Province of the
EASTERN CAPE
EDUCATION

EXAMINATIONS AND ASSESSMENT CHIEF DIRECTORATE
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2020 NSC CHIEF MARKER'S REPORT

SUBJECT:	**PHYSICAL SCIENCES**
PAPER:	**1**
DURATION OF PAPER:	**3 hours**

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

The Learner Performance was not very good in this question paper.

Once again, the basic problems that arise every year need once more to be highlighted. If teachers pay attention to these basic errors, many candidates would fare better, especially those who marginally fail. These problems are mentioned in the report at relevant places as well.

1) **Definitions**: The candidates' inability to answer the definitions is worrying. Many of the Department's strategies are to provide notes on the definitions and it is concerning that these resources are not properly utilised.
2) **Data Sheets**: The candidates do not know how to use the Data Sheets provided with the Question Paper. These Data- and Formula Sheets should be given to the candidates at the start of their matric year so that they can become familiar with the contents. Therefore, by the time they write exams, they will be familiar with the contents of the Data- and Formula Sheets. Many candidates write the wrong formula on the script while the correct formula is on the Formula Sheet.
3) **Units**. Candidates do not know the units of the values of their answer. One mark is awarded for the answer + unit. (Eg 5N $\surd$). If the unit is omitted, no marks are obtained. So, after calculating the answer correctly and the unit is wrong, the mark is unnecessarily lost.
4) **Calculators**: Many of the candidates do not know how to use a calculator correctly. They need to be taught how to use exponents correctly because they lose many marks by substituting correctly and then not being able calculate the answer on the calculator. Eg. The learners must be taught how to punch 3,5 x 10^{-9} into the calculator correctly, using the EXP button. The use of the trigonometric keys on the calculator (sin, cos and tan) is also problematic. It seems as if the candidates forgot what they learned in Mathematics and applied it incorrectly in Physical Sciences.
5) **Subscripts**. The use of the correct subscripts is vitally important when indicating the difference between similar values, such as forces. (Eg. F_G and F_{APP}). The omission of subscripts means marks are lost unnecessarily.
6) **Diagrams**: The drawing of diagrams needs to be done where vectors are involved. Candidates are not applying basic techniques taught in Gr 10. They lose marks when a vector is not drawn with a ruler and there is no arrow and label for the vector.
7) **Vectors and scalars:** The candidates should know that when the magnitude is asked, the answer should be a positive value. If the answer that is calculated is a vector, the direction must be indicated.
8) **Exam Guidelines**: Copies of the Exam Guidelines should be provided to each candidate at the beginning of the Grade 12 year.

SECTION 2:

Comment on candidates' performance in <u>individual questions</u>

(It is expected that a comment will be provided for each question on a separate sheet).

QUESTION 1 (Performance: 10th out of 10)
a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
The candidates did not perform well in this question and it was poorly answered. There was a poor interpretation of the basic concepts. It would seem as if many candidates did not know the content of the work and did a lot of guessing. Question 1.5 was the worst answered question in Question 1. Few candidates knew what the basic units were. Question 1.8 was a challenge for even the top candidates. They did not realise that a minimum is also a peak for an ac graph.

b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
The learners have not been taught the skill of elimination. It leads to them merely guessing the answer.

c) Provide suggestions for improvement in relation to Teaching and Learning.
Multiple-choice type of Questions (MCQ) should be included in as many tests as possible. The challenge is when 2 variables are given as possible answers, such as Questions 1.4 and 1.9. The skill of eliminating possible wrong choices must be taught to the learners. All previous exam papers can be used to improve this skill. Nevertheless, the better the learners understand the content of the work, the better they will do in this section.

d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.
Since tests that consist only of Multiple-choice type of questions are easy to mark, these types of tests can easily be done in a class. Teachers will need to spend some time preparing these tests, but it will be to the advantage of the candidates when answering Question 1 of this paper. The marks obtained in this question is sometimes the difference between, for example, Level 5 and Level 6 in the final mark. This will teach candidates how to eliminate options that are not relevant and then finally come to the correct answer. The better the candidates understand the content of the work, the higher the level of Multiple-choice Questions they would be able to answer.

QUESTION 2 (Performance: 2nd out of 10)

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

This question was the question that was the second-best answered. Question 2.1 (2 marks) and Question 2.2 (5 marks) are lower-level questions. The candidates should, if they know their definitions and have practised drawing vector diagrams, obtain full marks for these sub-sections.

Questions 2.3 and 2.4 were more challenging questions. Teachers must teach the learners the 2-force direction approach when solving problems such as Question 2.3. Many candidates used the single-force approach, and the candidates could not obtain full marks for this approach.

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

There seems to be a lack of knowledge of certain aspects of Newton's Second Law, specifically the application of the law. Many candidates could identify the forces but struggled when they needed to apply this knowledge.

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

Identification of forces acting on an object is taught in Grade 11. It seems as if the candidates are not taught what each force's application is. (Pulling, pushing, gravity etc.)

Many candidates did not use the correct or adequate subscripts to identify the different forces.

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

Teachers need to help the candidates to know how to apply each force and in which direction the force is applied. They also need to understand Newton's Second Law and how to apply it. ($F_{nett} = ma$).

The use of appropriate subscripts needs to be emphasised when drawing force- and free-body diagrams. Candidates lose unnecessary marks by using the wrong labels to represent the forces (F_g, $F_{//}$, $F_{\perp}$, f_s, f_k, F_{App}). Candidates also struggled to understand the difference between $F_{//}$ and F_H as well as $F_{\perp}$ and F_v.

Candidates are exposed to this section in Grade 11 and it is not done again in Grade 12. Teachers need to revise this topic quite often in Grade 12.

The fact that the candidates did not write June examinations due to Covid-19 may have had a negative effect on remembering exactly how to apply the knowledge they obtained in Grade 11.

QUESTION 3 (Performance: 3rd out of 10)

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

From the performance of the candidates, this question was fairly well answered.

However, the candidates seemed to lack the skills to interpret the graph.

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

The interpretation of the graph remained a problem in this question. For example, in question 3.2.3 the time was calculated as from 0,67 s. In Question 3.2.4, a time was required from a completely different motion, but the candidates still used the time from Question 3.2.3. They were confused about the position of the ball during its motion.

Candidates were not sure of when to use initial velocity (v_i) and final velocity (v_f) during the motion of the ball.

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

Unnecessary errors occurred because the candidates did not use the Data Sheets that were attached to the question paper.

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

Errors were made when candidates wrote some of the equations incorrectly or wrote incomplete formulas. Unnecessary marks were also lost when candidates wrote down the wrong units for their answers. The rounding off of the final answer to 2 decimal places cost some candidates a mark.

Emphasis should be placed on the interpretation of graphs. As graphs are always asked in the question paper, learners need to be taught how to read the graphs, use the gradient, use the x- and y-intercepts and naming the x- and y-axis when necessary.

QUESTION 4 (Performance: 1st out of 10)

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

This was the question in which the candidates performed the best.

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

The candidates answered the question well but lost unnecessary marks due to the incorrect use of subscripts.

In Question 4.2.1, the formula that the candidates needed to use is not on the Formula Sheet. Values such as initial momentum of object A (m_Av_{iA}) and initial momentum of object B (m_Av_{iA}) are different. The only way to differentiate between the two is by using the correct subscripts. The candidates failed to indicate the direction of motion of the respective balls before and after the collision.

In Question 4.2.2, many candidates confused **momentum**, **change in momentum** and **rate of change of momentum** and were not sure which one to use in the answering of this sub-section.

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

Since momentum is also a vector motion, candidates need to identify the direction of motion of each object to answer the question correctly. Teachers need to emphasise the use of + and – signs to indicate direction.

In this question, as well of most of the other questions, the use of the Examination Guidelines is essential to the candidates. These guidelines need to be in the candidate's hands so that they know exactly how to answer the definitions.

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

Candidates are confused with the use of the **momentum** (mv) and **kinetic energy** ($\frac{1}{2}mv^2$) formulas. Teachers need to guide the candidates to the correct use of **Change in momentum, Impulse** and **Conservation of momentum.** Also, the difference between $\mathbf{F_{nett}}$ and **Impulse** needs to be emphasised. .

QUESTION 5 (Performance: 5th out of 10)

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

This question was answered poorly.

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

The following facts caused this question to be answered poorly:

The candidates:

1) were confused between conservative and non-conservative forces. Once again, the definition was a problem. (Question 5.1)
2) struggled to choose the correct formula to use from the Formula sheet.
3) could not do the correct substitution.
4) could not identify which signs to use for direction (+ and -).
5) had a problem identifying between kinetic energy (E_k) and change in kinetic energy (ΔE_k). (Question 5.2)
6) could not distinguish between W_{nc} and W_{nett} (Question 5.3)

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

Candidates should be given many short tests to improve their skills in all the different sections of the work. The candidates do not understand the concepts very well and then struggle to do any application of these concepts in the given problems. They get confused between Ek and ΔE_k. This would not happen if they knew what Δ means. Teachers need to emphasise this and teach candidates the concepts correctly.

Basic mathematical problems arise when $(v_f^2 - v_i^2)$ is written as $(v_f - v_i)^2$.

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

The candidates struggle to understand the concepts and then do not know which formula to use from the Formula Sheet. Provide each learner with the Data and Formula sheet at the beginning of the year so that they can familiarise themselves with it.

QUESTION 6 (Performance: 6th out of 10)

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

This question was the 6th best answered question but was poorly answered. Once again, the graph caused the candidates problems because of their inability to read the graph. They could not interpret the frequency values on the graph as to whether the train was moving towards or away from the detector.

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

The first reason for this question being answered poorly, is the interpretation of the graph.
Secondly, many of the candidates could not state the Doppler Effect in words.
Thirdly, the majority of the candidates could not relate the graph to the Doppler effect and did not realise that one has to use simultaneous equations to calculate the speed of the train.
And lastly, they could not determine the time t_1 because they did not understand the graph.

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

Use everyday examples so that the candidates can understand the Doppler effect – the frequency observed when a car moves towards or way from you. Only when they understand the concept, will they understand how to use the Doppler effect equation and also the role of the velocities and frequency of the listener and object.
Candidates need to be taught to gather and interpret information from a graph.
Candidates also need to do revisions on basic wave equations such as $v = \lambda f$ and $T = \frac{1}{f}$.

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

The candidates were not well prepared in certain areas, such as graphs, identifying the given data and applying it appropriately to the equation. It was also evident that the candidates struggled to use their calculators properly when faced with the simultaneous equations.

QUESTION 7 (Performance: 4th out of 10)

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

This was the 4th best answered question but was poorly answered as a whole.

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

Candidates did not get the definition of an electric field correct (they confused it with the electric field at a point!). Choosing the correct formula to use from the Formula Sheet remains a problem. They did not know when to use $F_E = \frac{kQ1Q2}{r2}$ or $E = \frac{kQ}{r2}$. This is due to the lack of understanding of the basic concepts of Force and Electric field strength.

The calculation of the electrostatic force (F_E) between charges **A** and **B** should have earned the candidates easy marks. They struggled with choosing the correct formula. (some of them used the F_G formula). The correct use of the calculator proved a challenge as well since it involved exponents.

The candidates struggled with the identification of how the forces exerted by charges **A** and **B** had effect at point M. They did not know how to use the + and – signs of the charges.

The use of Pythagoras was also a problem for the candidates in Question 7.5.

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

The candidates should be exposed to a variety of different scenarios that can be found in different textbooks and exam papers. The concepts of force between charges and the electric field strength should be explained better. The candidates also need to be taught how to use their calculators when they must use the scientific notation. (EXP button on the calculator).

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

The correct use of the Formula Sheets will help in identification of the correct formulae which needsto be used. They also need to know which appropriate units need to be used. The provision of Exam Guidelines will help in this aspect.

QUESTION 8 (Performance: 8th out of 10)

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

This question was answered very poorly. It was the question that ranked as the 8th most difficult.

