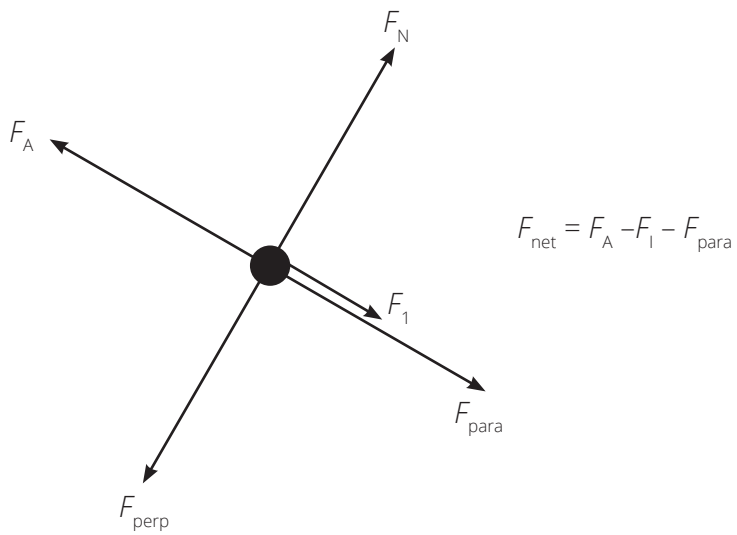
$f_L = [\frac{v + v_L}{v - v_s}]$. ✓

$23\ 930.$ ✓ $= [\frac{v + 25.}{v - 0.}$ ✓ $]\ 23\ 000$ ✓

$v = 1\ 474{,}36\ m{\cdot}1^{-1}$. ✓ (5)

[11]

3.1



F_f: applied force of winch ✓

F_1: force of friction ✓

$F_{parallel}$: parallel component of gravitational force ✓

F_N: normal force of slope on crate ✓

$F_{perpendicular}$: perpendicular component of gravitaional force ✓ (5)

3.2 $W_{net} = \Delta E_k$ ✓

$798 = \frac{1}{2}mv_1^2 - \frac{1}{2}mv_1^2 = \frac{1}{2} \times 30 \times v_f^2 - \frac{1}{2} \times 30 \times 0^2$ ✓

$\therefore v_1^2 = 53{,}2$ ✓

$\therefore v_1 = 7{,}29\ m{\cdot}s^{-1}$ ✓ (4)

[9]

Total Section B: [30]

Total: [50]

Exemplar Assessments

Time: 3 hours

Trial Exam Paper 1

MEMORANDUM

1.1 D✓✓ (2)
1.2 D✓✓ (2)
1.3 C✓✓ (2)
1.4 B✓✓ (2)
1.5 D✓✓ (2)
1.6 B✓✓ (2)
1.7 B✓✓ (2)
1.8 C✓✓ (2)
1.9 C✓✓ (2)
1.10 B✓✓ (2)

[20]

2.1 The uninterrupted motion of a falling object in the absence of air resistance, where only gravitational force acts on the object. ✓✓ (2)

2.2 2.2.1 $v_t = v_i + a\Delta t$ ✓

5 ✓ $= 0 + (9{,}8)\Delta t$ ✓

$\Delta t = 0{,}51$ s (3)

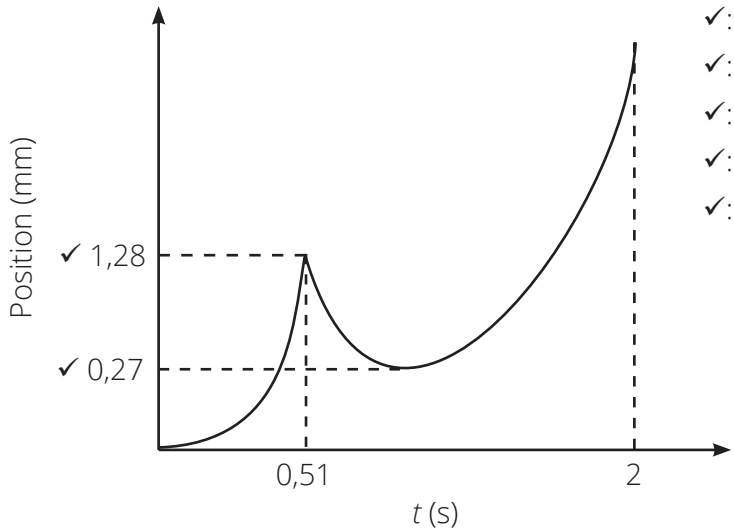
2.2.2 $v_f^2 = v_i^2 + 2a\Delta x$ ✓ OR: $\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓

