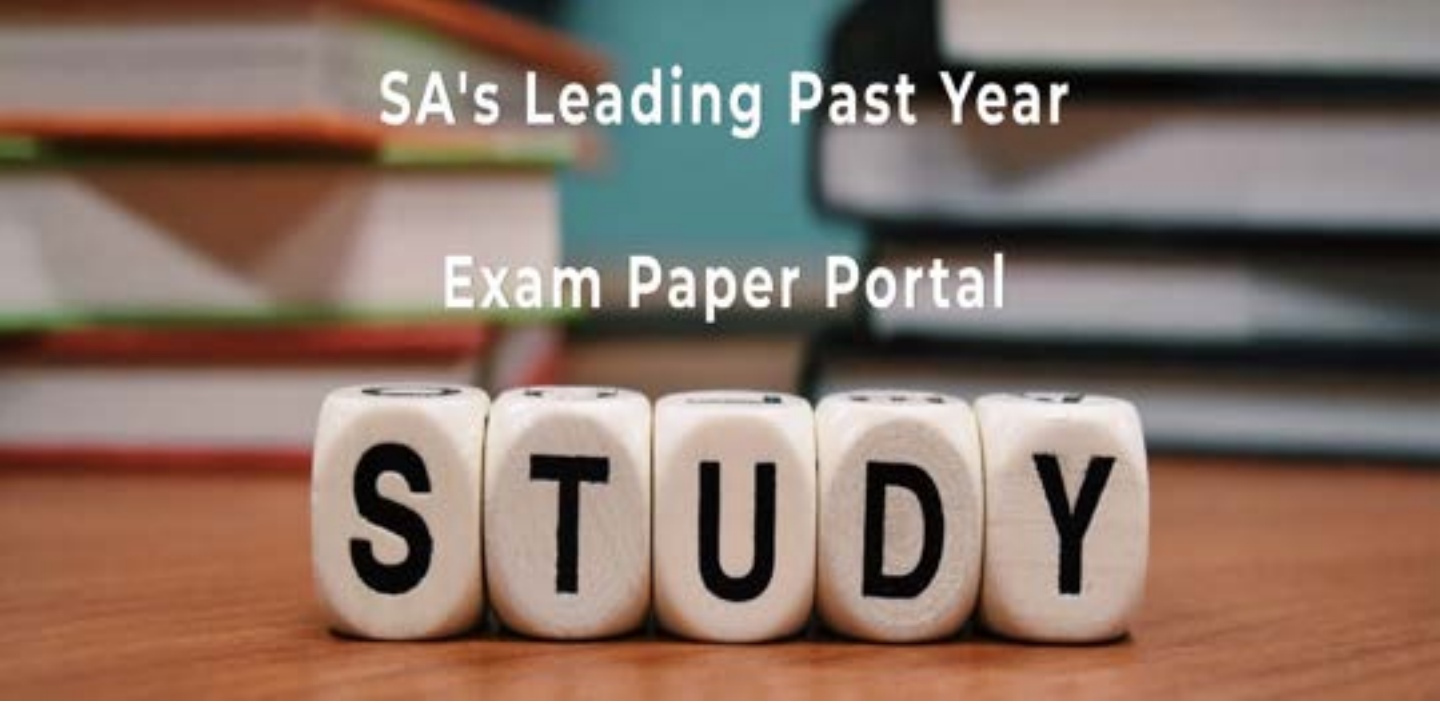

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GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

SEPTEMBER 2018

MARKS: 150

TIME: 3 hours

This paper consists of 18 pages and 3 information sheets

INSTRUCTIONS AND INFORMATION

1. Write your name on the ANSWER BOOK.
2. This question paper consists of ELEVEN 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 open between two subquestions, for example between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the attached DATA SHEETS.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your final numerical answers to a minimum of TWO decimal places.
11. Give brief motivations, discussions et cetera where required.
12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

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

1.1 Which ONE of the following is a conservative force?

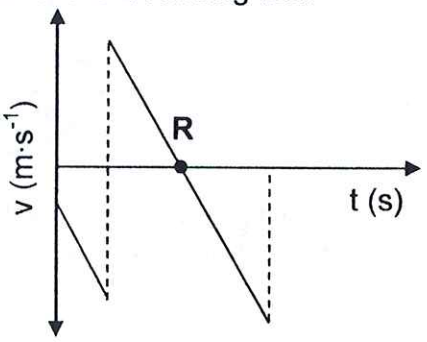
A Frictional force

B Gravitational force

C Normal force

D Tension in a rope (2)

1.2 A ball is projected vertically downwards from a height above the ground. It strikes the ground and bounces up. The velocity-time-graph below represents the motion of the bouncing ball.