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

The definition of *emf* was not given correctly by the candidates.

Leading up to question 8.2, the candidates did not note that the "voltmeter DECREASES **by** 1,5 V" and not **to** 1,5 V. The candidates need to read the question thoroughly.

Giving the reason (in Question 8.2) and explaining the answer (Question 8.4) was challenging for the candidates. This could be a language problem or that they are not taught how to answer questions like this.

The fact that the candidates do not understand exactly how a current works, led to them not answering the core of this question (8.3) correctly.

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

Electric circuits should be done properly in Grade 10 and Grade 11 so that they only need to master the emf and internal resistance concepts in Grade 12. If this is not done, the syllabus in Grade 12 does not allow time to reteach them Grade 10 and Grade 11 work. The calculation of resistors in parallel should be done using only the formulas provided on the Formula Sheet. Some candidates tried to use "shortcuts" in the calculation and lost unnecessary marks due to wrong mathematics. The relationship between V, I and R should be properly taught in the lower standards.

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

Since most marks in this question could be obtained from knowledge of Grade 10 and Grade 11 work, it is worrying that the candidates did not do better in this question. The knowledge of this question should be acquired in the lower grades.

Also, the use of the Formula Sheets was a problem – identifying which formulae to use and how to make correct substitutions.

QUESTION 9 (Performance: 3rd out of 10)

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

The question ranked amongst the best answered questions. However, the candidates did not perform well in this question.

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

The definition was not given correctly by many candidates.

The candidates could not identify between a generator and a motor.

The candidates could not identify between V_{rms} and I_{rms}.

The candidates wrote the wrong units for their answers.

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

The teachers need to emphasise the correct use of the following in this question:

1) The use of the correct subscripts.
2) The distinction between V_{rms} and I_{rms} and how to calculate the values correctly.
3) Using the correct SI units for the answers obtained.

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

The candidates struggle to understand the terms generator and electric motor and exactly how they work. They do not comprehend what exactly AC and DC means. This leads to them not understanding V_{rms} and I_{rms}. The understanding of the maximum values of V and I was also lacking. The proper understanding of these terms is vital in being successful in this question.

QUESTION 10 (Performance: 1st out of 10)

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

Even though this question was the best answered question in our analysis, it was poorly answered by the candidates.

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

The interpretation of the graph was done badly since the candidates did not know exactly what the values of the x- and y-axes meant. The candidates could not identify which formulae they could use from the Formula Sheet. They also lacked understanding of terms such as threshold frequency, work function and also how to use the "largest wavelength" given in Question 10.3.

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

The teachers need to show the candidates how the Photo Electric Effect applies to everyday life by making use of videos and other study aids. If candidates see the visual effect of the Photo Electric Effect, they will understand the relative terms related to this concept, such as threshold frequency and work function.

It is also evident that the candidates cannot apply their mathematic knowledge in the science class. Their ability to use their calculator correctly when using scientific notations is not good.

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

It is worrying that candidates confuse Work in energy principles ($W_{nett} = F_{nett}.\Delta x.\cos\theta$) with the Work Function in the Photo Electric Effect ($E = W_o + E_{k(max)}$).

The cause of this is that the teachers do not explain the Photo Electric Effect correctly to the candidates and do not do enough examples and problems for them to fully understand this concept.

GENERAL REMARKS:

The candidates make many careless mistakes due to not doing the basics correct.
Teachers need to guide them in the following:

- Reading and analysing the question asked and determine exactly what is required to be answered.
- Choosing the correct formula by making use of the Formula Sheet.
- Using the directions correctly when working with vectors.
- Using the correct subscripts.
- Using the calculator correctly – especially scientific notation.
- Using the correct SI units.

The candidates do a lot of memorszing without understanding the concepts. This causes them to not understand how to solve the problems where the application of the concept is required.
Teachers must refrain from using exam papers and memorandums for teaching purposes only. These must be used as study aids and for revision purposes.
Note to teachers: Please make sure the candidates **DO NOT** write in pencil. The question paper must be written in pen.

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE/ NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

NOVEMBER 2020

MARKS: 150

TIME: 3 hours

This question paper consists of 16 pages and 3 data sheets.

* P H S C E 1 *

EASTERN CAPE

INSTRUCTIONS AND INFORMATION

1. Write your examination number and centre 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. Show ALL formulae and substitutions in ALL calculations.

9. Round off your FINAL numerical answers to a minimum of TWO decimal places.

10. Give brief motivations, discussions, etc. where required.

11. You are advised to use the attached DATA SHEETS.

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 E.

1.1 The rate of change of momentum of an object is equal to the …

A impulse on the object.

B net force acting on the object.

C product of the object's mass and its change in velocity.

D product of the net force acting on the object and its acceleration. (2)

1.2 The gravitational acceleration on the surface of planet **X** with mass M and radius r is g.

The gravitational acceleration on the surface of planet **Y** with mass 2M and radius $\frac{1}{2}r$ is …

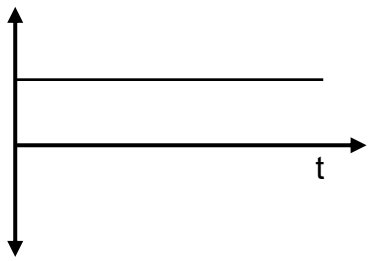
A $\frac{1}{2}g$

B g

C $4g$

D $8g$ (2)

1.3 The graph below shows how one of the physical quantities associated with an object in free fall changes with time t. The label on the y-axis is omitted. Ignore air friction.



Which ONE of the following physical quantities can be the label on the y-axis?

A Velocity

B Position

C Weight

D Momentum (2)

1.4 A ball of mass *m*, falling vertically downwards, hits the floor at a speed *v* and bounces vertically upwards at a speed 0,75*v*.

Which ONE of the following combinations regarding the change in momentum of the ball during the collision is CORRECT?

	MAGNITUDE	DIRECTION
A	0,25*mv*	Upwards
B	0,25*mv*	Downwards
C	1,75*mv*	Upwards
D	1,75*mv*	Downwards

(2)

1.5 The base SI unit of the physical quantity 'work' is …

A $kg \cdot m \cdot s^{-1}$

B $kg \cdot m^2 \cdot s^2$

C $kg \cdot m^2 \cdot s^{-2}$

D $kg \cdot m \cdot s^{-2}$ (2)

1.6 The siren of a police car, moving in front of a truck, emits sound waves of frequency *f*. Both vehicles are travelling at the same constant velocity.

The frequency of the sound heard by the driver of the truck is …

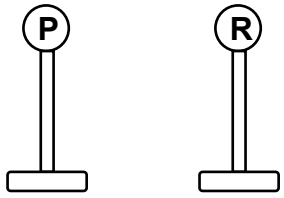
A *f*.

B zero.

C greater than *f*.

D smaller than *f.* (2)

1.7 Two identical metal spheres, **P** and **R**, on insulated stands, carry different charges. The spheres are brought into contact and then separated again.



If the charge on sphere **R** AFTER the separation is *q*, the charge on sphere **P** after the separation is …

A *q.*

B zero.

C less than *q.*

D greater than *q.* (2)

1.8 An AC generator generates a current with a frequency of 50 Hz.

The number of times that the maximum (peak) current is produced in one second is …

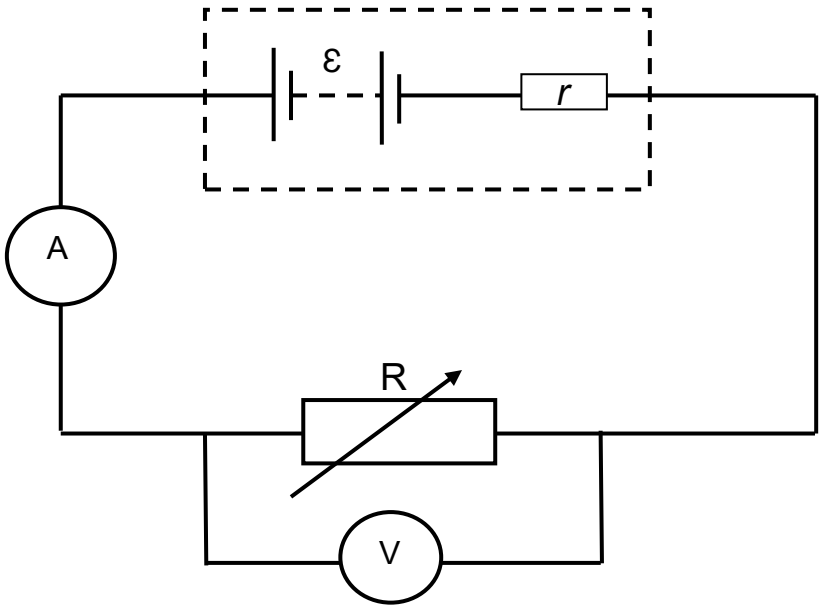
A 25.

B 50.

C 75.

D 100. (2)

1.9 In the circuit below, the battery has an internal resistance *r* and an emf ε. A variable resistor R is connected in the circuit and the ammeter and voltmeter register readings.



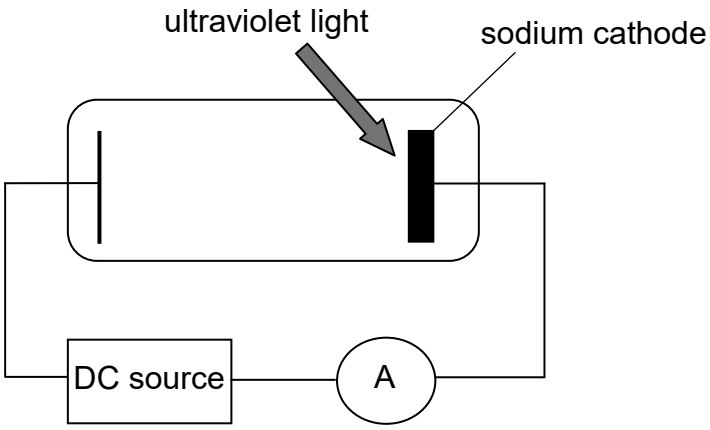
The resistance of the variable resistor R is INCREASED now.

Which ONE of the following combinations is the CORRECT representation of the change in the readings on the ammeter and voltmeter as the resistance of R is increased?

	AMMETER READING	VOLTMETER READING
A	Decreases	Increases
B	Increases	Increases
C	Increases	Decreases
D	Decreases	Decreases

(2)

1.10 The sodium cathode of a photocell is irradiated with ultraviolet light as shown in the diagram below. The ammeter registers a current.



Which ONE of the following changes will INCREASE the ammeter reading?

A Use a thinner sodium cathode.

B Increase the intensity of the ultraviolet light.

C Increase the frequency of the ultraviolet light.

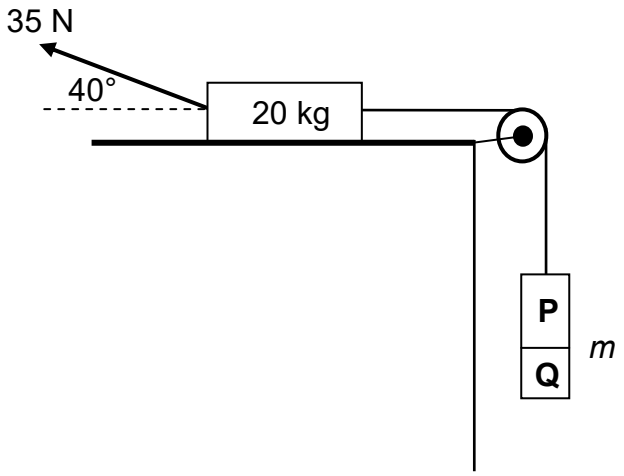
D Replace the sodium cathode with a cathode of lower work function. (2)

[20]

QUESTION 2 (Start on a new page.)

A 20 kg block, resting on a rough horizontal surface, is connected to blocks **P** and **Q** by a light inextensible string moving over a frictionless pulley. Blocks **P** and **Q** are glued together and have a combined mass of *m*.

