Province of the
EASTERN CAPE
EDUCATION

EXAMINATIONS AND ASSESSMENT CHIEF DIRECTORATE
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REPUBLIC OF SOUTH AFRICA, Website: www.ecdoe.gov.za

2022 NSC CHIEF MARKER'S REPORT

SUBJECT	**TECHNICAL SCIENCES**		
QUESTION PAPER	**1✓**	2	3
DURATION OF QUESTION PAPER	**3**	**HOURS**	
PROVINCE	**EASTERN CAPE**		
DATES OF MARKING	**8 DECEMBER 2022 – 23 DECEMBER 2022**		

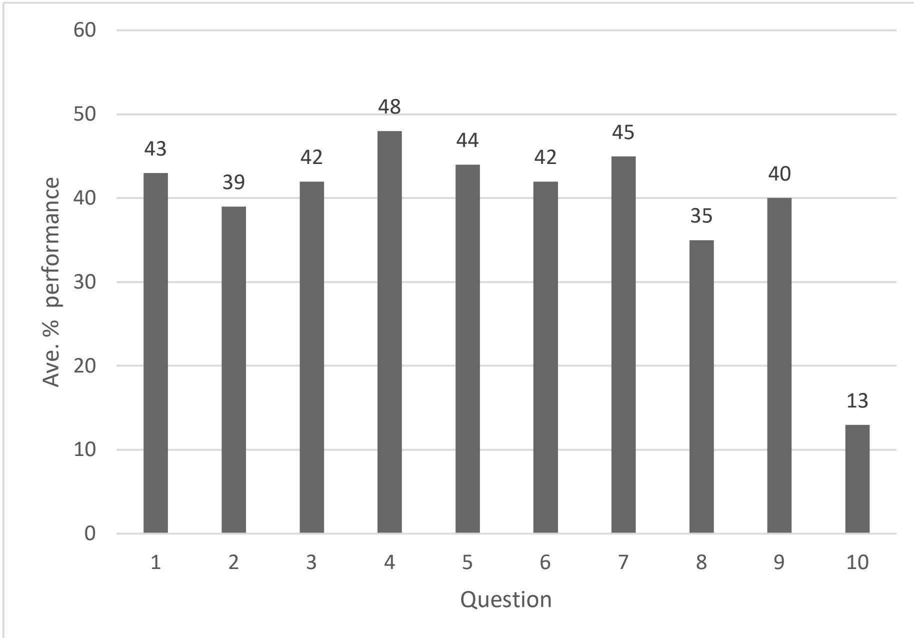
SECTION 1: (General overview of Learner Performance in the question paper as a whole)

The 2022 paper was generally fair, although the performance does not show that, at an average of 41% from the sampled analysis of the 100 scripts.
The data collected show many areas of weaknesses which range from poor levels of preparation, inadequate teaching and learning of basic concepts and skills. Candidates had challenges to give correct definitions as per examination guidelines, drawing and labelling free body diagrams, writing correct units, using correct directions in vectors, choosing correct formulae for calculations and many more which will be discussed in specific questions. The general performance is poor which is below 50%. The table and graph below show performance of learners in different topics.

Tables of topics and average performance in different questions of candidates.

Question	Topic	Ave. performance %
1	Multiple Choice (all topics)	43%
2	Newton's Laws	39%
3	Momentum & Impulse	42%
4	Energy & power	48%
5	Elasticity & Hydraulics	44%
6	Light	42%
7	Electromagnetic spectrum	45%
8	Electrostatics- Capacitance	35%
9	Electric circuits	40%
10	Electromagnetism	13%
Total		**41%**

Graph for overview performance from question 1 -10 in 2022 NSC examinations



The overview of the analysis of this graph however, show that Q4, 7, 5, 1, 3, 6 & 9 even though the performance was below an average of 50%. Questions 2, 8 and 10 the average performance is below 40% with Q10 being the worst performed question at an average of only 13%.

Breakdown of question-by-question analysis will be discussed in the next section below.

SECTION 2:

QUESTION 1- 43%

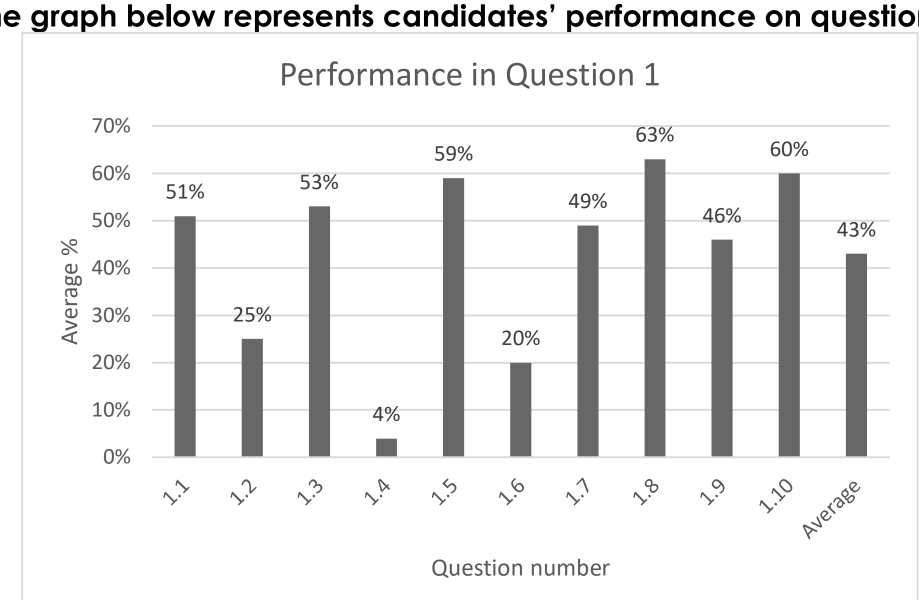
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

The question was not well answered though most questions were level 1 questions. The average percentage performance however is 43%. Questions 1.2, 1.4 and 1.6 are the least performed sub- questions in Q1 with an average that is below 40% and Q1.4 further performed below 10%. Question 1.2 is in Newton's Third, learners failed to apply the law in the given scenario. Learners lacked basic mathematics skill in Q1.4 and is evident that those few who managed to get marks relied on a guess work. In Q1.6 candidates could not manipulate the formulae given in order to correctly identify a suitable choice.

The table below is showing a general performance of learners in question 1:

1.1	Newton's First Law	51%
1.2	Newton's Third Law	25%
1.3	Impulse	53%
1.4	Work done	4%
1.5	Strain	59%
1.6	Pascal's Law	20%
1.7	Refraction	49%
1.8	Lenses	63%
1.9	Capacitance	46%
1.10	Electromagnetism- transformer	60%

The graph below represents candidates' performance on question 1:



(a) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Candidates performed poorly in question 1.2, 1.4 and 1.6. Question1.2 is based on Newton's Third Law. Learners failed to apply the law in the given scenario which shows that action-reaction pairs are not thoroughly taught. Learners lacked the basic mathematics skill in Q1.4 and is evident that those few who managed to get marks relied on a guess work. In Q1.6 candidates were unable to manipulate the equation of a hydraulic system to identify an incorrect one as asked in the question. Even those candidates who scored just over 50% in MCQ could still not get the mentioned questions correctly.

(b) Provide suggestions for improvement in relation to Teaching and Learning.

When teaching Newton's Third law teachers may use simple demonstrations that do not even require laboratory equipment like a hand pushing against the wall to enhance understanding. Teachers may even ask learners to do the demonstrations themselves by following a proper instruction from a teacher and later identify the action-reaction pairs.

Teachers must do a thorough preparation to identify concepts that may require solid Mathematics explanation as it appears in Q1.4.

The concepts of 'working with formula' must be thoroughly taught in grade 10 so that learners will be equipped with the necessary skills of working and manipulating the formula and be able to choose the correct or "incorrect" formula(equation)as was required in Q1.6

Teachers must also equip learners with the skill of eliminating the first two incorrect options and later choose the correct answer to avoid guessing in the multiple-choice questions in general.

Basic concepts must be well taught as certain questions required a thorough understanding of relationships between variables.

(**d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.**

Even though there is a fair performance in other questions there is a clear indication that learners rely on guess work when answering multiple choice questions. Subject advisors must organize workshops whereby teachers can be trained and mentor each other on answering multiple choice questions which in turn may train and assist the learners.

Team teaching with Mathematics and Technical Sciences teachers in certain arrears of the subject may also assist learners with poor mathematical foundation.

When preparing informal assessments multiple choice questions must always form part of the assessments. Subject advisors must also encourage common tests for the district which should always include multiple choice questions. When preparing for examinations learners must also extensively revise multiple choice questions by employing a correct strategy to answer the questions.

QUESTION 2- 39%

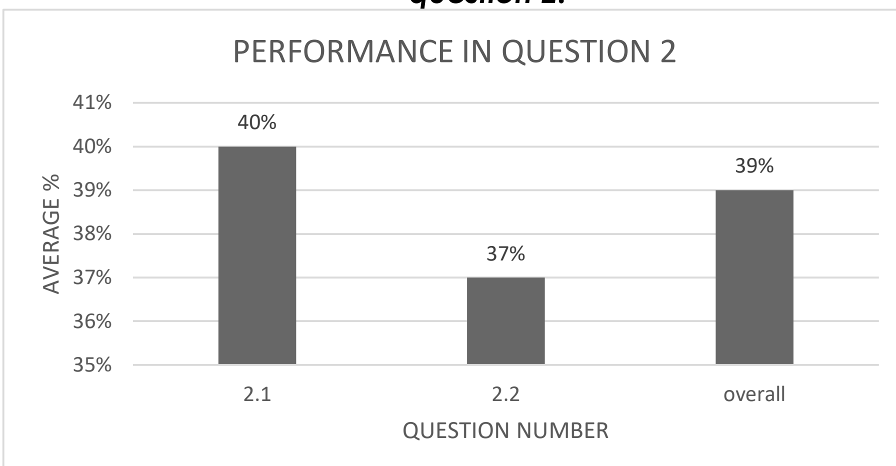
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

Question 2 was *poorly performed* by the learners with an average of 39%.

