Province of the
EASTERN CAPE
EDUCATION

EXAMINATIONS AND ASSESSMENT CHIEF DIRECTORATE
Home of Examinations and Assessment, Zone 6, Zwelitsha, 5600
REPUBLIC OF SOUTH AFRICA, Website: www.ecdoe.gov.za

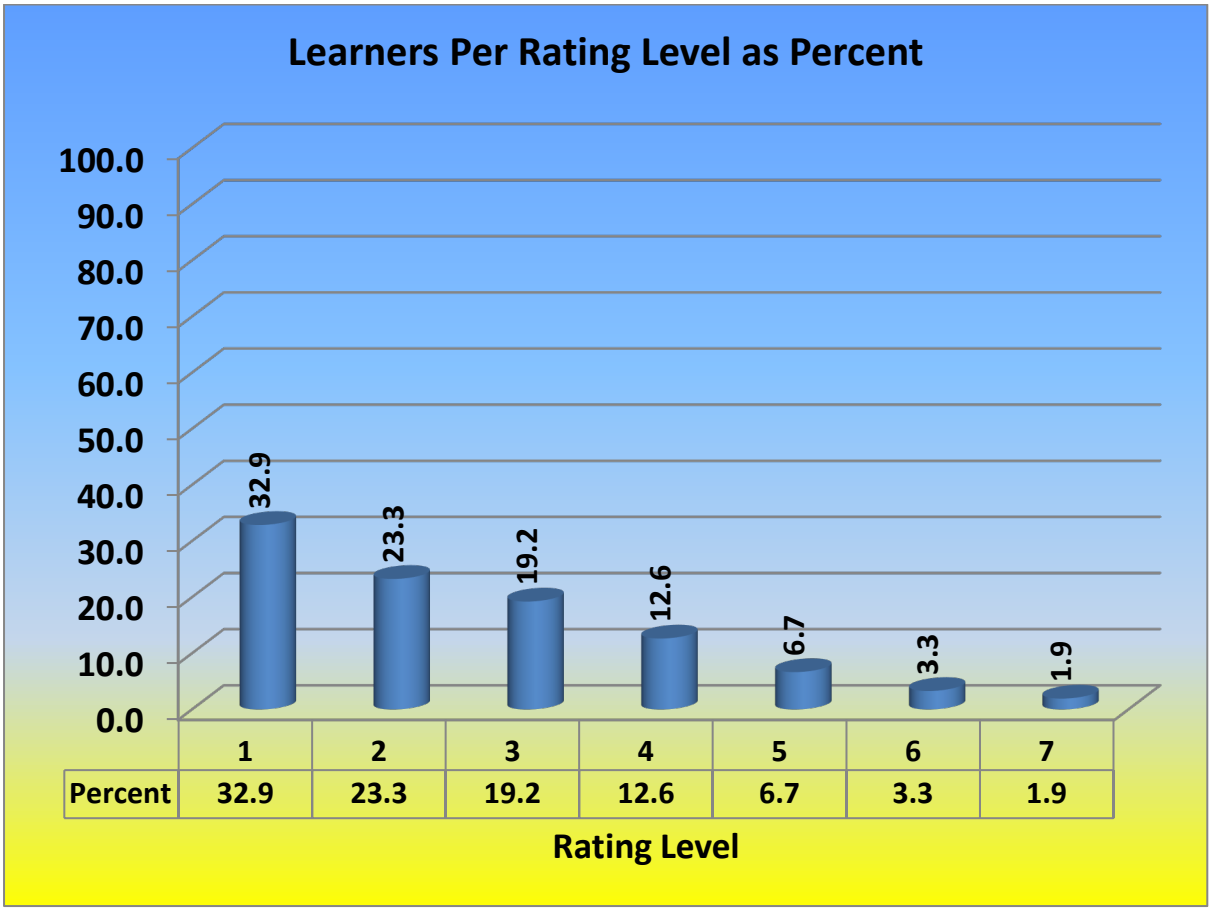
2022 NSC CHIEF MARKER'S REPORT

SUBJECT	**PHYSICAL SCIENCES**
QUESTION PAPER	**ONE**
DURATION OF QUESTION PAPER	**3 HOURS**
PROVINCE	**EASTERN CAPE**
DATES OF MARKING	**7/12/22 TO 22/12/22**

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

Generally, learners performed is poorly, the pass rate overall is 66,7%. Even though the pass rate is above average, the quality passes is very low. Only 24,5% obtained above 50% (level 4) a requirement for admonition into the universities.

LEVELS	PERCENTAGE PERFOMANCE (%)
1	32,9
2	23,3
3	19,2
4	12,6
5	6,7
6	3,3
7	1,9



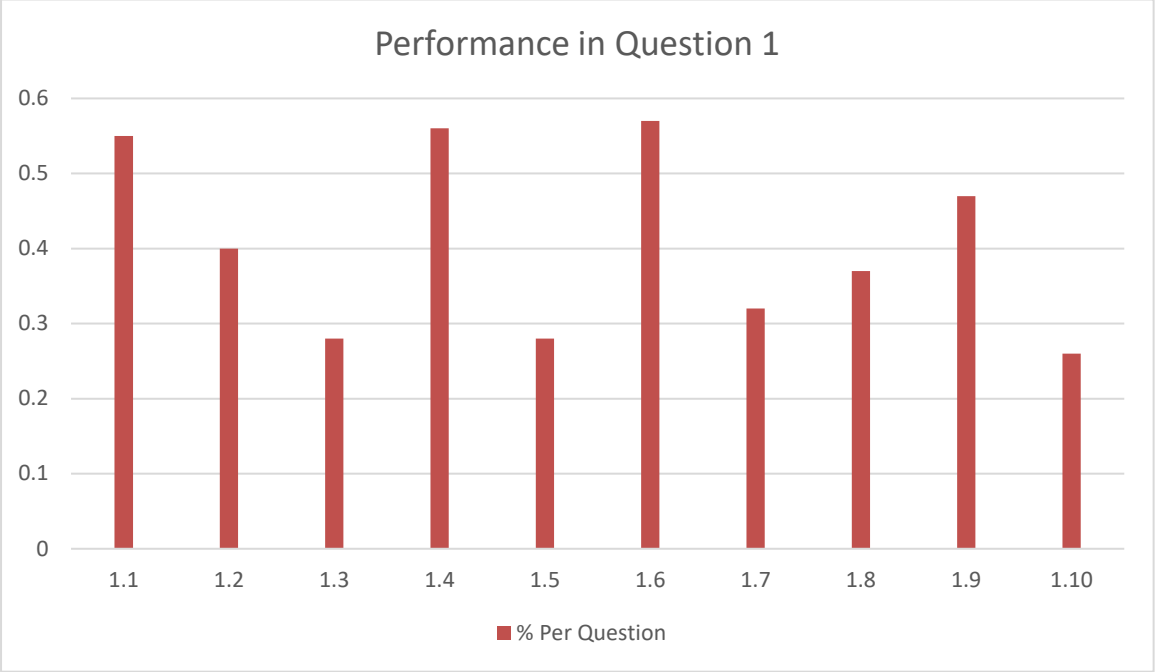
SECTION 2: Comment on candidates' performance in individual questions

QUESTION 1

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

Question 1 was the worst performed question. This is the worst also compared to previous years. The overall performance in question 1 is 41%. This is a multiple choice question yet the worst amongst all ten questions.

LEVELS	PERCENTAGE PERFOMANCE (%)
1.1	55%
1.2	40%
1.3	28%
1.4	56%
1.5	28%
1.6	57%
1.7	32%
1.8	37%
1.9	47%
1.10	26%



Question 1.3 and 1.10 are the worst performed sub question. 1.3 is a question integrating vertical motion and conservation of mechanical energy. 1.10 was on matter and materials. Emission and absorption spectra are usually not given enough attention since it is the last part of the ATP and constitute a very small percentage. 1.1 even though fairly answered but the low performance in that question could be due to the fact that it is covered in grade 10.

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

Question 1 generally was a high order question. In most question leaners had to integrate two or more concepts to answer the question. Most learners could not apply the integration of knowledge from different concepts.

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

Teachers should teach in a way that relates topics. For example the different topics under Mechanics should be tested in a way that integrate the concepts. In 1.3 learners could not relate the mechanical energy to the acceleration due to gravity. Use informal test to drill learners to understand that within the same question different concepts could be tested.

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

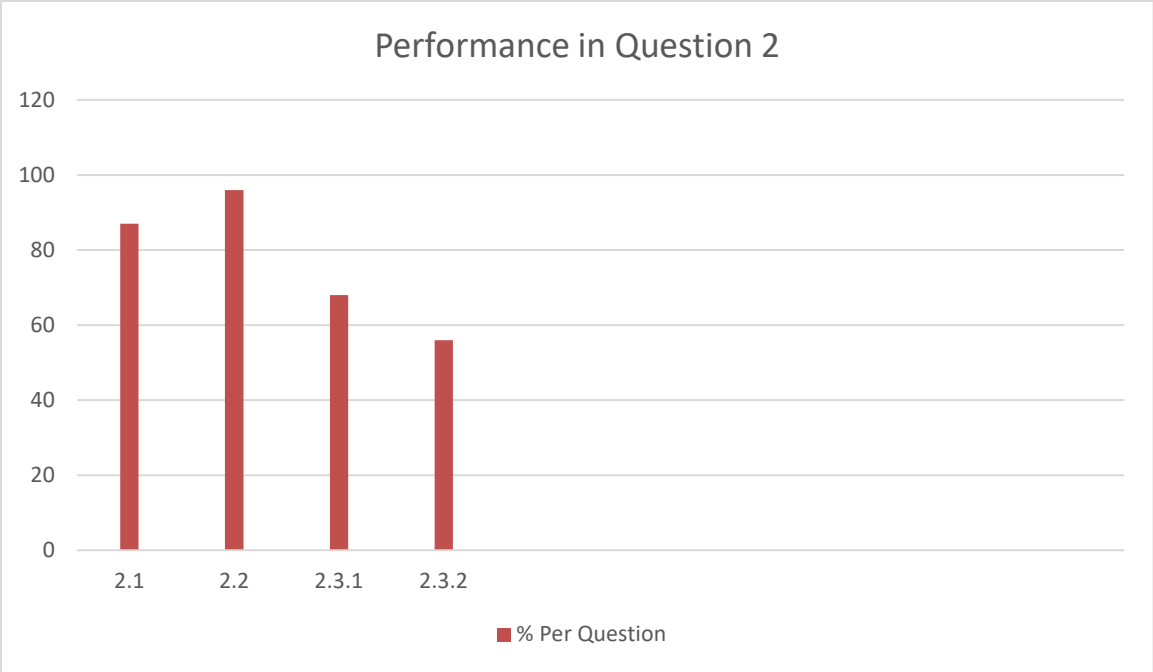
Learners could not interpret the graphs for relationship between distance and the electrostatic force in 1.7. They also fail to interpret the effect of doubling of the mass of one object and the halving the distance between the objects in question 1.3.

QUESTION 2

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

Question 2 was the best performed in this paper at 79%. Sub question 2.2 was the best answered at 96%. Most learners were able to draw the free body diagram and label correctly. Teachers should be appreciated for the effort put in to drill the learners ready for the examination.

LEVELS	PERCENTAGE PERFOMANCE (%)
2.1	87
2.2	96
2.3.1	68
2.3.2	56



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

In general, this was the best answered question. This could be attributed to the fact that Newton's laws is done in grade 11 and tested several test in grade 12, term 1 control test. June common assessment and in the trial examination as well.

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

Teacher should continue to drill learners using various pat question papers.

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

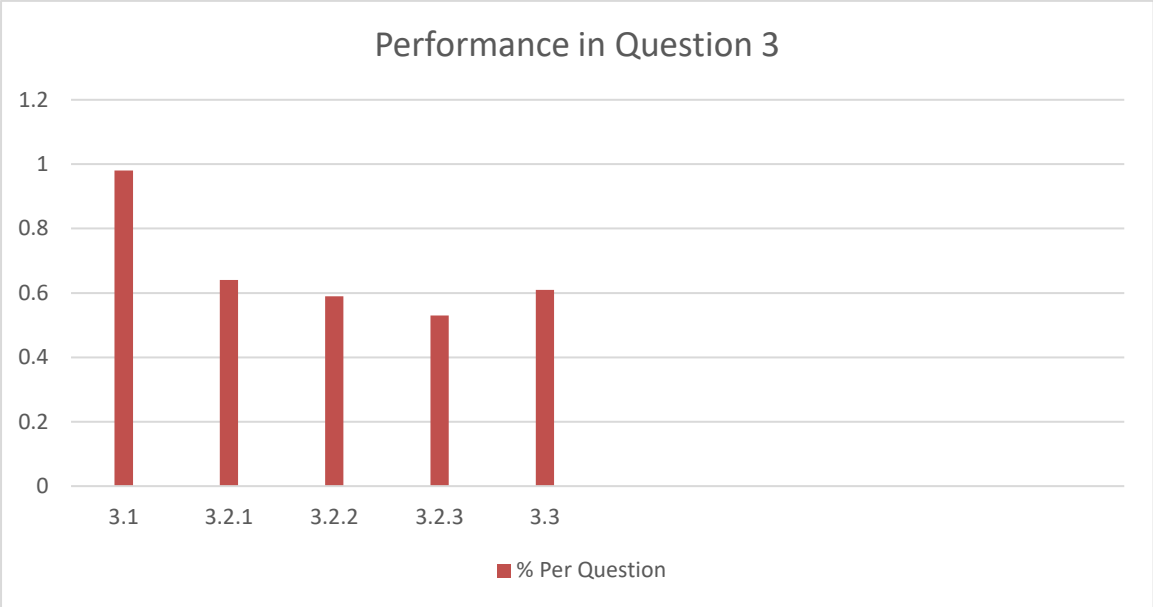
Some learners could not understand that when a force is inclined, the horizontal component of force is responsible for the motion. They were able to calculate the component of the force using $F_{net} = ma$ but could not calculate the angle using $F_x = F\cos\theta$.

QUESTION 3

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

This question was fairly answered at 68% compared to the previous year. 3.1 was the best answered sub question at 98%. The definition of free fall was mastered by most learners.

LEVELS	PERCENTAGE PERFOMANCE (%)
3.1	98
3.2.1	64
3.2.2	59
3.2.3	53
3.3	61



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

In 3.2.2 most learners lost 1 mark for not stating the direction of the velocity. This affected their score in the question. The drawing of graphs is still a challenge to most learners.

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

In teaching emphasis should be put on the vector quantities such as velocity, acceleration and displacement to learners to understand that vector quantities have both magnitude and direction. When calculating such quantities, the direction should be given.

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

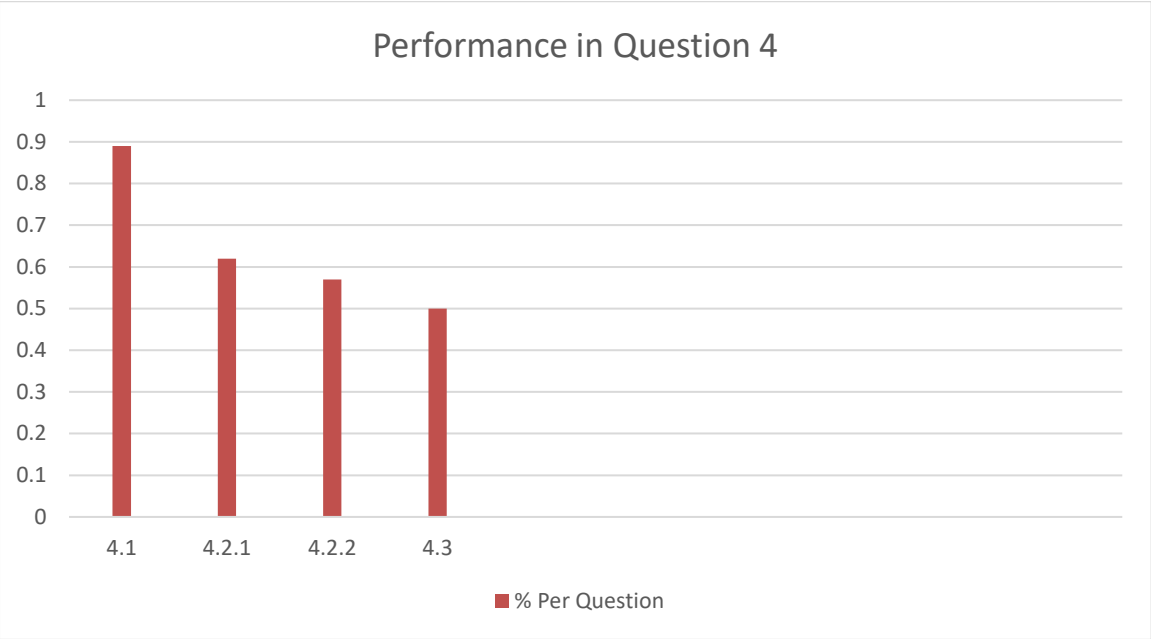
The drawing of graphs under vertical projectile motion should be given attention. The position – time, velocity – time and acceleration – time graphs should be emphasised. Bothe the drawing of the graph and the interpretation of the graphs should be given attention.

QUESTION 4

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

This question was fairly answered at 62% performance. 4.1 stating the principle of conservation of linear momentum was well answered by most learners at 89%. The worst sub question is 4.3, using calculation to prove whether a collision is elastic or inelastic.

LEVELS	PERCENTAGE PERFOMANCE (%)
4.1	89
4.2.1	62
4..2.2	57
4.3	50



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

The poor performance in 4.3 was due to the fact that learners started answering the question by drawing the conclusion already stating that $E_{ki} = E_{kf}$. Since the collision was inelastic they ended up losing 1 mark for their original statement.

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

Teachers should emphasise to learners not to give the conclusion before starting to calculate the proof when solving questions on elastic and inelastic collisions. Learners should calculate first the total kinetic energy before and after, compare them but concluding whether it is elastic or inelastic.