A force of 35 N is now applied to the 20 kg block at an angle of 40° with the horizontal, as shown below.



The 20 kg block experiences a frictional force of magnitude 5 N as it moves to the RIGHT at a CONSTANT SPEED.

2.1 Define the term *normal force*. (2)

2.2 Draw a labelled free-body diagram of the 20 kg block. (5)

2.3 Calculate the combined mass *m* of the two blocks. (5)

2.4 At a certain stage of the motion, block **Q** breaks off and falls down.

How will EACH of the following be affected when this happens?

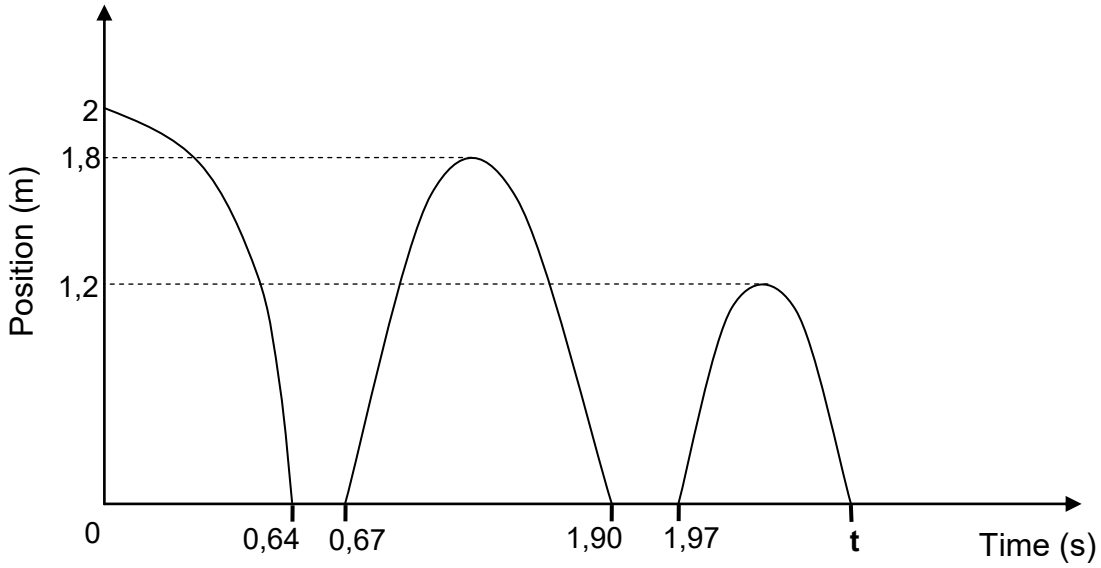
2.4.1 The tension in the string
Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)

2.4.2 The velocity of the 20 kg block
Explain the answer. (3)
[16]

QUESTION 3 (Start on a new page.)

A small ball is dropped from a height of 2 m and bounces a few times after landing on a cement floor. Ignore air friction.

The position-time graph below, not drawn to scale, represents the motion of the ball.



3.1 Define the term *free fall*. (2)

3.2 Use the graph and determine:

3.2.1 The time that the ball is in contact with the floor before the first bounce (2)

3.2.2 The time it takes the ball to reach its maximum height after the first bounce (2)

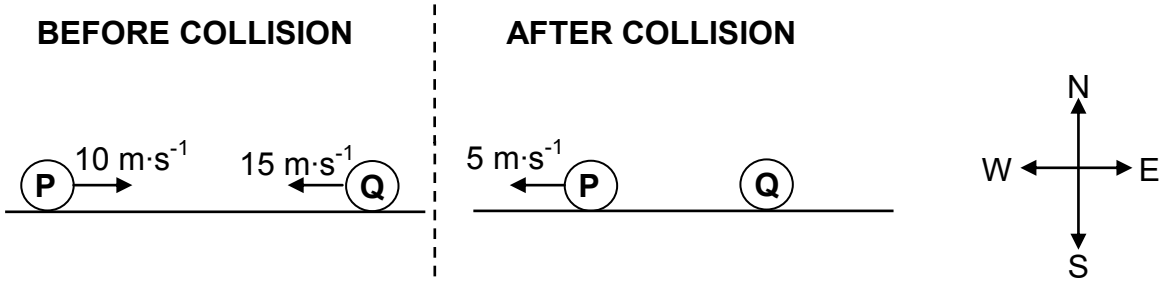
3.2.3 The speed at which the ball leaves the floor at the first bounce (3)

3.2.4 Time **t** indicated on the graph (6)
[15]

QUESTION 4 (Start on a new page.)

Ball **P** of mass 0,16 kg, moving east at a speed of 10 $m \cdot s^{-1}$, collides head-on with another ball **Q** of mass 0,2 kg, moving west at a speed of 15 $m \cdot s^{-1}$. After the collision, ball **P** moves west at a speed of 5 $m \cdot s^{-1}$, as shown in the diagram below.

Ignore the effects of friction and the rotational effects of the balls.



4.1 Define the term *momentum* in words. (2)

4.2 Calculate the:

4.2.1 Velocity of ball **Q** after the collision (5)

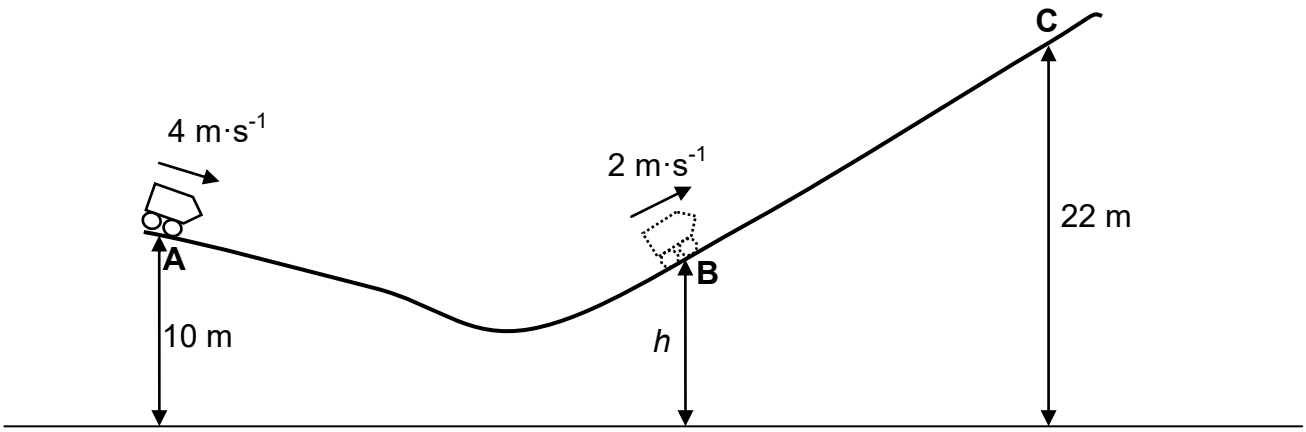
4.2.2 Magnitude of the impulse on ball **P** during the collision (3)
[10]

QUESTION 5 (Start on a new page.)

A roller-coaster car of mass 200 kg, with the engine switched off, travels along track **ABC** which has a rough surface, as shown in the diagram below. At point **A**, which is 10 m above the ground, the speed of the car is 4 $m \cdot s^{-1}$.

At point **B**, which is at a height *h* above the ground, the speed of the car is 2 $m \cdot s^{-1}$. During the motion from point **A** to point **B**, $3{,}40 \times 10^3$ J of energy is used to overcome friction.

Ignore rotational effects due to the wheels of the car.



5.1 Define the term *non-conservative force*. (2)

5.2 Calculate the change in the kinetic energy of the car after it has travelled from point **A** to point **B**. (3)

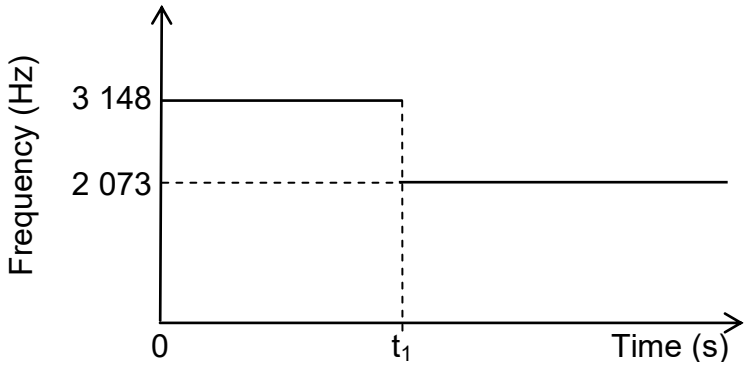
5.3 Use energy principles to calculate the height *h*. (4)

On reaching point **B**, the car's engine is switched on in order to move up the incline to point **C**, which is 22 m above the ground. While moving from point **B** to point **C**, the car travels for 5 s at a constant speed of 2 $m \cdot s^{-1}$, while an average frictional force of 50 N acts on it.

5.4 Calculate the power delivered by the engine to move the car from point **B** to point **C**. (5)
[14]

QUESTION 6 (Start on a new page.)

The siren of a train, moving at a constant speed along a straight horizontal track, emits sound with a constant frequency. A detector, placed next to the track, records the frequency of the sound waves. The results obtained are as shown in the graph below.



6.1 State the Doppler effect in words. (2)

6.2 Does the detector record the frequency of 3 148 Hz when the train moves TOWARDS the detector or AWAY from the detector? (1)

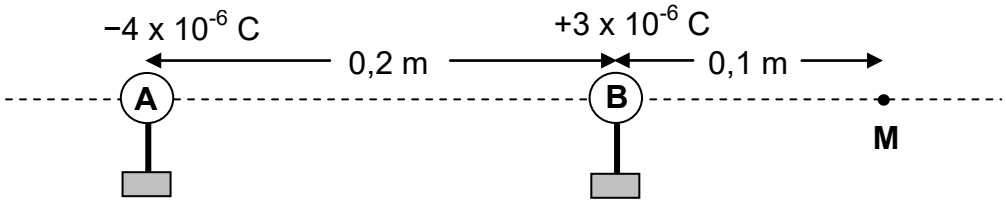
6.3 Calculate the speed of the train. Take the speed of sound in air as 340 $m \cdot s^{-1}$. (6)

6.4 The detector started recording the frequency of the moving train's siren when the train was 350 m away.

Calculate time t_1 indicated on the graph above. (2)
[11]

QUESTION 7 (Start on a new page.)

Two small charged spheres, **A** and **B**, are placed on insulated stands, 0,2 m apart, as shown in the diagram below. They carry charges of -4×10^{-6} C and $+3 \times 10^{-6}$ C respectively.



M is a point that is a distance of 0,1 m to the right of sphere **B**.

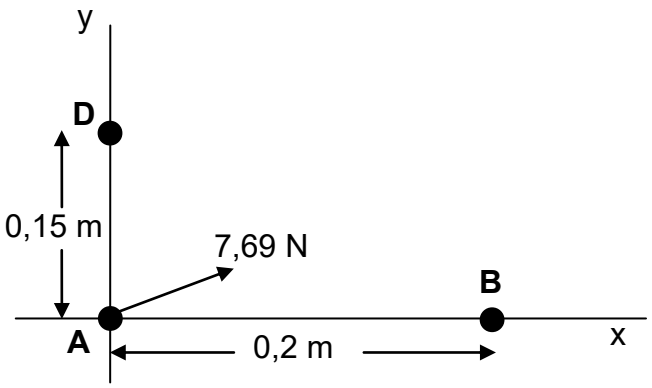
7.1 Calculate the number of electrons in excess on sphere **A**. (3)

7.2 Calculate the magnitude of the electrostatic force exerted by sphere **A** on sphere **B**. (3)

7.3 Describe the term *electric field*. (2)

7.4 Calculate the magnitude of the net electric field at point **M**. (5)

Charged spheres **A** and **B** and another charged sphere **D** are now arranged along a rectangular system of axes, as shown in the diagram below.