The table below contains performance of learners per sub-question

Sub-question	Topic	Ave. performance %
2.1	Newton's First Law	40%
2.2	Newton's Second Law	37%

The graph below shows performance of candidates in the sub-questions of question 2:



(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Inadequate preparation for examinations by the learners might have contributed to the low performance The performance in 2.1 is fair at an average of 40%. Most learners were unable to score full marks.

in 2.1.2 as they failed to state Newton's first Law in full. In 2.1.3 they either had an extra force/no dot/ gaps between the arrowhead and the line and therefore could not score full marks for the free body diagram. Some candidates were using the incorrect symbol f_R for friction and. Incorrect direction for friction was also a problem even though the direction of motion of the truck was given. In 2.1.3 candidates were not able to score full marks because they could not convert the velocity from $km \cdot h^{-1}$ to $m \cdot s^{-1}$ which is a grade10 work. Learners wrote the formula for acceleration as A = $\frac{\Delta v}{\Delta T}$ instead of a = $\frac{\Delta v}{\Delta t}$

Candidates lost marks in 2.1.5 as they only calculated the force for the truck only.

In 2.21 learners used the term "move" instead of "accelerate" when stating Newton's Second Law. Leaners were not able to calculate acceleration of the system in 2.2.2. and those who managed to calculate were not putting the direction of the acceleration in 2.2.2. Learners were not able to calculate the force in 2.2.3 which was dependent on the calculation of acceleration in the previous question. Learners in 2.2 were using an incomplete formula F = ma omitting the subscript "net" and therefore lost marks. Learners omitted the direction for both calculations in 2.1 and 2.2 even though acceleration and force are vector quantities.

(b) Provide suggestions for improvement in relation to Teaching and Learning

Teachers must emphasize the importance of all the phrases when writing definitions. Teachers must print Examination Guidelines for learners to assist them with definitions and must continuously assessed in the informal assessments. Free body diagrams must be taught well in grade 10 and thoroughly revised in both grade 11 and grade 12. Teachers must emphasize that when drawing free-body diagrams forces must:

- Be represented by arrows
- Start from a dot and move away from the dot to their respective directions.
- All touch the dot
- Be correctly labelled using ***correct*** labels.

Conversion between units of time and distance must be thoroughly taught in grade 10 and extensively revised in grade 12. More exercises must be given on vectors and the importance of choosing a positive direction and adding it in the final answers on calculations of vectors.

Teachers must train learners on equating the two equations on a two-body system calculation.

Learners must be trained on how to use a formula sheet. The formula sheets must be given to learners at the beginning of the year for it to be a constant reminder whenever calculations are involved.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

In teaching Newton's laws educators must emphasize key phrases in the statements, explain using sketch diagrams the meaning and importance of each phrase and apply the law in various contexts. Calculations based on the laws must be taught and learners must be exposed to various contexts.

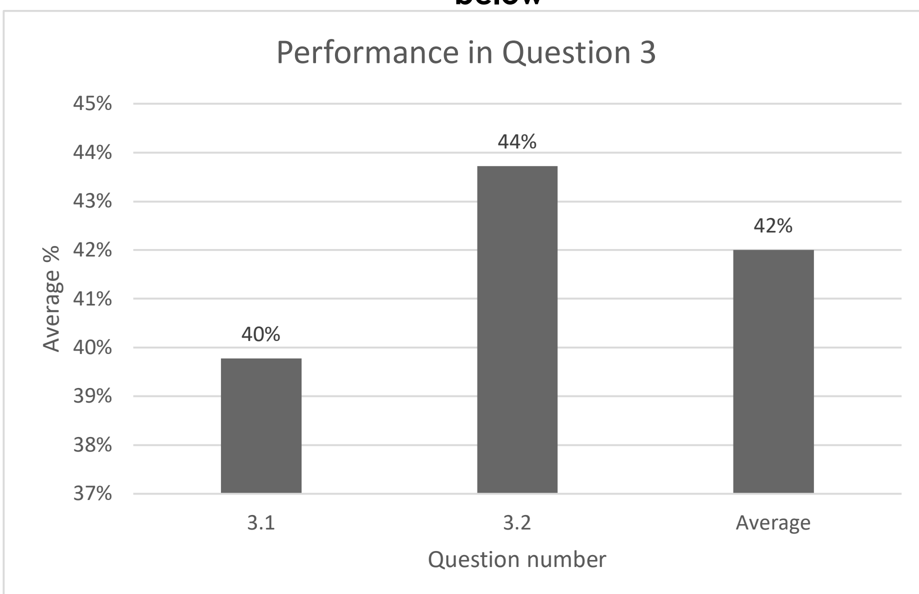
QUESTION 3- 42%

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

Candidates performed fairly with an average percentage of just over 40%. The table below shows performance per sub-question:

Sub-question	Topic	Ave. performance %
3.1	Impulse	40%
3.2	Principle of Conservation of Linear Momentum	44%

Performance in this question is also represented graphically in the graph below



(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

In question 3.1.1 learners omitted the phrase "product" when defining impulse. For those who defined it as per CAPS document had a tendency of defining it as "the rate of change of momentum" and therefore lost marks.

Most candidates in Q 3.1.2 were not converting the given mass to kg before calculating the impulse. Learners also did not assign a positive direction even though there was a change of direction in the statement. Both initial and final velocity were assigned a positive which caused a loss of marks. Direction was also omitted in the final answer.

In question 3.2.1 candidates omitted "total linear" when stating the law. In 3.2.2 learners omitted the ∑ in the formula and direction in the final answer and by that they were not able to score full marks.

Candidates started by equating $\sum Ek_{before}$ and $\sum Ek_{after}$ when proving if the collision was elastic or inelastic. For those who managed to calculate $\sum Ek_{before}$ separately from $\sum Ek_{after}$ were omitting the symbol "∑". Learners wrote an incomplete formula of Ek either by omitting $\frac{1}{2}$ or squared.

(c) Provide suggestions for improvement in relation to Teaching and Learning

Teachers must emphasize the importance of assigning a positive direction when dealing with calculations that involve vector quantities. The importance of writing complete formulae must be emphasized and teachers must train learners to use the datasheet to identify and choose the correct formula. Teachers must teach learners to write answers with correct SI units and

direction should it be a vector quantity. Learners must be drilled on writing correct definitions as they appear in the CAPS and Examination Guidelines. Teachers must emphasize the difference between elastic and inelastic collisions by giving more examples and more exercises.

Conversion of mass must be thoroughly taught in grade 10 and extensively revised in grade 12.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

The topic of momentum and impulse has easy-to-get marks. Teachers must teach the topic thoroughly explaining all the important aspects and they must make time to revise the topic.

Learners must be exposed to various context of calculations, and they must always be reminded about vector nature of velocity and force when dealing with the topic. Definitions must always be included in the formal tasks.

QUESTION 4 – 48%

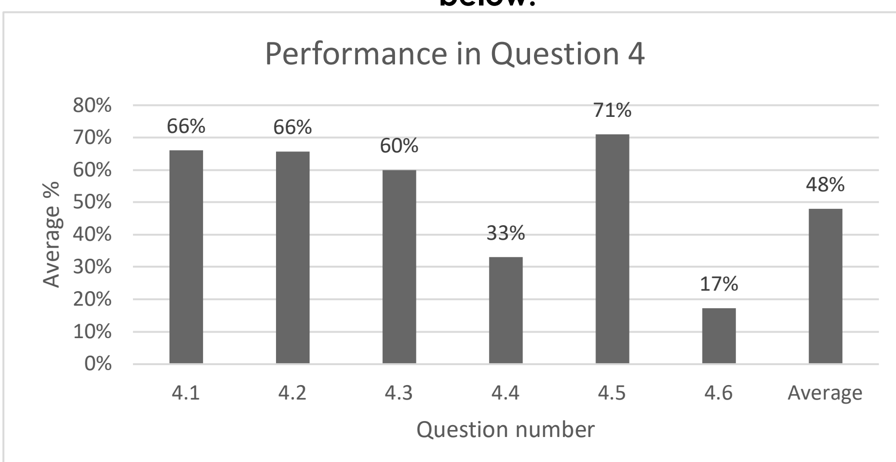
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

Learners performed generally fair in this question with an average of 48%. Learners were boosted

by questions 4.1(66%), 4.2(66%), 4.3(60%) and 4.5(70%). Question 4.6 is the most poorly performed with an average of 17%. The table below shows performance of learners in the question:

Sub-question	Topic	Ave. performance %
4.1	Principle of Conservation of Mechanical Energy in words	66%
4.2	Gravitational potential energy	66%
4.3	Mechanical energy	60%
4.4	Principle of Conservation of Energy- calculation	33%
4.5	Power	71%
4.6	Average power	17%

Performance in this question is also represented graphically in the graph below:



(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

In 4.1 candidates omitted "isolated system" when stating the principle and some included "linear". When calculating the mechanical energy at point B most learners lost marks due to incorrect substitution whereby learners omitted squared on the velocity. Leaners could not score full marks in 4.4 as they did not equate ME_B with ME_C ($ME_B = ME_C$) and some left the subscripts B and C in the formula. Learners lost marks for failing to correctly apply the principle of conservation of mechanical energy in question 4.4, instead were starting by writing the formulafor mechanical energy. In 4.6 candidates could not choose a suitable formula for the calculation of force. For those candidates who managed to choose an appropriate formula $P_{ave} = Fv_{ave}$, they were either writing an incomplete formula by omitting "ave". Some did not convert power from kW to W and forfeited marks.

(c) Provide suggestions for improvement in relation to Teaching and Learning

Teachers must drill learners to write definitions correctly as they appear in the CAPS and Examination Guidelines. In grade 10 the topic of Energy must be thoroughly taught and revised in grade 11 & 12. Learners must be given basic calculations of Ep, Ek and ME for practice.

Learners must be exposed to various types of questions in the topic which can be extracted from the previous examination question papers. The Principle of Conservation of Total Mechanical Energy must be thoroughly taught. Learners must be taught the use of $M_E = E_k + E_p$ at various levels of the fall/vertical motion to calculate any of the variables at various points.

Writing of correct SI units must be emphasized. Leaners must be drilled on writing formulas as they appear in the data sheet even when informal tasks are administered.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

When teaching this topic teachers must refrain from using incomplete formular as this may mislead learners. Teachers must put emphasis on the use of correct formula and substitutions when giving activities to learners.

Learners must be shown how they could lose marks should they omit certain information on calculations.

Teachers must use the correct symbol of mechanical energy ME as it appears in the CAPS and Examination Guidelines not EM. Teachers must train learners to always identify and covert variables that are not given in the correct SI units when administering informal tasks.