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

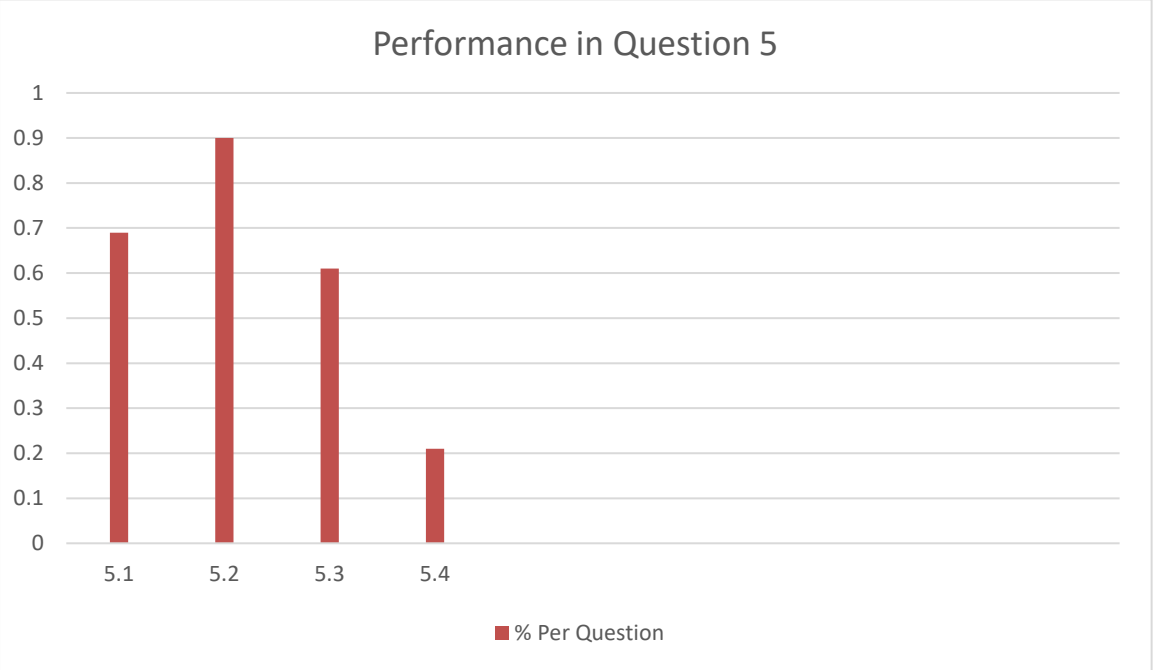
In 4.2.1, for calculations involving conservation of linear momentum, the v_f and v_i should not be swapped around when substituting into the formula $F_{net}\Delta t = mv_f - mv_i$.

QUESTION 5

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

This question was poorly answered by learners at 57%. Sub question 5.4 contributed to the poor performance of learners in this question at 21%.

LEVELS	PERCENTAGE PERFOMANCE (%)
5.1	69
5.2	90
5.3	61
5.4	21



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

5.4 was the worst answered sub question. This was a cognitive level 4 question hence it was not within the reach of most learners. In 5.1 learners who did not mention "work done or work it does" lost both marks to this question.

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

It must be emphasised that frictional force is not the only non-conservative force that can act on an object. Force applied is a non-conservative force. The poor performance of learners in this sub question was due to the fact leaners considered frictional force as the only non-conservative force.

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

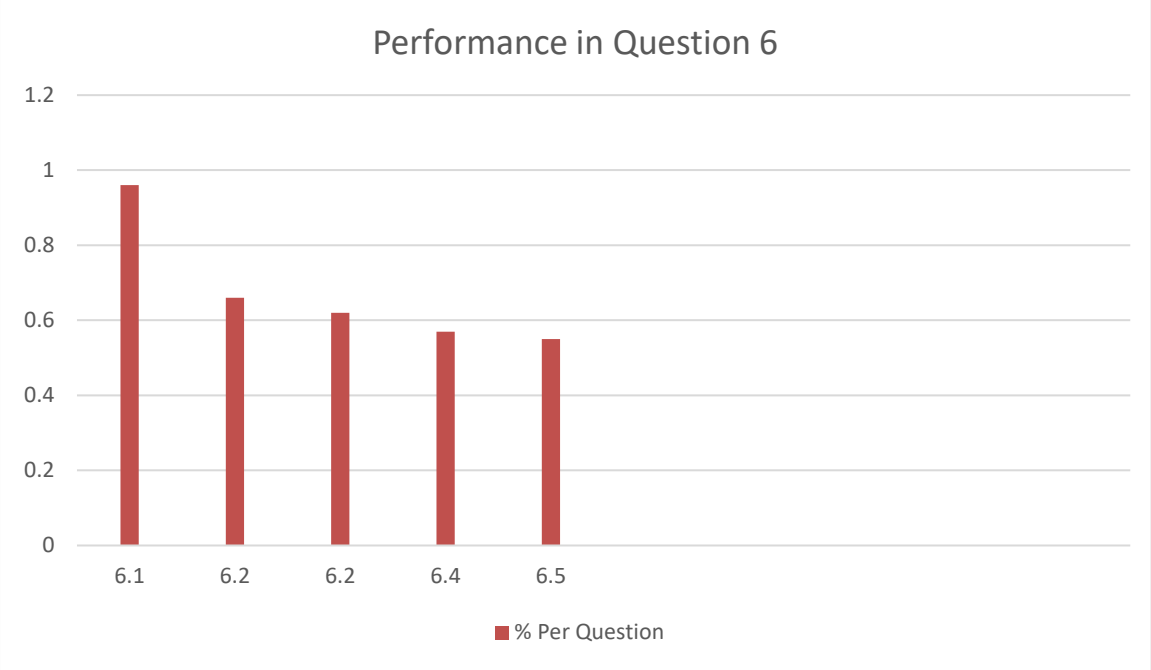
The free-body diagram for 5.2 was well answered as it is a skill developed from grade 11 and constantly tested.

QUESTION 6

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

This question was poorly answered at 62% compared to previous years. 6.1 was the best answered at 96% and the worst sub question was 6.5 at 55%.

LEVELS	PERCENTAGE PERFOMANCE (%)
6.1	96
6.2	66
6.3	62
6.4	57
6.5	55



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

6.5 was the most challenging question to learners. The could not relate the gradient of the graph to the ratio off the listener frequency to the source frequency, $\frac{f_L}{f_s}$. Most learners used the 1,06 given as either the source frequency or listener frequency or both.

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

Even though this type of graph has not been examined before but teachers can in their informal assessments create similar questions in all topics where the formula can be related to the equation of a straight line y = mx + c. compare to get the gradient and y-intercept from the graph. Teachers can integrate basic concepts in Mathematics in teaching Physics.

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

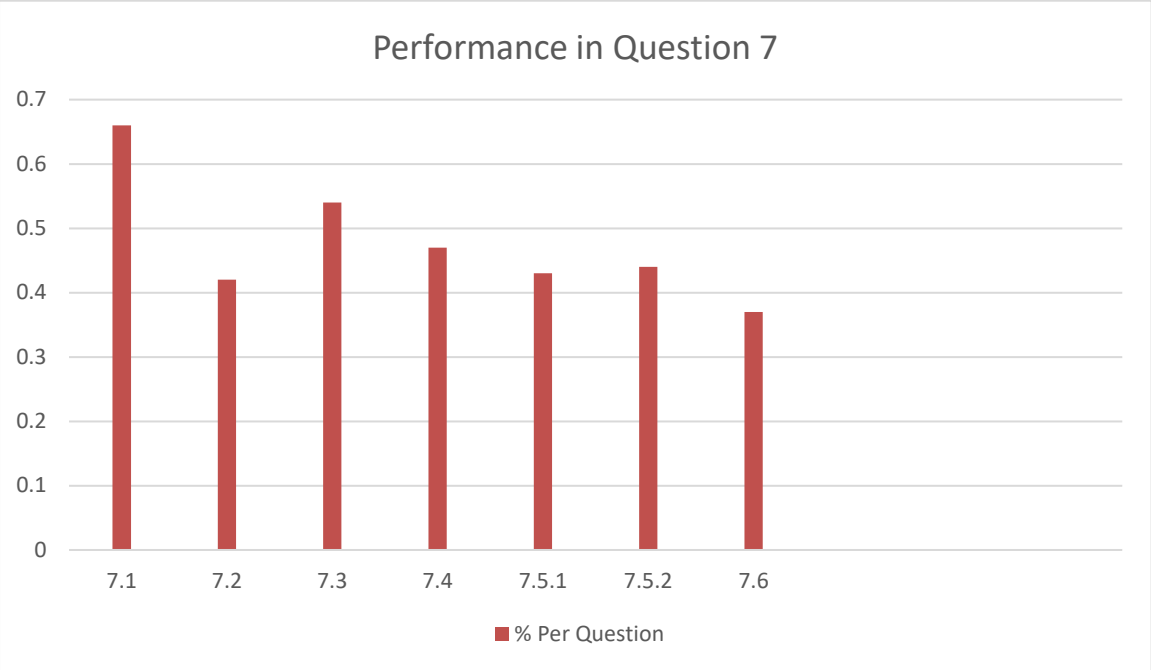
6.2 was on the medical application of the Doppler effect, most learners mentioned ultra scan omitting the word Doppler which resulted in them losing the mark. Because there are different type of scanners learners are supposed mention the Doppler scanner.

QUESTION 7

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

This question was poorly answered by most learners at 46%. The worst sub question is 7.6 at 37%. Learners had an impression that the charge hangs from a string and therefore there is a tension force. This understanding made them to draw a free body diagram with tension force which is counted as additional force therefore those learners lost 1 mark.

LEVELS	PERCENTAGE PERFOMANCE (%)
7.1	66
7.2	42
7.3	54
7.4	47
7.5.1	43
7.5.2	44
7.6	37



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

The misunderstanding in 7.3 contributed to the poor performance of learners in this question. Also learners could not relate the gravitational force or weight mg to the electrostatics force between the charges. In some cases leaners were substituting the mass of the charge as the weight. A misconception that should be addressed with learners.

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

Use past question paper to expose learners to scenarios were the electrostatic force is equal to the weight or tension or component of the

tension. This was not a totally new way of testing learners' knowledge in electrostatics yet they could not perform. Maybe curriculum planners should include electrostatics in control test in term 1 as well as June common assessment since this concept is taught in grade 11 most learners turn to give little attention to it in terms of revision.

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

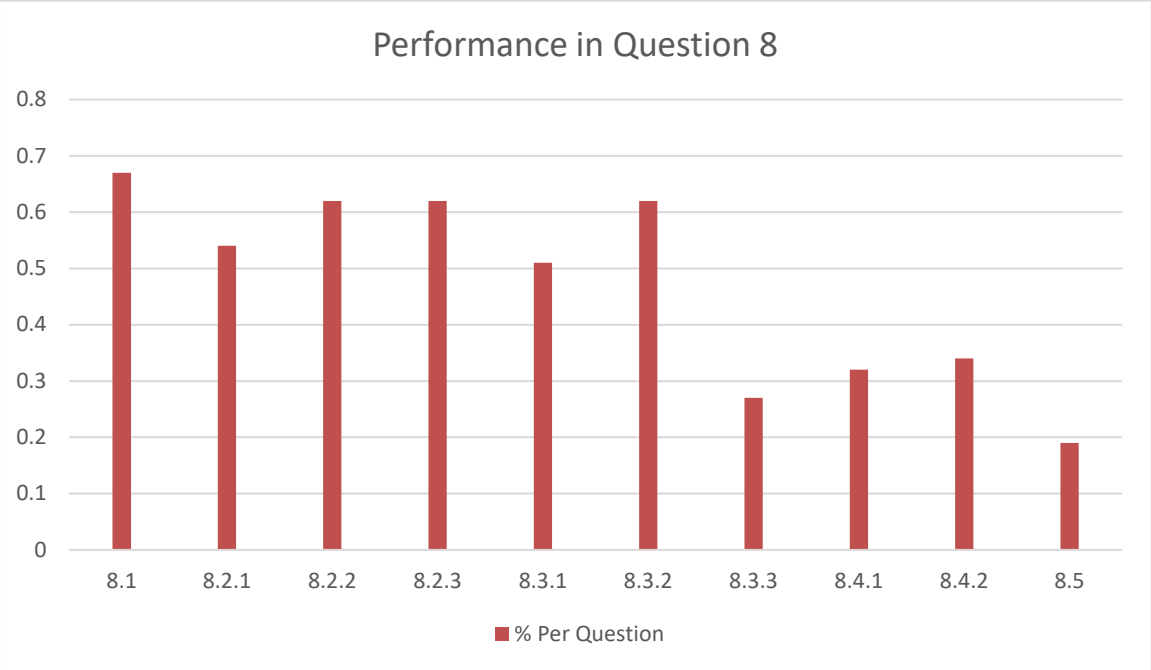
Some learners substituted the negative charge into the coulomb's law formula. This results in the learners getting the directions of the electric fields in 7.6 wrong. When using the coulomb's law formula only the magnitude of the charge should be substituted.

QUESTION 8

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

A poorly answered question at 45%. Electric circuits is generally challenging to leaners. 8.5 is the worst performed sub question at 19%.

LEVELS	PERCENTAGE PERFOMANCE (%)
8.1	67
8.2.1	54
8.2.2	72
8.2.3	62
8.3.1	51
8.3.2	62
8.3.3	27
8.4.1	32
8.4.2	34
8.5	19



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

Learners could not identify correctly the resistors that are in series and those parallel in 8.2.1. Many learners thought the 2 Ω resistor is in series in the circuit. This has been a serious misconception for many years. They think parallel resistors must be in lines that are parallel to each other. So they identified the 3 Ω and the 1 Ω to be parallel to each other and the 2Ω to be in series.

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

Use past question papers of different scenarios to expose learners to these type of questions. Learners should be made to under that the R_1 & R_2 in the parallel resistors formula are not necessarily individual resistance but resistance in the branch. In a branch in the circuit there could be more than one resistor but all the resistance in that branch is equivalent to R_1.

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

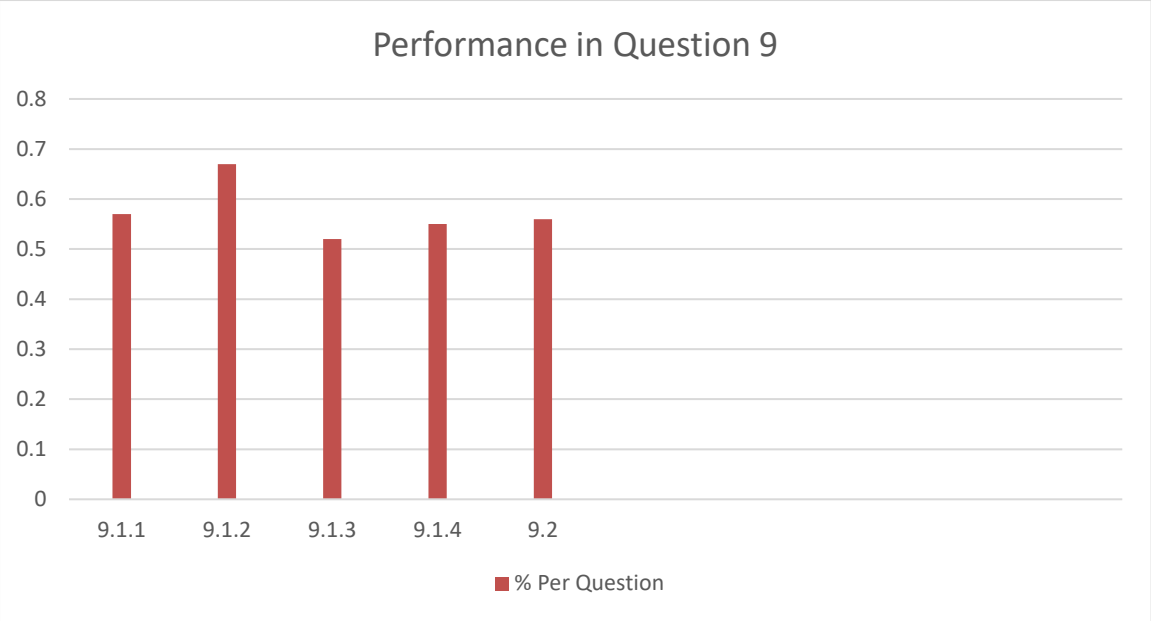
In 8.5 learners were required to explain the effect of having a high resistance voltmeter in one of the parallel branches. This was decimally answered. Teachers in teaching should take into consideration the different changes that can occur in the circuit and the effect of the change to the total resistance, current, lost volt, external voltage and the power dissipated by the battery or any resistor in the circuit.

QUESTION 9

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

Learners did not perform well in this question. The performance is at 57%.

LEVELS	PERCENTAGE PERFOMANCE (%)
9.1.1	57
9.1.2	67
9.1.3	52
9.1.4	55
9.2	56



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

In 9.1.4 learners did not write the maximum value of the output voltage. They just wrote maximum at the peak of the graph. They did not read the question clearly to see that the value was required.

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

Teachers should train learners to read questions carefully and analyse the information that is required before answering the questions. The use of past question papers can assist learners.