$5^2 = 0 + 2 \times 9{,}8 \times \Delta x$ ✓ $= 0(0{,}510) + \frac{1}{2}(9{,}8)(0{,}510)^2$ ✓

$\therefore \Delta x = 1{,}28$ m ✓✓ $= 1{,}28$ m ✓✓ (4)

2.3 It bounces inelastically✓✓ Or it loses kinetic energy. (2)

2.4



✓: shape 0–0,51 s
✓: shape 0,51–2 s
✓: 1,28
✓: 0,27
✓: 0,51 and 2 (–1 if axes labelled incorrectly) (5)

[16]

3.1.1 Law of conservation of mechanical energy ✓✓ (2)

3.1.2 Total $E_{M(A)}$ = Total $E_{M(B)}$ OR

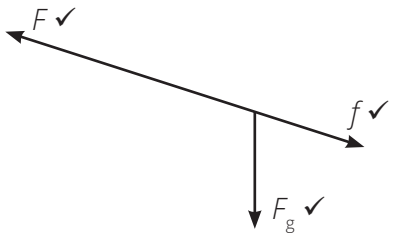
$mgh_A + \frac{1}{2}mv_A^2 = mgh_B + \frac{1}{2}mv_B^2$ ✓

$0{,}05(9{,}8)0{,}5 + 0$ ✓ $= 0{,}05(9{,}8)h_B + \frac{1}{2}(0{,}05)2{,}8^2$ ✓

$-0{,}49h_B = -0{,}049$

$h_B = 0{,}10$ m ✓ (4)

3.2.1



(3)

3.2.2 $W_F = F_F\Delta x\cos\theta$ ✓ $= 600(6)\cos 0°$ ✓

= 3 600J (2)

3.2.3 $W_{net} = \Delta E_k$ OR

$W_F + W_f = (\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2) + (mgh_f - mgh_i)$ ✓

3 600 ✓ + (–240) ✓ $= ([\frac{1}{2}]60v_f^2 - 0) + (60(9{,}8)(2) - 0)$ ✓

$v_f = 8{,}53\ m\cdot s^{-1}$ ✓ (5)

3.2.4 $P = \frac{W}{\Delta t}$ ✓

$= \frac{3\ 600}{10}$ ✓

= 360 W ✓ (3)

[19]

4.1 impulse ✓ (1)

4.2 The net force acting on an object is equal to the rate of change of momentum of the object. ✓✓ (2)

4.3 $F\Delta t = \Delta p$ ✓✓

$-1{,}2\ \Delta t = -0{,}24$ ✓

$\Delta t = 0{,}2$ s ✓ (4)

4.4 Total p_i = Total p_f

$m_1v_{ii} + m2_2v_{2i} = m_fv_{1f} + m_2v_{2f}$ ✓

$0{,}6(0{,}5) + 0{,}8(0)$ ✓ $= 0{,}6(0{,}1) + 0{,}8v_{2f}$ ✓

$v_{2f} = 0{,}30\ m\cdot s^{-1}$ ✓ (4)

4.5.1 no kinetic energy is lost/kinetic energy is conserved. ✓ (1)

4.5.2 Total E_{kl} = Total E_{kf} OR

$\frac{1}{2}mv_i^2 = \frac{1}{2}mv_f^2$ ✓

$0{,}016$ ✓ $= [\frac{1}{2}]0{,}8v_f^2$ ✓

$v_f = 0{,}2\ m{\cdot}s^{-1}{}_f$ ✓ in the opposite direction/left. ✓ (5)

[17]

5.1 The rate at which at work is done or energy is expended ✓✓

One watt is the rate of energy transfer of one joule per second. ✓✓ (4)

5.2 $W_A = \Delta E_k + \Delta E_p$

$= (\frac{1}{2}mv_1{}^2 - \frac{1}{2}mv_i^2) + (mgh_f - mgh_i)$ ✓

$= (\frac{1}{2})(60)(2^2) - (\frac{1}{2})(60)\ 0^2 + (60)(9{,}8)(5) - (60)(9{,}8)(0)$ ✓