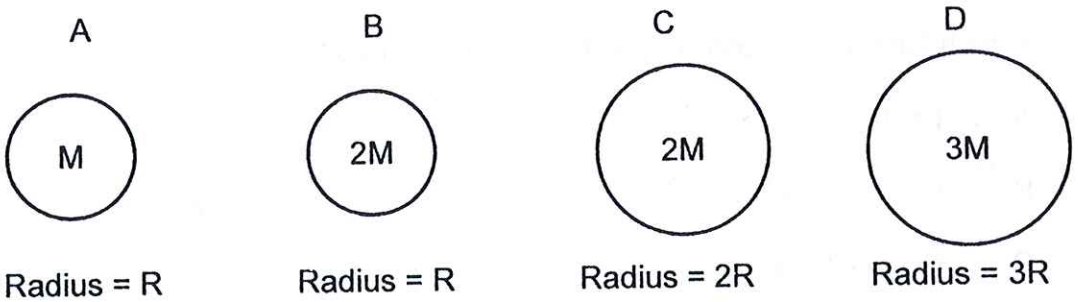


Which ONE of the combinations of the position and magnitude of the acceleration of the ball at point **R** on the graph, is CORRECT?

	POSITION	**MAGNITUDE OF ACCELERATION ($m \cdot s^{-2}$)**
A	On the ground	0
B	Maximum height after bounce	9,8
C	Maximum height after bounce	0
D	On the ground	9,8

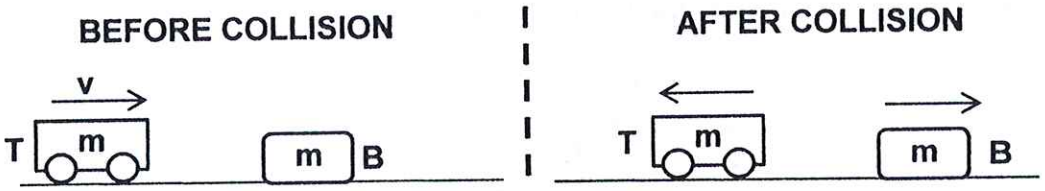
(2)

1.3 An object is dropped from a certain height above the surface of different planets. The mass and radius of each planet is shown in the options below. Which ONE of the following planets will cause the greatest gravitational acceleration on the object? Ignore any effects of air friction.

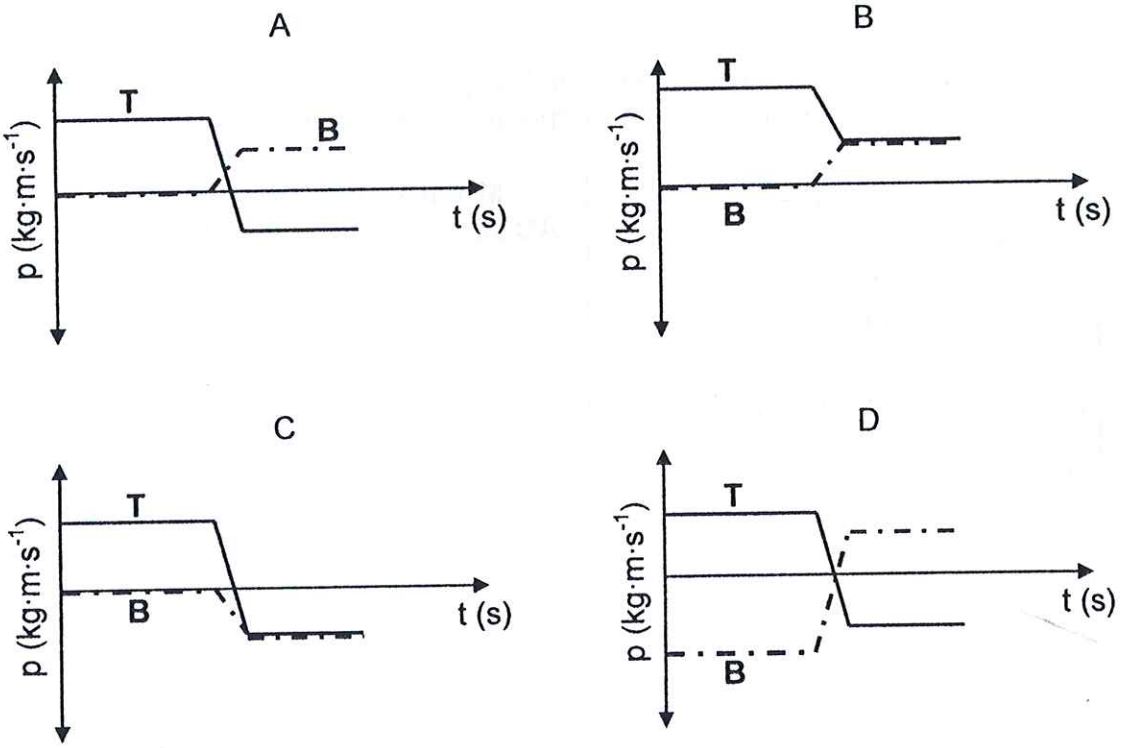


(2)

1.4 A trolley **T** with mass **m** moves on a frictionless horizontal surface to the right at a constant speed **v**. The trolley collides against a stationary block **B** with the same mass **m**. After the collision the trolley moves to the left.