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

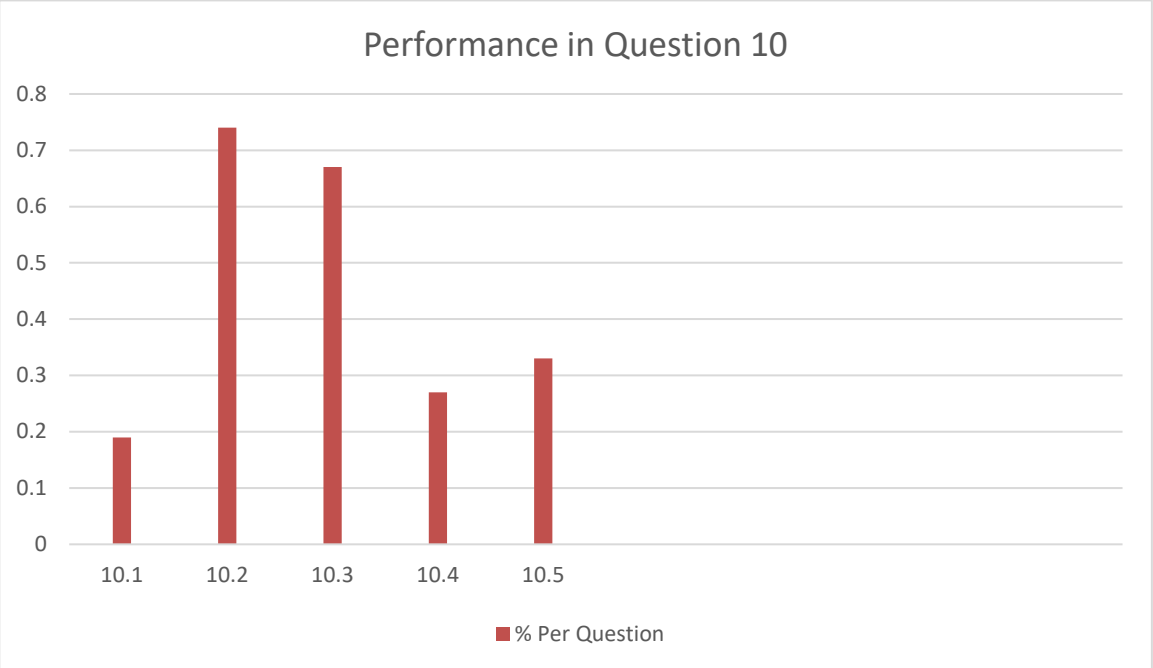
Learners identified the components in 9.1.1 as split ring but could not relate that to the drawing in 9.1.4. Some learners drew a.c graphs instead of d.c graphs.

QUESTION 10

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

This question was poorly answered at 46%. 10.1 was the worst answered at sub question 19%. 10.2 defining work function was fairly answered at 74%.

LEVELS	PERCENTAGE PERFOMANCE (%)
10.1	19
10.2	74
10.3	67
10.4	27
10.5	33



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

In 10.1 learners could not relate the photoelectric effect to the particle nature of light.
10.4, calculating the number of photon when given the current was a challenge to the learners. They could not integrate the concepts of electrostatics to photoelectric effect to answer the question.

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

Teachers should make learners aware that topics are not in isolation. Use pass question papers to drill learners before examination and throughout the year. More time should be given to matter and materials on the ATP.

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

The basics of photoelectric effect should be emphasised. The relationship between photoelectrons and the current should be explained clearly to learners.

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

NOVEMBER 2022

MARKS: 150

TIME: 3 hours

This question paper consists of 18 pages and 3 data sheets.

* P H S C E 1 *

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 10 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. Each question has only ONE correct answer. 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 Which ONE of the following combinations consists of only SCALAR quantities?

A Velocity, speed and time

B Time, distance and speed

C Acceleration, speed and distance

D Displacement, velocity and acceleration (2)

1.2 The acceleration due to gravity on Earth is ***g***.

Which ONE of the following represents the acceleration due to gravity on a planet that has TWICE the mass and HALF the radius of the Earth?

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

B $2g$

C $4g$

D $8g$ (2)

1.3 A ball is projected vertically upwards from the ground and reaches its maximum height after a while.

Ignore the effects of air friction.

How will the ACCELERATION and TOTAL MECHANICAL ENERGY of the ball at its maximum height compare to that immediately after it was projected?

	ACCELERATION	TOTAL MECHANICAL ENERGY
A	Equal to	Equal to
B	Greater than	Smaller than
C	Equal to	Greater than
D	Smaller than	Equal to

(2)

1.4 A car travels at CONSTANT VELOCITY along a horizontal road. A constant frictional force acts on the car during its motion.

Which ONE of the following statements about the power dissipated by the engine of the car during the motion is CORRECT?

The power …

A is zero.

B increases.

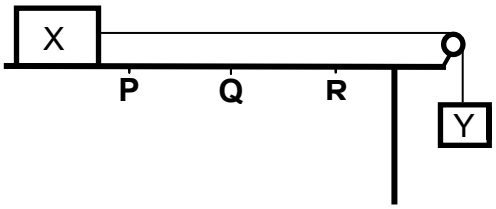
C decreases.

D remains constant. (2)

1.5 Block X is placed on a horizontal table and is connected to block Y by a light inextensible string passing over a frictionless pulley, as shown below.

A constant frictional force acts on block X while it moves to the right.

P, **Q** and **R** are points on the table such that the distance from **P** to **Q** is equal to that from **Q** to **R**.



When block X reaches point **Q**, the string is cut and block X continues to move towards point **R**. Ignore the effect of air friction.

Consider the following statements:

(i) The work done by the frictional force acting on block X is greater when the block moves from point **P** to point **Q** than when the block moves from point **Q** to point **R**.

(ii) Both the momentum and kinetic energy of block X decrease when the block moves from point **Q** to point **R**.

(iii) The total mechanical energy of block X remains constant when the block moves from point **Q** to point **R**.

Which of the statements above is/are CORRECT as block X moves from point **Q** to point **R**?

A (i) only

B (ii) only

C (i) and (ii) only

D (ii) and (iii) only (2)

1.6 Light emitted from a distant star contains a spectral line X of frequency *f*. The spectral lines of this star when observed on Earth are red shifted.

Which ONE of the following combinations of the OBSERVED FREQUENCY of spectral line X and the MOTION OF THE STAR is CORRECT?

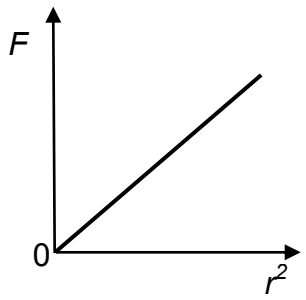
	OBSERVED FREQUENCY	**MOTION OF THE STAR**
A	Greater than *f*	Away from Earth
B	Greater than *f*	Towards Earth
C	Smaller than *f*	Away from Earth
D	Smaller than *f*	Towards Earth

(2)

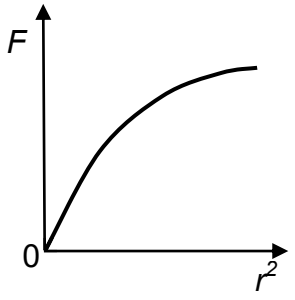
1.7 A proton and an electron are a distance *r* apart. The magnitude of the electrostatic force that they exert on each other is *F*.

Which ONE of the following graphs shows the relationship between *F* and r^2 as the proton and the electron approach each other?

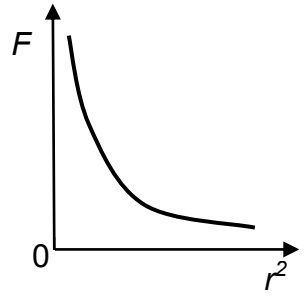
A



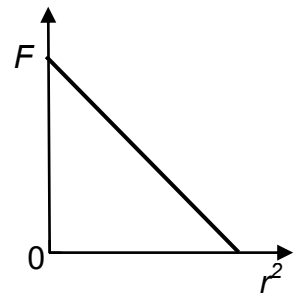
B



C

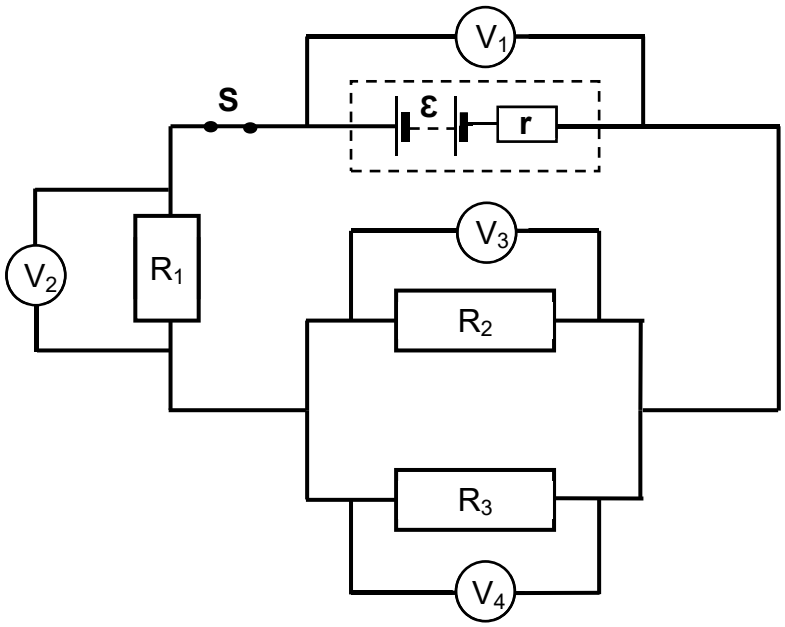


D



(2)

1.8 The emf of a battery is **ε** and its internal resistance is **r**. The battery is connected to three resistors and four voltmeters, as shown below. The resistance of the conducting wires is negligible, while the voltmeters have very high resistances.



Which ONE of the following equations represents the reading on voltmeter V_1 in terms of the readings on the other voltmeters?

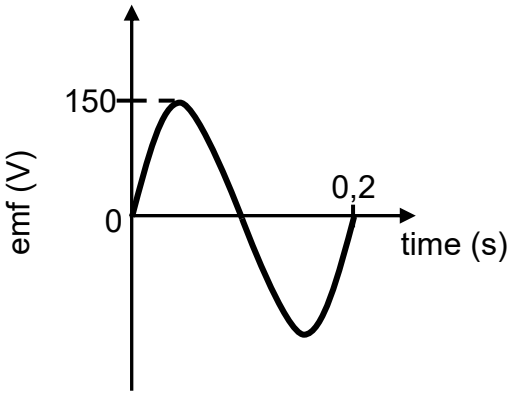
A $V_1 = V_2 + V_3$

B $V_1 = V_2 + \frac{1}{2}V_3$

C $V_1 = V_2 + V_3 + V_4$

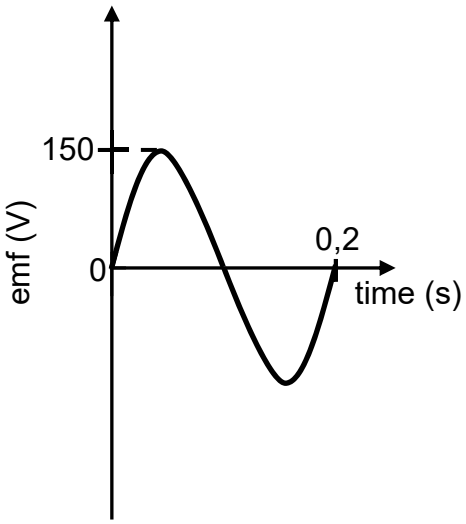
D $V_1 = V_2 + 2V_3$ (2)

1.9 An AC generator consists of a coil which is rotated in a magnetic field. The emf time graph for one complete rotation of the coil is shown below.

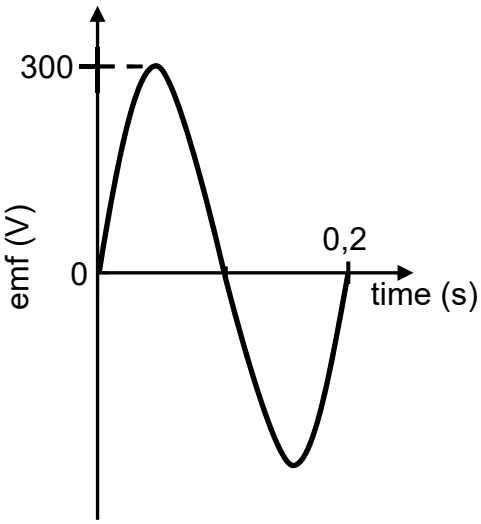


If the speed of rotation of the coil is now DOUBLED, which ONE of the following graphs is CORRECT for one complete rotation of the coil?

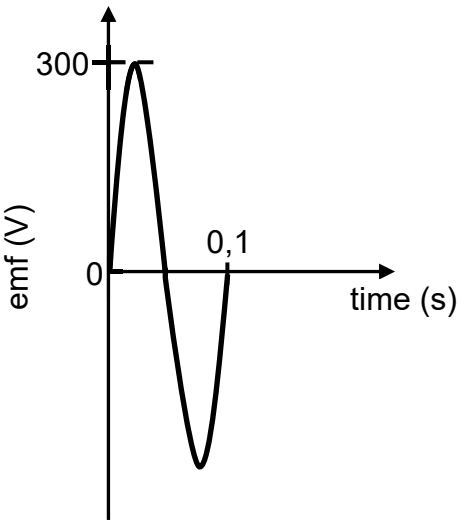
A



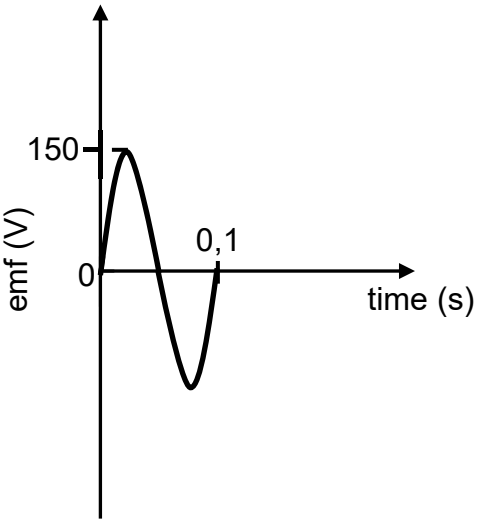
B



C

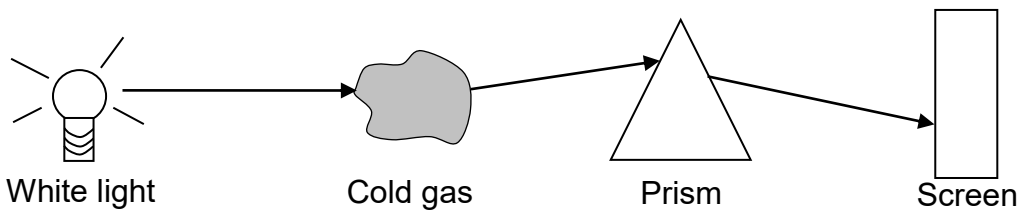


D



(2)

1.10 White light is passed through a cold gas and then through a prism, as shown below. A line spectrum is observed on the screen.



Which ONE of the following correctly describes the ENERGY TRANSITION of the atoms of the gas and the TYPE OF LINE SPECTRUM observed on the screen?

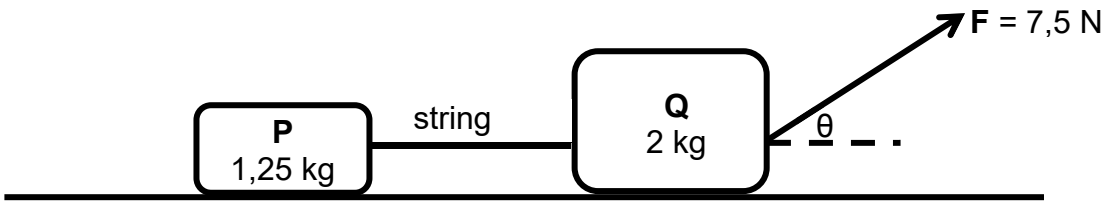
	ENERGY TRANSITION	TYPE OF LINE SPECTRUM
A	Higher to lower energy level	Emission
B	Lower to higher energy level	Emission
C	Higher to lower energy level	Absorption
D	Lower to higher energy level	Absorption

(2)
[20]

QUESTION 2 (Start on a new page.)

Crate **P** of mass 1,25 kg is connected to another crate, **Q**, of mass 2 kg by a light inextensible string. The two crates are placed on a rough horizontal surface. A constant force **F** of magnitude 7,5 N, acting at angle θ to the horizontal, is applied on crate **Q**, as shown in the diagram below.

The crates accelerate at 0,1 $m \cdot s^{-2}$ to the right.



Crate **P** experiences a constant frictional force of 1,8 N and crate **Q** experiences a constant frictional force of 2,2 N.

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

2.2 Draw a labelled free-body diagram for crate **P**. (4)

2.3 Calculate the magnitude of:

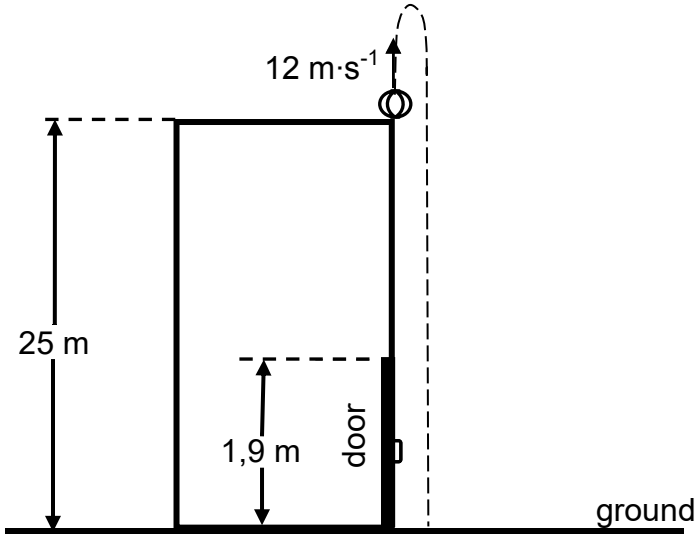
2.3.1 The tension in the string (4)

2.3.2 Angle θ (3)
[13]

QUESTION 3 (Start on a new page.)

A ball is thrown vertically upwards from the top of a building of height 25 m with a velocity of 12 $m \cdot s^{-1}$. On its way down, the ball passes a door which has a height of 1,9 m and then strikes the ground, as shown in the diagram below.

Ignore the effects of air friction.



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

3.2 Calculate the:

3.2.1 Time taken for the ball to reach its maximum height (3)

3.2.2 Velocity with which the ball strikes the ground (4)

3.2.3 Time it took the ball to move from the top of the door to the ground (4)

3.3 Draw a velocity versus time graph for the motion of the ball from the moment that the ball is thrown upwards until it strikes the ground. Use the ground as zero reference.