$= 3\ 060$ J ✓

$P = \frac{W}{\Delta t}$ ✓

$= \frac{3\ 060}{4{,}5}$ ✓

$= 680$ W ✓ (6)

[10]

6.1 The electric field at a point is the electrostatic force experienced per unit positive charge placed at that point. ✓✓ (2)

6.2 $E = \frac{F}{Q}$ ✓

$4\ 000$ ✓ $= \frac{F}{2{,}5 \times 10^{-9}}$ ✓

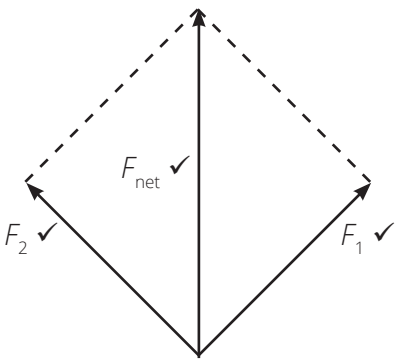
$\therefore F = 1 \times 10^{-5}$ N; right ✓ (4)

6.3 $F = \frac{kQ_1Q_2}{r^2}$ ✓

1×10^{-5} ✓ $= \frac{9 \times 10^9(2{,}5 \times 10^{-9})Q_2}{(0{,}075)^2}$ ✓ ✓

$Q_2 = +2{,}5 \times 10^{-9}$ C ✓ (5)

6.4



(3)

[14]

7.1.1 alternating current ✓ generator ✓ (2)

7.1.2 AC generator has slip rings. ✓ DC generator has a split ring commutator. ✓ (2)

7.1.3 Mechanical energy is converted to electrical energy. ✓ (1)

7.2.1 $I_{rms} = \frac{I_{max}}{\sqrt{2}}$ ✓

$= 22{,}63 \div \sqrt{2}$ ✓

$= 16$ A ✓ (2)

2.4.2 $V_{rms} = I_{rmsR}$ ✓

$= 16$ ✓ (3) ✓

$= 48$ V ✓ (4)

7.2.3 $P_{av} = V_{rms}I_{rms}$ ✓

$= 48$ ✓ $\times$ 16 ✓

$= 768$ W ✓ (4)

7.2.4 The resistance of the ceiling fan is less than that of the air conditioner. ✓ Since $P = I^2R$, and the current is the same through both appliances power is directly proportional to the resistance. ✓ The appliance with lower resistance will draw less power. (2)

[17]

8.1 the emf of the battery. ✓ (1)

8.2 Some of the voltage is lost due to the internal resistance ✓ of the battery. (1)

8.3 emf $= V_x + V_i$ ✓

$12 = 11{,}4 + Ir$

12 ✓ $= 11{,}4 + I(0{,}4)$ ✓

$i = 1{,}5$ A ✓ (4)

8.4 $V_x + IR_x$ ✓

11,4 ✓ $= 1{,}5R_x$ ✓

$R_x = 7{,}6\ \Omega$

$\frac{1}{R_x} = \frac{1}{(x+y)} + \frac{1}{z}$ ✓

but $x = y = z$, $\therefore \frac{1}{R_x} = \frac{1}{(2x)} + \frac{1}{x}$

$\frac{1}{7{,}6} = \frac{1}{(2x)} + \frac{1}{x}$ ✓

$2x = 7{,}6 + 2(7{,}6)$

$x = 11{,}40\ \Omega$ ✓ (6)

8.5.1 decreases ✓ (1)

8.5.3 increases ✓ (1)

[14]

9.1 Frequency (of sound detected by the listener (observer) ✓ (1)

9.2 The apparent change in frequency or pitch of a sound (detected by a listener) because the sound source and/or the listener have different velocities relative to the medium of sound propagation. ✓✓ (2)

9.3 Away ✓ ; detected frequency of source decreases ✓ (2)

9.4 Experiment 2 OR Experiment 3

$f_L = \frac{v \pm v_L}{v \pm v_3} f_S$ ✓ OR $f_L = \frac{v \pm v_L}{v \pm v_3} f_S$

