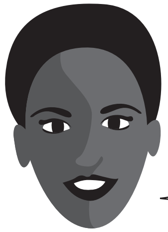
A. ABOUT THE PLANNER AND TRACKER

1. Your quick guide to using this planner and tracker

What is the NECT and where do I fit in?

What you do matters! What you do every day as a teacher can change the life-chances of every child that you teach. The NECT supports teachers by providing CAPS planners and trackers so that teachers can plan to cover the curriculum, track progress, and seek help when they are falling behind.

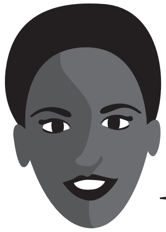


But who will help me?

The NECT will work with your school management team (SMT) and assist them to have supportive and professional conversations with you about curriculum coverage that will be orientated to identifying and solving problems.

I have looked at the planner and tracker. It goes too fast!

The CAPS planner and tracker is an expanded ATP. It helps you pace yourself as if you were able to cover everything in the ATP/CAPS. When you fall behind because time has been lost, or because the learners are progressing slowly, you need to confidently discuss this with your teaching team without feeling blamed. The pace of coverage will be determined by the pace of learning. That is why coverage must be tracked by the teacher and the SMT.

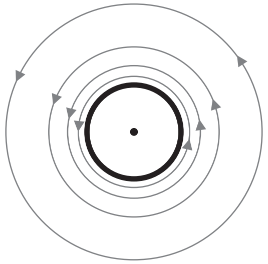


How do I use the planner and tracker?

See the "**Quick 5-step Guide to Using the CAPS Planners and Trackers**" on the opposite page.

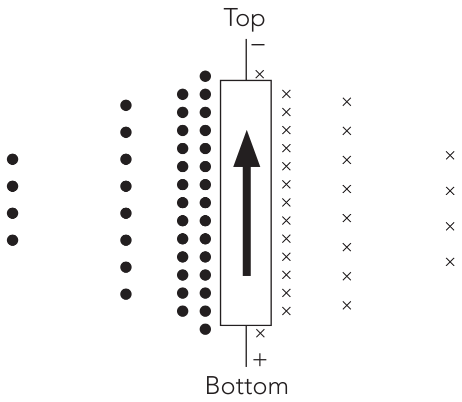
The crucial step in using these different views comes when you combine the current and the associated magnetic field. This link was first discovered by Ørsted. He found that a magnetic field formed around the conducting wire and that it was perpendicular to the direction of current. The magnetic field is strongest close to the conductor but becomes weaker further away. The magnetic field is illustrated by concentric circles and the direction of the field by arrows (Figure 4).

FIGURE 4: DIAGRAM OF A STRAIGHT CURRENT-CARRYING CONDUCTOR (TOP VIEW) SHOWING MAGNETIC FIELD



So what would the side view look like? The diagram in Figure 5 shows the magnetic field lines as dots and crosses. The dots show the direction of the field out of the page and the crosses represent the magnetic field direction into the page. This diagram shows that the magnetic field lines are closer together nearer the conductor and farther apart at a greater distance from the conductor.

FIGURE 5: DIAGRAM OF A STRAIGHT CURRENT-CARRYING CONDUCTOR (SIDE VIEW) SHOWING MAGNETIC FIELD



The diagram is also critical in developing the concept of magnetic flux. Initially you could ask learners to count the number of dots or crosses in a square close to the conductor. Next you could move the square away from the conductor and the number of dots and crosses passing through the square would decrease. This exercise links the idea of a magnetic field passing through an area that is perpendicular to the field and so defines the term magnetic flux.

One can then look at magnetic flux for a loop or a solenoid while exploring the idea that a moving charge (current) produces a magnetic field. Learners should be able to understand that the magnetic flux inside a solenoid is much higher than outside the coil.

The next step is to explore the converse relationship that Faraday discovered. Here we look at how a moving magnet field can induce an electromagnetic field (emf) across the ends of a conductor. The relationship is summarised in the equation for Faraday's Law $\varepsilon = -N\frac{\Delta\Phi}{\Delta t}$ where N is the number of turns in the coil and Φ is the magnetic flux. This is best demonstrated by moving a magnet into a coil connected to a galvanometer. We say the moving magnet induces an emf across the ends of the conducting wires. When these wires are connected to form a closed circuit, current will pass through the wire. The direction of the current changes when the direction of the movement of the magnet changes. The factors that affect the size of the induced emf may also be explored, including the strength of the magnet and the number of turns in the coil. Learners will also discover that the faster the magnet moves, the greater the induced emf. This evidence can be used to explain the phrase 'rate of change' which is found in the statement of Faraday's Law.

Electric circuits

The relationship between emf (potential difference) and current is explored in this topic. One of the crucial activities in this section of work is to verify Ohm's Law. It is important to link these topics, as your learners could be asked to combine Faraday's Law and Ohm's Law in order to calculate resistance of a coil or the magnitude of the induced current in a coil.

Electric circuits are not new to learners. However, it is important to revise the definitions of potential difference, emf, current and resistance with them. They should also be reminded about series and parallel connections. Drawing and interpreting circuit diagrams is also crucial.

Ohm's Law is a very powerful tool in solving circuit problems. Investigating the relationship between current passing through a conductor and the potential difference across its ends

Once learners have grasped these theoretical concepts, they need to apply them by exploring various acid–base reactions and then using them to prepare salts.

This section needs to include a lot of practical work and so preparation is critical. You can conduct most of the required investigations even if you do not have laboratory glassware. By doing practical work you will stimulate learners' interest and help them to apply the theory. This is particularly important when preparing salts. You can ask learners to write balanced chemical equations for each of the activities they complete. If you make it a requirement that learners must submit the chemical equations before doing the practicals they will be more motivated to get the chemical equations correct. You will also be able to identify learners or groups of learners who need remediation.

2. Prepare resources

This stage in your preparation is vital. The prescribed Learner's Books provide both information and activities. The Teacher's Guides also provide valuable information as teaching guidelines. When you are planning, you need to be familiar with the information in the Learner's Book your learners will be using. This will ensure that you do not need to either read from the Learner's Book or ask your learners to copy down notes from the chalkboard or projector.

Teaching Physical Sciences should not be based on reading and discussing the Learner's Book. Learners need activities, demonstrations, problem solving opportunities and active debates. This all takes careful planning and preparation of resources.

Resources can range from everyday objects like a marble or a ball, to more scientific apparatus like a ticker timer, or even digital resources like a short video clip or simulation. Whatever resource you select as the focus of the lesson, make sure you think carefully about the questions you will ask learners to think about and discuss. You may plan these discussions in pairs or small groups. Through observation, reflection and discussion you will engage learners in helping them construct their own knowledge. It is important to challenge this knowledge and at times disagree with them even if they are correct. You can also present a common misconception and encourage them to be critical of the proposed idea.

Problem solving and application of knowledge are very important in Physical Sciences. Your learners will need to practise exam-type questions; the Learner's Books all give worked examples. There are also end-of-chapter or unit questions, exam practice and additional worksheets. These have been referenced in the tracker for each book and are included as homework activities. However, in some cases the Learner's Book may not have enough questions and we have referred you to additional activities from the ***Everything Science*** Learner's Book. If your learners don't have a copy, they can access these questions online from www.everythingscience.co.za. The Learner's Books can also be downloaded or print copies can be ordered from a supplier referred to on the same site. There is a huge database of questions that will be very useful for learners to work through both for remediation, revision and extension. Not all the activities are referenced in the tracker. If you identify that your learners are struggling in a particular section, select questions that are relevant to them.

A list of resources for the term appears below in case you want to collect these well in advance. You will find it worthwhile to collect these well in advance and leave them in a box or something similar. This way, you will avoid a last-minute rush. Remember that some materials are used on several different occasions, so keep laboratory equipment safe and well cleaned. Depending on how quickly your learners complete a section, and on what activities you choose, you may find that you are still on a certain week when the following week's requirements are listed. Continue normally and check with the CAPS document to find out what you still need.

3. Plan for required formal assessment tasks

The CAPS requirements for formal assessment in Term 3 are a project (practical assessment) and an end-of-term test. The project specified for Term 3 is either a physics or a chemistry project. The physics project is based on work done in Term 2, and if it was done there, the mark must be recorded for Term 3 practical work. Projects have not been allocated class time in the trackers as it is expected that learners will do them in their own time. Most of the Learner's Books and/or Teacher's Guides provide examples of CAPS-compliant formal assessment tasks, including practical investigations, revision activities and a sample control test.

Where the LTSMs used at your school have the test in the Learner's Book, this test cannot be used because the learners will be able to prepare for it in advance, but it is useful for revision and informal assessment. An exemplar test is provided in Section F Assessment Resources of this tracker.