Clearly indicate the following on your graph:

- The velocity with which the ball was thrown upwards
- Time taken by the ball to reach its maximum height
- The velocity with which the ball strikes the ground (3)

[16]

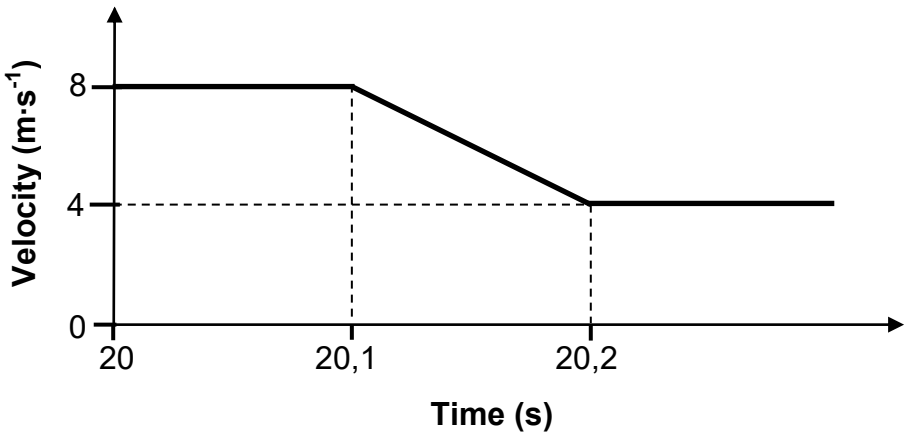
QUESTION 4 (Start on a new page.)

Trolley X of mass 1,2 kg travels at 8 $m \cdot s^{-1}$ east and collides with trolley Y of mass 0,5 kg which is initially at rest.

Ignore all frictional effects.

The velocity-time graph below shows the velocity of trolley X before, during and after the collision with trolley Y.

VELOCITY-TIME GRAPH FOR TROLLEY X



4.1 State the *principle of conservation of linear momentum*. (2)

4.2 Calculate the magnitude of the:

4.2.1 Velocity of trolley Y immediately after the collision (4)

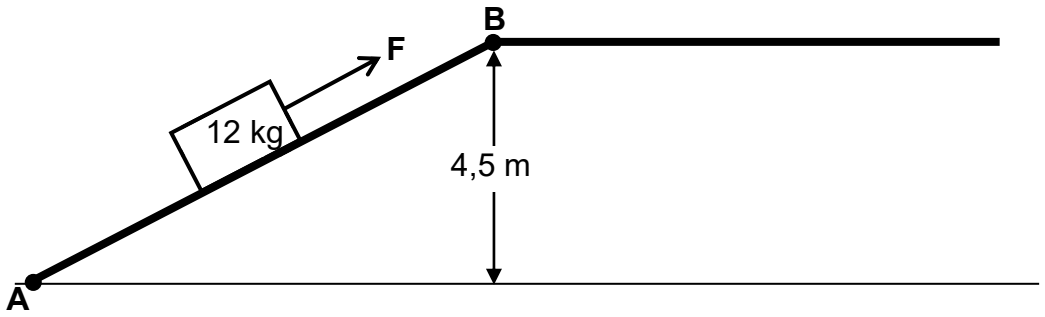
4.2.2 Average net force that trolley X exerts on trolley Y during the collision (3)

4.3 Is the collision ELASTIC or INELASTIC?

Explain the answer by means of suitable calculations. (5)
[14]

QUESTION 5 (Start on a new page.)

A 12 kg block is initially at rest at point **A** at the bottom of a ROUGH inclined plane. The block is pulled up the incline by a constant force **F** acting parallel to the incline. The block reaches point **B**, which is at a vertical height of 4,5 m above the horizontal, with a speed of 2,25 $m \cdot s^{-1}$. See the diagram below.

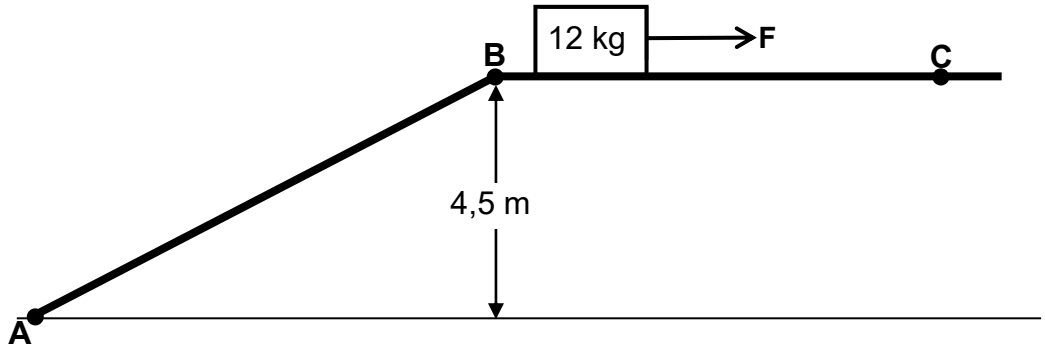


5.1 Define the term *non-conservative force.* (2)

5.2 Draw a labelled free-body diagram for the block when it is pulled up the inclined plane. (4)

5.3 Calculate the total work done on the block by the NON-CONSERVATIVE forces when the block moved from point **A** to point **B**. (4)

The same constant force **F** now moves the block at a CONSTANT VELOCITY across a rough horizontal surface from point **B** to point **C**, as shown below. Force **F** acts parallel to the horizontal surface.



The magnitude of the constant frictional force acting on the block while moving from point **B** to point **C** is 42 N LARGER than the magnitude of the constant frictional force acting on the block when it moves from point **A** to point **B**.

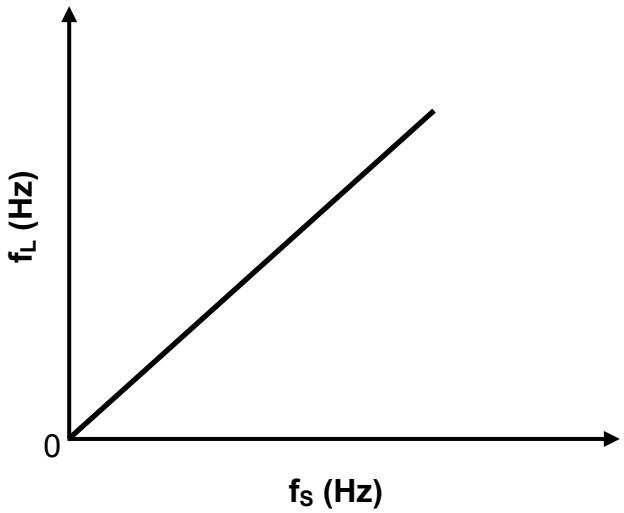
5.4 Calculate the distance from point **A** to point **B**. (5)
[15]

QUESTION 6 (Start on a new page.)

A learner investigates the relationship between the observed frequency and the frequency of sound waves emitted by a stationary source.

The learner moves towards the source at a constant velocity and records the observed frequency (f_L) for a given source frequency (f_S) . This process is repeated for different frequencies of the source, with the learner moving at the same constant velocity each time.

The graph below shows how the observed frequency changes as the frequency of sound waves emitted by the source changes.



6.1 Name the phenomenon illustrated by the graph. (1)

6.2 Name ONE application in the medical field of the phenomenon in QUESTION 6.1. (1)

6.3 Write down the type of proportionality that exists between $\mathbf{f_L}$ and $\mathbf{f_S}$, as illustrated by the graph. (1)

6.4 The gradient of the graph obtained is found to be 1,06.

If the speed of sound in air is 340 $m \cdot s^{-1}$, calculate the magnitude of the velocity at which the learner approaches the source. (5)

The investigation is now repeated with the learner moving at a HIGHER constant velocity towards the sound source.

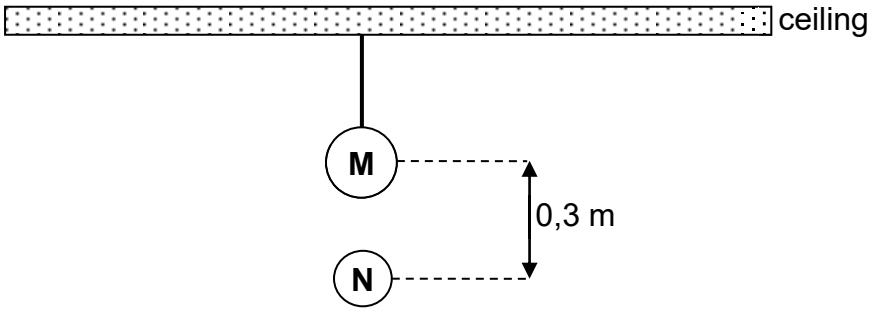
6.5 Copy the graph above in your ANSWER BOOK and label it as **A**. On the same set of axes, sketch the graph that will be obtained when the learner is moving at the HIGHER velocity. Label this graph as **B**. (2)

[10]

QUESTION 7 (Start on a new page.)

A charged sphere **M** is suspended from a ceiling by a light inextensible, insulated string.

Another charged sphere **N**, of mass 2,04 x 10^{-3} kg and carrying a charge of + 8,6 x 10^{-8} C, hangs STATIONARY vertically below sphere **M**. The centres of the spheres are 0,3 m apart, as shown in the diagram below.



7.1 State Coulomb's law in words. (2)

7.2 State whether the charge on sphere **M** is POSITIVE or NEGATIVE. (1)

7.3 Draw a labelled free-body diagram for sphere **N**. (2)

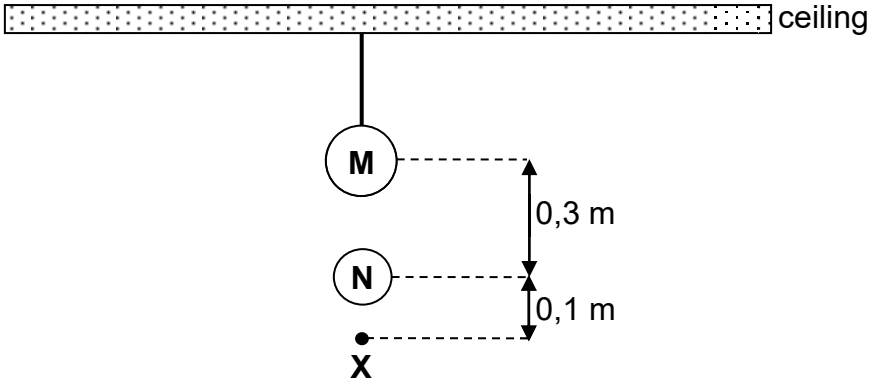
7.4 Calculate the magnitude of the charge on sphere **M**. (5)

7.5 How does the electrostatic force that sphere **M** exerts on sphere **N** compare to that exerted by sphere **N** on sphere **M** with respect to:

7.5.1 Magnitude (1)

7.5.2 Direction (1)

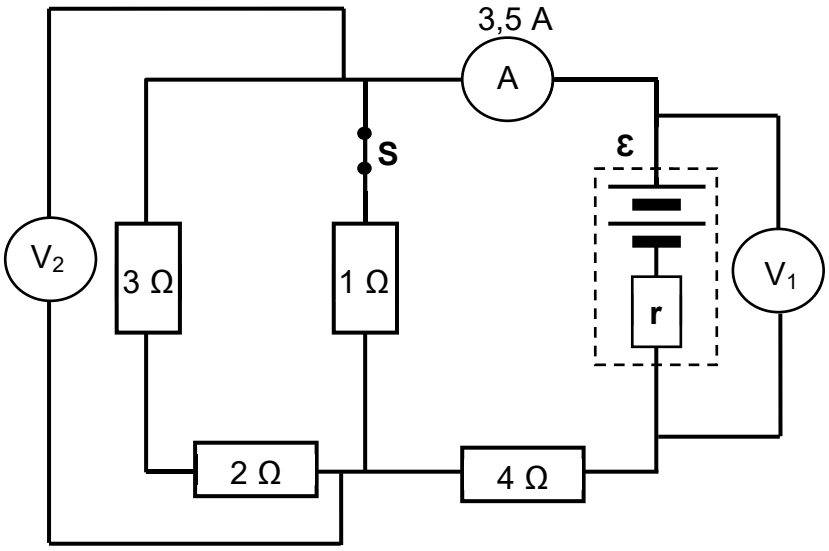
Point **X** is 0,1 m vertically below the centre of sphere **N**, as shown below.



7.6 Calculate the net electric field at point **X**. (5)
[17]

QUESTION 8 (Start on a new page.)

The circuit diagram below shows four resistors connected to a battery of emf **ε** and internal resistance **r**. The resistances of the ammeter and the connecting wires are negligible, while the voltmeters have very high resistances.



8.1 State Ohm's law in words. (2)

Switch **S** is CLOSED.

8.2 The reading on the ammeter is 3,5 A.

8.2.1 Calculate the total external resistance of the circuit. (4)

8.2.2 Calculate the reading on voltmeter V_1. (3)

8.2.3 How does the reading on voltmeter V_2 compare to the reading on voltmeter V_1? Choose from SMALLER THAN, EQUAL TO or GREATER THAN. (1)

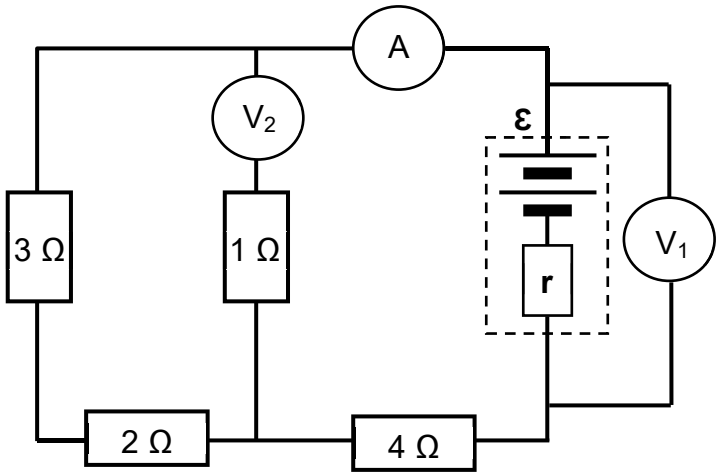
8.3 A learner concludes that the emf of the battery is equal to the reading on voltmeter V_1.

8.3.1 Define the term *emf*. (2)

8.3.2 Is the learner's conclusion CORRECT? Choose from YES or NO. (1)

8.3.3 Give a reason for the answer to QUESTION 8.3.2. (1)

Switch **S** is now removed and replaced by voltmeter V_2, as shown in the circuit diagram below.



8.4 How will EACH of the following change?

(Choose from INCREASES, DECREASES or REMAINS THE SAME.)

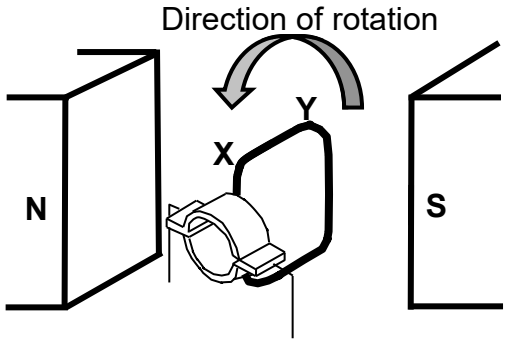
8.4.1 The power dissipated by the 4 Ω resistor (1)

8.4.2 The reading on voltmeter V_1 (1)

8.5 Explain the answer to QUESTION 8.4.2. (4)
[20]

QUESTION 9 (Start on a new page.)

9.1 The diagram below shows the initial position of the coil in a simple DC generator. The coil is rotated in an anticlockwise direction, as shown.



9.1.1 Name the component in this generator that ensures that the induced current in the external circuit is in one direction only. (1)

9.1.2 Is the direction of the induced current from **X to Y** or from **Y to X**? (1)

A maximum voltage of 90 V is generated when the coil is rotating at a frequency of 20 Hz.

9.1.3 Write down the time taken for the coil to complete ONE rotation. (1)

9.1.4 The coil starts rotating from the initial position, as shown in the diagram above.

Sketch a graph of output voltage versus time for one complete rotation of the coil. Indicate the maximum voltage and the relevant time values on the graph. (4)

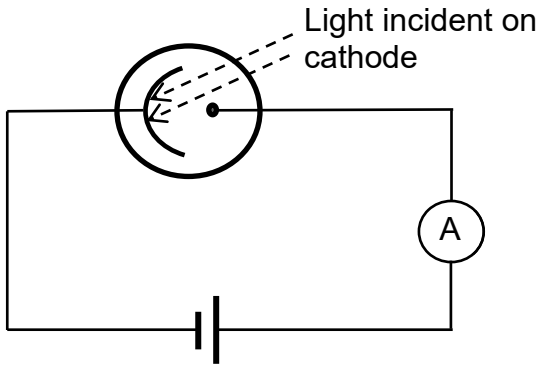
9.2 Wall sockets supply rms voltage and current.

A 220 V AC voltage is supplied from a wall socket to an electric kettle having a resistance of 32 Ω.

Calculate the average energy dissipated by the kettle in TWO minutes. (4)
[11]

QUESTION 10 (Start on a new page.)

Light is incident on the cathode of a photoelectric cell connected to a battery and a sensitive ammeter, as shown below.



10.1 What conclusive evidence about the nature of light is provided by the photoelectric effect? (1)

The cathode has a work function of $3,42 \times 10^{-19}$ J.

10.2 Define the term *work function*. (2)

Light of frequency $5,96 \times 10^{14}$ Hz is shone onto the cathode.

10.3 Calculate the maximum kinetic energy of an electron ejected from the cathode. (4)

10.4 The ammeter registers a constant current of 0,012 A.

Calculate the minimum number of photons of light that strike the cathode in a 10 s period. (4)

10.5 The intensity of the incident light is now INCREASED. How will this change affect the reading on the ammeter?

Choose from INCREASES, DECREASES or REMAINS THE SAME. Explain the answer. (3)
[14]

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*

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

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 Δ 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*

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

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE *NASIONALE SENIOR SERTIFIKAAT*

GRADE/*GRAAD* 12

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

NOVEMBER 2022

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 150

DBE CE	DBE IMs	Umalusi
29/11/2022	29/11/2022	29/11/2022

These marking guidelines consist of 32 pages.
Hierdie nasienriglyne bestaan uit 32 bladsye.