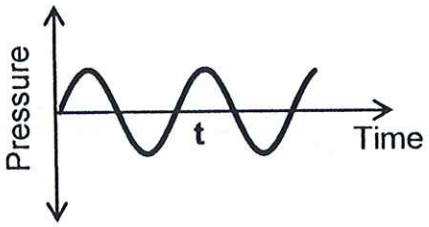
Which ONE of the following **p** versus **t** graphs is the CORRECT representation of the momentum of the trolley and block *before* and *after* the collision?



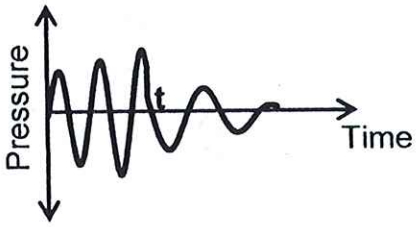
(2)

1.5 During an experiment a car produces a sound with a constant frequency of 800 Hz. The car moves with a constant velocity past a stationary listener at time **t**. Which one of the following pressure-time graphs below CORRECTLY represents the sound of the car, as observed by the listener?

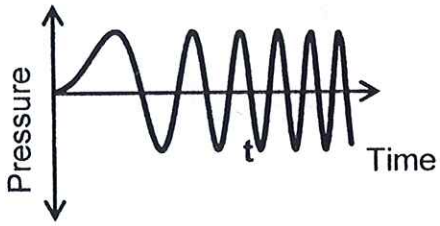
A



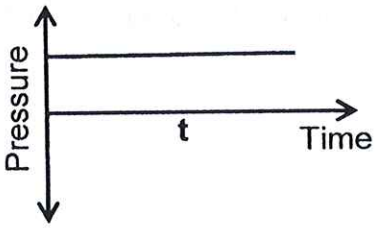
B



C

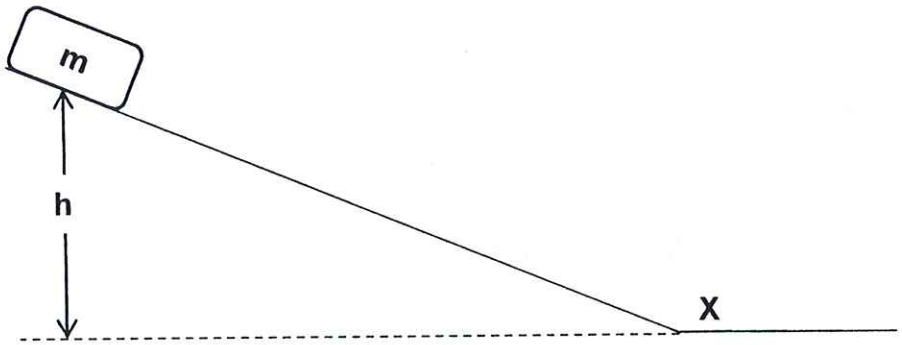


D



(2)

1.6 A block with a mass **m** moves from rest from a height **h** down a frictionless track and reaches point **X** with speed **v**.



Which ONE of the following changes will produce a speed of 2**v** at point **X**?

A Double the mass of the block.

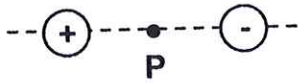
B Double the gradient of the track from the same height **h**.

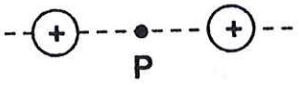
C Increase the height to 4**h**.

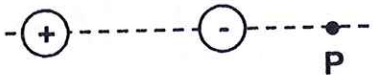
D Use a track with a rough surface. (2)

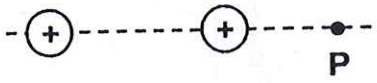
1.7 Two equally charged spheres are placed as shown in the diagrams below.

In which ONE of the diagrams will the net electric field at point **P** be the greatest?