$874 = \frac{v}{v + 10} \times (900)$ ✓ $850 = \frac{v}{v + 20} \times (900)$

$v = 336{,}15\ m{\cdot}s^{-1}$ ✓ $v = 340\ m{\cdot}s^{-}$

Experiment 4

$f_L = \frac{v \pm v_L}{v \pm v_3} f_S$

$827 = \frac{v}{v + 30} \times (900)$

$v = 339{,}86\ m{\cdot}s^{-1}$

$v_{ave} = \frac{336{,}15 + 340{,}00 + 339{,}86}{3}$

$= 338{,}67\ m{\cdot}s^{-1}$ ✓✓ (5)

9.5 Away from the earth. ✓ (1)

[11]

10.1 $c = f\lambda$ ✓

$3 \times 10^8 = f \times 600 \times 10^{-9}$ ✓

$\therefore f = 5 \times 10^{14}$ Hz ✓ (3)

10.2 $E = hf$ ✓

$= 6{,}63 \times 10^{-34} \times 5 \times 10^{14}$ ✓

$= 3{,}32 \times 10^{-19}$ J ✓ (3)

10.3 $E = W_0 + E_k$ ✓

$3{,}32 \times 10^{-19} = 1{,}2 \times 10^{-19} + E_k$ ✓

$\therefore E_k = 2{,}12 \times 10^{-19}$ J ✓ (3)

10.4 $W_0 = hf_0 = \frac{hc}{\lambda}$ ✓

$5{,}5 \times 10^{-19} = \frac{6{,}63 \times 10^{-34} \times 3 \times 10^8}{\lambda}$ ✓

$\therefore \lambda = 3{,}61 \times 10^{-7}$ Hz ✓ (3)

[12]

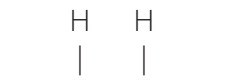
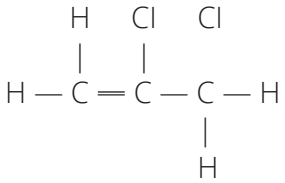
Total: [150]

Exemplar Assessments

Time: 3 hours

Trial Exam Paper 2

MEMORANDUM

1.1	A✓✓	(2)
1.2	A✓✓	(2)
1.3	B✓✓	(2)
1.4	C✓✓	(2)
1.5	A✓✓	(2)
1.6	C✓✓	(2)
1.7	B✓✓	(2)
1.8	D✓✓	(2)
1.9	A✓✓	(2)
1.10	A✓✓	(2)
		[20]
2.1.1	carboxylic acids ✓	(1)
2.1.2	H ✓	(1)
2.1.3	 ✓ : C=C ✓ : whole structure	(2)
2.1.4	B and G ✓✓	(2)
2.1.5	 ✓ : whole structure ✓ : C_1=C_2 ✓ : Cl atoms on C_2 and C_3	(3)
2.2.1	butan ✓-2-one ✓	(2)
2.2.2	3-methyl ✓ but- ✓ 1-ene ✓	(3)
2.3.1	primary ✓	(1)
2.3.2	propan ✓ -1-ol ✓	(2)
2.4.1	A ✓ and F ✓	(2)
2.4.2	propyl ✓ ethanoate ✓	(2)
2.4.3	dehydrating agent (OR removes water)/catalyst ✓	(1)
		[22]
3.1	The pressure exerted by vapour particles ✓ at equilibrium with their liquid in a closed system.✓	(2)
3.2	alkanes ✓	(1)

3.3 Will the vapour pressure of alkanes decrease with increasing number of carbon atoms (or molecular mass)?

✓: correctly identifying the variables

✓: correct relationship (2)

3.4 The same functional group/homologous series/type of intermolecular force/or all must be straight chain alkanes. ✓ (1)

3.5 Increasing the number of carbon atoms (or molecular mass), increases the surface area of the molecules/chain length/molecular mass. ✓ A larger surface area results in stronger intermolecular forces. ✓ Thus, more energy is needed to separate the particles, thus less volatile (or less vapour particles present), ✓ thus the vapour pressure will be lower. ✓ (4)

3.6 no; ✓ they do not have the same molecular formula. ✓ (2)

3.7 C_4H_{10} ✓✓ (2)

[14]