Please turn over/Blaai om asseblief

QUESTION 1/*VRAAG 1*

1.1 B ✓✓ (2)

1.2 D ✓✓ (2)

1.3 A ✓✓ (2)

1.4 D ✓✓ (2)

1.5 B ✓✓ (2)

1.6 C ✓✓ (2)

1.7 C ✓✓ (2)

1.8 A ✓✓ (2)

1.9 C ✓✓ (2)

1.10 D ✓✓ (2)

[20]

QUESTION 2/*VRAAG 2*

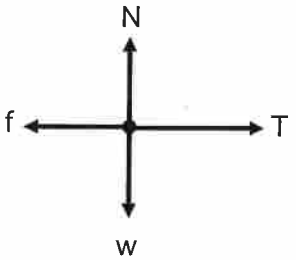
2.1

Marking criteria/*Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark/*Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

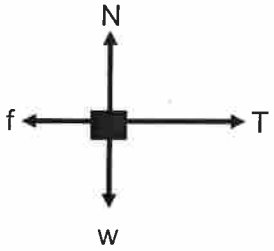
When a resultant/net force acts on an object, the object will accelerate in the direction of the force. The acceleration is directly proportional to the resultant/net force and inversely proportional to the mass of the object. ✓✓
Wanneer 'n resulterende/netto krag op 'n voorwerp inwerk, sal die voorwerp in die rigting van die krag versnel. Die versnelling is direk eweredig aan die netto krag en omgekeerd eweredig aan die massa van die voorwerp.

OR/*OF*
The resultant/net force acting on an object is equal to the rate of change of momentum of the object. **(2 or 0)**
Die resulterende/netto krag wat op 'n voorwerp inwerk is gelyk aan die tempo van verandering van momentum. ***(2 of 0)*** (2)

2.2



Accept force diagram/
Aanvaar kragte-diagram:



Accepted labels/*Aanvaarde benoemings*	
w	F_g /F_w /$F_{earth\ on\ P}$ /weight /mg /12,25 N /gravitational force *F_g /F_w /$F_{aarde\ op\ P}$ /gewig /mg /12,25 N /gravitasiekrag*
T	F_T /F_{string} /*F_{tou}* /F_t /tension /*spanning* /*F_s*
f	F_f /f_k /(kinetic) friction /*(kinetiese) wrywing* /1,8 N /*F_w*
N	F_N /Normal /F_{normal} /*$F_{normaal}$* /*Normaal*

Notes/*Aantekeninge*
- Mark awarded for label and arrow./*Punt toegeken vir benoeming en pyltjie.*
- Do not penalise for length of arrows since drawing is not to scale./*Moenie vir die lengte van die pyltjies penaliseer nie aangesien die tekening nie volgens skaal is nie.*
- Any other additional force(s)/*Enige ander addisionele krag(te):* Max/*Maks* $^3/_4$
- If everything correct, but no arrows/*Indien alles korrek, maar geen pyltjies*: Max/*Maks* $^3/_4$
- If force(s) do not make contact with the dot /*Indien krag(te) nie met die kolletjie kontak maak nie*: Max/*Maks* $^3/_4$

(4)

2.3.1

For P/*Vir P* **RIGHT AS POSITIVE/** ***REGS AS POSITIEF***	**For P/*Vir P*** **LEFT AS POSITIVE/** ***LINKS AS POSITIEF***
$F_{net} = ma$ $T + f = ma$ $T - f = ma$ } ✓ Any one/ *Enige een*	$F_{net} = ma$ $T + f = ma$ $-T + f = ma$ } ✓ Any one/ *Enige een*
$T - 1,8$ ✓$= (1,25)(0,1)$ ✓ $T = 1,93$ N ✓ (1,925 N)	$-T + 1,8$ ✓$= (1,25)(-0,1)$ ✓ $T = 1,93$ N ✓ (1,925 N)

(4)

2.3.2

POSITIVE MARKING FROM QUESTION 2.3.1/ ***POSITIEWE NASIEN VANAF VRAAG 2.3.1.*** **RIGHT AS POSITIVE/*REGS AS POSITIEF:*** **For Q/*Vir Q***	**Accept/*Aanvaar*** Sin(90°- θ)
$F_{net} = ma$ $F\cos\theta - T - f = ma$ $F\cos\theta + T + f = ma$ $7,5\cos\theta - 1,93 - 2,2$ ✓$= (2)(0,1)$ ✓ $\theta = 54,74°$ ✓ (Range:54,55° - 54,78°)	
LEFT AS POSITIVE/*LINKS AS POSITIEF:* **For Q/*Vir Q***	**Accept/*Aanvaar*** Sin(90°- θ)
$F_{net} = ma$ $-F\cos\theta + T + f = ma$ $F\cos\theta + T + f = ma$ $-7,5\cos\theta + 1,93 + 2,2$ ✓$= (2)(-0,1)$ ✓ $\theta = 54,74°$ ✓ (Range:54,55° - 54,78°)	

(3)
[13]

QUESTION 3/*VRAAG 3*

3.1 Motion under the influence of gravity/weight/gravitational force only. ✓✓
Beweging slegs onder die invloed van gravitasie/gewig/swaartekrag.
(2 or/of 0)

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

3.2.1

Marking criteria/*Nasienkriteria*
- Formula with Δt/*Formule met Δt* ✓
- Correct substitution into formula/*Korrekte vervanging in formule* ✓
- Final answer/*Finale antwoord*: 1,22 s ✓ (1,22 s to/*tot* 1,23 s)

OPTION 1/*OPSIE 1*

A-B:

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

$v_f = v_i + a\Delta t$ ✓
$0 = 12 + (-9,8)\Delta t$ ✓
$\Delta t = 1,22$ s ✓

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

$v_f = v_i + a\Delta t$ ✓
$0 = -12 + (9,8)\Delta t$ ✓
$\Delta t = 1,22$ s ✓

OPTION 2/*OPSIE 2*

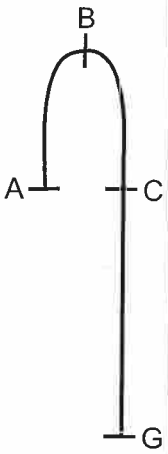
B-C:

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

$v_f = v_i + a\Delta t$ ✓
$-12 = 0 + (-9,8)\Delta t$ ✓
$\Delta t = 1,22$ s ✓

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

$v_f = v_i + a\Delta t$ ✓
$12 = 0 + (9,8)\Delta t$ ✓
$\Delta t = 1,22$ s ✓



OPTION 3/*OPSIE 3*

A-C:

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

$v_f = v_i + a\Delta t$ ✓
$-12 = 12 + (-9,8)\Delta t$ ✓
$\Delta t = 2,45$ s
$\Delta t_{up} = 1,23$ s ✓

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

$v_f = v_i + a\Delta t$ ✓
$12 = -12 + (9,8)\Delta t$ ✓
$\Delta t = 2,45$ s
$\Delta t_{up} = 1,23$ s ✓

OPTION 4/*OPSIE 4*

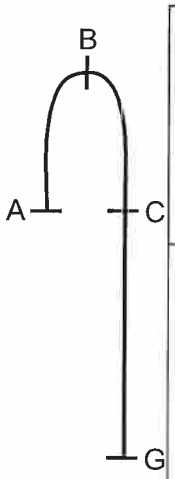
A-C:

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$0 = (12)\Delta t + \frac{1}{2}(-9,8)\Delta t^2$ ✓
$\Delta t = 2,45$ s
$\Delta t_{up} = 1,23$ s ✓

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$0 = (-12)\Delta t + \frac{1}{2}(9,8)\Delta t^2$ ✓
$\Delta t = 2,45$ s
$\Delta t_{up} = 1,23$ s ✓



OPTION 5/*OPSIE 5*
A-B OR/*OF* B-C:

$(E_{mech})_{Top/Bo} = (E_{mech})_{25\ m}$
$(E_P + E_K)_{Top/Bo} = (E_P + E_K)_{25\ m}$
$(mgh + \frac{1}{2}mv^2)_{Top/Bo} = (mgh + \frac{1}{2}mv^2)_{25\ m}$
$(9,8)h + 0 = 0 + (\frac{1}{2})(12)^2$
$\Delta h = 7,35$ m

OPTION 6/*OPSIE 6*
A-B OR/*OF* B-C

$W_{nc} = \Delta K + \Delta U$
$W_{nc} = \Delta K + mg(h_f - h_i)$
$0 = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 + mgh_f - mgh_i$
$0 = \frac{1}{2}(0^2 - 12^2) + (9,8)\Delta h$
$\Delta h = 7,35$ m

OPTION 7/*OPSIE 7*
A-B OR/*OF* B-C

$W_{net} = \Delta E_k$
$w\Delta y\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$(9,8)\Delta y\cos 180° = 0 - \frac{1}{2}(12)^2$
$\Delta y = 7,35$ m

OPTION 8/*OPSIE 8*
A-B:
UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

$v_f^2 = v_i^2 + 2a\Delta y$
$0^2 = 12^2 + 2(-9,8)\Delta y$
$\Delta y = 7,35$ m

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

$v_f^2 = v_i^2 + 2a\Delta y$
$0^2 = (-12)^2 + 2(9,8)\Delta y$
$\Delta y = -7,35$ m

OPTION 9/*OPSIE 9*
B-C:
UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

$v_f^2 = v_i^2 + 2a\Delta y$
$(-12)^2 = 0^2 + 2(-9,8)\Delta y$
$\Delta y = -7,35$ m

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

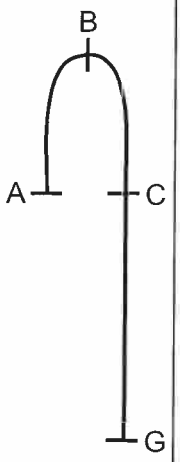
$v_f^2 = v_i^2 + 2a\Delta y$
$(12)^2 = 0^2 + 2(9,8)\Delta y$
$\Delta y = 7,35$ m

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$7,35 = \left(\frac{12 + 0}{2}\right)\Delta t$ ✓
$\Delta t = 1,23$ s ✓

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$-7,35 = \left(\frac{-12 + 0}{2}\right)\Delta t$ ✓
$\Delta t = 1,23$ s ✓



OPTION 10/*OPSIE 10*

A-B:

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF:

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

$\Delta y = \left(\frac{12 + 0}{2}\right)\Delta t$

$\Delta y = 6\Delta t$

$v_f^2 = v_i^2 + 2a\Delta y$

$0 = (12)^2 + 2(-9,8)(6\Delta t)$ ✓

$\Delta t = 1,22$ s ✓

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF:

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

$\Delta y = \left(\frac{-12 + 0}{2}\right)\Delta t$

$\Delta y = -6\Delta t$

$v_f^2 = v_i^2 + 2a\Delta y$

$0 = (-12)^2 + 2(9,8)(-6\Delta t)$ ✓

$\Delta t = 1,22$ s ✓

OPTION 11/*OPSIE 11*

B-C:

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF:

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

$\Delta y = \left(\frac{0 - 12}{2}\right)\Delta t$

$\Delta y = -6\Delta t$

$v_f^2 = v_i^2 + 2a\Delta y$

$-12 = (0)^2 + 2(-9,8)(-6\Delta t)$ ✓

$\Delta t = 1,22$ s ✓

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF:

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

$\Delta y = \left(\frac{12 + 0}{2}\right)\Delta t$

$\Delta y = 6\Delta t$

$v_f^2 = v_i^2 + 2a\Delta y$

$12^2 = 0^2 + 2(9,8)(6\Delta t)$ ✓

$\Delta t = 1,22$ s ✓

OPTION 12/*OPSIE 12*

A-B:

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF:

$F_{net}\Delta t = m\Delta v$
$F_{net}\Delta t = m(v_f - v_i)$ } ✓Any one/ *Enige een*

$-(9,8)\Delta t = 0 - 12$ ✓

$\Delta t = 1,22$ s ✓

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF:

$F_{net}\Delta t = m\Delta v$
$F_{net}\Delta t = m(v_f - v_i)$ } ✓Any one/ *Enige een*

$(9,8)\Delta t = 12 - 0$ ✓

$\Delta t = 1,22$ s ✓

(3)

3.2.2

Marking criteria/*Nasienkriteria*

- Formula with v_f./*Formule met* v_f. ✓
- Correct substitution into formula./*Korrekte vervanging in formule.* ✓
- Correct final answer/*Korrekte finale antwoord*:
  25,18 m·s^{-1} ✓ (25,03 m·s^{-1} to/*tot* 25,59 m·s^{-1})
- Correct direction (only if numerical value is given)./*Korrekte rigting (slegs indien numeriese waarde gegee is).*✓

OPTION 1/*OPSIE 1*

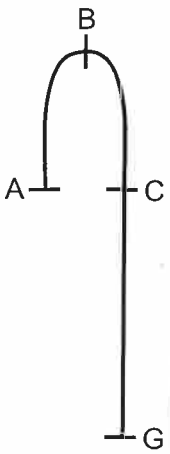
A-G:
UPWARDS AS POSITIVE/
***OPWAARTS AS POSITIEF*:**

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$v_f^2 = (12)^2 + 2(-9,8)(-25)$ ✓
v_f = 25,18 m·s^{-1}✓ downwards ✓
afwaarts

A-G:
DOWNWARDS AS POSITIVE/
***AFWAARTS AS POSITIEF*:**

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$v_f^2 = (-12)^2 + 2(9,8)(25)$ ✓
v_f = 25,18 m·s^{-1}✓ downwards ✓
afwaarts

OPTION 2/*OPSIE 2*



C-G:
UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$v_f^2 = (-12)^2 + 2(-9,8)(-25)$ ✓
v_f = 25,18 m·s^{-1}✓ downwards ✓
afwaarts

C-G:
DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$v_f^2 = (12)^2 + 2(9,8)(25)$ ✓
v_f = 25,18 m·s^{-1}✓ downwards ✓
afwaarts

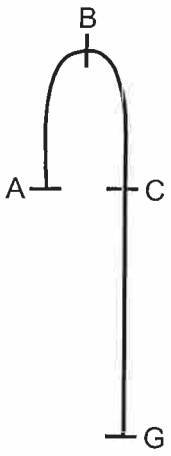
OPTION 3/*OPSIE 3*

B-G
UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$v_f^2 = (0)^2 + 2(-9,8)(-32,35)$ ✓
v_f = 25,18 m·s^{-1}✓ downwards ✓
afwaarts

B-G
DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$v_f^2 = (0)^2 + 2(9,8)(32,35)$ ✓
v_f = 25,18 m·s^{-1}✓ downwards ✓
afwaarts



OPTION 4/*OPSIE 4*

A-G:

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF:*

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$

$-25 = 12\Delta t + \frac{1}{2}(-9{,}8)\Delta t^2$

$\Delta t = 3{,}79$ s

A-G

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

$-25 = \left(\frac{12 + v_f}{2}\right)3{,}79$

$v_f = -25{,}18\ m\cdot s^{-1}$

$\therefore v_f = 25{,}18\ m\cdot s^{-1}$✓ downwards ✓
afwaarts

B-G

$v_f = v_i + a\Delta t$ ✓

$v_f = 0 + (-9{,}8)(3{,}79 - 1{,}22)$ ✓

$v_f = -25{,}19\ m\cdot s^{-1}$

$v_f = 25{,}19\ m\cdot s^{-1}$✓ downwards ✓
afwaarts

C-G

$v_f = v_i + a\Delta t$ ✓

$v_f = -12 + (-9{,}8)(1{,}35)$ ✓

$v_f = -25{,}19\ m\cdot s^{-1}$

$v_f = 25{,}19\ m\cdot s^{-1}$✓ downwards ✓
afwaarts

A-G:
DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF:*

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$

$25 = -12\Delta t + \frac{1}{2}(9,8)\Delta t^2$

$\Delta t = 3,79$ s

A-G

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

$25 = \left(\frac{-12 + v_f}{2}\right)3,79$ ✓

$\therefore v_f = 25,18$ m·s^{-1}✓ downwards ✓
afwaarts

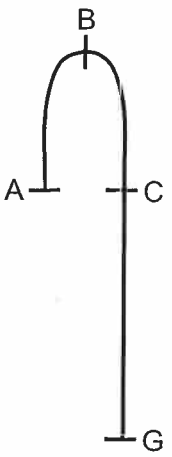
B-G

$v_f = v_i + a\Delta t$ ✓
$= 0 + (9,8)(3,79 - 1,22)$ ✓
$v_f = 25,19$ m·s^{-1}✓ downwards ✓
afwaarts

C-G

$v_f = v_i + a\Delta t$ ✓
$v_f = 12 + (9,8)(3,79 - 2(1,22))$ ✓
$v_f = 25,19$ m·s^{-1}✓ downwards ✓
afwaarts

OPTION 5/*OPSIE 5*



C-G:
UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$

$-25 = -12\Delta t + \frac{1}{2}(-9,8)\Delta t^2$

$\Delta t = 1,34$ s

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

$-25 = \left(\frac{-12 + v_f}{2}\right)1,34$ ✓

$v_f = -25,18$ m·s^{-1}
$\therefore v_f = 25,18$ m·s^{-1}✓ downwards ✓
afwaarts

C-G:
DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$

$25 = 12\Delta t + \frac{1}{2}(9,8)\Delta t^2$

$\Delta t = 1,34$ s

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

$25 = \left(\frac{12 + v_f}{2}\right)1,34$ ✓

$v_f = 25,18$ m·s^{-1}✓ downwards ✓
afwaarts

OPTION 6/*OPSIE 6*

$(E_{mech/meg})_i = (E_{mech/meg})_f$
$(E_P + E_K)_i = (E_P + E_K)_f$
$(mgh + \frac{1}{2}mv^2)_i = (mgh + \frac{1}{2}mv^2)_f$
} ✓Any one/ *Enige een*

$m(9,8)(25) + \frac{1}{2}m(12^2) = 0 + \frac{1}{2}mv_f^2$ ✓

$v_f = 25,18$ m·s^{-1}✓ downwards/*afwaarts* ✓

OPTION 7/*OPSIE 7*

$W_{nc} = \Delta E_k + \Delta E_p$
$= (E_{kf} - E_{ki}) + (E_{pf} - E_{pi})$
$= (\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2) + (mgh_f - mgh_i)$ ✓Any one/*Enige een*

$0 = [\frac{1}{2}mv_f^2 - \frac{1}{2}m(12)^2] + [0 - m(9,8)(25)]$ ✓
$v_f = 25,18\ m\cdot s^{-1}$ ✓ downwards/*afwaarts* ✓

OPTION 8/*OPSIE 8*

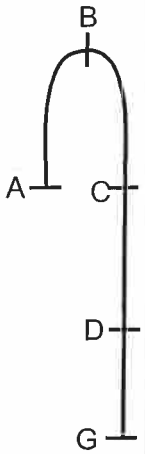
$W_{net} = \Delta E_k$
$= (E_{kf} - E_{ki})$
$= (\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2)$ ✓Any one/*Enige een*

$m(9,8)(25) = \frac{1}{2}mv_f^2 - \frac{1}{2}m(12)^2$ ✓
$v_f = 25,18\ m\cdot s^{-1}$ ✓ downwards/*afwaarts* ✓ (4)

3.2.3 **POSITIVE MARKING FROM QUESTION 3.2.2.**
POSITIEWE NASIEN VANAF VRAAG 3.2.2.