QUESTION 5- 44%

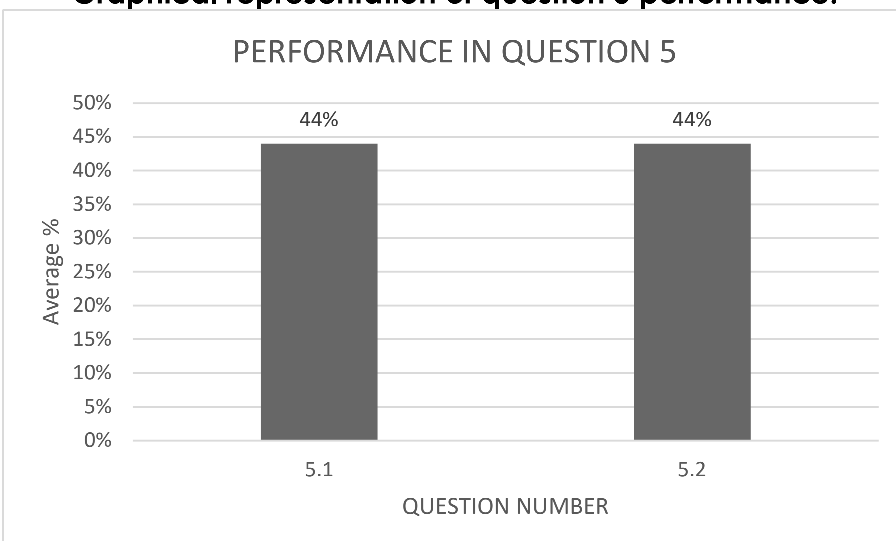
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

The question was fairly answered at an average of 44%. Questions 5.1.3 and 5.1.4 generally contributed well to the question. However, a lot still needs to be corrected in the topic to eliminate leaner mistakes and improve the performance.

Below is a table and graph illustrating the performance to question 5.

Sub-question	Topic	Ave. performance %
5.1	Force, stress & strain	44%
5.2	Pascal's Law	44%

Graphical representation of question 5 performance:



(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

In 5.1.2 learners could not convert the diameter from cm to m in order to calculate the area and therefore calculate the required force. In 5.1.3 learners were unable to choose a suitable formula to calculate in order to calculate the required magnitude of strain. In question 5.2.1 learners omitted key phrase such as equilibrium or transmitted equally when stating Pascal's law. In question 5.2.2 learners failed to round off the final answer to a minimum of two decimal places.

(c) Provide suggestions for improvement in relation to Teaching and Learning

Teachers must thoroughly teach conversion of units in grade 10 and continuously assess the learners when administering informal tasks. Learners must be provided with copies of examination guidelines and data sheets at the beginning of the year. Teachers must drill the learners on how to use and identify the formulae from the formula sheets for each particular question upon administering informal tasks. Learners must be trained to define Pascal's law as it appears in the examination guideline and CAPS document. Teachers must take learners through mark allocations from previous examination papers and marking guidelines in order for them to see how they can lose marks should they do not write correct SI units or round off to a minimum decimal place as per question paper instruction.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

There were indications that grade 10 and grade 11 work was not thoroughly taught. Learners were challenged by conversion of units which is grade 10's work.

Learners seem to forget certain concepts like calculating area which is covered in grade 8 mathematics. Teachers must note that thorough revision of previous grades' work is required for certain topics. When starting a new topic, teachers must identify the concepts covered in previous grades, revise and assess them, in that way they will be able to close those gaps.

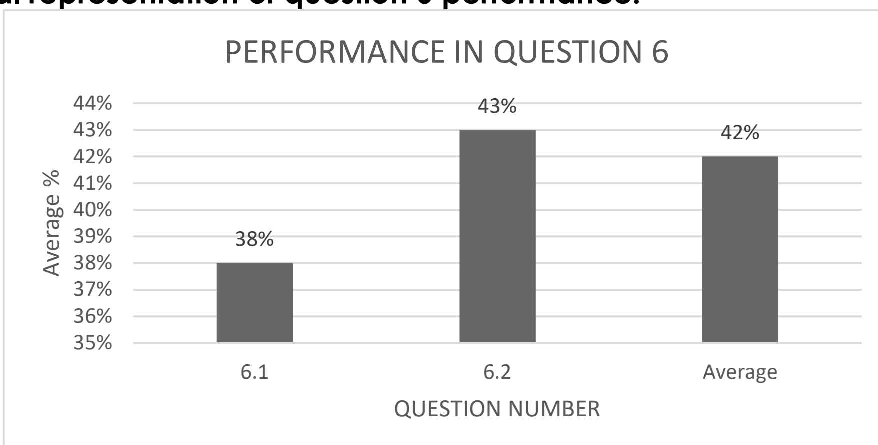
QUESTION 6- 42%

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

The question was not well answered. Questions in both 6.1 and 6.2 were lower order cognitive level questions and therefore learners were expected to score mark high marks. The average performance was poor considering the cognitive level tested in question 6. The table and graph below illustrate the performance in question 6:

Sub-question	Topic	Ave. performance %
6.1	Definition of Refraction	38%
6.2	Refraction	43%

Graphical representation of question 6 performance:



(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

In 6.1 learners were not able to write a full definition of refraction which led to them scoring 1mark. Some of the learners just unable to define refraction. Learners could not correctly identify light ray OB in 6.2.2 with some confusing it with an emergent ray. Angle 2 in 6.2.4 and line CD were not correctly named by the learners.

(c) Provide suggestions for improvement in relation to Teaching and Learning

Teachers must thoroughly teach and explain the concept in the topic of light as it is easy for learners to confuse the concepts. Teachers may extract different types of questions from previous examination question papers for revision purposes. Teachers can let learners draw and label their own diagrams illustrating the difference between refracted ray and emergent ray.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

Learners turn to focus more on topics that involve calculations therefore teachers must ensure that they to continue administer informal assessments on the topic of light even if it has already been covered in terms of teaching. This will ensure that learners do not forget the important concepts taught.

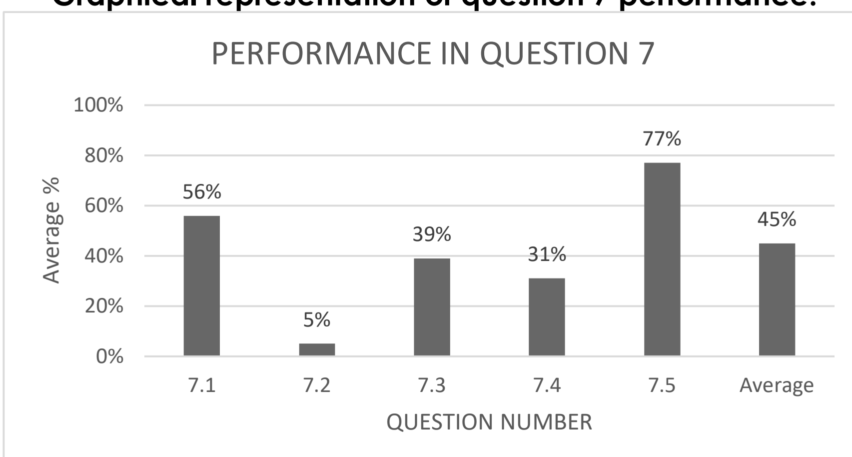
QUESTION 7- 45%

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

The average performance in question 7 is 45%. Question 7.2 is the worst performed with an average of 5%. Learners performed well in 7.5 with an average of 77% of which a 100% average was expected in this question. Below is the table and the graph illustrating the performance per sub-question in question 7.

Sub-question	Topic	Ave. performance %
7.1	Electromagnetic spectrum	56%
7.2	Uses of electromagnetic spectrum	5%
7.3	Energy of a photon	39%
7.4	Energy of a photon	31%
7.5	Visible light	77%

Graphical representation of question 7 performance:



b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Learners could not give the required names for the radiation in 7.1. In 7.2, instead of stating the uses of ultraviolet, learners were giving a description of ultraviolet. Leaners defined photon: as the "quantum of electromagnetic **wave**" which changed the meaning of the definition. Learners were unable to convert MHz to Hz in question 7.4 even though they managed to choose an appropriate formula for the calculation. Learners did not score full marks in question 7.5 because they were not correctly naming the colors in visible light.

(c) Provide suggestions for improvement in relation to Teaching and Learning

Teachers must expose learners in different kind of questions relating to electromagnetic spectrum. More pictures must be used to help learners correctly identify the electromagnetic radiation and the uses during revision and administering of informal assessments. Conversion of units between must be thoroughly taught in grade10 and revised in grade 11 & 12.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

The topic on its own is one the topics that can boost learner performance, but it seems as if it is not getting enough attention. Teachers must continuously assess learners in this topic because they can easily forget it due to not having many calculations. Teachers may also give learners informal assignments for learners to do their own research on the uses of EM radiation and then summarize to eliminate misconceptions as well.

QUESTION 8- 35%

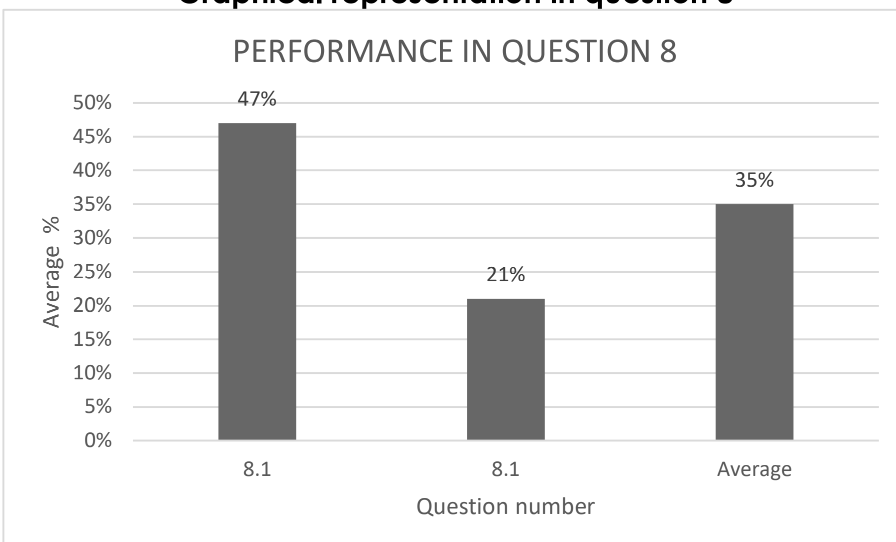
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

Question 8 performed on an average of 35% which is low. Question 8.2 learners scored low marks which contributed to the poor overall performance of the question.