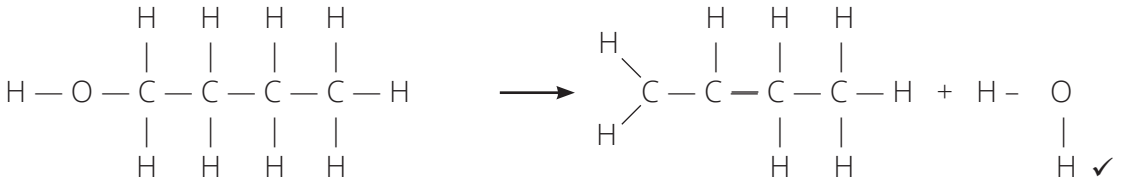
4.1.1 Substitution ✓ (1)

4.1.2 1- chloro✓butane ✓ (2)

4.1.3 H_2O ✓ (1)

4.2.1 H_2SO_4/Sulphuric acid ✓ (1)

4.2.2



✓ whole structure ✓ C = C ; ✓whole structure

(4)

4.2.3 but✓-1-ene✓ (2)

4.3.1 Esters ✓ (1)

4.3.2 butyl✓ethanoate✓ (2)

[14]

5.1 The pressure gauge is reading the atmospheric pressure. ✓ (1)

5.2 15 s ✓ (1)

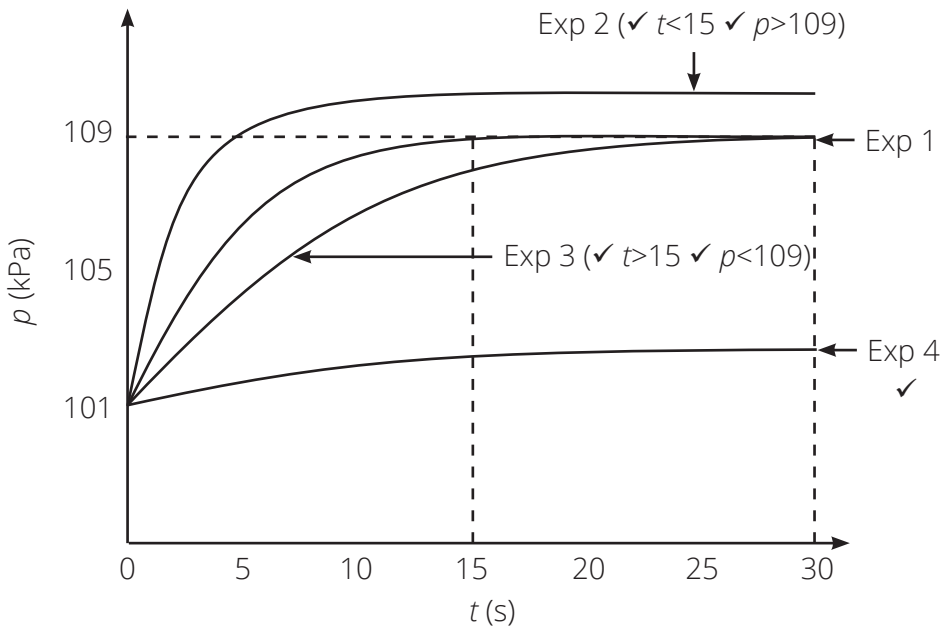
5.3 average rate = $\frac{\Delta p}{\Delta t}$

$= \frac{109 - 101}{15}$ ✓✓

$= 0{,}53\ kPa \cdot s^{-1}$ ✓ (3)

5.4.1 Less particles have enough kinetic energy. ✓ Less effective collisions per unit time, ✓ thus a lower reaction rate. ✓ (3)

5.4.2



(5)

5.5 Increase ✓ Finer powder means there is a larger surface area, ✓ so (more hydrogen peroxide particles will come into contact with the catalyst), more particles ✓ will have the correct orientation and enough kinetic energy, so there will be more effective collisions per unit time. ✓ (4)

5.6 $c = \frac{n}{V}$ ✓

$0{,}85 = \frac{n}{0{,}075}$ ✓

$n = 0{,}06375$ mol H_2O_2

but $2H_2O_2 : 1O_2$ ∴ $nO_2 = 0{,}031875$ mol.