Table 1 gives an overview of the practical task/investigations/project and control test provided in each of the LTSMs, and where they are scheduled in each tracker. This will help you in your preparation.

Study and Master Physical Sciences Week 5: Power, energy												
S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.	Date completed				
1	**Power, energy** • Define power as the rate at which electrical energy is converted in an electric circuit and is measured in watts (W) • Know that electrical power dissipated in a device is equal to the product of the potential difference across the device and current flowing through it: $P = IV$ • Know that power can also be given by $P = I^2R$ or $P = \frac{V^2}{R}$ • Solve circuit problems involving the concept of power	89	236–240	240 TYS 5 1a–c	D84	399–407						
	Homework: Prepare for practical investigation			238–239 Act. 5	D83–D84	407 Ex. 11.6 1–4	301–307					
2	**Power, energy** • Define power as the rate at which electrical energy is converted in an electric circuit and is measured in watts (W) • Know that electrical power dissipated in a device is equal to the product of the potential difference across the device and current flowing through it: $P = IV$ • Know that power can also be given by $P = I^2R$ or $P = \frac{V^2}{R}$ • Solve circuit problems involving the concept of power			238–239 Act. 5 Q. 1–4	D83–D84							
	Homework: Complete questions for practical investigation			238–239 Act. 5 Q. 1–4 240 TYS 5 Q. 2	D83–D84 D84–D85							
3	**Power, energy** • Know that the electrical energy is given by $E = P.\Delta t$ • and is measured in joules (J) • Solve problems involving the concept of electrical energy • Know that the kilowatt hour (kWh) refers to the use of 1 kilowatt of electrical energy for 1 hour • Calculate the cost of electricity usage given the power specifications of the appliances used, as well as the duration if the cost of 1 kWh is given	89	240–242	242 TYS 6 Q. 1	D85	409–412						

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Date completed				
						LB pp.	TG pp.					
	Homework			217 Act. 2 1, 2	187	349 Act. 2 6–12 355 Ex. 10.1 1–2	270–271					
4	**Magnetic field associated with current-carrying wires** • Use the Right Hand Rule to determine the magnetic field (B) associated with: – a straight current-carrying wire – a current-carrying loop (single) of wire – a solenoid • Draw the magnetic field lines around: – a straight current-carrying wire – a current-carrying loop (single) of wire – a solenoid • Discuss qualitatively the environmental impact of overhead electrical cables	86	218–219	217 Act. 1 1, 4	187–188	350–355						
				217 Act. 1 2, 3		356 Ex. 10.1 3–4	271–272					

Reflection

Think about and make a note of: What went well? What did not go well? What did the learners find difficult or easy to understand or do? What will you do to support or extend learners? Did you cover all the work set for the week? If not, how will you get back on track?	What will you change next time? Why?
	HOD: **Date:**

Successful Physical Sciences Week 3: Electromagnetism												
S #	**CAPS concepts, practical activities and assessment tasks**	**CAPS pp.**	**LB pp.**	**LB act.**	**TG pp.**	***Everything Science***		**Class**				
						LB pp.	**TG pp.**	**Date completed**				
1	**Faraday's Law** • State Faraday's Law • Use words and pictures to describe what happens when a bar magnet is pushed into or pulled out of a solenoid connected to a galvanometer • Use the Right Hand Rule to determine the direction of the induced current in a solenoid when the north or south pole of a magnet is inserted or pulled out	87	220–221	220 Exp. 1	188–189	357–362						
	Homework			221 Act. 2 1–3	189–190							
2	**Faraday's Law** • State Faraday's Law • Know that for a loop of area A in the presence of a uniform magnetic field B, the magnetic flux (Φ) passing through the loop is defined as: $\Phi = BA \cos \theta$ where θ is the angle between the magnetic field B and the normal to the loop of area A • Know that the induced current flows in a direction so as to set up a magnetic field to oppose the change in magnetic flux	87	222–223	223 Act. 2 4–5	190–191	357–362						
	Homework			223 Act. 2 1–4	190	367–368 Ex. 10.2 1–4	272–274					
3	**Faraday's Law** Calculate the induced emf and induced current for situations involving a changing magnetic field using the equation for Faraday's Law: $\varepsilon = -N\frac{\Delta\Phi}{\Delta t}$ where $\Phi = BA \cos \theta$ is the magnetic flux		224–225	225 Act. 1 1.1–1.3	191–192	363–367						
	Homework			225 Act. 1 2–3	192–193	368 Ex. 10.2 5–7	274–276					
4	**Electromagnetism** Review, remediation and consolidation		244–246	245–246 1–3	217	369 Ex. 10.3 1–4	276–277					
	Homework: Revision and extension			246 4–5	217–219	369 Ex. 10.3 5–9	278–279					

Reflection	
Think about and make a note of: What went well? What did not go well? What did the learners find difficult or easy to understand or do? What will you do to support or extend learners? Did you cover all the work set for the week? If not, how will you get back on track?	What will you change next time? Why?
	HOD: **Date:**

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science* LB pp.	*Everything Science* TG pp.	Class				
	Successful Physical Sciences **Week 4: Electric circuits**							Date completed				
1	**Ohm's Law** • Determine the relationship between current, voltage and resistance at constant temperature using a simple circuit	88	226–228	226–228 Exp. 1 1	194	372–375	282					
	Homework: Complete questions on Exp. 1 and prepare for Exp. 2			226–228 Exp. 1 2	194–195	375 Ex. 11.1 1a–e	283–284					
2	**Ohm's Law** • Determine the relationship between current, voltage and resistance at constant temperature using a simple circuit • State the difference between Ohmic and non-Ohmic conductors and give an example of each	88	229	229 Exp. 2	195–196	372–375	282					
	Homework: Complete report on Exp. 2			229 Exp. 2	195–196	375 Ex. 11.1 1a–e	283–284					

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Date completed					
						LB pp.	TG pp.						
3	**Ohm's Law** • State the difference between Ohmic and non-Ohmic conductors and give an example of each • Solve problems using the mathematical expression of Ohm's Law: $R = \frac{V}{I}$ for series and parallel circuits	88	230–232	232 Act. 1 1–5	196–197	376–383 Ex. 11.2 1–3	284–285						
	Homework			232 Act. 1 6–10	197–201	382–383 Ex. 11.3 1–5	287–289						
4	**Ohm's Law** • Solve problems using the mathematical expression of Ohm's Law: $R = \frac{V}{I}$ for series and parallel circuits	88	233–235	235 Act. 1 1–2	201–204	383–397 393 Ex. 11.4 1–6	290–294						
	Homework			235 Act. 1 3–5	204–207	397 Ex. 11.5 1–4	296–301						

Reflection	
Think about and make a note of: What went well? What did not go well? What did the learners find difficult or easy to understand or do? What will you do to support or extend learners? Did you cover all the work set for the week? If not, how will you get back on track?	What will you change next time? Why?
	HOD: **Date:**

Successful Physical Sciences Week 5: Power, energy

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.	Date completed				
1	**Power, energy** • Define power as the rate at which electrical energy is converted in an electric circuit and is measured in watts (W) • Know that electrical power dissipated in a device is equal to the product of the potential difference across the device and current flowing through it: $P = IV$ • Know that power can also be given by: $P = I^2R$ or $P = \frac{V^2}{R}$ • Solve circuit problems involving the concept of power	89	236–239	236 Exp 1	207–208	399–407						
	Homework			239 Act. 1 1–4	208–209	407 Ex. 11.6 1–4	301–307					
2	**Power, energy** • Solve circuit problems involving the concept of power • Know that the electrical energy is given by: $E = Pt$ • and is measured in joules (J) • Solve problems involving the concept of electrical energy	89	238–241	239 Act. 1 5–6 241 Act. 1 1–3	209–210 211	409–412						
	Homework			241 Act. 1 4–5	212	407 Ex. 11.6 5–6	307–310					
3	**Power, energy** • Know that the kilowatt hour (kWh) refers to the use of 1 kilowatt of electricity for 1 hour • Calculate the cost of electricity usage given the power specifications of the appliances used, as well as the duration if the cost of 1 kWh is given		242–243	243 Act. 1 2	213–214							
	Homework			243 Act. 1 1 and 3	213–214	407 Ex. 11.6 5–6	307–310					
4	**Electric circuits** Consolidation		244–246	246 1–2	219	413–414 Ex. 11.7 1–4	310–311					
	Homework			246 3–4	219–221	414–415 Ex. 11.7 5–9	311–315					

Reflection	
Think about and make a note of: What went well? What did not go well? What did the learners find difficult or easy to understand or do? What will you do to support or extend learners? Did you cover all the work set for the week? If not, how will you get back on track?	What will you change next time? Why?
	HOD: **Date:**