Below is the table and graph illustrating the performance in question 8:

Sub-question	Topic	Ave. performance %
8.1	Capacitance	47%
8.2	Capacitance	21%

Graphical representation in question 8



(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

8.1 was a multistep calculation which required learners to first calculate the capacitance. Most learners forfeited marks as they could not correctly convert the distance from mm to m. In the second step learners lost marks as they were not able to correctly substitute in the formula $C = \frac{Q}{V}$ in order to calculate the charge. In 8.2.1 learners only stated the effect of distance on capacitance without referring to the ratio as required by the question. In 8.2.2 learners still stated just the relationship between capacitance and distance without referring to the ratio.

(c) Provide suggestions for improvement in relation to Teaching and Learning

Teachers must revise conversion of units before introducing calculations in the topic. Teachers must start with simple calculations to ensure thorough understanding. Thorough revision must be done with learners where learners will be required to practice multistep calculations. Factors affecting capacitance of a capacitor must be thoroughly taught and revised.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

Generally, learners have high chances of scoring more marks in this topic, however teachers must spend more time on it and avoid assuming that it is a short topic and therefore learners will perform well.

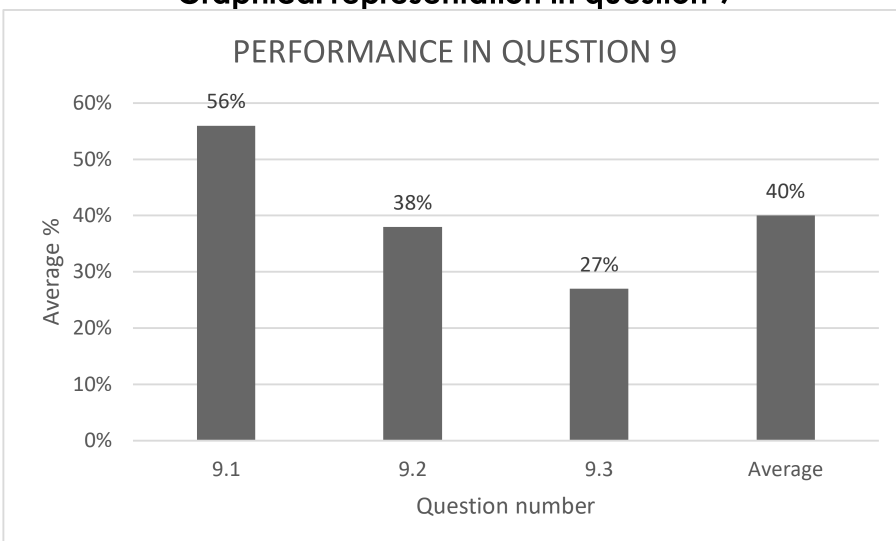
QUESTION 9- 40%

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

The average performance is 40% which is low considering that electric circuits are taught in grade 10 and 11. Question 9.2 and 9.3 perform below the actual average performance of the question. Below is a table and graph illustrating the performance in the question.

Sub-question	Topic	Ave. performance %
9.1	Total resistance	56%
9.2	Electric power	38%
9.3	Heating effect	27%

Graphical representation in question 9



(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Learners could not choose the correct formula for calculating the total resistance of the circuit in question 9.1. For those learners who managed to choose the correct formula they still forfeited a mark for the final answer as they omitted the SI unit. For the learners who used the $R_p = \frac{R1 \times R2}{R1+R2}$ they swoped around the numerator with the denominator and therefore forfeited marks. In 9.2 learners lost marks as they substituted with the total resistance instead of the resistance for an electric kettle as required. In 9.3 learners lost marks because they did not convert the unit of time from minutes to seconds.

(c) Provide suggestions for improvement in relation to Teaching and Learning

Teachers must revise grade 10&11 content and assess it before proceeding to the grade 12 work. Learners must be trained to read, analyze, and extract data from the statement and diagram before they proceed to the answer. Conversion between units of time must be emphasized and thoroughly taught. More exercises from previous grades must be given together with the grade12 work. The mathematical concept, $\frac{Product}{Sum}$ is not a formular therefore, teachers should emphasize that learners use the correct formula from the formular sheet.

d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

The performance in the question indicates that the topic was not well taught. Teachers mustgive full attention to the topic as learners usually get fair marks in the question. Teachers must teach all the prescribed content, not only the content that had been assessed in the previous years.

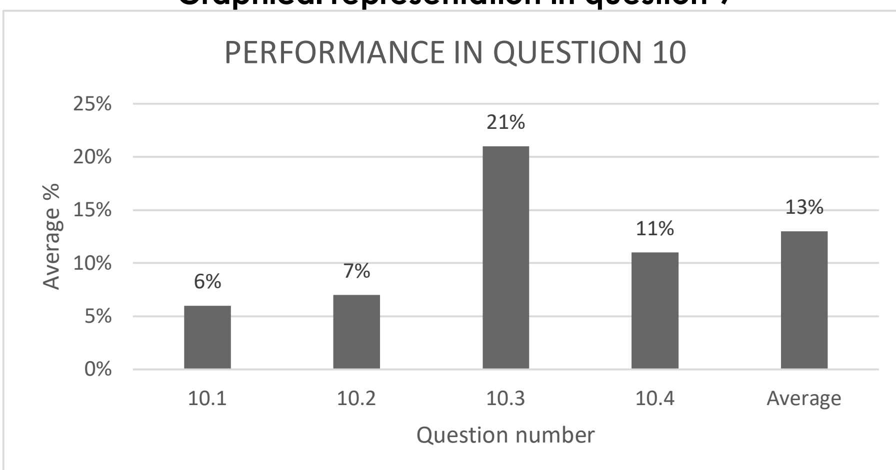
QUESTION 10 -13%

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

The question was poorly answered. Question 10 is the worst performed question with an average of 13%. Questions 10.1, 10.2 and 10.4 contributed more to the poor performance of this question.

Sub-question	Topic	Ave. performance %
10.1	Electromagnetic induction	6%
10.2	Electromagnetic induction	7%
10.3	Faraday's Law	21%
10.4	Electromagnetic induction	11%

Graphical representation in question 9



b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Learners did not know what will happen on the galvanometer when the magnet is moved into the coil in question 10.1 and therefore could not score marks. In 10.2 learners were required to explain their response to 10.1 but were not able to answer since they did not know the answer to 10.1. In question 10.3 learners were only stating the first part of the law therefore forfeited a mark. In question 10.4. learners did not know the ways of increasing the deflection
on the galvanometer.

(c) Provide suggestions for improvement in relation to Teaching and Learning

Teachers must conduct demonstrations using a solenoid, magnet, and a galvanometer to emphasize the electromagnetic induction failure to which there is no availability of apparatus teachers may use simulations as alternatives. Learners must be trained to state the laws as they appear in the CAPS and examination guidelines. Teachers must thoroughly teach factors affecting the induced emf and therefore explain how those factors can be used to increase the induced emf which in the case of question 10.4 will be increasing the deflection on the galvanometer.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

The performance in the question indicates that the topic was not well taught and revised.

Previous years' question papers must not be the determinants of what must be taught, all the prescribed topics must be well taught for the benefit of the learners.

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

TECHNICAL SCIENCES P1

NOVEMBER 2022

MARKS: 150

TIME: 3 hours

This question paper consists of 14 pages and 3 data sheets.

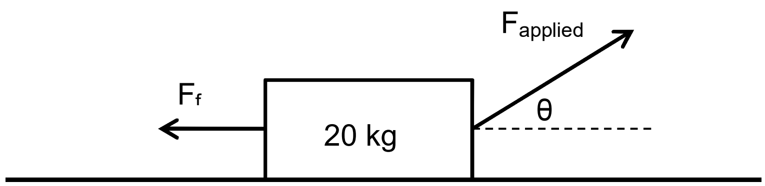
INSTRUCTIONS AND INFORMATION

1. Write your centre number and examination number in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of TEN questions. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE line between two subquestions, e.g. between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the attached DATA SHEETS.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your FINAL numerical answers to a minimum of TWO decimal places.
11. Give brief motivations, discussions, etc. where required.
12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 D.

1.1 A block with a mass of 20 kg moves towards the east at a constant velocity across a rough horizontal surface, as shown in the diagram below.



The velocity is constant because …

A $F_f = F_{applied}$ and $a = 9{,}8\ m{\cdot}s^{-2}$.

B $F_{applied} < F_f$ and $a = 0\ m{\cdot}s^{-2}$.

C $F_{applied}\sin\theta = F_f$ and $a = 9{,}8\ m{\cdot}s^{-2}$.

D $F_{applied}\cos\theta = F_f$ and $a = 0\ m{\cdot}s^{-2}$. (2)

1.2 Newton's Third Law of Motion refers to action-reaction pairs of forces. Which ONE of the following statements is INCORRECT for the action-reaction pairs in the picture?

A They act along the same line.

B Both forces act on the hammer simultaneously.

C These forces act on the hammer and the nail simultaneously.

D These forces act in opposite directions. (2)

1.3 Impulse is equal to the …

A change in momentum.

B rate of change in momentum.

C product of mass and velocity.

D work done by an object. (2)

1.4 The work done to move an object over a distance by a force **F**, which is applied at 30° to the horizontal, is **W**.

The work done to move the object through the same distance by the force **F** acting HORIZONTALLY to the surface is …

A $2\mathbf{W}$

B $\frac{1}{2}\mathbf{W}$

C $\frac{\sqrt{3}}{2}\mathbf{W}$

D $\frac{2}{\sqrt{3}}\mathbf{W}$ (2)

1.5 Which ONE of the following statements defines strain in a material? Strain is the ratio between the …

A change in diameter and the original length.

B total length and the original length.

C change in length and the original length.

D change in stress and the original stress. (2)

1.6 Force $\mathbf{F_1}$ is applied to a piston, with area $\mathbf{A_1}$, in a hydraulic system. Another piston in the same system has area $\mathbf{A_2}$ and this piston can exert a force, $\mathbf{F_2}$.

Which ONE of the following equations is INCORRECT according to Pascal's law?

A $F_2A_2 = F_1A_1$

B $F_1A_2 = F_2A_1$

C $\frac{F_1}{F_2} = \frac{A_1}{A_2}$

D $\frac{A_2}{F_2} = \frac{A_1}{F_1}$ (2)

1.7 When a light ray moves from a less optically dense medium to a more optically dense medium, the speed of the light will …

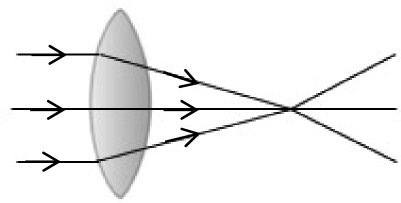
A increase.