Marking criteria/*Nasienkriteria*
- Substitution into formula to calculate v at the top of the door ✓
  Vervanging in formule om v bokant die deur te bereken.
- Formula to calculate Δt from top to bottom of door.✓
  Formule om Δt te bereken van bokant tot onderkant van deur.
- Substitution to calculate Δt. ✓
  Vervanging om Δt *te bereken.*
- Final answer/*Finale antwoord*: 0,07 to/*tot* 0,08 s ✓

OPTION 1/*OPSIE 1*
UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF:*



A-D:
$v_f^2 = v_i^2 + 2a\Delta y$
$v_f^2 = (12)^2 + 2(-9,8)(-23,1)$ ✓
$v_f = 24,43\ m\cdot s^{-1}$

C-D:
$v_f^2 = v_i^2 + 2a\Delta y$
$v_f^2 = (-12)^2 + (2)(-9,8)(-23,1)$ ✓
$v_f = 24,43\ m\cdot s^{-1}$

D-G:
$v_f^2 = v_i^2 + 2a\Delta y$
$(-25,18)^2 = (v_i)^2 + 2(-9,8)(-1,9)$ ✓
$v_i = 24,43\ m\cdot s^{-1}$

B-D
$v_f^2 = v_i^2 + 2a\Delta y$
$v_f^2 = 0 + 2(-9,8)(-30,447)$ ✓
$= 24,43\ m\cdot s^{-1}$

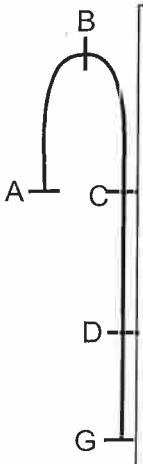
D-G:
$E_{(mech\ top/meg\ bo)} = E_{(mech\ bot/meg\ ond)}$
$(E_p + E_k)_{top/bo} = (E_p + E_k)_{bot/ond}$
$(mgh + \frac{1}{2}mv^2)_{top/bo} = (mgh + \frac{1}{2}mv^2)_{bot/ond}$
$m(9,8)(1,9) + \frac{1}{2}m(v_i)^2 = 0 + \frac{1}{2}m(25,18)^2$ ✓
$v_i = 24,43\ m\cdot s^{-1}$

D-G:
$v_f = v_i + a\Delta t$ ✓
$-25,18 = -24,43 + (-9,8)\Delta t$ ✓
$\Delta t = 0,08$ s ✓

D-G:
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$-1,9 = -24,43\Delta t + \frac{1}{2}(-9,8)\Delta t^2$ ✓
$\Delta t = 0,08$ s ✓

D-G:
$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$-1,9 = \left(\frac{-24,43 - 25,18}{2}\right)\Delta t$ ✓
$\Delta t = 0,08$ s ✓

DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF:*



A-D:

$v_f^2 = v_i^2 + 2a\Delta y$

$v_f^2 = (-12)^2 + 2(9,8)(23,1)$ ✓

$v_i = 24,43 \text{ m·s}^{-1}$

C-D:

$v_f^2 = v_i^2 + 2a\Delta y$

$v_f^2 = (12)^2 + (2)(9,8)(23,1)$ ✓

$v_f = 24,43 \text{ m·s}^{-1}$

D-G:

$v_f^2 = v_i^2 + 2a\Delta y$

$(25,18)^2 = (v_i)^2 + 2(9,8)(1,9)$ ✓

$v_i = 24,43 \text{ m·s}^{-1}$

B-D

$v_f^2 = v_i^2 + 2a\Delta y$

$v_f^2 = 0 + 2(9,8)(30,447)$ ✓

$= 24,43 \text{ m·s}^{-1}$

D-G:

$E_{(\text{mech top/}meg\ bo)} = E_{(\text{mech bot/}meg\ ond)}$

$(E_p + E_k)_{top/bo} = (E_p + E_k)_{bot/ond}$

$(mgh + \frac{1}{2}mv^2)_{top/bo} = (mgh + \frac{1}{2}mv^2)_{bot/ond}$

$m(9,8)(1,9) + \frac{1}{2}m(v_i)^2 = 0 + \frac{1}{2}m(25,18)^2$ ✓

$v_i = 24,43 \text{ m·s}^{-1}$

D-G:

$v_f = v_i + a\Delta t$ ✓

$25,18 = 24,43 + (9,8)\Delta t$ ✓

$\Delta t = 0,08$ s ✓

D-G:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓

$1,9 = 24,43\Delta t + \frac{1}{2}(9,8)\Delta t^2$ ✓

$\Delta t = 0,08$ s ✓

D-G:

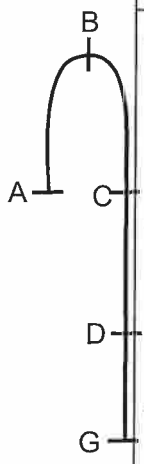
$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓

$1,9 = \left(\frac{24,43 + 25,18}{2}\right)\Delta t$ ✓

$\Delta t = 0,08$ s ✓

Marking criteria OPTION 2 and 3/*Nasienkriteria OPSIE 2 en 3*

- Either one of the formula to calculate Δt./*Enige een van die formules om Δt te bereken.* ✓
- Substitute into formula to calculate time from A to G or C to G/*Vervanging in formule om tyd te bereken tussen A tot G of C tot G* ✓
- Substitute into formula to calculate time from A to D or C to D/ *Vervanging in formule om tyd te bereken tussen A tot D of C tot D* ✓
- Final answer/*Finale antwoord*: 0,07 s ✓ (0,07s to/*tot* 0,08s)



OPTION 2/*OPSIE 2*

UPWARDS AS POSITIVE/ *OPWAARTS AS POSITIEF:*

A-G:

$v_f = v_i + a\Delta t$

$-25,18 = 12 + (-9,8)\ \Delta t$ ✓

$\Delta t = 3,79$ s

✓Any one/ *Enige een*

A-D:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$

$-23,1 = (12)\Delta t + ½(-9,8)\Delta t^2$ ✓

$\Delta t = 3,72$ s

Time from top to bottom of door/*Tyd van bokant tot onderkant van deur:*

D-G:

$3,79 - 3,72 = 0,07$ s ✓

DOWNWARDS AS POSITIVE/ *AFWAARTS AS POSITIEF:*

A-G:

$v_f = v_i + a\Delta t$

$25,18 = -12 + (9,8)\ \Delta t$ ✓

$\Delta t = 3,79$ s

✓Any one/ *Enige een*

A-D:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$

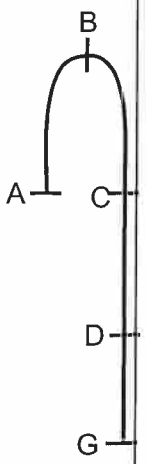
$23,1 = (-12)\Delta t + ½(9,8)\Delta t^2$ ✓

$\Delta t = 3,72$ s

Time from top to bottom/*Tyd van bokant tot onderkant van deur:*

D-G:

$3,79 - 3,72 = 0,07$ s ✓



OPTION 3/*OPSIE 3*

UPWARDS AS POSITIVE/ *OPWAARTS AS POSITIEF:*

C-G:

$v_f = v_i + a\Delta t$

$-25,18 = -12 + (-9,8)\ \Delta t$ ✓

$\Delta t = 1,34$ s

✓Any one/ *Enige een*

C-D:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓

$-23,1 = (-12)\Delta t + ½(-9,8)\Delta t^2$ ✓

$\Delta t = 1,27$ s

Time from top to bottom of door/*Tyd van bokant tot onderkant van deur:*

D-G:

$1,34 - 1,27 = 0,07$ s ✓

DOWNWARDS AS POSITIEF/ *AFWAARTS AS POSITIEF:*

C-G:

$v_f = v_i + a\Delta t$

$25,18 = 12 + (9,8)\ \Delta t$ ✓

$\Delta t = 1,34$ s

✓Any one/ *Enige een*

C-D:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓

$23,1 = (12)\Delta t + ½(9,8)\Delta t^2$ ✓

$\Delta t = 1,27$ s

Time from top to bottom of door/*Tyd van bokant tot onderkant van deur:*

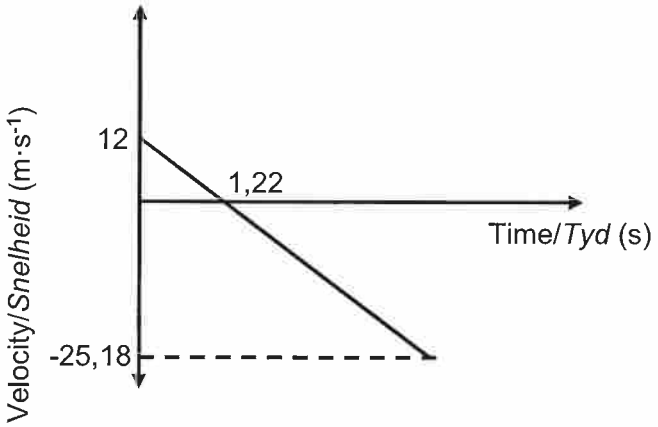
D-G:

$1,34 - 1,27 = 0,07$ s ✓

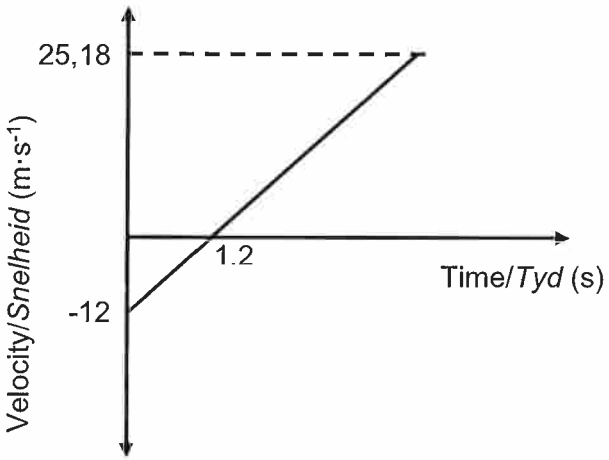
OPTION 4/*OPSIE 4*	
UPWARDS AS POSITIVE/ *OPWAARTS AS POSITIEF:*	**DOWNWARDS AS POSITIVE/ *AFWAARTS AS POSITIEF:***
G-D:	**G-D:**
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$1,9$ ✓$= \underline{25,18\Delta t + \frac{1}{2}(-9,8)\Delta t^2}$ ✓	$-1,9$ ✓$= \underline{-25,18\Delta t + \frac{1}{2}(9,8)\Delta t^2}$ ✓
$\Delta t = 0,08$ s ✓ (0,077 s)	$\Delta t = 0,08$ s ✓ (0,077 s)

(4)

3.3 **POSITIVE MARKING FROM QUESTION 3.2.1 AND QUESTION 3.2.2.**
POSITIEWE NASIEN VANAF VRAAG 3.2.1 EN VRAAG 3.2.2.
UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF*:



DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF:*



Criteria for graph/*Kriteria vir grafiek*	
Straight line starting at v = 12 m·s^{-1} with negtive final velocity or straight line starting at v = -12 m·s^{-1} with positive final velocity. */Reguitlyn wat begin by v = 12 m·s^{-1}met negatiewe finale snelheid of reguitlyn wat begin by v = -12 m·s^{-1}*met positiewe finale snelheid.	✓
Straight line cuts time axis at time calculated in Question 3.2.1/ *Reguitlyn sny tydas by die tyd bereken in Vraag 3.2.1.*	✓
Correct final velocity as calculated in Question 3.2.2 is indicated./*Korrekte finale snelheid soos uitgewerk in Vraag 3.2.2 is aangedui.*	✓

(3)
[16]

QUESTION 4/*VRAAG 4*

4.1

Marking criteria/*Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark./*Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

In an isolated/closed system the total (linear) momentum is conserved/remains constant. ✓✓
In 'n geïsoleerde/geslote sisteem bly die totale (lineêre) momentum behoue/konstant. (2)

4.2.1

OPTION 1/*OPSIE 1*
EAST AS POSITIVE/*OOS AS POSITIEF*

$\sum p_i = \sum p_f$
$m_xv_{ix} + m_yv_{iy} = m_xv_{fx} + m_yv_{fy}$ } ✓Any one/*Enige een*
$(1,2)(8)$ ✓ $+ (0,5)(0) = (1,2)(4) + (0,5)(v_{fy})$ ✓
$\therefore v_{fy} = 9,6\ m\cdot s^{-1}$ ✓

WEST AS POSITIVE/*WES AS POSITIEF*

$\sum p_i = \sum p_f$
$m_xv_{ix} + m_yv_{iy} = m_xv_{fx} + m_yv_{fy}$ } ✓ Any one/*Enige een*
$(1,2)(-8)$ ✓ $+ (0,5)(0) = (1,2)(-4) + (0,5)(v_{fy})$ ✓
$v_{fy} = -9,6\ m.s^{-1}$
$\therefore v_{fy} = 9,6\ m\cdot s^{-1}$ ✓

OPTION 2 /*OPSIE 2*
EAST AS POSITIVE/*OOS AS POSITIEF*

$\Delta p_x = -\Delta p_y$
$m(v_{xf} - v_{xi}) = -m(v_{yf} - v_{yi})$ } ✓ Any one/*Enige een*
$1,2(4 - 8)$ ✓ $= -0,5(v_f - 0)$ ✓
$\therefore v_{fy} = 9,6\ m\cdot s^{-1}$ ✓

WEST AS POSITIVE/*WES AS POSITIEF*

$\Delta p_x = -\Delta p_y$
$m(v_{xf} - v_{xi}) = -m(v_{yf} - v_{yi})$ } ✓ Any one/*Enige een*
$1,2(-4 + 8)$ ✓ $= -0,5(v_f - 0)$ ✓
$v_{fy} = -9,6\ m.s^{-1}$
$\therefore v_{fy} = 9,6\ m\cdot s^{-1}$ ✓ (4)

4.2.2

OPTION 1/*OPSIE 1*

EAST POSITIVE/*OOS POSITIEF:*
For X/*Vir X:*
$F_{net}\Delta t = \Delta p$
$F_{net}\Delta t = m(v_f - v_i)$ } ✓Any one/*Enige een*
$F_{net}(0,1) = 1,2(4 - 8)$ ✓
$F_{net} = -48$ N ✓
$\therefore F_{net} = 48$ N ✓

WEST POSITIVE/*WES POSITIEF:*
For X /*Vir X:*
$F_{net}\Delta t = \Delta p$
$F_{net}\Delta t = m(v_f - v_i)$ } ✓Any one/*Enige een*
$F_{net}(0,1) = 1,2(-4 + 8)$ ✓
$\therefore F_{net} = 48$ N ✓

OPTION 2/*OPSIE 2*

POSITIVE MARKING FROM QUESTION 4.2.1.
POSITIEWE NASIEN VANAF VRAAG 4.2.1.

EAST AS POSITIVE
OOS AS POSITIEF
For Y/*Vir Y:*

$F_{net}\Delta t = \Delta p$
$F_{net}\Delta t = m(v_f - v_i)$ ✓Any one/*Enige een*

$F_{net}(0,1) = 0,5(-9,6 - 0)$ ✓
$F_{net} = -48$ N
$\therefore F_{net} = 48$ N ✓

WEST AS POSITIVE
WES AS POSITIEF
For Y/*Vir Y:*

$F_{net}\Delta t = \Delta p$
$F_{net}\Delta t = m(v_f - v_i)$ ✓Any one/*Enige een*

$F_{net}(0,1) = 0,5(9,6 - 0)$ ✓
$F_{net} = 48$ N ✓

OPTION 3/*OPSIE 3*

EAST AS POSITIVE for X
OOS AS POSITIEF vir X

$v_f = v_i + a\Delta t$
$-4 = -8 + a(0,1)$
$a = -40\ m\cdot s^{-2}$

$F_{net} = ma$ ✓
$F_{net} = (1,2)(-40)$ ✓
$F_{net} = -48$ N
$\therefore F_{net} = 48$ N ✓

WEST AS POSITIVE for X
WES AS POSITIEF vir X

$v_f = v_i + a\Delta t$
$4 = 8 + a(0,1)$
$a = 40\ m\cdot s^{-2}$

$F_{net} = ma$ ✓
$F_{net} = (1,2)(40)$ ✓
$F_{net} = 48$ N✓

OPTION 4/*OPSIE 4*

EAST AS POSITIVE for X
OOS AS POSITIEF vir X

$\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$
$\Delta x = \left(\frac{8 + 4}{2}\right)(0,1)$
$\Delta x = 0,6$ m

$F_{net}\Delta x\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ ✓
$F_{net}(0,6)\cos 180° = \frac{1}{2}(1,2)(4)^2 - \frac{1}{2}(1,2)(8)^2$✓
$F_{net} = 48$ N ✓

WEST AS POSITIVE for X
WES AS POSITIEF vir X

$\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$
$\Delta x = \left(\frac{-8 - 4}{2}\right)(0,1)$
$\Delta x = -0,6$ m

$F_{net}\Delta x\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ ✓
$F_{net}(0,6)\cos 0° = \frac{1}{2}(1,2)(-4)^2 - \frac{1}{2}(1,2)(-8)^2$✓
$F_{net} = -48$ N ✓
$\therefore F_{net} = 48$ N ✓

OPTION 5/*OPSIE 5*

$\text{Gradient} = \frac{\Delta y}{\Delta x}$
$= \frac{\Delta v}{\Delta t}$
$= \frac{4 - 8}{0,1}$
$= -40\ m\cdot s^{-2}$

$F_{net} = ma$ ✓
$F_{net} = (1,2)(-40)$ ✓
$F_{net} = -48$ N
$F_{net} = 48$ N ✓

(3)

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

OPTION 1/*OPSIE 1*
Inelastic/*onelasties* ✓

Note/*Aantekening:*
Award mark according to final calculated answer./Ken punt toe volgens finale berekende antwoord.