Successful Physical Sciences Week 6: Energy and chemical change												
S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.	Date completed				
1	**Energy changes in reactions related to bond energy changes** • Explain the concept of enthalpy and its relationship to heat of reaction • Define exothermic and endothermic reactions • Identify that bond breaking requires energy and that bond formation releases energy • Classify (with reason) the following reactions as exothermic or endothermic: respiration, photosynthesis, combustion of fuels	90	248–253	248 Exp. 1 251 Act. 2 1–3	222–223	418–428 424 Ex. 12.1 1–2	318–319 319–320					
	Homework: Prepare for formal practical assessment (project)			251 Act. 2 4–5 252–253	223 224–227	428–429 Ex. 12.2 1–3	320–322					
2	**Energy changes in reactions related to bond energy changes** • Explain the concept of enthalpy and its relationship to heat of reaction		254–255	255 Act. 1 1.1–1.3	228							
	Homework: Prepare for formal practical assessment (project)			255 Act. 1 2–3 252–253	228 224–227							

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Date completed				
						LB pp.	TG pp.					
3	**Activation energy** Define activation energy • Explain a reaction process in terms of energy change and relate this change to bond breaking and formation and to 'activated complex' • Draw freehand graphs of endothermic reactions and exothermic reactions (with activation energy)	91	256–258	258 Act. 1 3–4	229	429–432 432 Ex. 12.3 1–2	323					
	Homework: Prepare for formal practical assessment (project)			258 Act. 1 1–2 252–253	229 224–227	433 Ex. 12.4 1–6	324–327					
4	**Investigate endothermic and exothermic reactions (project)** • Alternative investigation	91		252–253 260 Act. 3	224–227 230–231							
	Homework: Complete project report Revision and extension			252–253 290 1–5	224–227 243							

Reflection

Think about and make a note of: What went well? What did not go well? What did the learners find difficult or easy to understand or do? What will you do to support or extend learners? Did you cover all the work set for the week? If not, how will you get back on track?	What will you change next time? Why? **HOD:** **Date:**

Successful Physical Sciences Week 7: Types of reactions												
S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.	Date completed				
1	**Acid–base** • Use the acid–base theories of Arrhenius and Brønsted and Lowry to define acids and bases • Define an acid as an H^+ donor and a base as an H^+ acceptor in reaction • List common acids (including hydrochloric acid, nitric acid, sulfuric acid and acetic acid) and common bases (including sodium carbonate, sodium hydrogen carbonate and sodium hydroxide) by name and formula	92	261–265	265 Act. 1 1–10	231–233	438–440	330–331					
	Homework			265 Act. 1 11–19	233	441–442 Ex. 13.1 1–2	331–332					
2	**Acid–base** • Identify conjugate acid/base pairs • Define an ampholyte	92	266–267	266 Act. 2 1.1–1.7 267 Act. 3 1–3	233 234	440–442 443 Ex. 13.2 1–2	332–333					
	Homework			266 Act. 2 2–3 267 Act. 3 4–6	233–234 234	447 Ex. 13.3 1	334					
3	**Acid–base** • Write the overall equation for simple acid–metal hydroxide, acid–metal oxide and acid–metal carbonate reactions and relate these to what happens at the macroscopic and microscopic level	92	268–270	270 Act. 1 1–3	234	443–445, 447–450						
	Homework: Prepare for informal practical investigation on natural indicators			270 Act. 1 4–6	234	447 Ex. 13.3, 1 448 Ex. 13.4, 1 450 Ex. 13.5, 1	334					

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Date completed				
						LB pp.	TG pp.					
4	**Acid–base** • What is an indicator? • Look for some natural indicators	92	273–275	274 Exp. 1	236	445–446						
	Homework: Complete report on natural indicators			291 6.1–6.4	244	467 Ex. 13.9 4–6	344–345					

Reflection	
Think about and make a note of: What went well? What did not go well? What did the learners find difficult or easy to understand or do? What will you do to support or extend learners? Did you cover all the work set for the week? If not, how will you get back on track?	What will you change next time? Why?
	HOD: **Date:**

Successful Physical Sciences Week 8: Types of reactions

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.	Date completed				
1	**Acid-base** • Use acid-base reactions to produce and isolate salts, e.g. Na_2SO_4, $CuSO_4$ and $CaCO_3$	92	270–272	271 Exp. 2	235	450–452						
	Homework: Complete report on salt preparation Revision and extension			291 1–3	244	452 Ex. 13.6 1–3	334					
2	**Acid-base** • Use acid-base reactions to produce and isolate salts, e.g. Na_2SO_4, $CuSO_4$ and $CaCO_3$	92	270–272	271 Exp. 2	235	450–452						
	Homework: Complete report on salt preparation Revision and extension			291 4–5	244	452 Ex. 13.6 4–6	335					

S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Date completed					
						LB pp.	TG pp.						
3	**Acid-base** • Use acid-base reactions to produce and isolate salts, e.g. e.g. Na_2SO_4, $CuSO_4$ and $CaCO_3$ • Recommend Act. 3 as practical investigation as per teacher guide	92	270–272	271 Act. 3 1–3	235								
	Homework: Complete report on salt preparation			271 Act. 3 4–6	235	467–468 Ex. 13.9 7–9	345						
4	**Term 3 Consolidation** Revision and remediation			291 1–6	244	467–468 Ex. 13.9 7–9	343–345						

Reflection	
Think about and make a note of: What went well? What did not go well? What did the learners find difficult or easy to understand or do? What will you do to support or extend learners? Did you cover all the work set for the week? If not, how will you get back on track?	What will you change next time? Why?
	HOD: **Date:**

Successful Physical Sciences Week 9: Catch up and consolidation – plan your week												
S #	CAPS concepts, practical activities and assessment tasks	CAPS pp.	LB pp.	LB act.	TG pp.	*Everything Science*		Class				
						LB pp.	TG pp.	Date completed				
1												
2												
3												
4												

Reflection	
Think about and make a note of: What went well? What did not go well? What did the learners find difficult or easy to understand or do? What will you do to support or extend learners? Did you cover all the work set for the week? If not, how will you get back on track?	What will you change next time? Why?
	HOD: **Date:**

Successful Physical Sciences Weeks 10–11: Term 3 Control test, review of test and corrections	
End-of-term reflection	
Think about and make a note of: 1. Was the learners' performance during the term what you had expected and hoped for? Which learners need particular support with Physical Sciences in the next term? What strategy can you put in place for them to catch up with the class? Which learners would benefit from extension activities? What can you do to help them?	3. What ONE change should you make to your teaching practice to help you teach more effectively next term?
2. With which specific topics did the learners struggle the most? How can you adjust your teaching to improve their understanding of this section of the curriculum in the future?	4. Did you cover all the content as prescribed by the CAPS for the term? If not, what are the implications for your work on these topics in future? What plan will you make to get back **on track**?
HOD:	**Date:**

E. ADDITIONAL INFORMATION AND ENRICHMENT ACTIVITIES

CAPS concepts, practical activities and assessment tasks	Additional information and enrichment activities
Weeks 1–2: Electrostatics	
Coulomb's Law • State Coulomb's Law, which can be represented mathematically as: $F = \frac{kQ_1Q_2}{r^2}$ • Solve problems using Coulomb's Law to calculate the force exerted on a charge by one or more charges in one dimension (1D) and two dimensions (2D)	**Mindset Learn Videos:** http://learn.mindset.co.za/resources/physical-sciences/grade-11/electricity-magnetism-electrostatics Worksheet in Section G
Electric field • Describe an electric field as a region of space in which an electric charge experiences a force • The direction of the electric field at a point is the direction that a positive test charge (+1C) would move if placed at that point • Draw electric field lines for various configurations of charges • Define the magnitude of the electric field at a point as the force per unit charge $E = \frac{F}{q}$, E and F are vectors • Deduce that the force acting on a charge in an electric field is $F = q.E$ • Calculate the electric field at a point due to a number of point charges, using the equation $E = \frac{kQ}{r^2}$ to determine the contribution to the field due to each charge	**Mindset Learn Videos:** http://learn.mindset.co.za/resources/physical-sciences/grade-11/electricity-magnetism-electrostatics **PHET Simulation: Charges and fields** http://phet.colorado.edu/sims/charges-and-fields/charges-and-fields_en.html Worksheet in Section G
Weeks 2–4: Electromagnetism	
Magnetic field associated with current-carrying wires • Provide evidence for the existence of a magnetic field (B) near a current-carrying wire • Use the Right Hand Rule to determine the magnetic field (B) associated with: – a straight current-carrying wire – a (single) current-carrying loop of wire – a solenoid • Draw the magnetic field lines around: – a straight current-carrying wire, – a (single) current-carrying loop of wire – a solenoid • Discuss qualitatively the environmental impact of overhead electrical cables	**Mindset Learn Videos:** http://learn.mindset.co.za/resources/physical-sciences/grade-11/electricity-magnetism-electromagnetism Worksheet in Section G
Faraday's Law • State Faraday's Law • Use words and pictures to describe what happens when a bar magnet is pushed into or pulled out of a solenoid connected to a galvanometer • Use the Right Hand Rule to determine the direction of the induced current in a solenoid when the north or south pole of a magnet is inserted or pulled out • Know that for a loop of area A in the presence of a uniform magnetic field B, the magnetic flux (Φ) passing through the loop is defined as: $\Phi = BA \cos \theta$ where θ is the angle between the magnetic field B and the normal to the loop of area A • Know that the induced current flows in a direction so as to set up a magnetic field to oppose the change in magnetic flux • Calculate the induced emf and induced current for situations involving a changing magnetic field using the equation for Faraday's Law: $\varepsilon = -N\frac{\Delta\Phi}{\Delta t}$ where $\Phi = BA \cos \theta$ is the magnetic flux	**Mindset Learn Videos:** http://learn.mindset.co.za/resources/physical-sciences/grade-11/electricity-magnetism-electromagnetism **PHET Simulation: Faraday's Law** http://phet.colorado.edu/en/simulation/legacy/faraday