A 

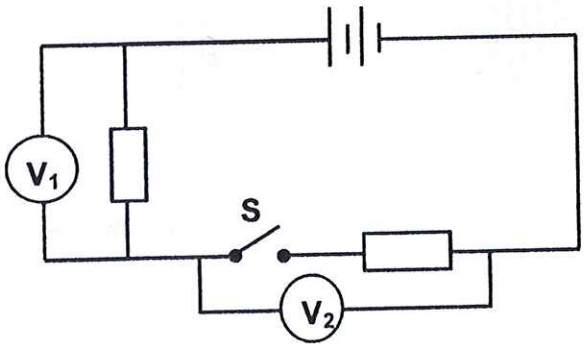
B 

C 

D 

(2)

1.8 A battery with negligible internal resistance is connected to two resistors as shown in the diagram below. The switch **S** is OPEN.



Switch **S** is now CLOSED.

How will the readings on the voltmeters V_1 and V_2 change?

	READING ON V_1	READING ON V_2
A	Increases	Increases
B	Decreases	Increases
C	Increases	Decreases
D	Decreases	Decreases

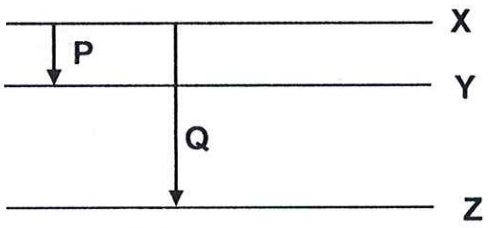
(2)

1.9 Which ONE of the following combinations represents the component(s) present AS WELL AS the energy conversion in a direct current (DC) motor?

	Component	Energy Transfer
A	Splitring commutator	Electrical to mechanical energy
B	Slip rings	Mechanical to electrical energy
C	Slip rings	Electrical to mechanical energy
D	Splitring commutator	Mechanical to electrical energy

(2)

1.10 The diagram below represents 3 energy levels **X**, **Y** and **Z** in an atom. The energy difference between levels **Y** and **Z** is DOUBLE the energy difference between levels **X** and **Y**.



The wavelength of a photon that is ejected due to transition **P** is λ. The wavelength of the photon that is ejected during transition **Q** is:

A 2λ

B 3λ

C $\lambda/2$

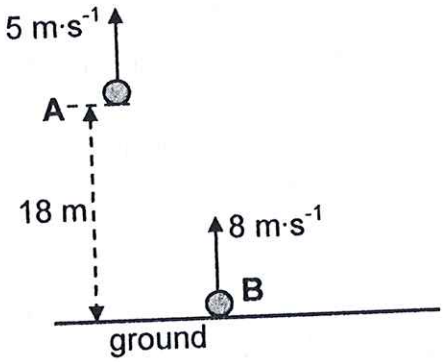
D $\lambda/3$

(2)
[20]

QUESTION 2 (Start on a new page)

Ball **A** is projected vertically upwards at a speed of 5 $m \cdot s^{-1}$ from the top of a 18 m high building. Ignore air resistance.

2.1 Calculate the time taken for ball **A** to reach its maximum height. (3)



At the same instant that ball **A** is projected, ball **B** is projected vertically upwards from the ground at a speed of 8 $m \cdot s^{-1}$.

2.2 Calculate the magnitude of the velocity of ball **B** the moment that ball **A** is at its maximum height. (3)

2.3 Calculate the time, from the moment the balls were projected, for the speed of the two balls to be EQUAL. (4)

2.4 Sketch velocity-time graphs for the COMPLETE motions of ball **A** and ball **B** ON THE SAME SET OF AXES. Label the respective graphs for ball **A** and **B** clearly.

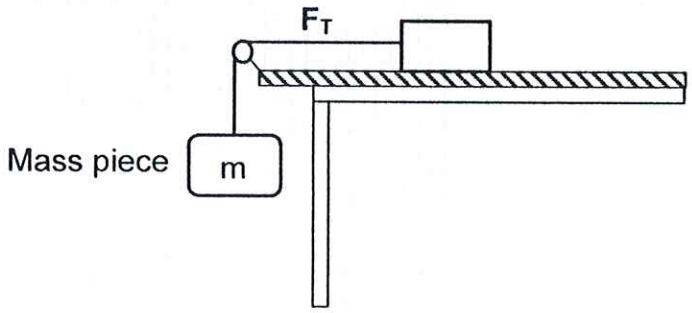
Show the following on the graphs:

- The initial velocity of ball **A**
- The time taken for ball **A** to reach its maximum height
- The initial velocity of ball **B**

(4)
[14]

QUESTION 3 (Start on a new page)

Learners are investigating the relationship between the applied force and acceleration of a block that is initially at rest on a rough surface. The block is attached to different mass pieces by a light inextensible string passing over a light frictionless pulley as shown in the diagram below. Ignore the effects of air resistance.