B decrease.

C stay the same.

D None of the above-mentioned (2)

1.8 The point where the light rays meet is known as the …



A focal length.

B focal point.

C optic axis.

D principal axis. (2)

1.9 Which ONE of the following combinations indicates the relationship between capacitance and electric charge?

	CAPACITANCE	ELECTRICAL CHARGE
A	increases	decreases
B	decreases	remains the same
C	increases	increases
D	remains the same	increases

(2)

1.10 The function of a step-up transformer is to …

A increase voltage.

B decrease voltage.

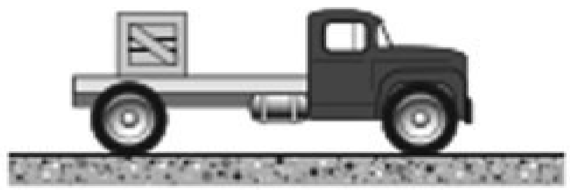
C increase magnetic flux.

D decrease magnetic flux. (2)

[20]

QUESTION 2 (Start on a new page.)

2.1 A 360 kg crate rests on the back of a truck with a rough surface. The mass of the truck is 4 550 kg and it is travelling at a speed of 105 km·h^{-1} to the right. The driver applies brakes and the truck slows down to a speed of 62 km·h^{-1} in 7 s.



2.1.1 If the crate is not secured with ropes, explain what will happen to it when the driver applies the brakes. (2)

2.1.2 NAME and STATE in words Newton's law of motion used to answer QUESTION 2.1.1. (3)

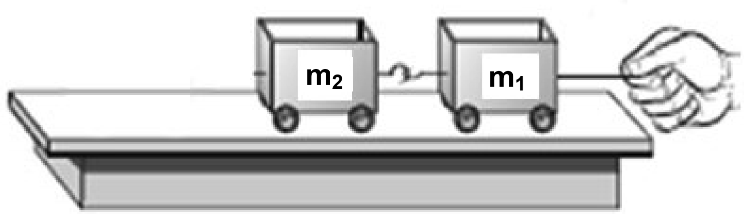
2.1.3 Draw a labelled free-body diagram of ALL the forces acting on the crate as the driver applies the brakes. (3)

2.1.4 Calculate the acceleration of the truck as the driver applies the brakes. (4)

2.1.5 Calculate the force applied by the brakes on the truck. (4)

2.2 Two toy cars with frictionless rollers are tied together and pulled, as shown in the diagram below.

The mass of each car is as follows: $\mathbf{m_1}$ = 0,75 kg and $\mathbf{m_2}$ = 0,8 kg
The cars are pulled to the right with a horizontal force of 6,5 N.



2.2.1 State Newton's Second Law of Motion in words. (2)

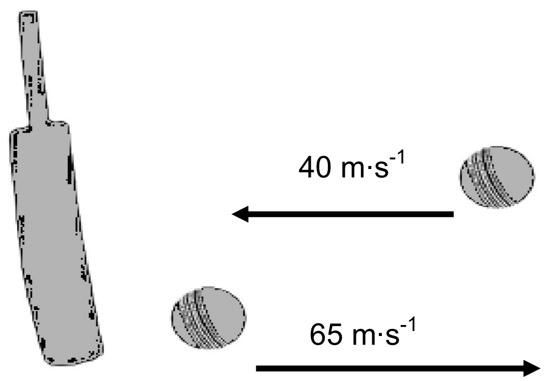
2.2.2 Calculate the acceleration of the system. (4)

2.2.3 Calculate the force exerted by car $\mathbf{m_1}$ on car $\mathbf{m_2}$. (3)
[25]

QUESTION 3 (Start on a new page.)

3.1 A 160 g ball, bowled with a velocity of 40 m·s^{-1}, is struck by a cricket bat. The ball leaves the cricket bat with a velocity of 65 m·s^{-1} in the opposite direction in a straight line, as shown in the diagram below.

The contact time between the cricket bat and the cricket ball is 4 x 10^{-3} s.



3.1.1 Define the term *impulse*. (2)

3.1.2 Calculate the impulse of the cricket bat on the ball. (4)

3.1.3 Calculate the magnitude of the net force exerted on the ball. (3)

3.2 Two blocks are sliding on a frictionless ice surface, as shown in the diagram below.

Before collision

After collision

3.2.1 State the principle of conservation of linear momentum in words. (2)

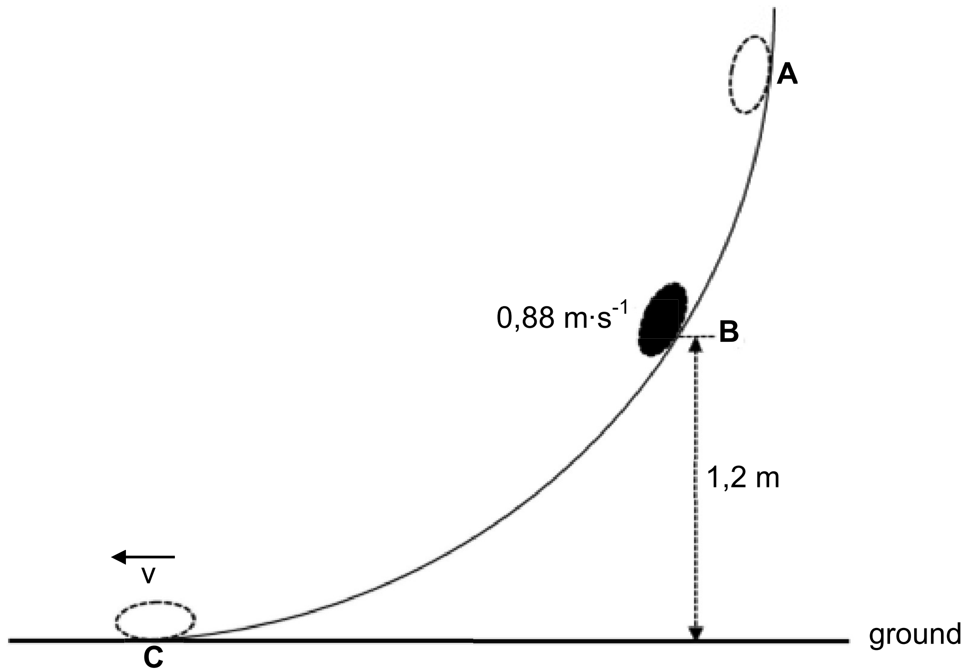
3.2.2 Calculate the velocity of the 1 kg block after the collision. (4)

3.2.3 Determine, by means of calculations, if the above collision is elastic or inelastic. (5)

[20]

QUESTION 4 (Start on a new page.)

An object of mass 2 kg slides down a frictionless track **ABC**. The object starts from rest at point **A**. It then passes point **B**, which is 1,2 m above the ground, with a speed of 0,88 $m \cdot s^{-1}$. The object reaches point **C**, on the ground, with an unknown speed v, as shown in the diagram below.



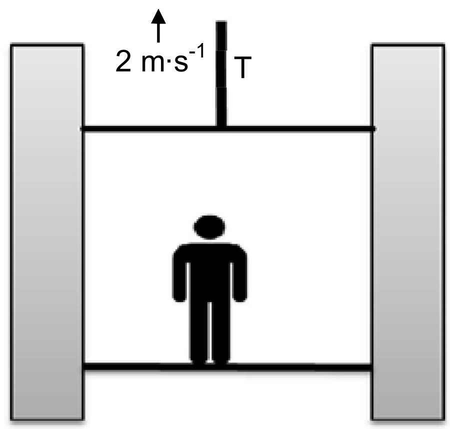
4.1 State the principle of conservation of mechanical energy in words. (2)

4.2 Determine the gravitational potential energy of the object at point **B**. (3)

4.3 Calculate the mechanical energy of the object at point **B**. (4)

4.4 Calculate the speed, v, with which the object reaches point **C**. (4)

The diagram below shows an elevator that is moving upwards with a person. A motor delivers 43 kW to lift the elevator with the person at a constant speed of 2 m·s^{-1}. Ignore air friction.

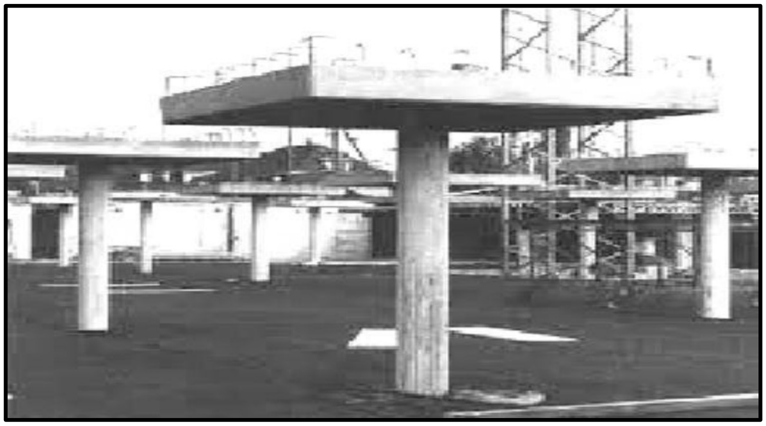


4.5 Define the term *power*. (2)

4.6 Calculate the magnitude of the tension, T, in the cable. (4)
[19]

QUESTION 5 (Start on a new page.)

5.1 A load causes a stress of $5,5 \times 10^6$ Pa in a round concrete bar, which has a diameter of 50 cm. The concrete bar has an original length of 3,5 m. Young's modulus for concrete is 85×10^9 Pa.



5.1.1 Define a *deforming force*. (2)

Calculate the:

5.1.2 Force on the bar (5)

5.1.3 Strain in the bar (3)

5.1.4 Change in length of the bar (3)

5.2 The diagram below shows a man lifting the side of a car with a hydraulic jack. The input and output pistons have areas of $4,8 \times 10^{-4}$ m^2 and $6,2 \times 10^{-2}$ m^2, respectively.