CAPS concepts, practical activities and assessment tasks	Additional information and enrichment activities
Weeks 4–5: Electric circuits	
Ohm's Law • Determine the relationship between current, voltage and resistance at constant temperature using a simple circuit • State the difference between Ohmic and non-Ohmic conductors, and give an example of each • Solve problems using the mathematical expression of Ohm's Law: $R = \frac{V}{I}$ for series and parallel circuits	**Mindset Learn Videos:** http://learn.mindset.co.za/resources/physical-sciences/grade-11/electricity-magnetism-electric-circuits **PHET Simulations: Electric Circuits** http://phet.colorado.edu/en/simulation/legacy/circuit-construction-kit-dc
Power, energy • Define power as the rate at which electrical energy is converted in an electric circuit and is measured in watts (W) • Know that electrical power dissipated in a device is equal to the product of the potential difference across the device and current flowing through it: $P = IV$ • Know that power can also be given by: $P = I^2R$ or $P = \frac{V^2}{R}$ • Solve circuit problems involving the concept of power • Know that the electrical energy is given by: $E = Pt$ and is measured in joules (J) • Solve problems involving the concept of electrical energy • Know that the kilowatt hour (kWh) refers to the use of 1 kilowatt of electricity for 1 hour • Calculate the cost of electricity usage given the power specifications of the appliances used, as well as the duration, if the cost of 1 kWh is given	**Mindset Learn Videos:** http://learn.mindset.co.za/resources/physical-sciences/grade-11/electricity-magnetism-electric-circuits
Week 6: Energy and chemical change	
Energy changes in reactions related to bond energy changes • Explain the concept of enthalpy and its relationship to heat of reaction • Define exothermic and endothermic reactions • Identify that bond breaking requires energy (endothermic) and that bond formation releases energy (exothermic) • Classify (with reason) the following reactions as exothermic or endothermic: respiration, photosynthesis, combustion of fuels	**Mindset Learn Videos:** http://learn.mindset.co.za/resources/physical-sciences/grade-11/chemical-change-energy-and-chemical-change
Exothermic and endothermic reactions • State that $\Delta H > 0$ for endothermic reactions. • State that $\Delta H < 0$ for exothermic reactions • Draw freehand graphs of endothermic reactions and exothermic reactions (without activation energy)	**Mindset Learn Videos:** http://learn.mindset.co.za/resources/physical-sciences/grade-11/chemical-change-energy-and-chemical-change
Activation energy • Define activation energy • Explain a reaction process in terms of energy change and relate this change to bond breaking and formation and to 'activated complex' • Draw freehand graphs of endothermic reactions and exothermic reactions (with activation energy)	**Mindset Learn Videos:** http://learn.mindset.co.za/resources/physical-sciences/grade-11/chemical-change-energy-and-chemical-change

CAPS concepts, practical activities and assessment tasks	Additional information and enrichment activities
Weeks 7–8: Types of reaction	
Acid–base • Use the acid–base theories of Arrhenius and Brønsted and Lowry to define acids and bases • Define an acid as an H+ donor and a base as an H+ acceptor in reactions • Identify conjugate acid/base pairs • Define an ampholyte • List common acids (including hydrochloric acid, nitric acid, sulfuric acid and acetic acid) and common bases (including sodium carbonate, sodium hydrogen carbonate and sodium hydroxide) by name and formula	**Mindset Learn Videos:** http://learn.mindset.co.za/resources/physical-sciences/grade-11/chemical-change-types-reactions-acids-bases
Acid–base • Write the overall equation for simple acid–metal hydroxide, acid–metal oxide and acid–metal carbonate reactions and relate these to what happens at the macroscopic and microscopic level • What is an indicator? • Look for some natural indicators • Use acid–base reactions to produce and isolate salts, e.g. Na_2SO_4, $CuSO_4$ and $CaCO_3$	**Mindset Learn Videos:** http://learn.mindset.co.za/resources/physical-sciences/grade-11/chemical-change-types-reactions-acids-bases

F. ASSESSMENT RESOURCES

1. Sample item analysis sheets

PHYSICAL SCIENCES TERM 3 GRADE 11

SUGGESTED ITEM ANALYSIS RECORD SHEET FOR FORMAL ASSESSMENT

TERM 3 CONTROL TEST										
		Questions								
		1	2	3	4	5	6	7	8	Total
		Multiple choice	Electrostatics	Electromagnetism	Electric circuits	Electric circuits	Energy and chemical change	Acids and bases	Acids and bases	
	Marks	10	20	9	14	12	12	6	17	100
Learner name	Learner surname									

SUGGESTED ITEM ANALYSIS RECORD SHEET FOR FORMAL ASSESSMENT

PRACTICAL PROJECT								
		Questions						
		1	2	3	4	5	6	Total
		Pre-practical preparation	Setting up equipment Conducting experiment	Collection of data	Tabulation and calculations	Discussion of results	Conclusion	
	Marks							
Learner name	Learner surname							

2. Physical Sciences Grade 11: End-of-Term 3 Control Test

INSTRUCTIONS AND INFORMATION

1. This question paper consists of 8 questions, a data sheet and a Periodic Table.
2. Make sure that your question paper is complete.
3. Read the questions carefully.
4. Write legibly and to set your work out neatly.
5. **Question 1** consists of 5 multiple-choice questions. There is only one correct answer to each question. Write only the letter (A–D) next to the question number, e.g. 1.2 A.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. Make use the data sheet whenever necessary.
9. Answer **all** questions.
10. Show all working clearly in all calculations.
11. Where appropriate round up answers to **two** decimal places.

Question 1

Multiple choice questions

Various options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A–D) next to the question number, e.g. 1.2 A.

1.1 Two spheres, A and B, have charges of +5 *n*C and –8 *n*C, respectively.

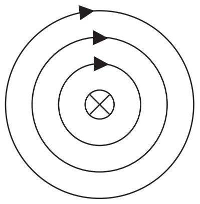
They are allowed to touch but then separate.

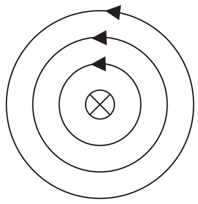
The charges (in *n*C) on the spheres after separation are …

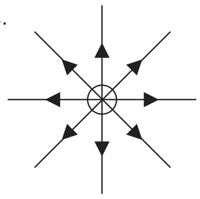
	Sphere A	**Sphere B**
A	+5	–8
B	–3	–3
C	+1,5	+1,5
D	–1,5	–1,5

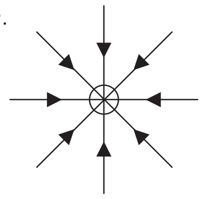
(2)

1.2 Which of the following diagrams correctly represents the magnetic field associated with a current-carrying conductor when the current flows into the plane of the page?

A.


B.


C.


D.


(2)

1.3 A current of 1,5 A passes through a light bulb will connected to a 12 V source.

How much energy is dissipated through the light bulb in 2,5 minutes?

A. 45 J

B. 45 W

A. 2,7 kJ

B. 2700 W (2)

1.4 In a given reversible reaction, the forward reaction is exothermic.

Which statement about the reverse reaction is true?