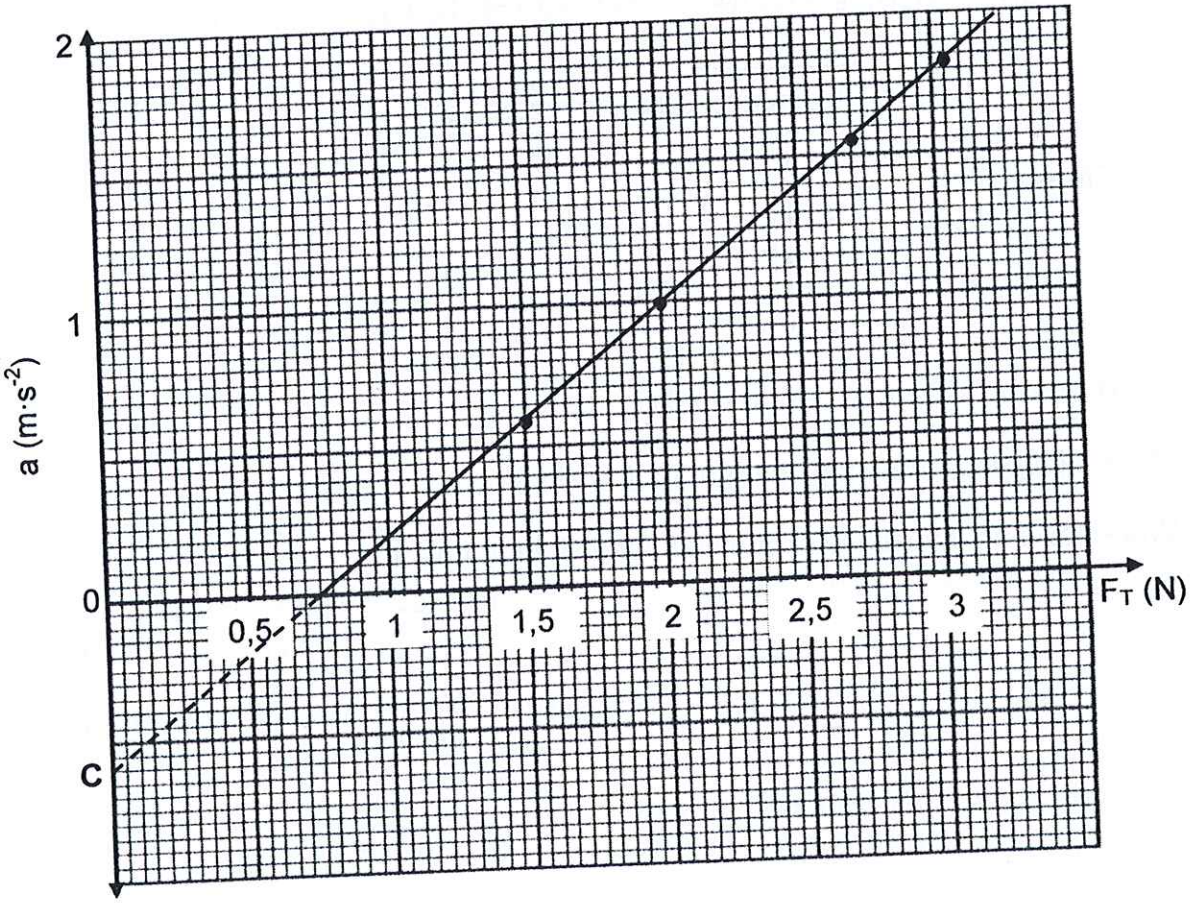


3.1 State Newton's Second Law in words. (2)

3.2 Draw a labelled free-body diagram for the block. (4)

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

The learners repeat the experiment a few times by using different mass pieces and then calculate the acceleration. They plot the following graph from their results as shown below.



3.4 Give a reason why the graph does NOT pass through the origin. (1)

3.5 From the graph, write down the kinetic frictional force between the block and the surface. (1)

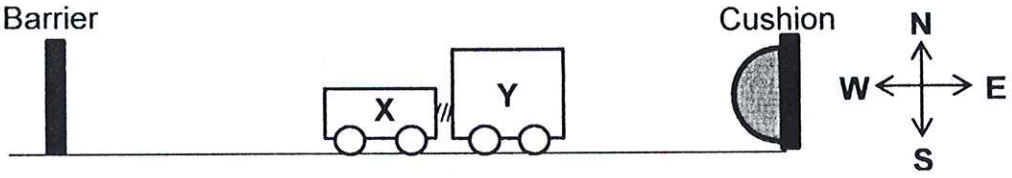
3.6 Calculate the gradient (slope) of the graph. (2)

3.7 Calculate the mass of the block. (2)

3.8 Write down the mathematical expression represented by the y-intercept **C** on the graph. (1)
[15]

QUESTION 4 (Start on a new page)

Trolley **X** with a mass **m** is placed against trolley **Y** with mass 3**m**, as shown in the diagram below. A compressed spring between the two trolleys releases in 0,3 s and the trolleys move in opposite directions. Trolley **X** moves west and hits a barrier after time **t**.