$n = \frac{m}{M}$ ✓

$0{,}031875$ ✓ $= \frac{n}{32}$ ✓

$m = 1{,}02$ g ✓ (6)

[23]

6.1 Dynamic equilibrium is when the rate of the forward reaction equals the rate of the reverse reaction. ✓✓ (2)

6.2 The reaction is exothermic, ✓ thus lower temperatures favour the forward reaction. ✓ If temperatures are too low, the reaction rate will be too slow, ✓ thus will not be economically viable. (3)

6.3 increase; ✓ Increase in pressure favours the reaction that leads to a decrease in the number of mol. ✓ Forward reaction is favoured. ✓ Concentration of product/quantity of ammonia increases. ✓ (4)

6.4.1 decreases ✓ (1)

6.4.2 Reverse reaction ✓

Kc value < 1, ✓ indicating that reactant formation ✓ is favoured. (3)

6.4.3

	N_2	$3H_2$	$2NH_3$
Initial mol.	x	14	0
Δ mol.	2	6	4
Equilibrium: mol	$x - 2$	8	4
$c = \frac{n}{V}$ $= \frac{n}{10}$ (mol·dm^{-3})	$\frac{x-2}{10}$	0,8	0,4

✓ use mol ratio
✓ subtraction
✓ divide by 10

$K_c = \frac{[NH_3]^2}{[N_2][H_2]^3}$ ✓

$4{,}4 \times 10^{-1}$ ✓ $= \frac{(0{,}4)^2}{[\frac{x}{10} - \frac{2}{10}](0{,}8)^3}$ ✓

$x = 9{,}10$ mol ✓ (7)

[20]

7.1.1 $m = cMV$ ✓
$= 0{,}5 \times 90 \times 0{,}5$ ✓
$= 22{,}5$ g ✓ (4)

7.1.2 Diprotic describes an acid that can donate two protons. ✓✓ (2)

7.1.3 $(COOH)_2 + 2H_2O \rightleftharpoons (COO)_2^{2-} + 2H_3O^+$
✓ : reactants; ✓ :products; ✓ : balancing (3)

7.2.1 $K_W = 10^{-14} = [H_3O^+][OH^-]$ ✓
$= [H_3O^+] \times 5 \times 10^{-3}$ ✓
$[H_3O^+] = \frac{10^{-14}}{(5 \times 10^{-3})}$
$= 2 \times 10^{-12}$ mol·dm^{-3} ✓
pH = –log $[H_3O^+]$ ✓
$= -\log(2 \times 10^{-12})$
$= 11{,}7$ ✓ (5)

7.2.2 bromothymol blue ✓ (1)

7.2.3 $\frac{n_a}{n_b} = \frac{(c_aV_a)}{(c_bV_b)}$ ✓
$\frac{1}{2} = \frac{(c_a \times 24)}{(5 \times 10^{-3} \times 27)}$ ✓
$c_a = 2{,}81 \times 10^{-3}$ mol·dm^{-3} ✓
$[(COOH)_2] = 2{,}81 \times 10^{-3}$ mol·dm^{-3} ✓ (4)

[19]

8.1.1 an electrolytic cell ✓ (1)

8.1.2 the positive carbon electrode ✓ (1)

8.1.3 Al^{3+} ✓ (1)

8.1.4 $2O^{2-} \rightarrow O_2 + 4e^-$ ✓✓ (2)

8.2.1 chemical energy → electrical energy ✓ (1)

8.2.2 $E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ ✓

$= 0{,}34 - (-1{,}66)$ ✓

$= 2$ V ✓

The calculated value is at standard conditions and the actual reading ≠ 2 V. ✓ (4)

8.2.3 Al^{3+} ✓ (1)

8.2.4 $Cu^{2+} + 2e^- \rightarrow Cu$ ✓✓ (2)

8.2.5 $3Cu^{2+} + 2Al \rightarrow 3\,Cu + 2\,Al^{3+}$

✓ : reactants; ✓ : products; ✓ : balanced (3)

8.2.6 increases ✓✓ (2)

[18]

Total: [150]

Notes

Notes

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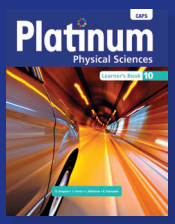

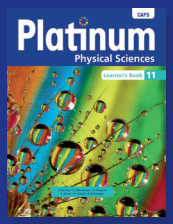

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