A. The reverse reaction is exothermic.

B. The energy released by the reverse reaction is equal to the activation energy of forward reaction.

C. The ΔH value for the reverse reaction is larger than that for the forward reaction.

D. The ΔH value for the reverse reaction is smaller than that for the forward reaction. (2)

1.5 For the reaction below, which are the Brønsted-Lowry bases?

$H_2O + H_2O \leftrightarrows OH^- + H_3O^+$

A. H_2O only

B. H_2O and H_3O^+

C. OH^- only

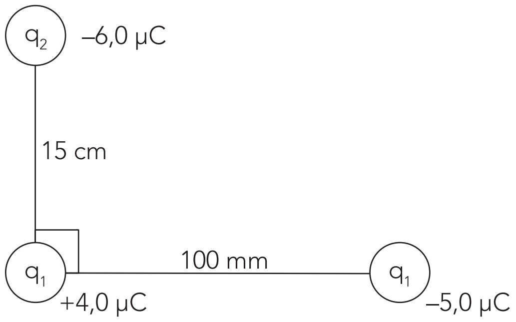
D. OH^- and H_2O (2)

(2) ×5 = **[10]**

Show all working in the following questions.

Question 2

Consider the diagram below, which shows three point charges q_1, q_2 and q_3 of charge +4,0 μC, –6,0 μC and –5,0 μC, respectively. The distance between q_1 and q_2 is 15 cm, and that between q_1 and q_3 is 100 mm. The diagram is not drawn to scale.



2.1 State Coulomb's Law. (2)

2.2 Draw a free-body diagram for all the electrostatic forces that act on q_1. (3)

2.3 Calculate the magnitude of the electrostatic force between q_1 and q_2. (4)

2.4 Calculate the net electrostatic force on q_1. (7)

2.5 Calculate the magnitude of the net electric field strength at the position of q_1. (4)

[20]

Question 3

A solenoid with 450 turns has a cross-sectional area of 176 cm^2. It is positioned perpendicular to a uniform magnetic field of 0,72 T.

3.1 Calculate the flux through the solenoid. (4)

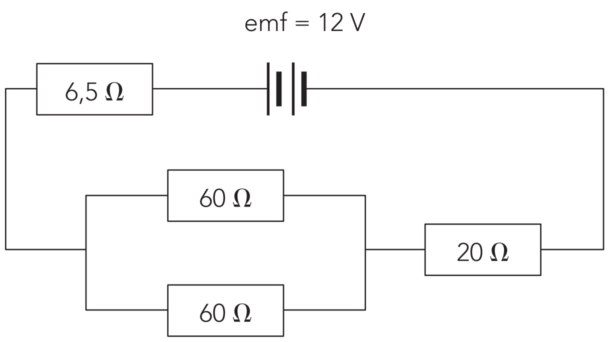
3.2 State Faraday's Law of electromagnetic induction. (2)

3.3 Calculate the induced emf if the solenoid is pulled out of the magnetic field in 0,22 s. (3)

[9]

Question 4

In the circuit represented below, two 60 Ω resistors connected to a 20 Ω resistor and a 6,5 Ω resistor as shown in the circuit diagram below. The battery has an emf of 12 V.



4.1 Explain what is meant by 'an emf of 12 V'. (3)

4.2 Calculate the following:

4.2.1 equivalent resistance of the two 60 Ω resistors. (3)

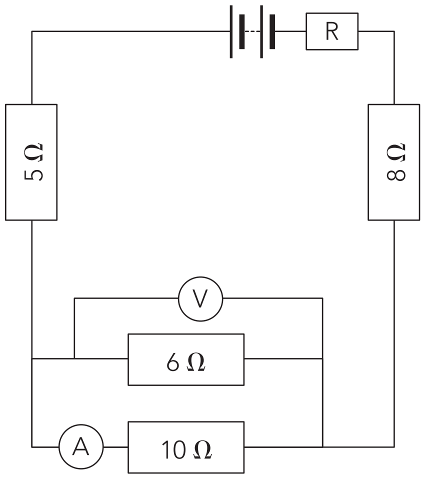
4.2.2 the current through the battery. (5)

4.2.3 the power dissipated by the 20 Ω resistor. (3)

[14]

Question 5

In the circuit represented below, a battery of emf 30 V is connected to an unknown resistor R and to a combination of resistors, as shown. Ignore the resistance of the ammeter and the connecting wires. The voltmeter has very high resistance.



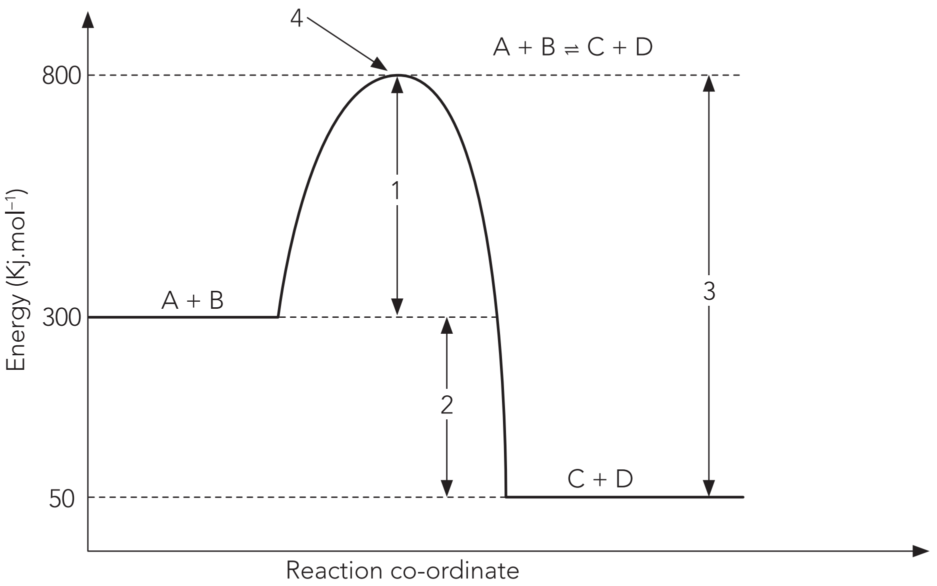
The current passing through the 10 Ω resistor is 0,6 A.

Calculate the resistance of R.

[12]

Question 6

The following energy profile diagram represents the energy changes that take place during a reversible reaction. The *x*-axis represents the reaction co-ordinate and the *y*-axis represents the energy of the reactants or products.



6.1	Provide names for labels 1 to 4.	(4)
6.2	Calculate the activation energy for the forward reaction shown on the graph.	(2)
6.3	Calculate the overall enthalpy of the forward reaction.	(2)
6.4	Define a catalyst.	(2)
6.5	Draw a sketch to show the effect of a catalyst.	(2)

[12]

Question 7

Carbon dioxide is extremely soluble in water and forms a weak acid called carbonic acid found in all fizzy drinks. The chemical equations below represent the reversible reactions taking place in a glass of sparkling water.

I: $CO_2\ (g) + H_2O\ (\ell) \leftrightarrows H_2CO_3\ (aq)$

II: $H_2CO_3\ (aq) + H_2O\ (\ell) \leftrightarrows HCO_3^-\ (aq) + H_3O^+\ (aq)$

III: $HCO_3^-\ (aq) + H_2O\ (\ell) \leftrightarrows CO_3^{2-}\ (aq) + H_3O^+\ (aq)$

7.1 Define an acid according to the Lowry-Brønsted theory. (2)

7.2 Identify the acid and its conjugate base for Reaction II. (2)

7.3 Write down the chemical formula of an ampholyte present in the sample of sparkling water. (2)

[6]

Question 8

8.1 What mass of NaOH(s) is needed to prepare 200 cm^3 of NaOH solution with a concentration of 0,4 $mol.dm^{-3}$? (2)

8.2 100 cm^3 of distilled water is added to the solution referred to in 8.1.

8.3 A standard solution of NaOH solution is used to determine the concentration of a sulphuric acid solution. The concentration of the sodium hydroxide solution is 0,25 $mol.dm^{-3}$.