The table below gives the position of trolley **X** for time intervals of 0,3 seconds:

Position (m)	0	1,38	2,88	4,38	5,88	7,38	7,38	7,38
Time (s)	0	0,3	0,6	0,9	1,2	1,5	1,8	2,1

4.1 At which time **t** does the trolley **X** hit the barrier? (1)

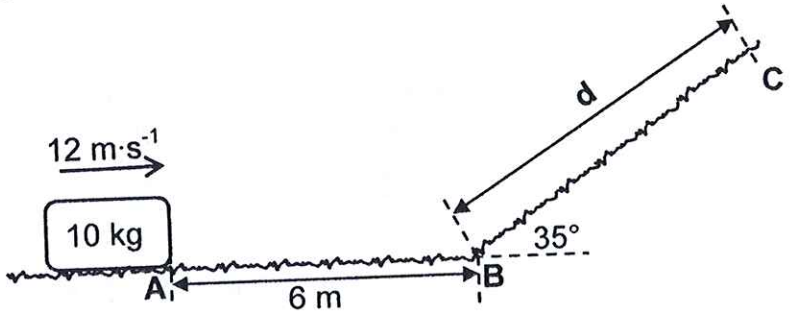
4.2 Explain, with reference to the values in the table, why trolley **X** moves with a constant speed between t = 0,3 s and t = 1,5 s. (2)

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

4.4 Calculate the speed of trolley **Y** after the spring is released. (4)
[9]

QUESTION 5 (Start on a new page)

A block with mass 10 kg moves on a rough surface and reaches point **A** at 12 $m \cdot s^{-1}$. The surface is horizontal from point **A** to **B** and at an incline of 35° from point **B** to **C** as shown in the diagram below.



5.1 Define the term *kinetic energy*. (2)

5.2 Calculate the kinetic energy of the block at point **A**. (3)

The coefficient of kinetic friction (μ_k) between the block and the surface **ABC** is 0,15.

5.3 Calculate the magnitude of the kinetic frictional force on the block while moving from point **A** to **B**. (3)

5.4 Calculate the speed of the block at point **B**. (4)

The block moves a distance **d** up the incline and comes to rest at point **C**. A kinetic frictional force of 12,04 N acts on the block while it moves from point **B** to **C**.

5.5 Draw a labelled free-body diagram for the block while it is moving up the incline **BC**. (3)

5.6 Explain why the kinetic frictional force on the block is less on surface **BC** than on surface **AB**. (1)

5.7 Use **energy principles** to calculate the distance **d**. (5)
[21]

QUESTION 6 (Start on a new page)

The siren of a stationary train emits sound waves with a frequency of 520 Hz as observed by a learner standing on a platform at the station. Take the speed of sound in air to be
340 $m \cdot s^{-1}$. Ignore the effects of wind.

6.1 State the Doppler Effect in words. (2)

6.2 Calculate the wavelength of the sound wave observed by the learner. (3)

A second train with an identical siren moves at a constant speed of 15 $m \cdot s^{-1}$ towards the learner on the platform.

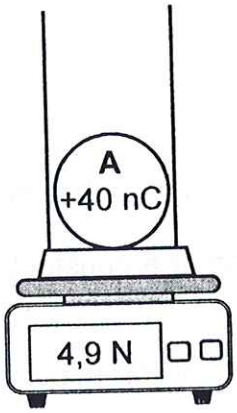
6.3 Calculate the frequency of the siren of the second train as observed by the learner. (4)

6.4 Write down the frequency heard by the driver of the second train. (1)

6.5 How does the wavelength of the sound waves from the siren of the SECOND train compare to that of the first train?
Write down only LONGER, SHORTER or THE SAME. Explain the answer. (3)
[13]

QUESTION 7 (Start on a new page)

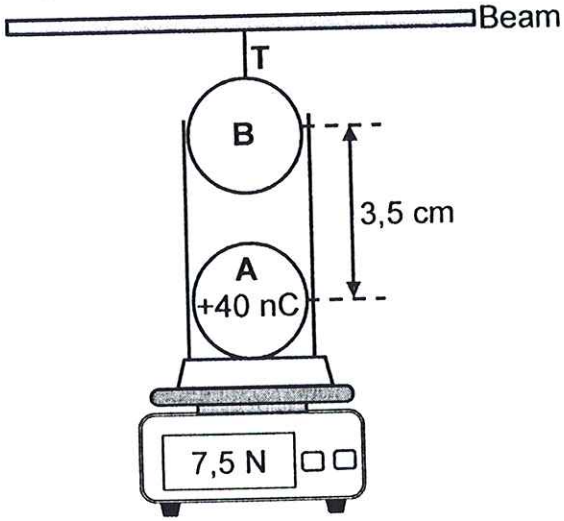
Sphere **A** with a charge of +40 nC is placed in a tall cylinder on a newton scale as shown in the diagram below. The scale has a reading of 4,9 N.