The net electrostatic force experienced by sphere **A** is 7,69 N in the direction as shown in the diagram above.

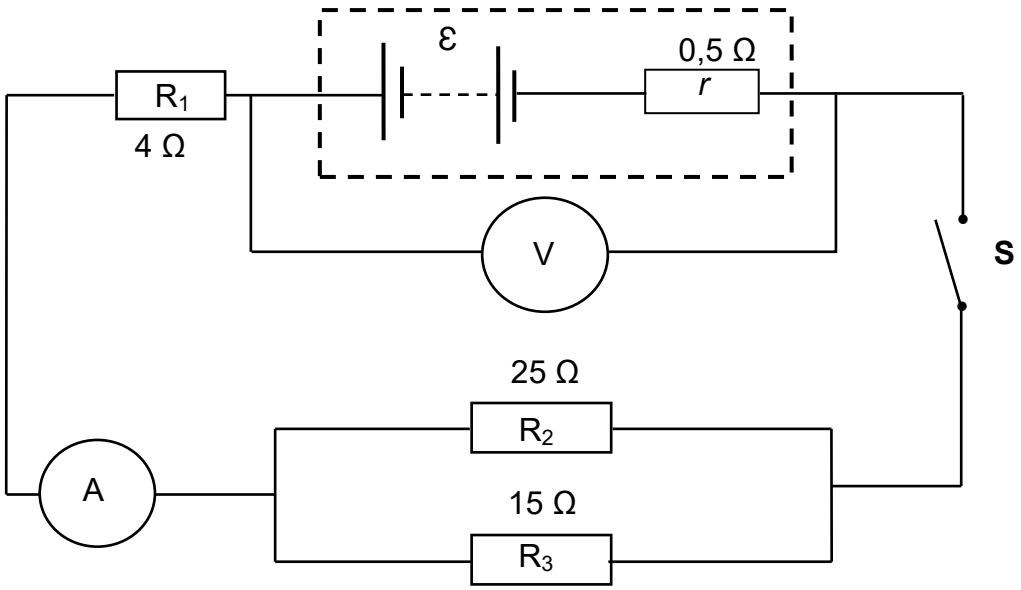
7.5 Is the charge on sphere **D** POSITIVE or NEGATIVE? (1)

7.6 Calculate the magnitude of the charge on sphere **D**. (3)
[17]

QUESTION 8 (Start on a new page.)

A battery with an internal resistance of 0,5 Ω and an unknown emf (ε) is connected to three resistors, a high resistance voltmeter and an ammeter of negligible resistance, as shown in the circuit diagram below.

The resistance of the connecting wires must be ignored.



8.1 Define the term *emf* of a battery. (2)

The reading on the voltmeter DECREASES by 1,5 V when switch **S** is closed.

8.2 Give a reason why the voltmeter reading decreases. (2)

8.3 Calculate the following when switch **S** is closed:

8.3.1 Reading on the ammeter (3)

8.3.2 Total external resistance of the circuit (4)

8.3.3 Emf of the battery (3)

8.4 A learner makes the following statement:

The current through resistor R_3 is larger than the current through resistor R_2.

Is this statement CORRECT? Choose from YES or NO. Explain the answer. (3)

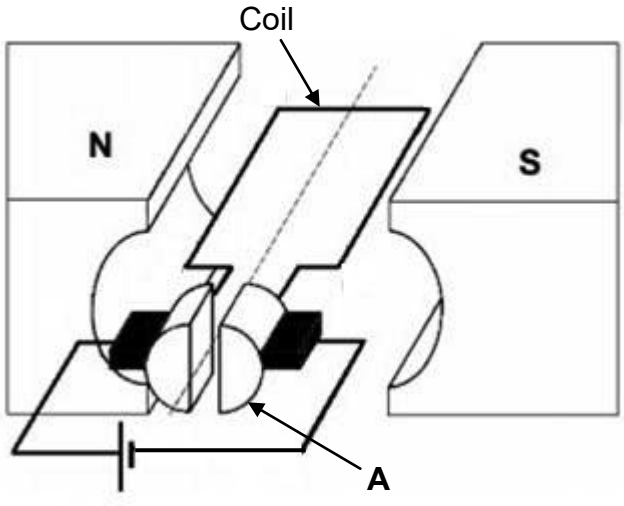
8.5 The 4 Ω resistor is now removed from the circuit.

How will this affect the emf of the battery? Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)

[18]

QUESTION 9 (Start on a new page.)

9.1 A simplified diagram of an electrical machine is shown below.



9.1.1 Is this machine a DC motor or a DC generator? (1)

9.1.2 Write down the energy conversion that takes place while this machine is in operation. (2)

9.1.3 Write down the name of component **A** in the diagram. (1)

9.1.4 In which direction will the coil, shown in the diagram above, rotate? Choose from CLOCKWISE or ANTICLOCKWISE. (2)

9.2 An electrical device is marked 200 W ; 220 V.

9.2.1 Define the term *rms voltage*. (2)

9.2.2 Calculate the resistance of the device. (3)

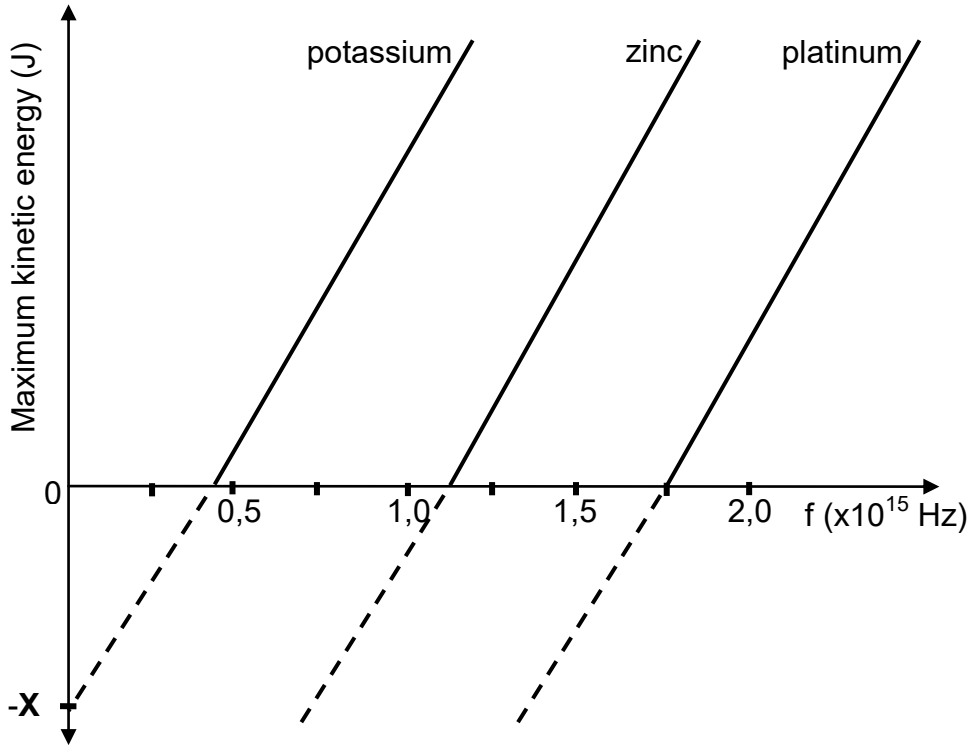
This device is now connected to a 150 V AC source.

9.2.3 Calculate the energy dissipated by the device in 10 minutes. (5)
[16]

QUESTION 10 (Start on a new page.)

An experiment is conducted to investigate the relationship between the frequency of light incident on a metal and the maximum kinetic energy of the emitted electrons from the surface of the metal. This experiment is conducted for three different metals.

The graph below represents the results obtained.



10.1 Name the phenomenon on which this experiment is based. (1)

10.2 Name the physical quantity represented by **X** on the graph. (1)

10.3 Which ONE of the three metals needs incident light with the *largest wavelength* for the emission of electrons?

Give a reason for the answer. (2)

10.4 Define the term *work function* in words. (2)

10.5 Calculate the:

10.5.1 Work function of **platinum** (3)

10.5.2 Frequency of the incident light that will emit electrons from the surface of **platinum** with a maximum velocity of 5,60 x 10^5 m·s^{-1} (4)

[13]

TOTAL: 150

DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12
VRAESTEL 1 (FISIKA)

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

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekragversnelling*	g	$9,8\ m{\cdot}s^{-2}$
Universal gravitational constant *Universele gravitasiekonstant*	G	$6,67 \times 10^{-11}\ N{\cdot}m^2{\cdot}kg^{-2}$
Radius of the Earth *Radius van die Aarde*	R_E	$6,38 \times 10^6$ m
Mass of the Earth *Massa van die Aarde*	M_E	$5,98 \times 10^{24}$ kg
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·s
Coulomb's constant *Coulomb se konstante*	k	$9,0 \times 10^9\ N{\cdot}m^2{\cdot}C^{-2}$
Charge on electron *Lading op elektron*	e	$-1,6 \times 10^{-19}$ C
Electron mass *Elektronmassa*	m_e	$9,11 \times 10^{-31}$ kg

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/*BEWEGING*

$v_f = v_i + a\Delta t$	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ or/*of* $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$v_f^{\,2} = v_i^{\,2} + 2a\Delta x$ or/*of* $v_f^{\,2} = v_i^{\,2} + 2a\Delta y$	$\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ or/*of* $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$

FORCE/*KRAG*

$F_{net} = ma$	$p = mv$
$f_s^{max} = \mu_s N$	$f_k = \mu_k N$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = G\frac{m_1 m_2}{d^2}$ or/*of* $F = G\frac{m_1 m_2}{r^2}$	$g = G\frac{M}{d^2}$ or/*of* $g = G\frac{M}{r^2}$

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* $E_k = \frac{1}{2}mv^2$	$W_{net} = \Delta K$ or/*of* $W_{net} = \Delta E_k$ $\Delta K = K_f - K_i$ or/*of* $\Delta E_k = E_{kf} - E_{ki}$
$W_{nc} = \Delta K + \Delta U$ or/*of* $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{ave} = Fv_{ave}$ / $P_{gemid} = Fv_{gemid}$	

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

$v = f\lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ or/*of* $f_L = \frac{v \pm v_L}{v \pm v_b} f_b$	$E = hf$ or /*of* $E = \frac{hc}{\lambda}$
$E = W_0 + E_{k(max)}$ or $E = W_0 + K_{max}$ where $E = hf$ and $W_0 = hf_0$ and $E_{k(max)} = \frac{1}{2}mv_{max}^2$ / $K_{max} = \frac{1}{2}mv_{max}^2$	
$E = W_0 + E_{k(maks)}$ *of* $E = W_0 + K_{maks}$ *waar* $E = hf$ *en* $W_0 = hf_0$ *en* $E_{k(maks)} = \frac{1}{2}mv_{maks}^2$ / $K_{maks} = \frac{1}{2}mv_{maks}^2$	

ELECTROSTATICS/*ELEKTROSTATIKA*

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$V = \frac{W}{q}$	$E = \frac{F}{q}$
$n = \frac{Q}{e}$ or/*of* $n = \frac{Q}{q_e}$	

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

$R = \frac{V}{I}$	emf (ε) = $I(R + r)$ emk (ε) = $I(R + r)$
$R_s = R_1 + R_2 + ...$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + ...$	$q = I\Delta t$
$W = Vq$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$

ALTERNATING CURRENT/*WISSELSTROOM*

$I_{rms} = \frac{I_{max}}{\sqrt{2}}$ / $I_{wgk} = \frac{I_{maks}}{\sqrt{2}}$	$P_{ave} = V_{rms}I_{rms}$ / $P_{gemiddeld} = V_{wgk}I_{wgk}$
	$P_{ave} = I_{rms}^2R$ / $P_{gemiddeld} = I_{wgk}^2R$
$V_{rms} = \frac{V_{max}}{\sqrt{2}}$ / $V_{wgk} = \frac{V_{maks}}{\sqrt{2}}$	$P_{ave} = \frac{V_{rms}^2}{R}$ / $P_{gemiddeld} = \frac{V_{wgk}^2}{R}$

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE/*SENIOR SERTIFIKAAT*
NATIONAL SENIOR CERTIFICATE/
NASIONALE SENIOR SERTIFIKAAT

GRADE/*GRAAD* 12

PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)

NOVEMBER 2020

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 145

These marking guidelines consist of 19 pages./
Hierdie nasienriglyne bestaan uit 19 bladsye.