Write a balanced chemical equation for this reaction. (4)

8.4 Calculate the concentration of the sulphuric acid if 25 cm^3 NaOH neutralises exactly 12,4 cm^3 of the acid. (7)

[17]

TOTAL MARKS: 100

TIME: 2 HOURS

END OF TEST

DATA SHEET

GRADE 11 TERM 3

TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Coulomb's constant	k	$9{,}0 \times 10^{9}$ N.m^2.C^{-2}
Avogadro's constant	N_A	$6{,}02 \times 10^{23}$ mol^{-1}

TABLE 2: FORMULAE

ELECTROSTATICS

$F = \frac{kQ_1Q_2}{r^2}$ ($k = 9{,}0 \times 10^9$ N.m^2.C^{-2})	$E = \frac{F}{q}$
$E = \frac{k.Q}{r^2}$ ($k = 9{,}0 \times 10^9$ N.m^2.C^{-2})	$E = \frac{V}{d}$

ELECTROMAGNETISM

$\varepsilon = -\frac{N.\Delta\Phi}{\Delta t}$	$\Phi = BA \cos \theta$

ELECTRICAL CURRENTS

$I = \frac{Q}{\Delta t}$	$R = \frac{V}{I}$
$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$	$R_T = r_1 + r_2 + r_3 \ldots$
$W = Vq$	$P = \frac{W}{\Delta t}$
$W = VI\Delta t$	$W = VI\Delta t$
$W = I^2R\Delta t$	$W = I^2R\Delta t$
$P = \frac{V^2\Delta t}{R}$	$P = \frac{V^2\Delta t}{R}$

CHEMISTRY

$\frac{C_aV_a}{C_bV_b} = \frac{n_a}{n_b}$	$c = \frac{n}{V} = \frac{m}{MV}$
$c = \frac{m}{M} = \frac{V}{V_m} = \frac{N}{N_A}$	

TABLE 3: THE PERIODIC TABLE OF ELEMENTS

KEY

Atomic number: 29 — Electronegativity: 1,9 — Symbol: Cu — Approximate relative atomic mass: 63,5

1 (I)	2 (II)	3	4	5	6	7	8	9	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	18 (VIII)
1 2,1 **H** 1																	2 **He** 4
3 1,0 **Li** 7	4 1,5 **Be** 9											5 2,0 **B** 11	6 2,5 **C** 12	7 3,0 **N** 14	8 3,5 **O** 16	9 4,0 **F** 19	10 **Ne** 20
11 0,9 **Na** 23	12 1,2 **Mg** 24											13 1,5 **Aℓ** 27	14 1,8 **Si** 28	15 2,1 **P** 31	16 2,5 **S** 32	17 3,0 **Cℓ** 35,5	18 **Ar** 40
19 0,8 **K** 39	20 1,0 **Ca** 40	21 1,3 **Sc** 45	22 1,5 **Ti** 48	23 1,6 **V** 51	24 1,6 **Cr** 52	25 1,5 **Mn** 55	26 1,8 **Fe** 56	27 1,8 **Co** 59	28 1,8 **Ni** 59	29 1,9 **Cu** 63,5	30 1,6 **Zn** 65	31 1,6 **Ga** 70	32 1,8 **Ge** 73	33 2,0 **As** 75	34 2,4 **Se** 79	35 2,8 **Br** 80	36 **Kr** 84
37 0,8 **Rb** 86	38 1,0 **Sr** 88	39 1,2 **Y** 89	40 1,4 **Zr** 91	41 **Nb** 92	42 1,8 **Mo** 96	43 1,9 **Tc**	44 2,2 **Ru** 101	45 2,2 **Rh** 103	46 2,2 **Pd** 106	47 1,9 **Ag** 108	48 1,7 **Cd** 112	49 1,7 **In** 115	50 1,8 **Sn** 119	51 1,9 **Sb** 122	52 2,1 **Te** 128	53 2,5 **I** 127	54 **Xe** 131
55 0,7 **Cs** 133	56 0,9 **Ba** 137	57 **La** 139	72 1,6 **Hf** 179	73 **Ta** 181	74 **W** 184	75 **Re** 186	76 **Os** 190	77 **Ir** 192	78 **Pt** 195	79 **Au** 197	80 **Hg** 201	81 1,8 **Tℓ** 204	82 1,8 **Pb** 207	83 1,9 **Bi** 209	84 2,0 **Po**	85 2,5 **At**	86 **Rn**
87 0,7 **Fr**	88 0,9 **Ra** 226	89 **Ac**															
				58 **Ce** 140	59 **Pr** 141	60 **Nd** 144	61 **Pm**	62 **Sm** 150	63 **Eu** 152	64 **Gd** 157	65 **Tb** 159	66 **Dy** 163	67 **Ho** 165	68 **Er** 167	69 **Tm** 169	70 **Yb** 173	71 **Lu** 175
				90 **Th** 232	91 **Pa**	92 **U** 238	93 **Np**	94 **Pu**	95 **Am**	96 **Cm**	97 **Bk**	98 **Cf**	99 **Es**	100 **Fm**	101 **Md**	102 **No**	103 **Lr**

3. Physical Sciences Grade 11: End-of-Term 3 Control Test Memorandum

Question 1

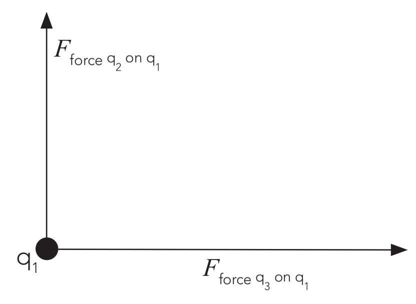
1.1 D ✓✓ 1.2 A ✓✓ 1.3 C ✓✓ 1.4 B ✓✓ 1.5 D ✓✓

5 × (2) = **[10]**

Question 2

2.1 The force of attraction or repulsion that two charged objects at rest exert on each other is directly proportional to the product of the charges and inversely proportional to the square of the distance between their centres. ✓✓ (2)

2.2



✓✓✓ (3)

2.3 $F_{q_2 \text{ on } q_1} = \frac{k.q_2q_1}{r^2}$ ✓

$= \frac{(9 \times 10^9)(4 \times 10^{-6})(6 \times 10^{-6})}{(00,15)^2}$ ✓✓

$= 9,6$ N ✓ (4)

2.4 $F_{q_3 \text{ on } q_1} = \frac{k.q_3q_1}{r^2}$ ✓

$= \frac{(9 \times 10^9)(4 \times 10^{-6})(5 \times 10^{-6})}{(00,10)^2}$ ✓✓

$= 18$ N ✓

$F_{net} = \sqrt{(F_{q_2 \text{ on } q_1})^2 + (F_{q_3 \text{ on } q_1})^2} = \sqrt{(9,6)^2 + (18)^2}$ ✓ (c.o.e.)

$= 20,4$ N ✓

$\tan \theta = \frac{9,6}{18} = 0,533$ ✓

$= 28,07°$

$F_{net} = 20,4$ N at an angle of 28,07° to the force of q_3 on q_1 ✓ (7)

2.5 $E = \frac{F_{net}}{Q}$ ✓ $= \frac{20,4}{4 \times 10^{-6}}$ ✓ $= 5,1 \times 10^6$ N.C^{-1} ✓ at an angle of 28,07° to $F_{\text{force } q_3 \text{ on } q_1}$ ✓ (4)

[20]

Question 3

3.1 $\Phi = B \perp A = BA \cos \theta$ ✓

$= (0,72)(176 \times 10^{-4}) \cos 90°$ ✓✓

$= 0,013$ Wb ✓ or $1,27 \times 10^{-2}$ Wb (4)

3.2 Faraday's law states that the induced emf is directly proportional to the rate of change of magnetic flux. (2)

3.3 $\varepsilon = -N\frac{\Delta\Phi}{\Delta t}$ ✓

$= \frac{-V \div 0,22 \times 10^{-2} \text{ V}}{0,22}$ ✓ (c.o.e. from 3.1)

$= -25,92$ ✓ (3)

[9]

Question 4

4.1 An emf of 12 V tells us that 12 J of energy ✓ is the total amount of energy transferred by the battery ✓ per coulomb of charge passing through it. ✓ (3)

4.2 $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓

$= \frac{1}{60} + \frac{1}{60}$ ✓

$R_{eq} = \frac{2}{60} = 30\ \Omega$ ✓ (3)

4.3 $R_T = 30 + 20 + 6,5 = 56,5\ \Omega$ ✓✓

$I_T = \frac{V_T}{R_T}$ ✓ $= \frac{12}{56,5}$ ✓ $= 0,21$ A ✓ (5)

4.4 $P = I^2.R$ ✓

$= (0,21)^2 \times 20$ ✓

$= 0,88$ W ✓ (3)

[14]

Question 5

$V_{10\,\Omega} = V_{6\,\Omega} = IR$ ✓

$= 0,6 \times 10$

$= 6$ V ✓

$I_{6\,\Omega} = \frac{V_{6\,\Omega}}{R_{6\,\Omega}} = \frac{6}{6} = 1$ A ✓

Total current $= I_1 + I_2$ ✓ $= 1 + 0,6 = 1,6$ A ✓

$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓ $= \frac{1}{6} + \frac{1}{10} = 0,2667$

$R_p = 3,75\ \Omega$ ✓

$R_T = \frac{V_T}{I_T}$ ✓ $= \frac{30}{1,6}$ ✓ $= 18,75\ \Omega$

$R = R_T - (R_p + R_{5\,\Omega} + R_{8\,\Omega})$ ✓

$= 18,75 - (3,75 + 5 + 8)$ ✓

$= 2\ \Omega$ ✓

[12]