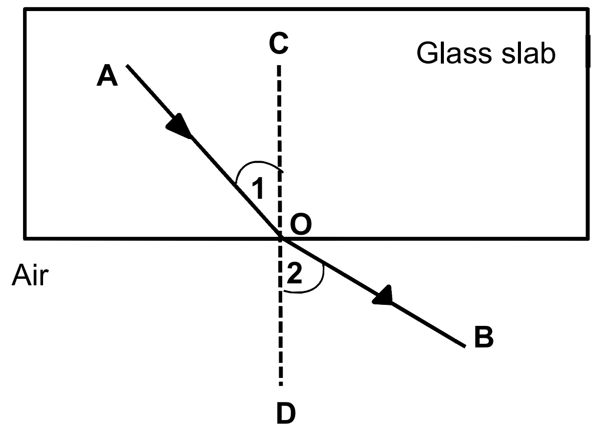
5.2.1 State Pascal's law in words. (2)

5.2.2 If the man applies a force of 40 N to lift the side of the car, calculate the weight of the car experienced by the jack at that point. (4)

[19]

QUESTION 6 (Start on a new page.)

The diagram below shows light ray **AO** moving from a glass slab into air. This phenomenon is known as refraction.



6.1 Define the term *refraction.* (2)

6.2 Write down the names of the following:

6.2.1 Light ray **AO** (1)

6.2.2 Light ray **OB** (1)

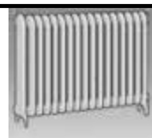
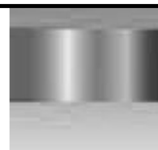
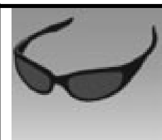
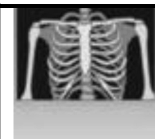
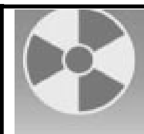
6.2.3 Angle **1** (1)

6.2.4 Angle **2** (1)

6.2.5 Line **CD** (1)
[7]

QUESTION 7 (Start on a new page.)

The table with pictures below represents the electromagnetic spectrum arranged from the lowest frequency to the highest frequency, numbered **1** to **7**.

						
1 Radio wave	**2**	**3**	**4** Visible light	**5** Ultraviolet	**6**	**7**

7.1 Name the radiation numbered:

7.1.1 **2** (1)

7.1.2 **3** (1)

7.1.3 **7** (1)

7.2 State TWO uses of ultraviolet rays. (2)

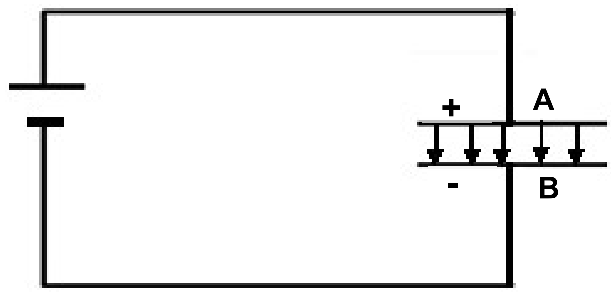
7.3 Define a *photon* of light. (2)

7.4 A radio station broadcasts at a frequency of 102,5 MHz. Calculate the energy of the radio waves. (3)

7.5 Name any THREE colours in visible light. (3)
[13]

QUESTION 8 (Start on a new page.)

Two plates of the parallel plate capacitor shown below are 6 mm apart and have an area of 5×10^{-2} m^2. A potential difference of 100 V is applied across the plates of the capacitor.



8.1 Calculate the charge on EACH plate. (5)

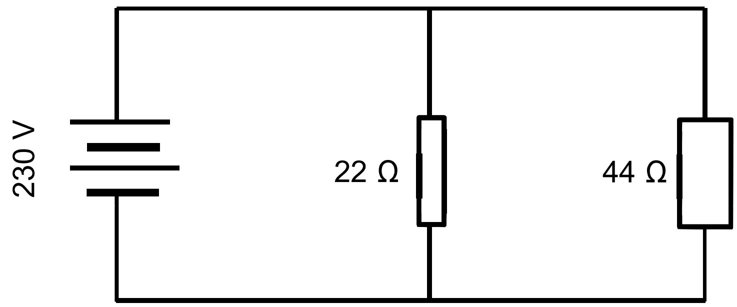
8.2 The distance between the plates is now doubled.

8.2.1 How will this change affect the magnitude of the capacitance? Refer to the RATIO in the answer. (2)

8.2.2 Explain the answer to QUESTION 8.2.1. (2)
[9]

QUESTION 9 (Start on a new page.)

An electric kettle with resistance 22 Ω and a microwave oven with resistance 44 Ω are connected in parallel and the combination is connected across a source of voltage 230 V as shown in the diagram.



Calculate the:

9.1 Total resistance of the circuit (3)

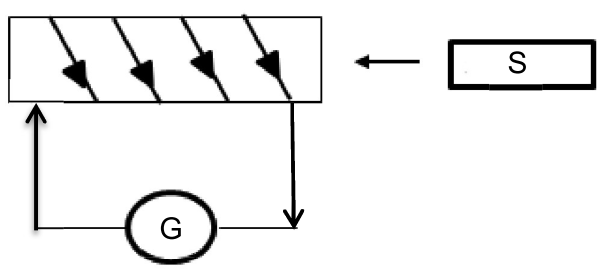
9.2 Power dissipated by the electric kettle (3)

9.3 Heat produced in the electric kettle in 2 minutes (3)
[9]

QUESTION 10 (Start on a new page.)

Learners conducted an experiment to demonstrate electromagnetic induction using a magnet and a galvanometer.

Study the diagram below and answer the questions that follow.



10.1 What is observed on the galvanometer when the magnet is moved into the coil? (1)

10.2 Explain the observation in QUESTION 10.1. (2)

10.3 NAME and STATE in words the law used to explain this observation. (3)

10.4 State THREE ways in which the deflection on the galvanometer can be increased. (3)
[9]

TOTAL: 150

DATA FOR TECHNICAL SCIENCES GRADE 12
PAPER 1

GEGEWENS VIR TEGNIESE WETENSKAPPE GRAAD 12
VRAESTEL 1

TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES*

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekragversnelling*	g	$9{,}8\ m\cdot s^{-2}$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	$3{,}0 \times 10^{8}\ m\cdot s^{-1}$
Planck's constant *Planck se konstante*	h	$6{,}63 \times 10^{-34}\ J\cdot s$
Electron mass *Elektronmassa*	m_e	$9{,}11 \times 10^{-31}\ kg$
Permittivity of free space *Permatiwiteit van vrye spasie*	ε_o	$8{,}85 \times 10^{-12}\ F.m^{-1}$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

FORCE/*KRAG*

$F_{net} = ma$	$p = mv$
$f_s^{max} = \mu_s N$	$f_k = \mu_k N$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$F_g = mg$
$a = \frac{\Delta v}{\Delta t}$	$MA = \frac{L}{E} = \frac{e}{I}$

WORK, ENERGY AND POWER/*ARBEID, ENERGIE EN DRYWING*

$W = F\Delta x \cos\theta$	$U = mgh$ or/*of* $E_P = mgh$
$K = \frac{1}{2}mv^2$ or/*of* $E_k = \frac{1}{2}mv^2$	$P = \frac{W}{\Delta t}$
$P_{ave} = Fv_{ave}$ / $P_{gemid} = Fv_{gemid}$	$M_E = E_k + E_p$

ELASTICITY, VISCOSITY AND HYDRAULICS/*ELASTISITEIT, VISKOSITEIT EN HIDROULIKA*

$\sigma = \frac{F}{A}$	$\varepsilon = \frac{\Delta \ell}{L}$
$\frac{\sigma}{\varepsilon} = K$	$\frac{F_1}{A_1} = \frac{F_2}{A_2}$
$P = \frac{F}{A}$	$P = \rho gh$

ELECTROSTATICS/*ELEKTROSTATIKA*

$C = \frac{Q}{V}$	$E = \frac{V}{d}$
$C = \frac{\varepsilon_0 A}{d}$ or/*of* $C = \frac{\kappa \varepsilon_0 A}{d}$	

CURRENT ELECTRICITY/*STROOMELEKTRISITEIT*

$R = \frac{V}{I}$	
$R_s = R_1 + R_2 + ...$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + ...$	$q = I \Delta t$
$W = VQ$ $W = VI \Delta t$ $W = I^2 R \Delta t$ $W = \frac{V^2 \Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2 R$ $P = \frac{V^2}{R}$

ELECTROMAGNETISM/*ELEKTROMAGNETISME*

$\phi = BA$	$\varepsilon = -N\frac{\Delta\phi}{\Delta t}$
$\frac{V_s}{V_p} = \frac{N_s}{N_p}$	

WAVES, SOUND AND LIGHT/*GOLWE, KLANK EN LIG*

$v = f\lambda$	$T = \frac{1}{f}$
$E = hf$ or/*of* $E = h\frac{c}{\lambda}$	

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE
NASIONALE SENIOR SERTIFIKAAT

GRADE/*GRAAD* 12

TECHNICAL SCIENCES P1/ *TEGNIESE WETENSKAPPE V1*

NOVEMBER 2022

MARKING GUIDELINES/*NASIENRIGLYNE*

DEPARTMENT OF BASIC EDUCATION
PRIVATE BAG X895, PRETORIA 0001
2022 -11- 22
APPROVED MARKING GUIDELINE
PUBLIC EXAMINATION

MARKS/*PUNTE*: 150

DBE: CE	DBE: IM	DBE: IM	Umalusi: EM	Umalusi :EM
22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022

These marking guidelines consist of 11 pages.
Hierdie nasienriglyne bestaan uit 11 bladsye.