$E_k = \frac{1}{2}mv^2$ ✓

$\sum E_{ki} = \frac{1}{2}m_Xv_{Xi}^2 + \frac{1}{2}m_Yv_{Yi}^2$
$= \frac{1}{2}(1,2)(8)^2 + 0$ ✓
$= 38,4$ J

$\sum E_{kf} = \frac{1}{2}m_Xv_{Xf}^2 + \frac{1}{2}m_Yv_{Yf}^2$
$= \frac{1}{2}(1,2)(4)^2 + \frac{1}{2}(0,5)(9,6)^2$ ✓
$= 32,64$ J

$\sum E_{ki} \neq \sum E_{kf}$ ✓

OPTION 2/*OPSIE 2* (Change in E_{ktotal} total /*verandering in* $E_{ktotaal}$))
Inelastic/onelasties ✓

Note/*Aantekening:*
Award mark according to final calculated answer./Ken punt toe volgens finale berekende antwoord.

$E_k = \frac{1}{2}mv^2$ ✓

$\Delta E_k(X) = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$= \frac{1}{2}(1,2)(4)^2 - \frac{1}{2}(1,2)(8)^2$ ✓
$= -28,8$ J

$\Delta E_k(Y) = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$= \frac{1}{2}(0,5)(9,6)^2 - \frac{1}{2}(0,5)(0)^2$ ✓
$= 23,04$ J

$\Delta E_k(X) \neq \Delta E_k(Y)$ ✓

Note/*Aantekening:*
If candidate starts with conservation of kinetic energy/*Indien kandidaat begin met behoud van kinetiese energie:* max/*maks* $\frac{4}{5}$

(5)
[14]

QUESTION 5/*VRAAG 5*

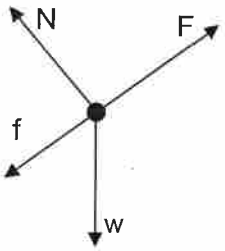
5.1

Marking criteria/*Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark./*Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

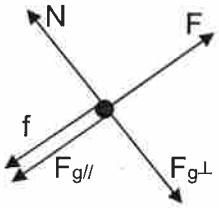
A force is non-conservative if the work done by the force on an object (which is moving between two points) depends on the path taken. ✓✓
'n Krag waarvoor die arbeid wat verrig word deur die krag op 'n voorwerp (wat tussen twee punte beweeg,) afhanklik is van die pad wat gevolg word.
OR/*OF*
A force is non-conservative if the work it does in moving an object around a closed path is non-zero.
'n Krag is nie-konserwatief wanneer die arbeid wat dit verrig om 'n voorwerp in 'n geslote pad te beweeg, nie nul is nie. (2)

Note/*Aantekening:*
-If work done is ommited/ Indien arbeid verrig uitgelaat word: $\frac{0}{2}$

5.2



OR/*OF*



Accepted labels/*Aanvaarde benoemings*	
w	F_w / F_g / mg /117,6 N / gravitational force / *gravitasiekrag* / weight / *gewig*
F	F_A /Applied force / T /*Toegepaste krag*/ F_T
f	F_f / f_k / (kinetic) Friction / *(kinetiese) wrywing* / F_w
N	F_N / Normal / *Normaal*

Notes/*Aantekeninge:*
- Mark awarded for label and arrow./*Punt toegeken vir benoeming en pyltjie.*
- Do not penalise for length of arrows since drawing is not to scale./*Moenie vir die lengte van die pyltjies penaliseer nie aangesien die tekening nie volgens skaal is nie.*
- If w is not shown but $F_{//}$ and $F_{g\perp}$ are shown, give 1 mark for both./*Indien w nie aangetoon is nie maar $F_{//}$ en $Fg_{\perp}$ is getoon, ken 1 punt toe vir beide.*
- Any other additional force(s)/*Enige ander addisionele krag(te):* Max/*Maks* $\frac{3}{4}$
- If everything is correct, but no arrows/*Indien alles korrek is, maar geen pyltjies*: Max/*Maks* $\frac{3}{4}$ •
- If force(s) do not make contact with the dot /Indien krag(te) nie met die kolletjie kontak maak nie: Max/Maks $\frac{3}{4}$

(4)

5.3

OPTION 1/*OPSIE 1*

$W_{nc} = \Delta E_k + \Delta E_p$

$W_{nc} = \frac{1}{2}m(v_f^2 - v_i^2) + mg(h_f - h_i)$ ✓ Any one/Enige een

$= \frac{1}{2}(12)(2,25^2 - 0)$ ✓ + $(12)(9,8)(4,5 - 0)$ ✓

$= 559,58$ J ✓

OPTION 2/*OPSIE 2*

$W_{Fg//} = F_{g//}\Delta x\cos$

$= (mg\sin\theta)\Delta x\cos\theta$

$= (12)(9,8)\left(\frac{4,5}{\Delta x}\right)\Delta x\cos 180°$

$= -529,2$ J

$W_{Fg} = F_g\Delta x\cos(90° + \theta)$

$= mg\Delta x(-\sin\theta)$

$= (12)(9,8)\left(\frac{-4,5}{\Delta x}\right)\Delta x$

$= -529,2$ J

$W_{net} = \Delta Ek$

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

$= \frac{1}{2}(12)(2,25)^2 - 0^2$ ✓

$= 30,375$ J

$W_{net} = W_{nc} + W_c$ ✓

$30,375 = W_{nc} + (-529,2)$ ✓

$W_{nc} = 559,575$ J ✓ (559,58 J)

OPTION 3/*OPSIE 3*

$\sin\theta = \frac{4,5}{\Delta x}$

$\Delta x = \frac{4,5}{\sin\theta}$

$W_{net} = \Delta E_k$

$W_F + W_f + W_w = \Delta E_k$ ✓Any one/ *Enige een*

$W_{nc} + (mg\sin\theta)\Delta x(\cos\beta) = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

$W_{nc} + (12)(9,8)\left(\frac{4,5}{\sin\theta}\right)\sin\theta\cos 180°$ ✓ $= \frac{1}{2}(12)(2,25)^2 - 0^2$ ✓

$W_{nc} = 559,58$ J ✓

(4)

5.4 **POSITIVE MARKING FROM QUESTION 5.3.**
POSITIEWE NASIEN VANAF VRAAG 5.3.

Marking criteria for OPTION 1 /*Nasienkriteria vir OPSIE 1*

- Formula for W_{nc} /*Formule vir* W_{nc} ✓
- Correct substitution of 559,58 J in W_{nc} along inclined plane ✓
  Korrekte vervanging van 559,58 J in W_{nc} *langs die skuinsvlak*
- Correct force equation and substitution of 0 for F_{net} **OR** $F = f_2$ on horizontal plane✓
  Korrekte kragvergelyking en vervanging van 0 vir F_{net} ***OF*** $F = f_2$ *op die horisontale vlak.*
- Relating the two frictional forces (substitution of $f_1 + 42$ for f_2).✓
  Bring die twee wrywingskragte in verband (vervanging van $f_1 + 42$ *vir* f_2*).*
- Correct answer/*Korrekte antwoord*: 13,32 m.✓

OPTION 1/*OPSIE 1*

ALONG THE INCLINE/AB/*TEEN DIE SKUINSVLAK*

$W_{nc} = W_F + W_f$
$W_{nc} = F\Delta x\cos 0° + f_1\Delta x\cos 180°$ } ✓ Any one/*Enige een*
$559,58 = F\Delta x\cos 0° + f_1\Delta x\cos 180°$
$559,58$ ✓ $= (F - f_1)\Delta x$ .....(1)

ALONG THE HORIZONTAL/BC/*LANGS DIE HORISONTAAL*

$F - f_2 = ma$
$F - f_2 = 0$ ✓ **OR/*OF*** $F = f_2$
$F - (f_1 + 42)$ ✓ $= 0$
$F - f_1 = 42$.....(2)

Substitute/*Vervang* (2) into/*in* (1):
$559,58 = 42\Delta x$
$\Delta x = 13,32$ m ✓

Marking criteria for OPTION 2 and 3 /*Nasienkriteria vir OPSIE 2 en 3*

- Correct force equation and substitution of 0 for F_{net} **OR** $F = f_2$ on horizontal plane✓
  Korrekte kragvergelyking en vervanging van 0 vir F_{net} ***OF*** $F = f_2$ *op die horisontale vlak.*
- Relating the two frictional forces (substitution of $f_1 + 42$ for f_2).✓
  Bring die twee wrywingskragte in verband (vervanging van $f_1 + 42$ *vir* f_2*).*
- Formula for W_{nc} **OR** W_{net} /*Formule vir* W_{nc} ***OF*** W_{net}✓
- Correct substitution into equation for W_{nc} **OR** W_{net} on the horizontal plane✓
  Korrekte vervanging in W_{nc} ***OF*** W_{net} *vergelyking langs die skuinsvlak*
- Correct answer/*Korrekte antwoord*: 13,32 m.✓

NOTE/LETWEL
If calculation for F along horizontal not shown but 42N substituted for $F - f_1$ in W_{nc} calculation, allocate 2 marks/Indien berekening vir F langs horisontaal nie getoon nie, maar 42N vervang vir $F - f_1$ in W_{nc} berekening, ken 2 punte toe.

OPTION 2/*OPSIE 2*

ALONG THE HORIZONTAL/BC/*LANGS DIE HORISONTAAL*

$F - f_2 = ma$
$F - f_2 = 0$ ✓ **OR/*OF*** $F = f_2$
$F - (f_1 + 42)$ ✓ $= 0$
$F = f_1 + 42$

ALONG THE INCLINE/AB/*TEEN DIE SKUINSVLAK*

$W_{nc} = \Delta E_K + \Delta E_P$
$(F - f_1)\Delta x\cos\theta = [\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2] + [mgh_f - mgh_i]$ } ✓ Any one/*Enige een*
$(f_1 + 42 - f_1)\Delta x\cos 0° = [\frac{1}{2}(12)(2,25)^2 - 0^2] + [(12)(9,8)(4,5) - 0]$ ✓
$\Delta x = 13,32$ m ✓ (13,32 m)

OPTION 3/*OPSIE 3*

ALONG THE HORIZONTAL/BC/*LANGS DIE HORISONTAAL*

$F - f_2 = ma$
$F - f_2 = 0$ ✓

OR/*OF* $F = f_2$

$F - (f_1 + 42)$ ✓$= 0$
$F = f_1 + 42$

ALONG THE INCLINE/AB/*TEEN DIE SKUINSVLAK*

$W_{net} = \Delta E_K$
$(F - f_1 - F_{g//})\Delta x\cos\theta = [\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2]$
} ✓ Any one/ *Enige een*

$[(42) - (12)(9,8)\left(\frac{4,5}{\Delta x}\right)]\ \Delta x\cos 0^\circ = \frac{1}{2}(12)(2,25)^2$ ✓$- 0^2$

$\Delta x = 13,323214$ m ✓ (13,32 m)

OPTION 4/*OPSIE 4*

$W_{nc} = \Delta E_K + \Delta E_P$
$W_{nc} = [\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2] + [mgh_f - mgh_i]$
} ✓ Any one/ *Enige een*

$(f_1 + 42 - f_1)$✓$\Delta x\cos 0^\circ$ ✓$= 559,575$ ✓
$(42)\Delta x\cos 0^\circ = 559,575$
$\Delta x = 13,323214$ m ✓ (13,32 m)

Marking criteria for OPTION 5/*Nasienkriteria vir OPSIE 5*

- Correct force equation and substitution of 0 for F_{net} **OR** $F = f_2$ on horizontal plane✓/ *Korrekte kragvergelyking en vervanging van 0 vir F_{net}* ***OF*** *$F = f_2$ op die horisontale vlak.*
- Relating the two frictional forces (substitution of $f_1 + 42$ for f_2).✓
  Bring die twee wrywingskragte in verband (vervanging van $f_1 + 42$ vir f_2).
- Correct substitution to calculate a./*Korrekte vervanging om a te bereken.* ✓.
- Substitution to calculate F_{net}./*Vervanging om F_{net} te bereken.* ✓
- Correct answer/*Korrekte antwoord*: 13,32 m.✓

OPTION 5/*OPSIE 5*

ALONG THE HORIZONTAL/BC/*LANGS DIE HORISONTAAL*

$F - f_2 = ma$
$F - f_2 = 0$ ✓

OR/*OF* $F = f_2$

$F - (f_1 + 42)$ ✓$= 0$
$F = f_1 + 42$ .....(1)

ALONG THE INCLINE/AB/*TEEN DIE SKUINSVLAK*

$v_f^2 = v_i^2 + 2a\Delta x$
$2,25^2 = 0 + 2a\Delta x$ ✓
$a = \frac{2,53}{\Delta x}$

$F_{net} = ma$
$F - F_{g//} - f_1 = ma$
$F - mg\sin\theta - f_1 = 12a$ .....
$F - (12)(9,8)\sin\theta - f_1 = 12\left(\frac{2,53}{\Delta x}\right)$ ✓....(2)

Substitute/*Vervang* (2) into/*in* (1):
$42 - (12)(9,8)\left(\frac{4,5}{\Delta x}\right) = 30,38$
$\Delta x = 13,32$ m ✓

(5)
[15]

QUESTION/*VRAAG 6*

6.1 Doppler Effect/*Doppler-effek* ✓ (1)

6.2 Measurement of foetal heartbeat./*Meting van die hartklop van 'n fetus.*✓

OR/*OF*
Measurement of blood flow./*Meting van bloedvloei.* ✓

OR/*OF*
Doppler flow meter/*Doppler vloeimeter* ✓

OR/*OF*
Doppler ultrasound/*Doppler ultraklank*✓ (1)

6.3 $f_L \propto f_s$ ✓

OR/*OF*
Directly (proportional)/*Direk (eweredig)* (1)

6.4

Marking criteria/*Nasienkriteria*

- Doppler formula/*Doppler formule* ✓
- Correct substitution for v and v_S./*Korrekte vervanging van v en v_S.* ✓
- Substitution for $\frac{f_L}{f_S} = 1{,}06$ **OR** $f_L = 1{,}06\ f_s$ **OR** any set of values for f_L and f_S so that $f_L = 1{,}06\ f_S$ / *Vervanging van* $\frac{f_L}{f_S} = 1{,}06$ ***OF*** $f_L = 1{,}06\ f_s$ ***OF*** *enige stel waardes vir* f_L *en* f_S *sodat* $f_L = 1{,}06\ f_S$ ✓✓
- Final answer/*Finale antwoord:* 20,4 $m \cdot s^{-1}$ ✓

OPTION 1/*OPSIE 1*

$f_L = \frac{v \pm v_L}{v \pm v_S} f_S$ ✓ **OR/*OF*** $f_L = \frac{v + v_L}{v} f_S$

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

✓✓ $1{,}06 = \left(\frac{340 + v_L}{340}\right)$ ✓

$v_L = 20{,}4\ m \cdot s^{-1}$ ✓

OPTION 2/*OPSIE 2*

Gradient $= \frac{0 - f_L}{0 - f_S}$

✓✓ $1{,}06 = \frac{0 - f_L}{0 - f_S}$

$f_L = 1{,}06\ f_S$

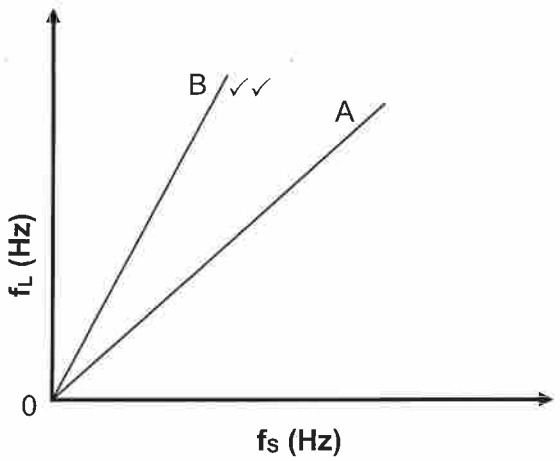
$f_L = \frac{v \pm v_L}{v \pm v_S} f_S$ ✓ **OR/*OF*** $f_L = \frac{v + v_L}{v} f_S$

$1{,}06\ f_S = \left(\frac{340 + v_L}{340}\right) f_S$ ✓

$v_L = 20{,}4\ m \cdot s^{-1}$ ✓

(5)

6.5



Marking criteria/*Nasienkriteria*	
Graph is a straight line starting at the origin./ Grafiek is 'n reguitlyn wat by die oorsprong begin.	✓
Gradient of B is greater than gradient of A./ *Gradiënt van B is groter as gradiënt van A.*	✓
Notes/*Aantekeninge:* • If only one graph labelled do not penalise./*Moenie penaliseer indien slegs een grafiek benoem is nie.* • If A and B are not indicated/*Indien A en B nie aangedui is nie:* $\frac{0}{2}$	

(2)
[10]