Question 6

6.1 1 – Activation Energy (EA) of the forward reaction ✓

2 – Enthalpy or Heat of Reaction (ΔH) ✓

3 – Activation Energy (EA) of the reverse reaction ✓

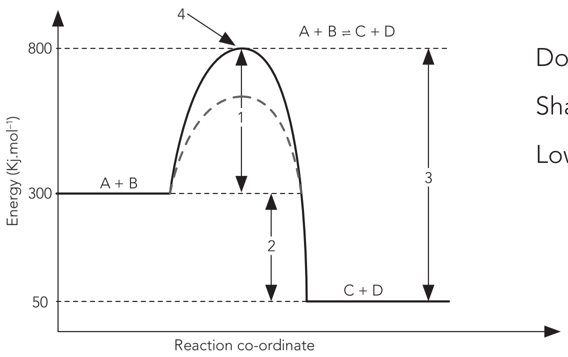
4 – Activation complex ✓ (4)

6.2 $E_A = 800 - 300 = 500$ kJ.mol^{-1} ✓✓ (2)

6.3 $\Delta H = 50 - 300 = -250$ kJ.mol^{-1} ✓✓ (2)

6.4 A catalyst is a chemical substance that takes part in a chemical reaction without being used up. ✓✓ (2)

6.5



Dotted line – effect of catalyst

Shape ✓

Lower Activation Energy ✓ (2)

[12]

Question 7

7.1 An acid is a proton donor ✓✓ (2)

7.2 H_2CO_3 (aq) ✓ and HCO_3^- (aq) ✓ (2)

7.3 HCO_3^- (aq) ✓✓ (2)

[6]

Question 8

8.1 m = CMV ✓ = (0,4)(40)(0,2) = 3,2 g ✓ (2)

8.2 $n = \frac{m}{M} = \frac{3,2}{40}$ = 0,08 mol ✓

$C = \frac{n}{V}$ ✓ $= \frac{0,08}{(0,2 + 0,1)}$ ✓ = 0,27 mol.dm^{-3} ✓ 4)

8.3 2 NaOH ✓ + H_2SO_4 ✓ → Na_2SO_4 ✓ + 2 H_2O ✓ (B) (4)

8.4 $n_b = C_b \times V_b$

= (0,25)(25 × 10^{-3}) ✓

= 6,25 × 10^{-3} mol ✓

From the balanced equation ratio of moles of base to acid is 2:1 ✓

$n_a = \frac{6,25 \times 10^{-3}}{2}$ = 3,125 × 10^{-3} mol ✓

$C_a = \frac{n}{V}$ ✓

$= \frac{3,125 \times 10^{-0}}{12,4 \times 10^{-0}}$ ✓

= 0,25 mol.dm^{-3} ✓ (7)

[17]

TOTAL MARKS: 100

4. Cognitive Analysis for Physical Sciences Grade 11: End-of-Term 3 Control Test

There are no guidelines for the weightings of content for the Grade 11 Term 3 Control Test. The target weightings given in the tables below for the Control Test are based on the weighting of time given to a topic. The actual marks allocated are fairly close to the targets but there were more questions assigned to Electric Circuits as this is a topic examined in Grade 12.

Level 1: Recall Level 2: Comprehension
Level 3: Analysis, application Level 4: Evaluation, synthesis

Question	1	2	3	4	Electrostatics	Electromagnetism	Electric circuits	Energy and chemical change	Acids and bases	
Marks required	**15**	**35**	**40**	**10**	**17**	**17**	**22**	**11**	**33**	**100**
Actual	15	35	40	10	22	11	28	14	25	100
Question 1										**10**
1.1			2		2					2
1.2		2				2				2
1.3			2				2			2
1.4		2						2		2
1.5	2								2	2
Question 2										**20**
2.1	2				2					2
2.2		3			3					3
2.3		4			4					4
2.4	2		5		7					7
2.5		4			4					4
Question 3										**9**
3.1		2	2			4				4
3.2	2					2				2
3.3		1	2			3				3

Question	1	2	3	4	Electrostatics	Electromagnetism	Electric circuits	Energy and chemical change	Acids and bases	
Question 4										**14**
4.1			3				3			3
4.2	3						3			3
4.3		2	3				5			5
4.4			3				3			3
Question 5										**12**
		4		8			12			12
Question 6										**12**
6.1		4						4		4
6.2			2					2		2
6.3		2						2		2
6.4	2							2		2
6.5			2					2		2
Question 7										**6**
7.1	2								2	2
7.2			2						2	2
7.3			2						2	2
Question 8										**17**
8.1		2	2						4	4
8.2			2	2					4	4
8.3		3							3	3
8.4			6						6	6
Marks required	15	35	40	10	17	17	22	11	33	100
Actual	**15**	**35**	**40**	**10**	**22**	**11**	**28**	**14**	**25**	**100**

G. ADDITIONAL WORKSHEET

1. Worksheet 1: Electrostatics and electromagnetism

Question 1

The electrostatic force between a point charge of –4 nC and another of +6 nC is found to be F N when the two point charges are 20 mm apart.

1.1 Use Coulomb's Law to calculate the value of F. (4)

1.2 Without further calculations, complete the table below:

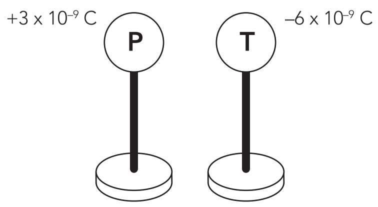
Force (N)	Charge 1 (nC)	Charge 2 (nC)	Distance (m)
F	–4	+6	20×10^{-3}
1,5 F	–4	Q_2 = ?	20×10^{-3}
$F_{new} = nF$ = ?	–4	+6	1×10^{-2}
0,25 F	–4	+6	r = ?

(3)

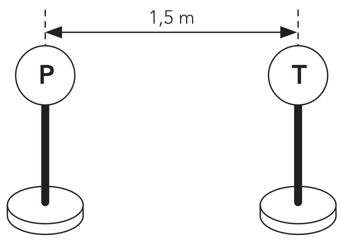
[7]

Question 2

Two metal spheres, P and T, on insulated stands, carry charges of $+3 \times 10^{-9}$ C and -6×10^{-9} C, respectively.



The spheres are allowed to touch each other and are then placed 1,5 m apart as shown below.



2.1 In which direction will electrons flow while spheres P and T are in contact? Write down only FROM P TO T or FROM T TO P. (1)

2.2 Calculate the net charge gained or lost by sphere P after the spheres have been in contact. (3)

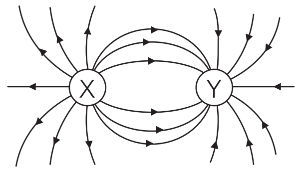
2.3 Calculate the number of electrons transferred during the process in Question 2.2. A third sphere R, carrying a charge of -3×10^{-9} C, is now placed between P and T at a distance of 1 m from T. (2)

2.4 Calculate the net force experienced by sphere R as a result of its interaction with P and T. (6)

[12]

Question 3

3.1 The diagram below shows the electric field pattern due to two point charges X and Y.



Which ONE of the following represents the charge on X and Y respectively?

	POINT CHARGE X	POINT CHARGE Y
A.	Negative	Negative
B.	Positive	Positive
C.	Positive	Negative
D.	Negative	Positive

(2)

3.2 Two identical insulated spheres, each carrying a charge Q and separated by a distance r, exert an electrostatic force of magnitude F on each other. The distance between the spheres is now HALVED.

The magnitude of the force the spheres now exert on each other is:

A. $\frac{1}{2}F$

B. F

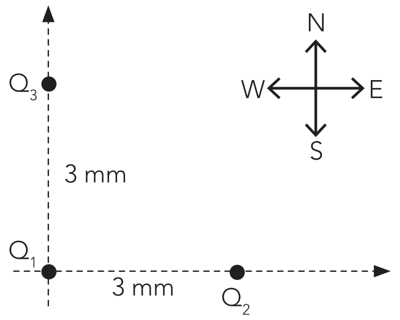
C. $2F$

D. $4F$ (2)

[4]

Question 4

Three small, identical metal spheres, Q_1, Q_2 and Q_3 are placed in a vacuum. Each sphere carries a charge of –4 μC. The spheres are arranged such that Q_2 and Q_3 are each 3 mm from Q_1 as shown in the diagram below.



4.1 State Coulomb's Law in words. (2)

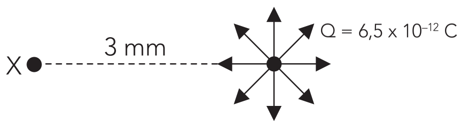
4.2 Draw a force diagram showing the electrostatic forces exerted on Q_1 by Q_2 and Q_3. (2)

4.3 Calculate the net force exerted on Q_1 by Q_2 and Q_3. (8)

[12]

Question 5

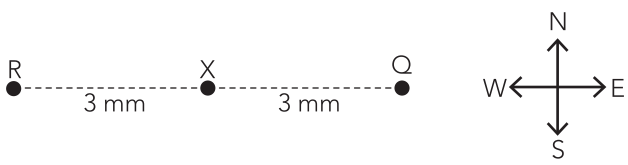
An isolated point charge Q is located in space as shown in the diagram below. Point charge Q contributes to an electric field as shown. Point X is located 3 mm away from point charge Q.