Approved DBE IM 2020-11-29

approved DBE IM 29/11/2020

Approved Umalusi Ext. Mod 2020-11-29

Approved Umalusi Ext Mod 2020-11-29

Approved DBE Com. 29/11/2020

QUESTION 1/*VRAAG 1*

1.1 B ✓✓ (2)

1.2 D ✓✓ (2)

1.3 C ✓✓ **Accept/*Aanvaar*** B (2)

1.4 C ✓✓ (2)

1.5 C ✓✓ (2)

1.6 A **or/*of*** f ✓✓ (2)

1.7 A **or/*of*** q ✓✓ (2)

1.8 D ✓✓ (2)

1.9 A ✓✓ (2)

1.10 B ✓✓ (2)

[20]

QUESTION 2/*VRAAG 2*

2.1

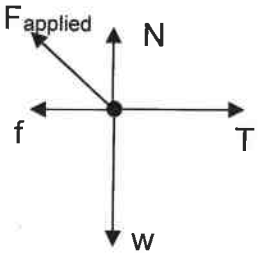
Marking criteria/*Nasienriglyne*
If any of the underlined key words/phrases in the correct context are omitted:
- 1 mark per word/phrase.
Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word:
- 1 punt per woord/frase

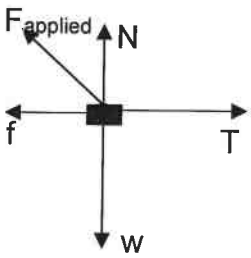
The perpendicular force exerted by a surface on an object in contact with the surface. ✓✓
Die loodregte krag deur 'n oppervlak uitgeoefen op 'n voorwerp wat daarmee in kontak is.

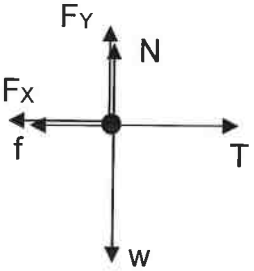
(2)

2.2

ACCEPT/*AANVAAR*







	Accepted symbols/*Aanvaarde simbole*
N ✓	F_N/Normal/Normal force/173,5N /*Normaal/Normaalkrag*
f ✓	F_f /f_k /frictional force/*wrywingskag*/kinetic frictional force/*kinetiese wrywingskrag/5 N*
w ✓	F_g /mg/Weight/$F_{Earth\ on\ block}$/Fw/*Gewig*/Gravitational force/ *Gravitasiekrag*/196 N
T ✓	Tension/*Spanning*/F_T
$F_{applied}$ ✓ $F_{toegepas}$	F/Applied force/35 N/Toegepaste krag/ F_A

Notes/*Aantekeninge*
- Mark is awarded for label and arrow./*Punt word toegeken vir byskrif en pyltjie.*
- Do not penalise for length of arrows./*Moenie vir die lengte van die pyltjies penaliseer nie.*
- Deduct 1 mark for any additional force./*Trek 1 punt af vir enige addisionele krag.*
- If all forces are correctly drawn and labelled, but no arrows, deduct 1 mark. / *Indien all kragte korrek geteken en benoem is, maar geen lyne nie, trek 1punt af.*
- If force(s) do not make contact with body/dot /*Indien krag(te) nie met die voorwerp / kolletjie kontak maak nie:* Max./*Maks:* 4/5

(5)

2.3

For the/*Vir die* 20 kg:

$F_{net} = ma$
$T - f - F_{Ax} = ma$ ✓
$T - 5 - 35\cos 40° \checkmark = 0 \checkmark$
$T = 31{,}81$ N

For/*vir* m:

$F_{net} = ma$
$mg - T = ma$
$m(9{,}8) - 31{,}81 \checkmark = 0$
$m = 3{,}25$ kg ✓

Marking criteria/*Nasienriglyne*

- Formula for 20 kg or m kg/*Formule vir 20 kg of m kg* / $F_{net} = ma$ ✓
- Substitution of zero into either formula ✓
  Vervanging van nul in een van die formules
- All substitutions into F_{net} for 20 kg as shown ✓
  Alle vervanging in F_{net} for 20 kg soos getoon
- Substitution of value of T in eqn for m
  /*Substitusie van waarde vir T in vgl vir m* ✓
- Final answer/*finale antwoord*: 3,25 kg ✓

Note/*Let wel*:
If starting with/*Indien begin met*:
$\Sigma F = 0$ or/*of* $F_{net} = 0$ ✓✓
$T = f + F_{AX}$ ✓✓
$T - f - F_{AX} = 0$ ✓✓

(5)

2.4.1 Decreases/*Neem af* ✓ (1)

2.4.2 **POSITIVE MARKING FROM QUESTION 2.3**
POSITIEWE NASIEN VANAF VRAAG 2.3
Moving to the right/*Beweeg na regs*
Velocity decreases/*snelheid neem af* ✓

Accelerates/Net force to left /*Versnelling/netto krag na links*✓✓

OR/*OF*
As the tension force decreases, the net force/acceleration acts in the opposite direction of motion /to the left. ✓✓
Soos die spanning afneem, is daar 'n netto krag/versnelling in die teenoorgestelde rigting / na links

Moving to the left/Beweeg na links
Velocity increases/*snelheid neem toe* ✓
Accelerates/Net force to left /*Versnelling/netto krag na links*✓✓ (3)
[16]

QUESTION 3/*VRAAG 3*

3.1 (Motion of an object) under the influence of gravity (weight) only. ✓✓ **(2 or 0)**
(Beweging van 'n voorwerp) slegs onder die invloed van gravitasie (gewig). ***(2 of 0)***

OR/*OF*
(Motion in which) the only force acting on the object is gravity (weight). **(2 or 0)**
(Beweging waar) die enigste krag wat op die voorwerp inwerk, gravitasie (gewig) is. ***(2 of 0)*** (2)

3.2.1 $\Delta t = 0,67 - 0,64 = 0,03$ s ✓✓

IF/*INDIEN*
From/*vanaf* 0,64 s to/*tot* 0,67 s ✓ (2)

NOTE/*LET WEL*
If no calculation shown award 2 marks for the answer./*Indien geen berekening ken twee punte toe vir die antwoord.*

3.2.2

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$\Delta t = \frac{(1,90 - 0,67)}{2}$ ✓ $= 0,62$ s ✓ (0,615 s)	$\Delta x = v_i\Delta t + \frac{1}{2} a\Delta t^2$ $(-1,8) = 0 + \frac{1}{2}(-9,8)\Delta t^2$ ✓ $\Delta t = 0,61$ s ✓ (0,606 s)
OPTION 3/*OPSIE 3*	**OPTION 4/*OPSIE 4***
$\Delta t = \frac{(1,90 + 0,67)}{2} = 1,285$ s $\Delta t = 1,285 - 0,67$ ✓ $= 0,62$ s ✓ (0,615 s)	$v_f^2 = v_i^2 + 2a\Delta x$ $0 = v_i^2 + 2(-9,8)(1,8)$ $v_i = 5,94$ m·s^{-1} $v_f = v_i + a\Delta t$ $0 = 5,94 + (-9,8)\Delta t$ ✓ $\Delta t = 0,61$ s ✓

(2)

3.2.3

POSITIVE MARKING FROM QUESTION 3.2.2
POSITIEWE NASIEN VANAF VRAAG 3.2.2

Marking Criteria/*Nasienriglyne*
- Any appropriate formula/*Enige geskikte formule* ✓
- Correct substitution/*Korrekte vervanging* ✓
- Final answer/*Finale antwoord*: 5,81 to 6,076 / 6,08 m·s^{-1} ✓

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
Upwards positive/*Opwaarts positief* $v_f = v_i + a\Delta t$ ✓ $0 = v_i + (-9,8)(0,62)$ ✓ $v_i = 6,08$ m·s^{-1} (6,076 m·s^{-1}) ✓	Upwards positive/*Opwaarts positief* $\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓ $1,8 = v_i(0,62) + \frac{1}{2}(-9,8)(0,62)^2$ ✓ $v_i = 5,94$ m·s^{-1} (5,9412 m·s^{-1}) ✓
Downwards positive/*Afwaarts positief* $v_f = v_i + a\Delta t$ ✓ $0 = v_i + (9,8)(0,62)$ ✓ $v_i = -6,08$ $\therefore 6,08$ m·s^{-1} (6,076 m·s^{-1}) ✓	Downwards positive/*Afwaarts positief* $\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓ $1,8 = v_i(0,62) + \frac{1}{2}(9,8)(0,62)^2$ ✓ $v_i = -5,94$ $\therefore v_i = 5,94$ m·s^{-1} (5,9412 m·s^{-1}) ✓

OPTION 3/*OPSIE 3*

Motion from top to bottom /
Beweging vanaf bo na onder

Downwards positive/*Afwaarts positief*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$v_f^2 = \underline{0 + 2(9,8)(1,8)}$ ✓
$v_f = 5,94\ m\cdot s^{-1}$ ✓
initial velocity/*beginsnelheid*=5,94 $m\cdot s^{-1}$

Upwards positive/*Opwaarts positief*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$v_f^2 = \underline{0 + 2(-9,8)(-1,8)}$ ✓
$v_f = 5,94\ m\cdot s^{-1}$ ✓
initial velocity/*beginsnelheid*=5,94 $m\cdot s^{-1}$

Motion from bottom to top
Beweging vanaf onder na bo

Downwards positive/*Afwaarts positief*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$\underline{0^2 = v_i^2 + 2(9,8)(-1,8)}$ ✓
$v_i = 5,94\ m\cdot s^{-1}$ ✓

Upwards positive/*Opwaarts positief*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$\underline{0 = v_i^2 + 2(-9,8)(1,8)}$ ✓
$v_i = 5,94\ m\cdot s^{-1}$ ✓

OPTION 4/*OPSIE 4*

Upwards positive/*Opwaarts positief*

$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
$\underline{0 = v_i(1,23) + \frac{1}{2}(-9,8)(1,23)^2}$ ✓
$v_i = 6,03\ m\cdot s^{-1}$ ✓

Downwards positive/*Afwaarts positief* $\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
$\underline{0 = v_i(1,23) + \frac{1}{2}(9,8)(1,23)^2}$ ✓
$v_i = -6,03\ m\cdot s^{-1}$
speed/*spoed* = 6,03 $m\cdot s^{-1}$ ✓

OPTION 5/*OPSIE 5*

$\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$ ✓

$1,8 = \left(\frac{0 + v_i}{2}\right)(0,62)$ ✓

$v_i = 5,81\ m\cdot s^{-1}$ ✓

OPTION 6/*OPSIE 6*

$F_{net}\Delta t = m\Delta v$
$F_{net}\Delta t = m(v_f - v_i)$ } ✓
$\underline{m(9,8)(0,62) = m(0 - v_i)}$ ✓
$v_i = 5,94\ m\cdot s^{-1}$ ✓

OPTION 7/*OPSIE 7*

$(E_p + E_k)_{floor/vloer} = (E_p + E_k)_{top/bo}$ ✓
$(mgh + \frac{1}{2} mv^2)_{floor/vloer} = (mgh + \frac{1}{2} mv^2)_{top/bo}$
$\underline{0 + \frac{1}{2} v^2 = (9,8)(1,8) + 0}$ ✓
$v = 5,94\ m\cdot s^{-1}$ ✓

(3)

3.2.4

OPTION/*OPSIE* 1, 2, 3, 4: Marking criteria/*Nasienriglyne*

Calculate initial velocity:
Bereken aanvanklike snelheid:

- Appropriate formula/*Geskikte formule* ✓
- Substitution/*Vervanging* ✓

Calculate/*Bereken* Δt:

- Appropriate formula/*Geskikte formule* ✓
- Substitution/*Vervanging* ✓
- $\underline{1,97\ s} + \Delta t$ ✓
- Final answer/*Finale antwoord*: 2,95 – 2,97 s ✓

Calculate initial velocity: ***Bereken beginsnelheid***	**Calculate time Δt** ***Bereken tyd Δt***
OPTION 1/*OPSIE 1*	Upwards positive
Downwards positive/*Afwaarts positief*	*Opwaarts positief*
$v_f^2 = v_i^2 + 2a\Delta y$ ✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$0 = v_i^2 + 2(9,8)(-1,2)$ ✓	$1,2 = (4,85)\Delta t + \frac{1}{2}(-9,8)\Delta t^2$ ✓
$v_i = -4,85\ m\cdot s^{-1}$	$\Delta t = 0,4898$ s / 0,5 s
	$t = 1,97 + 2(0,4898)$ ✓
Upwards positive/*Opwaarts positief*	= 2,95 s / 2,97 s ✓
$v_f^2 = v_i^2 + 2a\Delta y$ ✓	**OR/*OF***
$0 = v_i^2 + 2(-9,8)(1,2)$ ✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$v_i = 4,85\ m\cdot s^{-1}$	$0 = (4,85)\Delta t + \frac{1}{2}(-9,8)\Delta t^2$ ✓
	$\Delta t = 0,9898$ s (or $\Delta t = 0$)
OPTION 2/*OPSIE 2*	$t = 1,97 + 0,9898$ ✓
$(E_{mech})_{top} = (E_{mech})_{bot/ond}$ } ✓Any one/	= 2,96 s ✓
$(E_p + E_k)_{top} = (E_p + E_k)_{Bot/Ond}$ } *Enige een*	
$(mgh + \frac{1}{2}mv^2)_{top} = (mgh + \frac{1}{2}mv^2)_{Bot/Ond}$	Downwards positive
$(9,8)(1,2) + 0 = 0 + (\frac{1}{2})v^2$ ✓	*Afwaarts positief*
$v_i = 4,85\ m\cdot s^{-1}$ upwards /*opwaarts*	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
	$1,2 = (-4,85)\Delta t + \frac{1}{2}(9,8)\Delta t^2$ ✓
OPTION 3/*OPSIE 3*	$\Delta t = 0,4898$ s / 0,5 s
$W_{nc} = \Delta E_p + \Delta E_k$	$t = 1,97 + 2(0,4898)$ ✓
$0 = (0 - mgh) + \frac{1}{2}m(v_f^2 - v_i^2)$ } ✓Any one/	= 2,95 s / 2,97 s ✓
Enige een	**OR/*OF***
$0 = -(9,8)(1,2) + \frac{1}{2}v_i^2$ ✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$v_i = 4,85\ m\cdot s^{-1}$ upwards /*opwaarts*	$0 = (4,85)\Delta t + \frac{1}{2}(9,8)\Delta t^2$ ✓
	$\Delta t = 0,9898$ s (or $\Delta t = 0$)
OPTION 4/*OPSIE 4*	$t = 1,97 + 0,9898$ ✓
$W_{net} = \Delta E_k$	= 2,96 s ✓
$w\Delta x\cos 180° = \frac{1}{2}m(v_f^2 - v_i^2)$ } ✓Any one/	**OR/*OF***
Enige een	$v_f = v_i + a\Delta t$ ✓
$(9,8)(1,2)\cos 180° = \frac{1}{2}v_i^2$ ✓	$-4,85 = 4,85 + (-9,8)\Delta t$ ✓
$v_i = -4,85\ m\cdot s^{-1}$	$\Delta t = 0,9898$ s
	$\Delta t = 1,97 + 0,9898$ ✓
	= 2,96 s ✓
	OR/*OF*
	Upwards positive
	Opwaarts positief
	$v_f = v_i + a\Delta t$ ✓
	$0 = 4,85 + (-9,8)\Delta t$ ✓
	$\Delta t = 0,4949$ s
	$\Delta t = 1,97 + (2)(0,4949)$ ✓
	= 2,96 s ✓
	OR/*OF*
	$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
	$1,2 = \left(\frac{0 + 4,85}{2}\right)\Delta t$ ✓
	$\Delta t = 0,4948$ s
	$\Delta t_{total} = 2(0,4948) = 0,99$ s
	$\Delta t = 1,97 + 0,99$ ✓ = 2,96 s ✓

OPTION 5/*OPSIE 5*	**OPTION 5: Marking criteria/ *OPSIE 5: Nasienriglyne***
Downwards positive/*Afwaarts positief* $\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓ 1,2 ✓ = 0 + ½(9,8) Δt^2 ✓ Δt = 0,49 s t = 1,97 + ✓ 2(0,49) ✓ = 2,96 s ✓ Upwards positive/*Opwaarts positief* $\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓ -1,2 ✓ = 0 + ½(-9,8)Δt^2 ✓ Δt = 0,49 s t = 1,97 + ✓ 2(0,49) ✓ = 2,96 s ✓	• Formula ✓/*Formule* • Substitution/*Vervanging* Δy = 1,2 ✓ • Substitution/*Vervanging* 0 + ½(9,8) Δt^2 • 1,97 s + ✓ • 2 Δt ✓ • Final answer/*Finale antwoord*: 2,95 - 2,97 s ✓

(6)
[15]

QUESTION 4/*VRAAG 4*

4.1 (Linear) momentum (of an object) is the product of mass and velocity. ✓✓
(Liniêre) momentum (van 'n voorwerp) is die produk van massa en snelheid.
(2 or/*of* 0) (2)

4.2.1

OPTION 1/*OPSIE 1*
East as positive/*Oos as positief*
$\sum p_i = \sum p_f$ $m_p v_{pi} + m_Q v_{Qi} = m_p v_{pf} + m_Q v_{Qf}$ } ✓Any one/*Enige een*
(0,16)(10) + (0,2)(-15) ✓ = (0,16)(-5) +(0,2)v_{Qf} ✓ v_{Qf} = -3 m·s^{-1} v_{Qf} = 3 m·s^{-1} ✓ west/*wes* ✓ (**Accept/*aanvaar***: left/*links*)
OPTION 2/*OPSIE 2*
West as positive/*Wes as positief*
$\sum p_i = \sum p_f$ $m_p v_{pi} + m_Q v_{Qi} = m_p v_{pf} + m_Q v_{Qf}$ } ✓Any one/*Enige een*
(0,16)(-10) + (0,2)(15) ✓ = (0,16)(5) +(0,2)Q_{Nf} ✓ v_{Qf} = 3 m·s^{-1} ✓ west/*wes* ✓ (**Accept/*aanvaar***: left/*links*)
OPTION 3/*OPSIE 3*
$\Delta p_p = -\Delta p_Q$ ✓ (0,16)(-5 – 10) ✓ = -(0,2)(v – (-15)) ✓ v = -3 m·s^{-1} = 3 m·s^{-1} ✓west/*wes* ✓ (**Accept/*aanvaar***: left/*links*) **IF/*INDIEN***: $\Delta p_p = \Delta p_Q$ 0/5

(5)

4.2.2

For ball/*Vir bal* P:
West as negative/*Wes as negatief*
Impulse = Δp
$F_{net}\Delta t = \Delta p$
$\Delta p = m(v_{Pf} - v_{Pi})$ } ✓Any one/ *Enige een*
$= 0,16(-5 - 10)$ ✓
$= -2,4$
$\therefore 2,4$ N·s ✓ $(2,4\ kg{\cdot}m{\cdot}s^{-1})$

OR/*OF*
West as positive /*Wes as positief*
Impulse = Δp
$F_{net}\Delta t = \Delta p$
$= m(v_{Pf} - v_{Pi})$ } ✓Any one/ *Enige een*
$= 0,16(5 - (-10))$ ✓
$= 2,4$ N·s ✓

POSITIVE MARKING FROM QUESTION 4.2.1 /*POSITIEWE NASIEN VANAF VRAAG 4.2.1*

For ball/*Vir bal* Q:
West as negative/*Wes as negatief*
Impulse = Δp
$F_{net}\Delta t = \Delta p$
$= m(v_{Qf} - v_{Qi})$ } ✓ Any one/ *Enige een*
$= 0,2[-3 - (-15)]$ ✓
$= 2,4$ N·s ✓ $(2,4\ kg{\cdot}m{\cdot}s^{-1})$

OR/*OF*
West as positive /*Wes as positief*
Impulse = Δp
$F_{net}\Delta t = \Delta p$
$= m(v_{Qf} - v_{Qi})$ } ✓Any one/ *Enige een*
$= 0,16(3 - (15))$ ✓
$= -2,4$ N·s
$\therefore 2,4$ N·s ✓ $(2,4\ kg{\cdot}m{\cdot}s^{-1})$

(3)
[10]

QUESTION 5/*VRAAG 5*

5.1

Marking criteria/*Nasienriglyne*
If any of the underlined key words/phrases in the correct context are omitted: - 1 mark per word/phrase. However, **IF**: The word "work" is omitted 0 marks
Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: - 1 punt per woord/frase. Maar, ***INDIEN***: Die woord "arbeid" uitgelaat is, 0 punte

A force is non-conservative if the work it does on an object (which is moving between two points) depends on the path taken. ✓✓
'n Krag is nie-konserwatief indien die arbeid wat dit verrig (op 'n voorwerp wat tussen twee punte beweeg*) afhanklik is van die pad.*

OR/*OF*
A force is non-conservative if the work it does on an object depends on the path taken. ✓✓
'n Krag is nie-konserwatief indien die arbeid wat dit verrig afhanklik is van die pad.

OR/*OF*
A force is non-conservative if the work it does in moving an object around a closed path is non-zero. ✓✓
'n Krag is nie-konserwatief indien die arbeid wat dit verrig om 'n voorwerp op 'n geslote pad te beweeg, nie-nul is nie.

(2)

5.2

$K = \frac{1}{2}mv^2$ / $E_k = \frac{1}{2}mv^2$
$\Delta K = K_f - K_i$
$\Delta K = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$= \frac{1}{2}m(v_f^2 - v_i^2)$
$= \frac{1}{2}(200)(2^2 - 4^2)$ ✓ } ✓Any one /*Enige een*
$\Delta K = -1\ 200$ J ✓

(3)

5.3

POSITIVE MARKING FROM QUESTION 5.2.
POSITIEWE NASIEN VANAF VRAAG 5.2.