7.1 Were electrons ADDED TO or REMOVED FROM the sphere to obtain a charge of +40 nC? (1)

7.2 Calculate the number of electrons that were added to or removed from the sphere. (3)

A second sphere **B** with a mass of 0,4 kg hangs 3,5 cm above sphere **A** on a light, inextensible string **T** from a beam. The reading on the scale changes to 7,5 N.



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

7.4 What is the nature of the charge of sphere **B**?
Write down only POSITIVE or NEGATIVE.

Give a reason for the answer. (2)

7.5 Calculate the:

7.5.1 Charge on sphere **B** (5)

7.5.2 Tension in the string **T** (3)
[16]

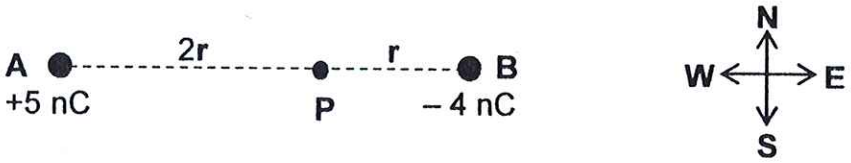
QUESTION 8 (Start on a new page)

Two small spheres, **A** with a charge of +5 nC and **B** with a charge of – 4 nC, are placed in a vacuum at a distance apart, as shown in the diagram below.

8.1 Define the term *electric field.* (2)

8.2 Draw the net electric field pattern due to the two charged spheres. (3)

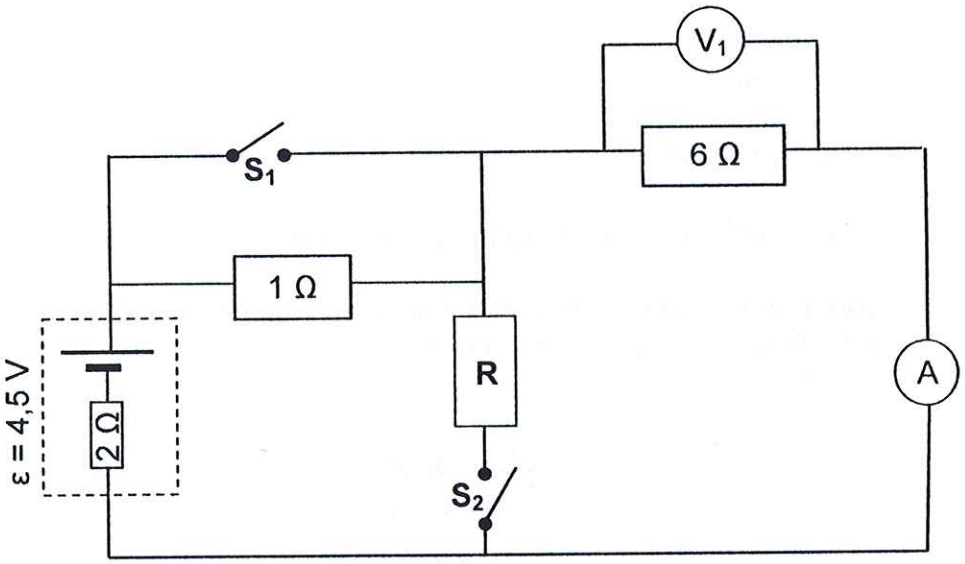
P is a point between spheres **A** and **B**. Point **P** is a distance **r** from sphere **B** and a distance 2**r** from sphere **A** as shown in the diagram below. The net electric field at point **P** is 1181,25 $N \cdot C^{-1}$ east.



8.3 Calculate the distance **r**. (6)
[11]

QUESTION 9 (Start on a new page)

A cell with an emf (ε) of 4,5 V and an internal resistance of 2 Ω is connected in a circuit as shown in the diagram below.



9.1 Which device in the circuit diagram measures the rate of flow of charge? Write down only VOLTMETER or AMMETER. (1)

Both switches S_1 and S_2 are OPEN.

9.2 Calculate the:

9.2.1 Ammeter reading (3)

9.2.2 Voltmeter reading V_1 (3)

When both switches S_1 and S_2 are CLOSED, the ammeter reading remains THE SAME.