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

5.2 Calculate the magnitude of the electric field at point X. (3)

5.3 Point charge R carrying a charge of $+6{,}5 \times 10^{-12}$ C is placed 3 mm away from point X as shown in the diagram below.

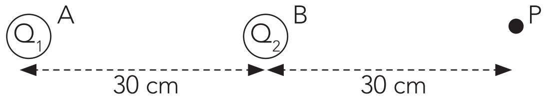


5.4 Calculate the net electric field at point X. (4)

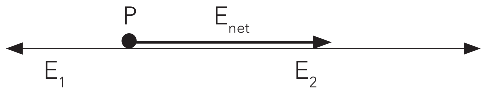
[9]

Question 6

Two identical conducting spheres A and B with charges Q_1 and Q_2, respectively, are placed in fixed positions along the same straight line as shown in the diagram below. Spheres A and B are placed 30 cm from each other. Point P is positioned 30 cm to the right of sphere B on the same straight line.



The charge on sphere B is positive. The net electric field E_{net} at point P as a result of the two charges Q_1 and Q_2 is toward the right as shown in the diagram below.



6.1 What is the sign of the charge on sphere A? Give a reason for your answer. (3)

6.2 The net electric field at point P is 1 600 $N.C^{-1}$ to the right and the charge on sphere B has a magnitude of +12 *n*C. Calculate the magnitude of the charge on sphere A. (7)

6.3 A proton is placed at point P without changing the charges and positions of spheres A and B.

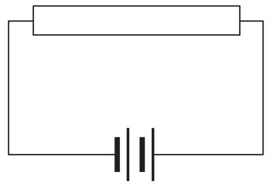
Calculate the net electrostatic force experienced by the proton. (4)

[14]

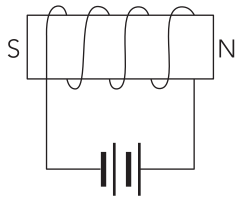
Question 7

Complete the following sketch diagrams, by clearly indicating the direction of the current and the direction of the associated magnetic field:

7.1 A conductor connected to a battery of two cells. (4)



7.2 A coil of wire connected to a battery of two cells. Also label the North and South poles. (4)



7.3 The view of the solenoid in 7.2 when looking from position Y. (4)

[12]

TOTAL: 70

2. Answers for Worksheet 1

Question 1

1.1 $F = \frac{kQ_1Q_2}{r^2}$ ✓

$= \frac{(9\times10^9)(4\times10^{-9})(6\times10^{-9})}{(20\times10^{-3})^2}$ ✓✓

$= 5,4 \times 10^{-4}$ N attraction ✓ (4)

1.2

Force (N)	Charge 1 (nC)	Charge 2 (nC)	Distance (m)
$F = 5,4 \times 10^{-4}$ N	–4	+6	20×10^{-3}
$1,5\,F$	–4	$Q_2 = 6 \times 1,5 = 9$ ✓	20×10^{-3}
$F_{new} = nF = 4F = 2,16 \times 10^{-3}$ N ✓	–4	+6	1×10^{-2}
$0,25\,F$	–4	+6	$r = 40 \times 10^{-3}$ ✓

(3)

[7]

Question 2

2.1 FROM T to P ✓ (1)

2.2 $Q = \frac{3\times10^{-9} + (-6\times10^{-9})}{2} = -1,5 \times 10^{-9}$ C ✓

$\Delta QP = QP(\text{final}) - QP(\text{initial})$

$= -1,5 \times 10^{-9} - 3 \times 10^{-9}$ ✓

$= -4,5 \times 10^{-9}$ C ✓ (3)

2.3 Number of electrons $= \frac{-4,5\times10^{-9}}{-1,6\times10^{-19}}$ ✓✓ $= 2,81 \times 10^{10}$ (2)

2.4 $F_{TR} = \frac{kQ_1Q_2}{r^2}$

$= \frac{(9\times10^9) + (1,5\times10^{-9})(3\times10^{-9})}{(1)^2}$ ✓

$= 4,05 \times 10^{-8}$ N to the left/towards P ✓

$F_{PR} = \frac{kQ_1Q_2}{r^2}$

$= \frac{(9\times10^9) + (1,5\times10^{-9})(3\times10^{-9})}{(0,5)^2}$ ✓

$= 1,62 \times 10^{-7}$ N to the right/towards T ✓

Let the direction to the right (towards T) be positive

$F_{net} = 1,62 \times 10^{-7} + (-4,05 \times 10^{-8})$ ✓

$= 1,22 \times 10^{-7}$ N to the right ✓ (6)

[12]

Question 3

3.1 C ✓✓ (2)

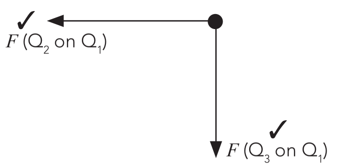
3.2 D ✓✓ (2)

[4]

Question 4

4.1 The magnitude of the electrostatic force exerted by one charge on another is directly proportional to the product of the charges ✓ and inversely proportional to the square of the distance between their centres. ✓ (2)

4.2



(2)

4.3 $F_{(Q_2 \text{ on } Q_1)} = \frac{kQ_2Q_1}{r^2}$

$= \frac{(9\times10^9) + (4\times10^{-6})(4\times10^{-6})}{(3\times10^{-3})^2}$ ✓✓

$= 16\,000$ N left ✓

$F_{(Q_3 \text{ on } Q_1)} = \frac{kQ_3Q_1}{r^2}$ (for both equations)

$= \frac{(9\times10^9) + (4\times10^{-6})(4\times10^{-6})}{(3\times10^{-3})^2}$ ✓

$= 16\,000$ N downwards ✓

$F_{net} = 22\,627,42$ N ✓ at 45° south of west ✓ (8)

[12]

Question 5

5.1 The force ✓ per unit charge ✓ at that point. (2)

5.2 $E = \frac{kQ}{r^2}$ ✓

$= \frac{(9 \times 10^9) + (6,5 \times 10^{-12})}{(0,003)^2}$ ✓

$= 6,5 \times 10^3$ N.C^{-1} ✓ (3)

5.3 At point X:

$E_Q = 6,5 \times 10^3$ N.C^{-1} west ✓

$E = \frac{kQ}{r^2}$

$= \frac{(9 \times 10^9) + (6,5 \times 10^{-12})}{(0,003)^2}$

$= 6,5 \times 10^3$ N.C^{-1} east ✓

E_{net} = EQ + ER ✓

$= 6,5 \times 10^3 + (-6,5 \times 10^3)$

$= 0$ N.C^{-1} ✓ (4)

[9]

Question 6

6.1 Negative ✓
The direction of E_1 on the diagram is to the left ✓
This is opposite to that of E_2 which indicates the field for a positive charge ✓ (3)

6.2 $E_2 = \frac{kQ_2}{r^2}$ ✓

$= \frac{(9 \times 10^9) + (12 \times 10^{-9})}{(0,03)^2}$ ✓✓

$= 1\,200$ N.C^{-1} to the right

$E_{net} = E_2 - E_1$ ✓

$1\,600 = 1\,200 - E_1$ ✓

$E_1 = -400$ N.C^{-1}

$E = \frac{kQ_1}{r^2}$

$-400 = \frac{(9 \times 10^9)Q_2}{(0,6)^2}$ ✓

$Q_2 = -1,60 \times 10^{-8}$ C ✓ (7)

6.3 $E = \frac{F}{q}$

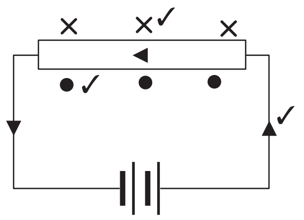
$1\,600$ ✓ $= \frac{F}{1,6 \times 10^{-19}}$

$F = 2,56 \times 10^{-16}$ N right ✓ (4)

[14]

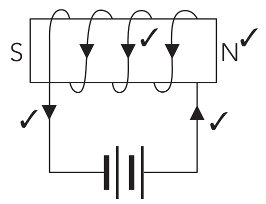
Question 7

7.1



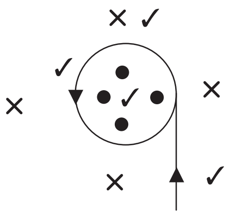
(4)

7.2



(4)

7.3



(4)

[12]

TOTAL: 70