Marking criteria/*Nasienriglyne*

- Appropriate formula/*Geskikte formule* ✓
- Substitution into appropriate formula together with/*Vervanging in geskikte formule saam met* $-3{,}40 \times 10^3$ ✓✓
- Final answer/*Finale antwoord*: 8,88 m ✓

OPTION 1/*OPSIE 1*

$W_{nc} = \Delta K + \Delta U$
$W_{nc} = \frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2 + mgh_f - mgh_i$
$= \frac{1}{2} m (v_f^2 - v_i^2) + mg(h_f - h_i)$
} ✓Any one/*Enige een*

$-3{,}40 \times 10^3$ ✓ $= -1\,200 + 200(9{,}8)(h_f - 10)$ ✓
h = 8,88 m ✓ (8,87765 m)

OPTION 2/*OPSIE 2*

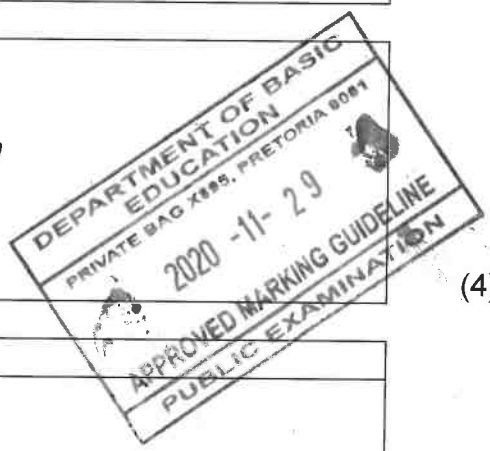
$E_{(mech/meg)A} + W_f = E_{(mech)B}$
$(E_p + E_k)_A + W_f = (E_p + E_k)_B$
$(mgh + \frac{1}{2}mv^2)_A + W_f = (mgh + \frac{1}{2}mv^2)_B$
} ✓Any one/*Enige een*

$200(9{,}8)(10) + \frac{1}{2}(200)(4^2) - 3{,}40 \times 10^3$ ✓ $= 200(9{,}8)(h) + \frac{1}{2}(200)(2)^2$ ✓
h = 8,88 m ✓ (8,87755)

OPTION 3/*OPSIE 3*

$W_{net} = \Delta K$
$W_f + W_w = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$W_f - \Delta E_p = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$W_f - mg(h_f - h_i) = \frac{1}{2}m(v_f^2 - v_i^2)$
} ✓Any one/*Enige een*

$-3{,}40 \times 10^3 - 200(9{,}8)(h-10)$ ✓ $= -1\,200$ ✓
h = 8,88 m ✓ (8,87755 m)



(4)

ACCEPT/*AANVAAR*

OPTION 1/*OPSIE 1*

$W_{nc} = \Delta K + \Delta U$
$W_{nc} = \frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2 + mgh_f - mgh_i$
$= \frac{1}{2} m (v_f^2 - v_i^2) + mg(h_f - h_i)$
} ✓Any one/*Enige een*

$3{,}40 \times 10^3$ ✓ $= -1\,200 + 200(9{,}8)(h_f - 10)$ ✓
h = 12,35 m ✓

OPTION 2/*OPSIE 2*

$E_{(mech/meg)A} + W_f = E_{(mech)B}$
$(E_p + E_k)_A + W_f = (E_p + E_k)_B$
$(mgh + \frac{1}{2}mv^2)_A + W_f = (mgh + \frac{1}{2}mv^2)_B$
} ✓Any one/*Enige een*

$200(9{,}8)(10) + \frac{1}{2}(200)(4^2) + 3{,}40 \times 10^3$ ✓ $= 200(9{,}8)(h) + \frac{1}{2}(200)(2)^2$ ✓
h = 12,35 m ✓

OPTION 3/*OPSIE 3*

$W_{net} = \Delta K$
$W_f + W_w = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$W_f - \Delta E_p = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$W_f - mg(h_f - h_i) = \frac{1}{2}m(v_f^2 - v_i^2)$
} ✓Any one/*Enige een*

$3{,}40 \times 10^3 - 200(9{,}8)(h-10)$ ✓ $= -1\,200$ ✓
h = 12,35 m ✓

(4)
[9]

QUESTION 6/*VRAAG 6*

6.1

Marking criteria/*Nasienriglyne*
If any of the underlined key words/phrases in the correct context are omitted:
- 1 mark per word/phrase.
Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word:
- 1 punt per woord/frase

The change in frequency✓ (or pitch) (of the sound) detected by a listener because the source and the listener have different velocities relative to the medium of propagation. ✓
Die verandering in die frekwensie (of toonhoogte) (van die klank) waargeneem deur 'n luisteraar omdat die bron en die luisteraar verskillende snelhede relatief tot die voortplantingsmedium het.

OR/*OF*
An (apparent) change in (observed/detected) frequency (pitch), as a result of the relative motion between a source and an observer (listener).
'n (Skynbare) verandering in (waargenome) frekwensie (toonhoogte), as gevolg van die relatiewe beweging tussen die bron en 'n waarnemer/ luisteraar.

(2)

6.2 Towards/*Nader* ✓ (1)

6.3

$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓ **OR/*OF*** $f_L = \frac{v}{v - v_s} f_s$ **OR/*OF*** $f_L = \frac{v}{v + v_s} f_s$

$3148 \overset{\checkmark}{=} \left(\frac{340+0}{340-v_s}\right)^{\checkmark} f_s$ $\qquad 2073 \overset{\checkmark}{=} \left(\frac{340-0}{340+v_s}\right)^{\checkmark} f_s$

$\frac{3148(340-v_s)}{340+0} = \frac{2073(340+v_s)}{340-0}$

Ignore zeros for marking purposes
Ignoreer nulle vir nasien doeleindes

$v_s = 70\ m \cdot s^{-1}$✓ (69,95 - 70,16 $m \cdot s^{-1}$)

(6)

6.4

POSITIVE MARKING FROM QUESTION 6.3
POSITIEWE NASIEN VANAF VRAAG 6.3

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***	**OPTION 3/*OPSIE 3***
$\Delta t = \frac{\Delta x}{v}$ $\Delta t = \frac{350}{70}$ ✓ $\Delta t = 5\ s$ ✓	$\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$ $350 = 70\Delta t + 0$ ✓ $\Delta t = 5\ s$ ✓	$\Delta x = \left(\frac{v_i + v_f}{2}\right) \Delta t$ $350 = \left(\frac{70+70}{2}\right) \Delta t$ ✓ $\Delta t = 5\ s$ ✓

(2)
[11]

QUESTION 7/VRAAG 7

7.1

NOTE/LET WEL
Negative answer not accepted.
Negatiewe antwoord nie aanvaar nie.

$$n = \frac{Q}{e} \checkmark$$
$$= \frac{(-)4 \times 10^{-6}}{(-)1,6 \times 10^{-19}} \checkmark$$
$$= 2,5 \times 10^{13} \checkmark$$

(3)

7.2 **NOTE/LET WEL**
Ignore the negative signs in the substitution and the answer.
Ignoreer die negatiewe tekens in vervanging en die antwoord.

Electrostatic force on B due to A:/Elektrostatiese krag op B a.g.v. A:

$$F_{AB} = \frac{kQ_1Q_2}{r^2} \checkmark$$
$$= \left[\frac{9 \times 10^9 (4 \times 10^{-6})(3 \times 10^{-6})}{0,2^2}\right] \checkmark$$
$$= 2,7 \text{ N} \checkmark$$

(3)

7.3

Marking criteria/Nasienriglyne
If any of the underlined key words/phrases in the correct context are omitted:
- 1 mark per word/phrase.
Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word:
- 1 punt per woord/frase

Electric field is a region (in space) where (in which) an (electric) charge experiences a (electric) force. ✓✓
Elektriese veld is 'n gebied (in die ruimte) waarin 'n (elektriese) lading 'n (elektriese) krag ondervind.

(2)

7.4

Marking criteria/*Nasienriglyne*

- Appropriate formula/*Geskikte formule* ✓
- Correct substitution for A and B/*Korrekte vervanging van A en B* ✓✓
- Subtraction of electric fields/*Aftrek van elektriesevelde*✓
- Final answer/*Finale antwoord*: 2,3 x10^6 N·C^{-1}✓

OPTION 1/*OPSIE 1*

Electric field at M due to / *Elektriese veld by M as gevolg van*: -4 x10^{-6} C

$E_{AM} = k\frac{Q}{r^2}$ ✓

$= 9\times10^9\frac{(4\times10^{-6})}{(0,3)^2}$ ✓

= 4,0 x 10^5 N·C^{-1} (to left /*links*)

Electric field at M due to / *Elektriese veld by M as gevolg van*: +3 x10^{-6} C,

$E_{BM} = k\frac{Q}{r^2}$

$= 9\times10^9\frac{(3\times10^{-6})}{(0,1)^2}$ ✓

= 2,7 x10^6 N·C^{-1} (to right /*regs*)

Net electric field at M /*Netto elektrieseveld by M*

$E_{net} = E_{BM} + E_{AM}$

= 4,0 x10^5 – 2,7 x10^6 ✓

= 2,3 x10^6 N·C^{-1} ✓(right/*regs*)

OR/*OF*

Net electric field at M /*Netto elektrieseveld by M*

$E_{net} = E_{BM} + E_{AM}$

= -4,0 x10^5 + 2,7 x10^6 ✓

= - 2,3 x10^6 N·C^{-1}

= 2,3 x10^6 N·C^{-1} ✓ (right)

OPTION 2/*OPSIE 2*

$F_{AM} = \frac{kQ_1Q_2}{r^2} = \frac{(9\times10^9)(4\times10^{-6})Q}{(0,3)^2}$ ✓ = 4 x 10^5Q N

$F_{BM} = \frac{kQ_1Q_2}{r^2} = \frac{(9\times10^9)(3\times10^{-6})Q}{(0,1)^2}$ ✓ = 2,7 x 10^6Q N

F_{net} = 2,7 x 10^6Q + (-4 x 10^5Q)✓ = 2,3 x 10^6Q

$E = \frac{F}{q}$ ✓= $\frac{2,3\times10^6Q}{Q}$ = 2,3 x 10^6 N·C^{-1} ✓(right/*regs*)

(5)

7.5 Positive/*Positief* ✓ (1)

7.6

POSITIVE MARKING FROM 7.2/*POSITIEWE NASIEN VANAF 7.2*

Marking criteria/*Nasienriglyne*

- Correct substitution into Pythagoras's equation/*Korrekte vervanging in Pythagoras se vergelyking* ✓
- Correct substitution into Coulomb's Law/*Korrekte vervanging in Coulomb se wet* ✓
- Correct answer/*Korrekte antwoord* ✓

$(F_{net})^2 = (F_{AD})^2 + (F_{AB})^2$

$(7,69)^2 = (F_{AD})^2 + (2,7)^2$ ✓

$F_{AD} = 7,2$ N

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

$$7,2 = \frac{(9\times10^9)(4\times10^{-6})Q}{(0,15)^2}$$ ✓

$Q_D = 4,5 \times 10^{-6}$ C ✓

OR/*OF*

$$F_{AD} = k\frac{Q_1Q_2}{r^2}$$

$$= 9\times10^9\frac{(4\times10^{-6})Q}{0,15^2}$$ ✓

$= 1,6 \times 10^6\ Q$

$F_{net} = \sqrt{F_{AB}^{\ 2} + F_{AD}^{\ 2}}$ **OR/*OF*** $F_{net}^{\ 2} = F_{AB}^{\ 2} + F_{AD}^{\ 2}$

$7,69 = \sqrt{2,7^2 + (1,6\times10^6\,Q)^2}$ ✓

$Q = 4,50 \times 10^{-6}$ C ✓

(3)
[17]

QUESTION 8/*VRAAG 8*

8.1

Marking criteria/*Nasienriglyne*
If any of the underlined key words/phrases in the correct context are omitted:
- 1 mark per word/phrase.
Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word:
- 1 punt per woord/frase

(Maximum) energy provided (work done) by a battery per coulomb/unit charge passing through it. ✓✓
(Maksimum) energie verskaf (arbeid verrig) deur 'n battery per coulomb/ eenheidslading wat daardeur beweeg.

Work done by the battery to move a unit coulomb of charge across the circuit./*Arbeid verrig deur die battery om 'n eenheidslading oor die stroombaan te beweeg.* (2)

8.2 Energy (per coulomb of charge) is converted to heat in the battery due to the internal resistance. ✓✓
Energie (per coulomb lading) word na hitte omskep binne-in die battery a.g.v. interne weerstand.