QUESTION 7/VRAAG 7

7.1

Marking criteria/*Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark./*Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

The magnitude of the electrostatic force exerted by one point charge on another is directly proportional to the product of the magnitudes of the charges and inversely proportional to the square of the distance between them. ✓✓
Die grootte van die elektrostatiese krag wat een puntlading op 'n ander uitoefen, is direk eweredig aan die produk van die grootte van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle. (2)

7.2 Negative/*negatief* ✓ (1)

7.3

Accepted labels/*Aanvaarde byskrifte*	
F_E	$F_{electrostatic}$/ F/ $F_{M\ ON\ N}$/ electrostatic force/ F_M *$F_{elektrostaties}$/ F/ $F_{M\ OP\ N}$/ elektrostatiese krag/ F_M*
w	F_g / w/ mg/ gravitational force / F_w/ weight/ gravity F_g / w/ mg/ *gravitasiekrag*/ F_w/ *gewig*/ *swaartekrag*

Notes/*Aantekeninge*:

- Do not penalise for length of arrows./*Moenie vir lengte van die pyltjie penaliseer nie.*
- Any other additional force(s)/*Enige addisionele krag(te)*: Max/*Maks* $^1/_2$
- If arrows are omitted but correctly labelled/*Indien pyltjies weggelaat is, maar korrek benoem*: Max/*Maks* $^1/_2$
- If force(s) do not make contact with the dot /Indien krag(te) nie met die kolletjie kontak maak nie: Max/Maks $^1/_2$

(2)

7.4

Marking criteria/*Nasienkriteria*

- Correct substitution to calculate weight of M./*Korrekte vervanging om gewig van M te bereken.* ✓
- Coulomb's formula/*Coulomb se formule* ✓
- Substitute/*Vervang* $F_{net} = 0$/ $mg = \frac{kQ_MQ_N}{r^2}$ (equating forces)/ $0,02 = \frac{kQ_MQ_N}{r^2}$ (equating forces)✓
- Correct substitution into $\frac{kQ_MQ_N}{r^2}$/*Korrekte vervanging in* $\frac{kQ_MQ_N}{r^2}$ ✓
- Correct final answer (accept negative value)/*Korrekte finale antwoord (aanvaar negatiewe waarde):* $2,33 \times 10^{-6}$ C to/*tot* $2,32 \times 10^{-6}$ C✓

$F_g = mg$
$= (2,04 \times 10^{-3})(9,8)$ ✓
$= 0,02$ N

$F = \frac{kQ_MQ_N}{r^2}$ ✓

$F_{net} = mg - \frac{kQ_MQ_N}{r^2}$

$0 = 0,02 - \frac{(9 \times 10^9)(Q_M)(8,6 \times 10^{-8})}{(0,3)^2}$ ✓

$Q_M = 2,33 \times 10^{-6}$ C ✓

IF/*INDIEN*:

$F = \frac{kQ_MQ_N}{r^2}$ ✓

$2,04 \times 10^{-3})(9,8)$ ✓✓ $= \frac{(9 \times 10^9)(Q_M)(8,6 \times 10^{-8})}{(0,3)^2}$ ✓

$Q_M = 2,33 \times 10^{-6}$ C ✓

(5)

7.5.1 Equal/*Gelyk* ✓

OR/*OF*
Same/*Dieselfde* (1)

7.5.2 Opposite **OR** upwards/*Teenoorgesteld* ***OF*** *opwaarts*✓ (1)

7.6 **POSITIVE MARKING FROM QUESTION 7.4.**
POSITIEWE NASIEN VANAF VRAAG 7.4.

Marking criteria/*Nasienkriteria*

- Formula for E./*Formule vir E.* ✓
- Correct substitution for M **OR** N./*Korrekte vervanging vir M* ***OF*** *N.* ✓
- Subtraction of $E_M - E_N$ **OR** $E_N - E_M$ /*Aftrekking van* $E_M - E_N$ ***OF*** $E_N - E_M$. ✓
- Correct final answer/*Korrekte finale antwoord:*
  $5{,}31 \times 10^4$ N.C^{-1} to/*tot* $5{,}37 \times 10^4$ N·C^{-1}✓
- Correct direction/*Korrekte rigting*: upwards/*opwaarts* ✓

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF:*

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

$$E_{net} = \left(\frac{(9 \times 10^9)(2{,}33 \times 10^{-6})}{(0{,}4)^2}\right) \checkmark - \left(\frac{(9 \times 10^9)(8{,}6 \times 10^{-8})}{(0{,}1)^2}\right) \checkmark$$

E_{net} = 131 062,5 - 77 400
= 53 662,5 N·C^{-1} ✓ ($5{,}36 \times 10^4$ N.C^{-1}) upwards/towards M
opwaarts/na M ✓

DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF:*

$$E_{net} = \frac{kQ}{r^2} \checkmark$$

$$E_{net} = \left(\frac{(9 \times 10^9)(8{,}6 \times 10^{-8})}{(0{,}1)^2}\right) \checkmark - \left(\frac{(9 \times 10^9)(2{,}33 \times 10^{-6})}{(0{,}4)^2}\right) \checkmark$$

E_{net} = 77 400 – 131 062,5
= - $5{,}37 \times 10^4$ N·C^{-1}
∴ E_{net} = 53 662,5 N·C^{-1} ✓ ($5{,}36 \times 10^4$ N.C^{-1}) upwards/towards M
opwaarts/na M ✓

(5)
[17]

QUESTION 8/*VRAAG 8*

8.1

Marking criteria/*Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark./*Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

The potential difference across a conductor is directly proportional to the current in the conductor at constant temperature (provided temperature and all other physical conditions are constant). ✓✓
Die potensiaalverskil oor 'n geleier is direk eweredig aan die stroom in die geleier by konstante temperatuur (mits temperatuur en alle fisiese toestande konstant bly).

OR/*OF*
The ratio of potential difference to current is constant at constant temperature.
Die verhouding van potensiaalverskil tot stroom is konstant by konstante temperatuur.

OR/*OF*
The current in a conductor is directly proportional to the potential difference across the conductor at constant temperature (provided temperature and all other physical conditions are constant).
Die stroom in 'n geleier is direk eweredig aan die potensiaalverskil oor 'n geleier by konstante temperatuur (mits temperatuur en alle fisiese toestande konstant bly). (2)

NOTE/*LET WEL*
Accept three or more parallel resistors in formula /*Aanvaar drie of meer parallelle weerstande in formule weerstande*

Do not award the mark for addition of 4 if any other value is added to R_p/ *Moenie die punt vir bytel van 4 toeken indien enige ander waarde by R_p bygetel word nie.*

8.2.1

OPTION 1/*OPSIE 1*

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} \checkmark$$

$$\frac{1}{R_p} = \frac{1}{1} + \frac{1}{5} \checkmark$$

$R_p = 0,83\ \Omega$

$R_T = 0,83 + 4$ ✓
$= 4,83\ \Omega$ ✓

OPTION2/*OPSIE2*

$$R_p = \frac{R_1 R_2}{R_1 + R_2} \checkmark$$

$$R_p = \frac{(1)(5)}{1+5} \checkmark$$

$R_p = 0,83\ \Omega$

$R_T = 0,83 + 4$ ✓
$= 4,83\ \Omega$ ✓

(4)

8.2.2 **POSITIVE MARKING FROM QUESTION 8.2.1.**
POSITIEWE NASIEN VANAF VRAAG 8.2.1.

OPTION 1/*OPSIE 1*

$R = \frac{V}{I}$ ✓

$4{,}83 = \frac{V}{3{,}5}$ ✓

$V = 16{,}91$ V ✓ (16,92 V)

OPTION 2/*OPSIE 2*

$R_p = \frac{V_2}{I}$ ✓

$0{,}83 = \frac{V}{3{,}5}$

$V_2 = 2{,}91$ V

$R_{4\Omega} = \frac{V_{4\Omega}}{I}$ ✓ Any one/*Enige een*

$4 = \frac{V_{4\Omega}}{3{,}5}$

$V_{4\Omega} = 14$ V

$V_1 = V_2 + V_{4\Omega}$
$V_1 = 2{,}91 + 14$
$= 16{,}91$ V ✓ (16,92 V) (3)

8.2.3 Smaller than/*Kleiner as* ✓ (1)

8.3.1

Marking criteria/*Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark./*Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

Maximum work done by the battery per unit charge. ✓✓
Maksimum arbeid verrig deur die battery per eenheidslading.

OR/*OF*
Maximum energy supplied by the battery per unit charge.
Maksimum energie verskaf deur die battery per eenheidslading.

OR/*OF*
The total amount of electric energy supplied by the battery per coulomb/per unit charge.
Die totale hoeveelheid elektriese energie verskaf deur die battery per coulomb/per eenheidslading. (2)

8.3.2 No/*Nee* ✓ (1)

8.3.3 The battery has internal resistance.✓
Die battery het interne weerstand.

OR/*OF*
Some energy per coulomb of charge/volts is used to overcome internal resistance.
'n Gedeelte van die energie per coulomb lading/volts word gebruik om interne weerstand te oorkom.

OR/*OF*
There is a potential drop/lost volts inside the battery.
Daar is 'n potensiaalval/verlore volts binne-in die battery.

OR/*OF*
$\varepsilon = V_{ext} + V_{int}$

OR/*OF*
$\varepsilon > V_{ext}$ (1)

8.4.1 Decreases/*Verlaag* ✓ (1)

8.4.2 Increases/*Verhoog* ✓ (1)

8.5 When the voltmeter is connected:
- No/very little current through the 1 Ω branch **OR** Branch with 1 Ω resistor is disabled/bypassed **OR** A voltmeter has a very high resistance **OR** The resistance of the parallel branch increases. ✓
- (Total) resistance of the circuit increases. ✓
- Current in circuit decreases. ✓
- $V_{internal}$/ Internal volts/ V_{lost} decreases. ✓

Therefore, external volts increase for a constant emf.

Wanneer die voltmeter geskakel word:
- *Geen/baie min stroom deur die 1 Ω-tak **OF** Tak met 1 Ω-weerstand is uitgeskakel **OF** Voltmeter het baie hoë weerstand **OF** Die weerstand van die parallelle tak neem toe.*
- *(Totale) weerstand van die stroombaan neem toe.*
- *Stroom in stroombaan neem af.*
- *V_{intern}/ Interne volts/ $V_{verlore}$ neem af.*

Dus neem die eksterne volts toe vir konstante emf. (4)
[20]

QUESTION 9/*VRAAG 9*

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

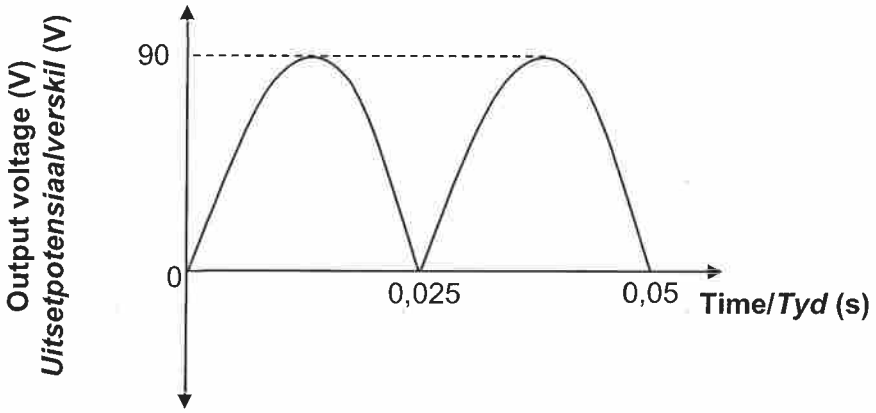
9.1.2 **Y** to/*na* **X** **OR/*OF*** 0 /no current/*geen stroom nie*✓ (1)

9.1.3 $T = \frac{1}{f}$

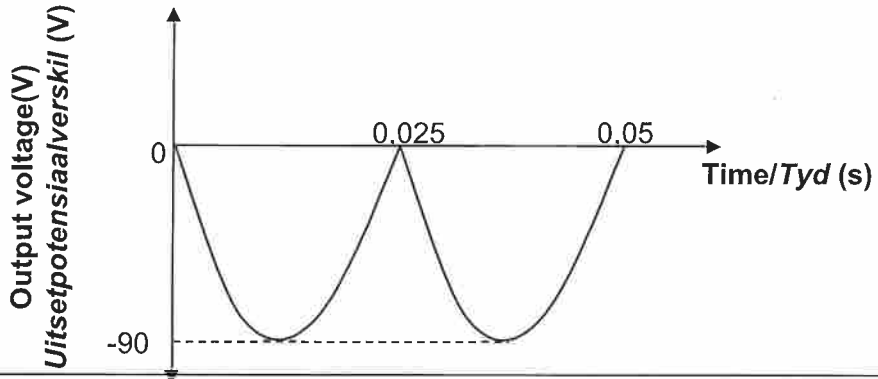
$T = \frac{1}{20}$

$T = 0{,}05$ s ✓ (1)

9.1.4 **POSITIVE MARKING FROM QUESTION 9.1.3.**
POSITIEWE NASIEN VANAF VRAAG 9.1.3.



OR/*OF*



Criteria for graph/*Kriteria vir grafiek*	
Correct shape with one full cycle./*Korrekte vorm met 1 volledige siklus.*	✓
Curve starts at zero to first peak./*Kurwe begin by nulpunt tot eerste piek.*	✓
Any one of the correct time values at the correct position./*Enige een van die korrekte tyd waardes op die korrekte posisie.*	✓
Maximum voltage of 90 V OR -90 V/ *Maksimum potensiaalverskil van 90 V OF -90 V*	✓
NOTE/*LET WEL*: - 1 mark for half cycle/incomplete cycle or more than one cycle *-1 punt vir halwe siklus/onvoltooide siklus of meer as een siklus*	

(4)

9.2

Marking criteria/*Nasienkriteria*

- Formula to calculate W_{ave} (do not penalise if subscripts are ommited)./ *Formule om W_{gem} te bereken (moenie penaliseer indien onderskrifte uitgelaat is nie).* ✓
- Substitution of 220 and 32 in correct equation. ✓ *Vervanging van 220 en 32 in die korrekte vergelyking.*
- Substitution of 120 for Δt/*Vervanging van 120 in Δt.* ✓
- Correct answer in range: 181 500 J to 181 764 J ✓ *Korrekte antwoord in gebied: 181 500 J tot 181 764 J* ✓

OPTION 1/*OPSIE 1*

$W_{ave} = \frac{V_{rms}^2 \Delta t}{R}$ ✓

$= \frac{220^2(120)}{32}$ ✓

$= 181\ 500$ J ✓

OPTION 2/*OPSIE 2*

$R = \frac{V_{rms}}{I_{rms}}$ ✓

$32 = \frac{220}{I_{rms}}$

$I_{rms} = 6,88$ A (6,875 A)

$W_{ave} = V_{rms} I_{rms} \Delta t$ ✓
$= (220)(6,88)(120)$ ✓
$= 181\ 632$ J ✓

OR/*OF*

$W_{ave} = I_{rms}^2 R \Delta t$ ✓
$= (6,88)^2(32)(120)$ ✓
$= 181\ 764,10$ J ✓

OPTION 3/*OPSIE 3*

$R = \frac{V_{rms}}{I_{rms}}$ ✓

$32 = \frac{220}{I_{rms}}$ ✓

$I_{rms} = 6,88$ A (6,875 A)

$P_{ave} = V_{rms} I_{rms}$
$= (220)(6,88)$
$= 1\ 513,6$ W
$(1,51 \times 10^3$ W)

$P_{ave} = I_{rms}^2 R$
$= (6,88)^2(32)$
$= 1\ 514,7$ W (1 512,5 W)
$(1,51 \times 10^3$ W)

$P = \frac{W}{\Delta t}$ ✓

$1\ 513,6 = \frac{W}{120}$ ✓

$W = 181\ 632$ J ✓ $(1,82 \times 10^5$ J)

OPTION 4/OPSIE 4

$P_{ave} = \frac{V_{rms}^2}{R}$

$P_{ave} = \frac{220^2}{32}$ ✓

$P_{ave} = 1\ 512,5$ W
$(1,51 \times 10^3$ W)

(4)
[11]

QUESTION 10/*VRAAG 10*

10.1 Light has a particle nature/is quantized (accept particle nature and wave nature).✓
Lig het 'n deeltjie geaardheid/is gekwantiseerd (aanvaar deeltjie geaardheid en golf geaardheid). (1)

10.2

Marking criteria/*Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark./*Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

The minimum energy (of incident photons) that can eject electrons from a metal/surface. ✓✓
Die minimum energie (van invallende fotone) wat elektrone kan vrystel vanuit 'n metaal/oppervlak. (2)

10.3

$E = W_0 + E_{k(max)}$
$hf = hf_0 + E_{k(max)}$
$hf = hf_0 + \frac{1}{2}mv^2_{max}$
$E = W_0 + \frac{1}{2}mv^2_{max}$
✓ Any one/ *Enige een*

$(6,63 \times 10^{-34})(5,96 \times 10^{14})$ ✓ $= 3,42 \times 10^{-19} + E_{k(max)}$ ✓
$E_{k(max)} = 5,30 \times 10^{-20}$J ✓ $(5,32 \times 10^{-20}$ J) (4)

10.4 $q = I\Delta t$
$= (0,012)(10)$ ✓
$= 0,12$ C

$n = \frac{Q}{e}$

$n = \frac{0,12}{1,6 \times 10^{-19}}$ ✓ ✓

$n = 7,5 \times 10^{17}$ (electrons/*elektrone*)

number of photons/*aantal fotone* = $n = 7,5 \times 10^{17}$✓ (4)

10.5 Increases/*Verhoog* ✓

More photons strike the surface of the metal per unit time/ at a higher rate✓hence more (photo) electrons ejected per unit time ✓(resulting in increased current).
Meer fotone tref die oppervlak van die metaal per eenheidstyd/ teen 'n hoër tempo, gevolglik word meer (foto)elektrone per eenheidstyd vrygestel (wat tot 'n verhoogde stroom lei). (3)
[14]

TOTAL/*TOTAAL*: 150