9.3 Calculate the:

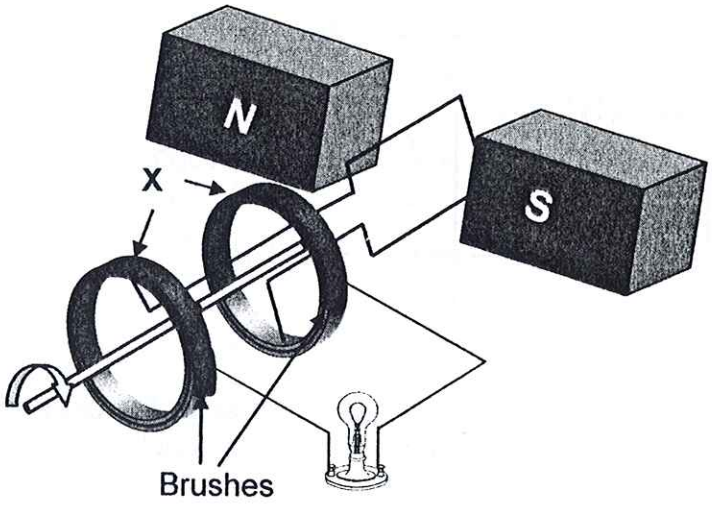
9.3.1 'Lost volts' (1)

9.3.2 Current through the cell (2)

9.3.3 Resistance of resistor **R** (3)
[13]

QUESTION 10 (Start on a new page)

The diagram below represents a simplified drawing of an electric device that is connected to a bulb.

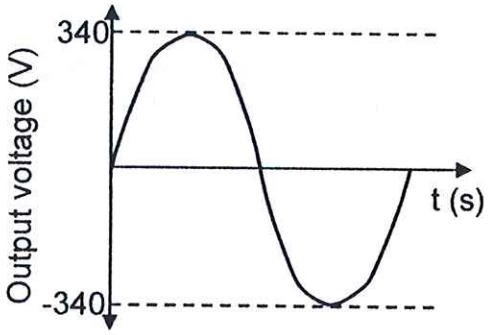


10.1 Write down the principle on which the device operates. (1)

10.2 Write down ONE method to increase the brightness of the bulb. (1)

10.3 Write down the name of component **X**. (1)

The graph below shows the output voltage for one rotation of the coil in this electric device.

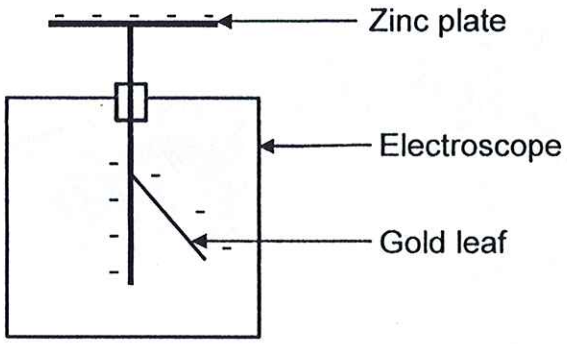


A 100 W bulb is connected to this electric device and burns with maximum intensity.

10.4 Calculate the resistance of the bulb. (5)
[8]

QUESTION 11 (Start on a new page)

The diagram below shows a gold leaf electroscope with a negatively charged zinc plate on top.



When the zinc plate is irradiated with visible light, no change is observed. When the zinc plate is irradiated with ultra violet light, the gold leaf falls back.

11.1 Write down the name of this phenomenon. (1)

11.2 Explain why white light has no effect on the gold leaf but ultra violet light causes the gold leaf to fall back. (2)

The work function of the zinc metal is $5,97\times10^{-19}$ J.

11.3 Calculate the:

11.3.1 Threshold frequency of the zinc plate (3)

11.3.2 Maximum kinetic energy of an electron ejected from the zinc plate when it is irradiated with light of wavelength 300 nm (4)
[10]

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 gravitasiekonstante*	G	$6{,}67 \times 10^{-11}\ N{\cdot}m^2{\cdot}kg^{-2}$
Radius of Earth *Radius van die Aarde*	R_E	$6{,}38 \times 10^{6}\ m$
Mass of 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	$6{,}63 \times 10^{-34}\ J{\cdot}s$
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 $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{ave} = F\cdot v_{ave}$ / $P_{gemid} = F\cdot v_{gemid}$	

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

$v = f\lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ $\quad f_L = \frac{v \pm v_L}{v \pm v_b} f_b$	$E = hf$ 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* $W_o = hf_o$ 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)
$R_s=R_1+R_2+...$ $\frac{1}{R_p}=\frac{1}{R_1}+\frac{1}{R_2}+...$	$q = I\,\Delta t$
$W = Vq$ $W = VI\,\Delta t$ $W = I^2R\,\Delta t$ $W=\frac{V^2\Delta t}{R}$	$P=\frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P=\frac{V^2}{R}$

ALTERNATING CURRENT / WISSELSTROOM

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