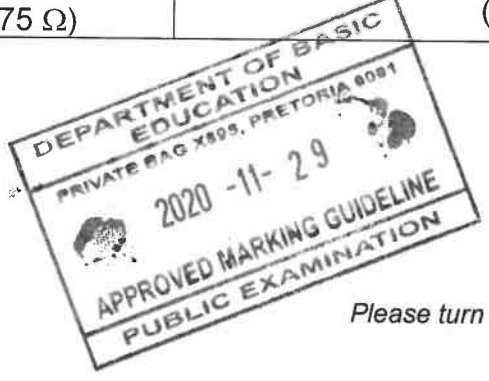
ACCEPT/*AANVAAR*
The terminal voltage decreases because there is a potential/voltage drop/"lost volts" / inside the battery / internal resistance of the battery (the battery has to do work to move the charges internally).
Die terminale potensiaalverskil neem af omdat daar 'n potensiaalverskil oor die interne weerstand van die battery is (die battery moet arbeid verrig om die ladings intern te beweeg). (2)

8.3.1
$$I = \frac{V}{R} \checkmark$$
$$I = \frac{1,5}{0,5} \checkmark$$
$$= 3\ A \checkmark$$
(3)

8.3.2

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓	$R_p = \frac{R_1 R_2}{R_1 + R_2}$ ✓
$\frac{1}{R_P} = \frac{1}{25} + \frac{1}{15}$ ✓	$R_p = \frac{(25)(15)}{25+15}$ ✓
$R_p = 9,375\ \Omega$	$R_p = 9,375\ \Omega$
$R_{ext} = 9,375 + 4$ ✓ $= 13,38\ \Omega$ ✓ (13,375 Ω)	$R_{ext} = 9,375 + 4$ ✓ $= 13,38\ \Omega$ ✓ (13,375 Ω)

(4)



8.3.3

POSITIVE MARKING FROM QUESTIONS 8.3.1 AND 8.3.2. ***POSITIEWE NASIEN VANAF VRAAG 8.3.1 EN 8.3.2.***
OPTION 1/*OPSIE 1* $\mathcal{E} = I(R + r)$ ✓ $= 3(13,38 + 0,5)$ ✓ $= 41,64$ V ✓ (Range/*Gebied:* 41,625 – 41,64)
OPTION 2/*OPSIE 2* $\mathcal{E} = V_{ext/eks} + V_{int}$ ✓ $= (3)(13,38) + 1,5$ ✓ $= 41,64$ V ✓ (Range/*Gebied:* 41,625 – 41,64)

(3)

8.4 Yes. ✓/*Ja*

For the same voltage/potential difference, ✓
a larger current will flow through a smaller resistor ($I = \frac{V}{R}$) ✓
Vir dieselfde spanning/ potensiaalverskil
sal 'n groter stroom deur die kleiner weerstand vloei ($I = \frac{V}{R}$).

OR/*OF*

$I \alpha \frac{1}{R}$ ✓, V = constant /*konstant*✓
I is inversely proportional to R and V is constant.
I is omgekeerd eweredig aan R en V is konstant.

OR/*OF*

$V_{||} = IR$
$= (3)(9,38)$
$= 28,14$ V

$I_{R2} = \frac{V}{R} = \frac{28,14}{25} = 1,13$ A ✓
$I_{R3} = \frac{V}{R} = \frac{28,14}{15} = 1,88$ A ✓

OR/*OF*

V is the same / *V is dieselfde* ✓

$I_{15\Omega} = \frac{25}{40} I$
$I_{25\Omega} = \frac{15}{40} I$ ✓

(3)

8.5 Remains the same/*Bly dieselfde*✓

(1)
[18]

QUESTION 9/*VRAAG 9*

9.1.1 (DC) motor/*(GS-)motor* ✓ (1)

9.1.2 **POSITIVE MARKING FROM QUESTION 9.1.1**
POSITIEWE NASIEN VANAF VRAAG 9.1.1
Electrical to mechanical /kinetic (energy) ✓✓ **(2 or 0)**
Elektriese na meganiese/kinetiese (energie) ***(2 of 0)*** (2)

9.1.3 Split ring/commutator/*Splitring/kommutator* ✓ (1)

9.1.4 Anticlockwise/*antikloksgewys* ✓✓ (2)

9.2.1 (The rms voltage/value of AC is) the AC voltage/potential difference which dissipates the same amount of energy/heat/power as an equivalent DC voltage/potential difference. ✓✓ **(2 or 0)**
(Die wgk-waarde van WS is) die WS-potensiaalverskil/spanning wat dieselfde hoeveelheid energie/hitte/drywing verbruik as 'n ekwivalente GS-spanning/ potensiaalverskil. ***(2 of 0)***

ACCEPT/*AANVAAR*
The rms voltage/value of AC is the DC potential difference which dissipates the same amount of energy/heat/power as AC.
Die wgk-waarde van WS is die GS-potensiaalverskil wat dieselfde hoeveelheid energie/hitte/drywing verbruik as die WS. (2)

QUESTION 9.2.2 /*VRAAG 9.2.2*
No subscripts are required.
Geen onderskrifte benodig.

9.2.2

Marking criteria/*Nasienriglyne*
- Appropriate formula for P_{ave}/*Geskikte formule* vir P_{ave} ✓
- Substitution to calculate/*Vervanging vir berekening van* R ✓
- Final answer/*Finale antwoord*: 242 Ω ✓

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***	**OPTION 3/*OPSIE 3***
$P_{ave} = \frac{V_{rms}^2}{R}$ ✓ $200 = \frac{220^2}{R}$ ✓ R = 242 Ω ✓	$P_{ave} = V_{rms}I_{rms}$ ✓ $200 = I_{rms}(220)$ I_{rms} = 0,909 A (0,91) $R = \frac{V_{rms}}{I_{rms}}$ or/*of* $R = \frac{V}{I}$ $R = \frac{220}{0,909}$ ✓ R = 242 Ω ✓ (241,76 Ω)	$P_{ave} = V_{rms}I_{rms}$ ✓ $200 = I_{rms}(220)$ I_{rms} = 0,909 A(0,91) $P_{ave} = I_{rms}^2R$ $200 = (0,909)^2R$ ✓ R = 242 Ω ✓ (241,52 Ω)

(3)

9.2.3

POSITIVE MARKING FROM QUESTION 9.2.2.
POSITIEWE NASIEN VANAF VRAAG 9.2.2.

OPTION 1/*OPSIE 1*

Marking criteria / *Nasienriglyne*

- Appropriate formula for W containing V/*Geskikte formule vir W wat V bevat* ✓✓
- Substitution/*Vervanging* ✓✓
- Final answer/*Finale antwoord*: 55 785,12 J ✓

$$W = \frac{V^2\Delta t}{R} \checkmark\checkmark$$
$$= \frac{(150^2)(10 \times 60)}{242} \checkmark$$
$$= 55\,785{,}12 \text{ J} \checkmark$$

Marking criteria for options 2, 3 and 4 /*Nasienriglyne vir opsies 2,3 en 4*

- Appropriate formula to calculate P or I_{rms} /*Geskikte formule om* P *of* I_{rms} te bereken ✓
- Substitution/*Vervanging* ✓
- Formula for P or W containing Δt/*Formule vir P of W wat* Δt *bevat* ✓
- Substitution/*Vervanging* ✓

Final answer/Finale antwoord: 55 785,12 J ✓

Subscripts are only required in OPTION 2 and 5
Geen onderskrifte slegs benodig in OPSIE 2 en 5

OPTION 2/*OPSIE 2*

$$P_{ave} = \frac{V_{rms}^2}{R} \checkmark$$
$$= \frac{150^2}{242} \checkmark$$
$$P_{av} = 92{,}975 \text{ W}$$
$$P = \frac{W}{\Delta t} \checkmark$$
$$92{,}975 = \frac{W}{(10)(60)} \checkmark$$
$$W = 55\,785{,}12 \text{ J} \checkmark$$
(55785,12 – 55896 J)

OPTION 3/*OPSIE 3*

$$R = \frac{V_{rms}}{I_{rms}} \checkmark / \; R = \frac{V}{I}$$
$$242 = \frac{150}{I_{rms}} \checkmark$$
$$I_{rms} = 0{,}620 \text{ A}$$
$$P_{ave} = I_{rms} V_{rms}$$
$$= (0{,}62)(150)$$
$$= 92{,}97 \text{ W (93 W)}$$
$$P = \frac{W}{\Delta t} \checkmark$$
$$92{,}975 = \frac{W}{(10)(60)} \checkmark$$
$$W = 55\,785{,}12 \text{ J} \checkmark$$
(55785,12 – 55896 J)

OPTION 4/*OPSIE 4*

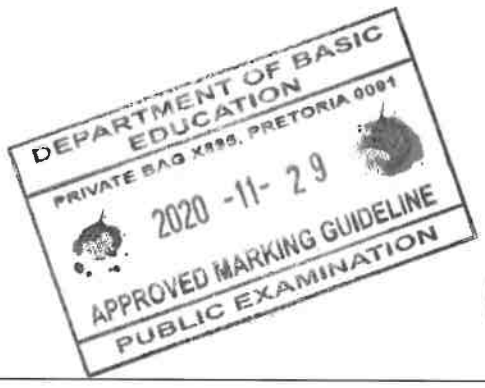
$$R = \frac{V_{rms}}{I_{rms}} \checkmark / \; R = \frac{V}{I}$$
$$242 = \frac{150}{I_{rms}} \checkmark$$
$$I_{rms} = 0{,}620 \text{ A}$$
$$W = I^2 R \Delta t \checkmark$$
$$= (0{,}62)^2(242)(10)(60) \checkmark$$
$$= 55\,814{,}88 \text{ J} \checkmark$$
(55785,12 – 55896 J)

OR/*OF*

$$W = VI\Delta t$$
$$= (150)(0{,}62)(600)$$
$$= 55\,800 \text{ J}$$

OPTION 5/*OPSIE 5*

$$P_{ave} = \frac{V_{rms}^2}{R} \checkmark = \frac{150^2}{242} \checkmark = 92{,}975 \text{ W}$$
$$P_{ave} = I_{rms}^2 R$$
$$92{,}975 = I_{rms}^2(242)$$
$$I_{rms} = 0{,}6198 \text{ A}$$
$$W = I^2 R\Delta t \checkmark$$
$$= (0{,}6198)^2(242)(10)(60) \checkmark$$
$$= 55\,778{,}88 \text{ J} \checkmark$$



(5)
[16]

QUESTION 10/*VRAAG 10*

10.1 Photoelectric effect/*Fotoëlektriese effek* ✓ (1)

10.2 Work function (of potassium)/*Werksfunksie/Arbeidsfunksie (van kalium)* ✓ (1)

10.3 Potassium/*Kalium* ✓
It has the lowest work function / threshold frequency / highest threshold wavelength. ✓
Dit het die laagste arbeidsfunksie / drumpelfrekwensie / hoogste drumpel golflengte. (2)

10.4

Marking criteria/*Nasienriglyne*
If any of the underlined key words/phrases in the correct context are omitted: - 1 mark per word/phrase.
Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: - 1 punt per woord/frase

The work function of a metal is the minimum energy that an electron (in the metal) needs✓ to be emitted/ejected from the metal / surface. ✓
Die werkfunksie/arbeidsfunskie van 'n metaal is die minimum energie benodig om 'n elektron vanaf 'n oppervlak / metaal vry te stel. (2)

10.5.1 $W_o = hf_o$ ✓
$= (6{,}63 \times 10^{-34})(1{,}75 \times 10^{15})$ ✓
$= 1{,}160 \times 10^{-18}$ J ✓

OR/*OF*
$E = W_o + E_{k(max)}$
$hf = W_o + E_{k(max)}$
✓ Any one / *Enigeen*
$(6{,}63 \times 10^{-34})(1{,}75 \times 10^{15}) = W_o + 0$ ✓
$W_o = 1{,}160 \times 10^{-18}$ J ✓ (3)

10.5.2 **POSITIVE MARKING FROM QUESTION 10.5.1.**
POSITIEWE NASIEN VANAF VRAAG 10.5.1.

$E = W_0 + E_{k(max)}$
$hf = hf_o + \frac{1}{2}mv^2_{max}$
✓Any one/*Enige een*

$(6{,}63 \times 10^{-34})f$ ✓ $= 1{,}160 \times 10^{-18} + \frac{1}{2}(9{,}11 \times 10^{-31})(5{,}60 \times 10^5)^2$ ✓

$\therefore f = 1{,}97 \times 10^{15}$ Hz ✓ (4)

[13]

TOTAL/*TOTAAL*: 145