QUESTION 1/*VRAAG* 1

1.1	D	✓✓	(2)
1.2	B	✓✓	(2)
1.3	A	✓✓	(2)
1.4	D	✓✓	(2)
1.5	C	✓✓	(2)
1.6	A	✓✓	(2)
1.7	B	✓✓	(2)
1.8	B	✓✓	(2)
1.9	C	✓✓	(2)
1.10	A	✓✓	(2)
			[20]

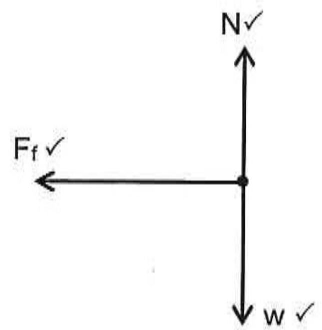
QUESTION 2/*VRAAG 2*

2.1.1 The crate will slide✓ to the right. ✓/*Die krat sal na regs gly.*
Accept: The crate will move forward
Aanvaar: die krat sal vorentoe beweeg. (2)

2.1.2 Newton's First Law of Motion. ✓
An object <u>will continue in a state of rest or uniform velocity</u> ✓ <u>unless acted upon by a non-zero resultant / net force</u> ✓

Newton's se eerste bewegingswet
'n Voorwerp sal <u>in sy toestand van rus of uniforme beweging volhard tensy 'n nie-nul resulterende/ netto krag daarop inwerk</u>. (3)

2.1.3



NOTES/*NOTAS*:	ACCEPTABLE LABELS/ *AANVAARBARE BYSKRIFTE*:
• One mark for each arrow with a correct label./*Een punt vir elke pyl met die korrekte byskrif.* • Penalise ONCE for each: *Penaliseer een keer vir elk.* ➢ No arrows/*Geen pylpunt* ➢ No dot/ *Geen kol.* ➢ Gap between the line and the dot./ *Spasie tussen die lyn en die kol.* ➢ Dotted lines are used./*Stippellyne gebruik.* ➢ Additional force is included./*Ekstra kragte ingesluit.* ➢ A force diagram is given./*'n Kragtediagram geteken.*	N/F_N: Normal/ *Normaal* F_g/w: Force due to gravity/weight *Gravitasiekrag/ gewig* F_f/f/f_k: friction/ *wrywing*

(3)

2.1.4

OPTION 1/*OPSIE 1*	OPTION 2/*OPSIE 2*
$a=\frac{\Delta v}{\Delta t}$; $a=\frac{v_f - v_i}{t}$ ✓ $=\frac{(17{,}22-29{,}17)✓}{7✓}$ $= -1{,}71\ m\cdot s^{-2}$ = 1,71 m·s⁻² to the left / opposite direction✓/*Na links/ teenoorgestelde rigting*	$F_{net}\Delta t = m\Delta v$ ✓ $F_{net}(7) = 4910(17{,}22 - 29{,}17)$ ✓ $F_{net} = -8382{,}07\ N$ $F_{net} = ma$ $-8382{,}07 = 4910a$ ✓ $a = 1{,}71\ m\cdot s^{-2}$ to the left / opposite direction✓/ *Na links/ teenoorgestelde rigting*

(4)

2.1.5

POSITIVE MARKING FROM 2.1.4/ *POSITIEWE NASIEN VANAF 2.1.4*	
OPTION 1/*OPSIE 1*	OPTION 2/*OPSIE 2*
$F_{net} = ma$✓ $= (4910)(-1{,}71)$ ✓ $= -8396{,}10$ = 8 396,10 N✓ to the left✓/*na links*	$F_{net} = \frac{m(v_f - v_i)}{\Delta t} = \frac{\Delta P}{\Delta t}$ ✓ $= \frac{(4910)(17{,}22-29{,}17)}{7}$ ✓ = 8382, 07 N ✓to the left✓/*na links*
Range/*Gebied*: 8382, 07 N - 8 396,10 N	

(4)

2.2.1 When a net force, F_{net}, is applied on an object of mass (m), it accelerates the object in the direction of the net force. ✓✓ This acceleration is directly proportional to the net force and inversely proportional to the mass of the object./ *Wanneer 'n resulterende/netto krag op 'n voorwerp met massa(m), inwerk, versnel die voorwerp in die rigting van die krag. Die versnelling is direk eweredig aan die resulterende/netto krag en omgekeerd eweredig aan die massa van die voorwerp.*

NOTE/*NOTA*:

- 2 marks if the word "net force" is in the first part. */2 punte indien die woorde "netto krag' in die eerste deel voorkom.*
- 1 mark if the word "net force" is in the second part only./ *1 punt indien die word "netto krag" slegs in die tweede deel voorkom.*
- 0 if the word "net force" is missing./ *0 indien die woorde "netto krag" weggelaat was.*

(2)

2.2

OPTION 1/*OPSIE 1*	OPTION 2/*OPSIE 2*
m_1 $F_{net} = ma$ ✓ $F_{applied} + (-F) = ma$ $6{,}5 - F = 0{,}75a$ .... (1) ✓ **m_2** $F_{net} = ma$ $F = ma$ $F = 0{,}8a$ .....(2) ✓ (1) + (2) $6{,}5 = 0{,}75a + 0{,}8a$ ∴ a = $4{,}19\ m{\cdot}s^{-2}$ to the right✓/*na regs*	$F_{net} = ma$ ✓ $6{,}5$ ✓ $= 1{,}55a$ ✓ $\frac{6{,}5}{1{,}55} = a$ $a = 4{,}19\ m{\cdot}s^{-2}$ $= 4{,}19\ m{\cdot}s^{-2}$ to the right✓/*na regs*

(4)

2.2.3 **POSITIVE MARKING FROM 2.2.2/*POSITIEWE NASIEN VANAF 2.2.2***

OPTION 1/*OPSIE 1*	OPTION 2/*OPSIE 2*
$F_{net} = ma$ $F = 0{,}8 \times 4{,}19$ ✓ $= 3{,}35$ N ✓ to the right✓/na *regs* **NOTE**: Penalise 1 mark for the formula if the subscript "net" is omitted./ *Penaliseer met 1 punt vir die formule indien die onderskrif "net" weggelaat is.*	$F_{net} = ma$ $F_{applied} - F = ma$ $6{,}5 - F = 0{,}75(4{,}19)$ ✓ $-F = -3{,}35$ N $F = 3{,}36$ N✓ to the right✓/*na regs*
Range/*Gebied*: 3,35 N – 3,36 N	

(3)
[25]

QUESTION 3/*VRAAG* 3

3.1.1 The product of the resultant/net force acting on an object and the time the net force acts on the object.✓✓

Die produk van die resulterende/netto krag wat op die voorwerp inwerk en die tyd wat die netto krag op die voorwerp inwerk. (2)

3.1.2

OPTION 1/*OPSIE 1*	OPTION 2/*OPSIE 2*
Positive to the right/*Regs as positief* Impulse = Δp } ✓ Anyone $F_{net}\Delta t = \Delta p$ } $= m(v_f - v_i)$ $= 0{,}16(65 - (-40))$ ✓ $= 16{,}8\ kg{\cdot}m{\cdot}s^{-1}$ ✓to the right✓/ opposite direction to the original direction. *Na regs / teenoorgestelde rigting as oorspronklike.*	Positive to the left/*Links as positief.* Impulse = Δp } ✓ Anyone $F_{net}\Delta t = \Delta p$ } $= 0{,}16(-65 - 40)$ ✓ $= -16{,}8$ Answer : $16{,}8\ kg{\cdot}m{\cdot}s^{-1}$ ✓to the right✓ opposite direction to the original direction. *Na regs/ teenoorgestelde rigting as oorspronklike.*

(4)

3.1.3

POSITIVE MARKING FROM 3.1.2/ *POSITIEWE NASIEN VANAF 3.1.2*	
OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$F_{net} = \frac{\Delta p}{\Delta t}$ ✓ $= \frac{16,8}{4\times10^{-3}}$ ✓ $= 4\,200$ N ✓	$F_{net} = \frac{\Delta p}{\Delta t}$ ✓ $= \frac{-16,8}{4\times10^{-3}}$ ✓ $= -4200$N $= 4200$ N✓
OPTION 3/*OPSIE 3*	
$a = \frac{v_f - v_i}{\Delta t}$ $= \frac{65-(-40)}{4\times10^{-3}}$ ✓ $= 26\,250\ m\cdot s^{-2}$	$F_{net} = ma$ ✓ $= 0,16)(26\,250)$ $= 4200$ N ✓

(3)

3.2.1 The total linear momentum in an isolated system ✓ remains constant/ is conserved in magnitude and direction✓
OR
In an isolated system, the total momentum before a collision/explosion is equal to the total momentum after the collision/explosion in magnitude and direction.

Die totale liniêre momentum in 'n geslote stelsel bly konstant.
OF
Die totale liniêre momentum van 'n geslote stelsel is voor die botsing/ ontploffing gelyk aan die totale liniêre momentum na die botsing/ ontploffing. (2)

3.2.2
$\Sigma p_{before/voor} = \Sigma p_{after/na}$
$m_1v_{i1} + m_2v_{i2} = m_1v_{f1} + m_2v_{f2}$ ✓
$(1)(5) + (1,8)(2,5)$ ✓ $= (1)(v) + (1,8)(3)$ ✓
$5 + 4,5 = v + 5,4$
$4,1 = v$
∴ $v = 4,1\ m\cdot s^{-1}$ to the right ✓/ in the direction of motion.
Na regs/ in die bewegingsrigting. (4)

3.2.3 **POSITIVE MARKING FROM 3.2.2./*POSITIEWE NASIEN VANAF 3.2.2***

$\Sigma k_{before/voor} = \frac{1}{2}mv^2 + \frac{1}{2}mv^2$✓ $= \frac{1}{2}(1)(5)^2 + \frac{1}{2}(1,8)(2,5)^2$ ✓ $= 12,5 + 5,63$ $= 18,13$ J	$\Sigma k_{after/na} = \frac{1}{2}mv^2 + \frac{1}{2}mv^2$ $= \frac{1}{2}(1)(4,1)^2 + \frac{1}{2}(1,8)(3)^2$ ✓ $= 8,41 + 8,1$ $= 16,51$ J

$\Sigma k_{before/voor} \neq \Sigma k_{after/na}$ ✓
Inelastic✓ /*Onelasties* (5)
[20]

QUESTION 4/*VRAAG 4*

4.1 Total mechanical energy (sum of gravitational potential energy and kinetic energy) in an isolated system ✓remains constant. ✓

Accept: The total (mechanical) energy of an isolated system remains constant

Die totale meganiese energie (som van die gravitasie- potensiële en kinetiese energie) van 'n geïsoleerde stelsel bly konstant.

Aanvaar: *Die totale (meganiese) energie van 'n geisoleerde sisteem bly konstant.* (2)

4.2 Ep = mgh ✓
= (2)(9.8)(1,2) ✓
= 23,52J ✓ (3)

4.3 **POSITIVE MARKING FROM QUESTION 4.2/*POSITIEWE NASIEN VANAF 4.2***
$ME = E_p + E_k$ ✓
= 23,52✓ + (½)(2)(0,88)^2 ✓
= 24,29 J ✓ (4)

4.4 **POSITIVE MARKING FROM QUESTION 4.3/POSITIEWE NASIEN VANAF 4.3**
ME at C = ME at B
$(E_p + E_k)_{at\ C} = (E_p + E_k)_{at\ B}$ ✓
0 + (½)(2)v^2 ✓= 24,29 ✓
v = 4,93 m.s^{-1} ✓ (4)

4.5 Power is the rate at which work is done. ✓✓
OR
Power is the rate at which energy is expended/ transferred.
Drywing is die tempo waarteen arbeid verrig word.
OF
Drywing is die tempo waarteen energie verbruik/oorgedra word. (2)

4.6 $P_{ave/gem} = Fv_{ave/gem}$ ✓
43000 ✓ = F(2) ✓
F = 21500 N
T = 21500 N ✓ (4)
[19]

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QUESTION 5/*VRAAG 5*

5.1.1 A force that changes the shape and size of a body✓✓

'n Krag wat die vorm en grootte van 'n voorwerp verander. (2)

5.1.2

OPTION 1/*OPSIE 1*	OPTION 2/*OPSIE 2*
$\text{Area} = \frac{\pi d^2}{4}$ $= \frac{\pi(0,5)^2}{4}$ ✓ $= 1,96 \times 10^{-1}\ m^2$ $\sigma = \frac{F}{A}$ ✓ $5,5 \times 10^6$ ✓ $= \frac{F}{1,96 \times 10^{-1}}$ ✓ $F = 1,08 \times 10^6\ N$ ✓	$\sigma = \frac{F}{A}$ ✓ $= \frac{F}{\frac{\pi d^2}{4}}$ $5,5 \times 10^6$ ✓ $= \frac{F}{\frac{\pi(0,5)^2}{4}}$ ✓ ✓ $F = 1,08 \times 10^6\ N$ ✓
OPTION 3/*OPSIE 3*	**OPTION 4/*OPSIE 4***
$\text{Area} = \pi r^2$ $\text{Area} = \pi(0,25)^2$ ✓ $= 1,96 \times 10^{-1}\ m^2$ $\sigma = \frac{F}{A}$ ✓ $5,5 \times 10^6$ ✓ $= \frac{F}{1,96 \times 10^{-1}}$ ✓ $F = 1,08 \times 10^6\ N$ ✓	$\sigma = \frac{F}{A}$ ✓ $5,5 \times 10^6$ ✓ $= \frac{F}{\pi(0,25)^2}$ ✓ ✓ $F = 1,08 \times 10^6\ N$ ✓

(5)

5.1.3

$$K = \frac{\sigma}{\varepsilon} \checkmark$$

$$85 \times 10^9 = \frac{5,5 \times 10^6}{\varepsilon} \checkmark$$

$$\varepsilon = 6,47 \times 10^{-5} \checkmark$$

(3)

5.1.4 **POSITIVE MARKING FROM 5.1.3/*NASIEN VANAF 5.1.3***

$$\varepsilon = \frac{\Delta\lambda}{L} \checkmark$$

$$6,47 \times 10^{-5} = \frac{\Delta\lambda}{3,5} \checkmark$$

$$\Delta\lambda = 2,26 \times 10^{-4}\ m \checkmark$$

(3)

5.2.1 In a continuous liquid in equilibrium, the pressure applied at a point is transmitted equally to other parts of the liquid. ✓✓

In 'n kontinue vloeistof by ewewig, sal die druk by 'n punt eweredig oorgedra word na al die ander dele van die vloeistof. (2)

5.2.2

OPTION 1/*OPSIE 1*	OPTION 2/*OPSIE 2*
$\frac{F_1}{A_1} = \frac{F_2}{A_2}$ ✓ $\frac{40}{4,8\times10^{-4}}$ ✓ $= \frac{F_2}{6,2\times10^{-2}}$ ✓ F_2 = 5 166,67 N✓	$P = \frac{F}{A}$ ✓ $P = \frac{40}{4,8\times10^{-4}}$ ✓ = 83 333,33 Pa $P = \frac{F}{A}$ $83333,33 = \frac{F}{6,2\times10^{-3}}$ ✓ F = 5 166,67 N✓

(4)
[19]

QUESTION 6/*VRAAG* 6

6.1 Bending of light ✓when it passes from one medium to another (of a different optical density).✓

Die buiging/breking van lig wanneer dit van een medium na 'n ander beweeg. (wat verskil in optiese digtheid). (2)

6.2.1 Incident (ray)✓/*Invallende straal* (1)

6.2.2 Refracted (ray)✓*Gebuigde/ gebroke/ gebreekte straal* (1)

6.2.3 (Angle of) incidence✓/*invalshoek* (1)

6.2.4 (Angle of) refraction✓*Brekingshoek* (1)

6.2.5 Normal ✓/ *Normaal* (1)
[7]

QUESTION 7/*VRAAG* 7

7.1.1 Microwave✓/ *Mikrogolwe*
7.1.2 Infrared✓/ *Infrarooi*
7.1.3 Gamma ✓/ *Gamma* (3)

7.2
- Sterilise medical equipment✓/ *Steriliseer mediese apparaat*
- Treat skin conditions✓/ *Behandeling velkondisies*
- Production of vitamin D/ *Vervaardiging van vitamiene D*
- To check the counterfeit notes/ *Verifieer vals geldnote. (any two/enige twee)*

Accept: any other correct answer ***Aanvaar:*** *enige ander korrekte antwoord* (2)

7.3 A quantum/packet of (electromagnetic) energy.✓✓/ *'n Kwantum/pakkie van (elektomagnetiese) energie.* (2)

7.4 $E = hf$ ✓
$= (6{,}63 \times 10^{-34})(102{,}5 \times 10^{6})$ ✓
$= 6{,}8 \times 10^{-26}$ J✓ (3)

7.5
- Red✓/ *Rooi*
- Orange✓/ *Oranje*
- Yellow✓/ *Geel*
- Green/ *Groen*
- Blue/ *Blou*
- Indigo/ *Indigo*
- Violet/ *Violet* (any three/ *enige drie*) (3)

[13]

QUESTION 8/*VRAAG* 8

8.1

Anyone/enige een✓

$C = \frac{\varepsilon_0 A}{d}$

$= \frac{(8{,}85 \times 10^{-12})(5 \times 10^{-2})}{6 \times 10^{-3}}$ ✓ ✓

$= 7{,}38 \times 10^{-11}$ F

$C = \frac{Q}{V}$

$7{,}38 \times 10^{-11} = \frac{Q}{100}$ ✓

$Q = 7{,}38 \times 10^{-9}$ C ✓ (5)

8.2.1 Capacitance will be decreased ✓by half ✓/ reduced by 50%/decrease by a factor of 2 / it will reduce to the ration 2:1.

Accept/*Aanvaar*: reduce to 3,69 x 10^{-9} F
Kapasitansie sal verminder/ halfeer/ met 50% / verminder met 'n faktor van 2/ dit sal veminder tot verhouding van 2:1. (2)

8.2.2 Capacitance is inversely proportional to the distance between the plate.✓✓
OR
Distance between the plates increases the capacitance will decrease with the same ratio/ factor.
Kapasitansie is omgekeerd eweredig aan die afstand tussen die plate.
OF
Indien die afstand tussen die plate verhoog sal die kapasitansie verlaag met dieselfde faktor/ verhouding. (2)
[9]

QUESTION 9/*VRAAG* 9

9.1

OPTION 1/ *OPSIE 1*	**OPTION 2/ *OPSIE 2***
$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓ $= \frac{1}{22} + \frac{1}{44}$ ✓ $\therefore R_T = 14{,}67\ \Omega$ ✓	$R_P = \frac{R_1 \times R_2}{R_1 + R_2}$ ✓ $R_P = \frac{22 \times 44}{22 + 44}$ ✓ $R_T = 14{,}67\ \Omega$ ✓

(3)

9.2

OPTION 1/ *OPSIE 1*	**OPTION 2/ *OPSIE 2***	**OPTION 3/ *OPSIE 3***
$P = \frac{V^2}{R}$ ✓ $= \frac{230^2}{22}$ ✓ $= 2404{,}55$ W ✓	$I = \frac{V}{R}$ $I = \frac{230}{22}$ $= 10{,}45$ A $P = VI$ ✓ $= (230)(10{,}45)$ ✓ $= 2404{,}55$ W ✓	$I = \frac{V}{R}$ $I = \frac{230}{22}$ $= 10{,}45$ A $P = I^2R$ ✓ $= (10{,}45^2)(22)$ ✓ $= 2402{,}46$ W ✓
Range/*Gebied*: 2402,45 – 2404,55		

(3)

POSITIVE MARKING FROM QUESTION 9.2/*POSITIEWE NASIEN VANAF 9.2*

9.3

OPTION 1/*OPSIE 1*	OPTION 2/*OPSIE 2*
$W = VI\Delta t$ ✓ $= (230)(10{,}45)(120)$✓ $= 288\ 420$ J✓	$W = \frac{V^2}{R}\Delta t$ ✓ $= \frac{230^2}{22}(120)$ ✓ $= 288\ 545{,}45$ J✓
OPTION 3/ *OPSIE 3*	**OPTION 4/ *OPSIE 4***
$W = I^2 R\Delta t$ ✓ $= (10{,}45^2)(22)(120)$ ✓ $= 288\ 294$ J✓	$W = P\Delta t$ ✓ $= (2404{,}55)(120)$✓ $= 288\ 546$ J✓ (or 288 295,2 J)
Range/*Gebied*: 288 294 – 288545,45	

(3)
[9]

QUESTION 10/*VRAAG* 10

10.1 The needle in the galvanometer deflects✓/ Galvanometer reading will change.
Die naald van die galvanometer sal uitwyk./ Galvanometer lesing sal verander. (1)

10.2 When the magnet is moved in and out of the coil an emf is induced in the coil. ✓ The induced emf produces a current which then moves the needle. ✓

Wanneer die magnet in en uit die spoel beweeg word, word n emk in die spoel geinduseer.Die geinduseerde emk wek n stroom op wat die naald laat uitwyk. (2)

10.3 Faraday's law, ✓ states that when the magnetic flux linked with the coil changes, an emf is induced in the coil. ✓The magnitude of the induced emf is directly proportional to the rate of change of magnetic flux. ✓

Faraday se wet bepaal dat, wanneer die magnetiese vloed wat met die spoel verbind is, verander, 'n emk in die spoel geïnduseer word. Die grootte van die geïnduseerde emk is direk eweredig aan die tempo van verandering van die magnetiese vloed. (3)

10.4
- Increase the number of windings/ turns on the coil. ✓
- Increase the speed at which the magnet is moving. ✓
- Use a stronger magnet. ✓

- *Verhoog die aantal windings op die spoel.*
- *Verhoog die spoed waarmee die magneet beweeg word.*
- *Gebruik 'n sterker magnet.*

(3)
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