GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

GAUTENG DEPARTMENT OF EDUCATION

PREPARATORY EXAMINATION

2019

10841

PHYSICAL SCIENCES: PHYSICS

PAPER 1

TIME: 3 hours
MARKS: 150
19 pages + 3 Information sheets

PHYSICAL SCIENCES: Paper 1

10841E

X10

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INSTRUCTIONS AND INFORMATION

1. Write your name in the appropriate space on the ANSWER BOOK.
2. This question paper consists of 11 questions. Answer ALL the questions in the ANSWER BOOK.
3. Start the answer to each question on a NEW page.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE line open between sub-questions, 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 discussions, et cetera where required.
12. Write neatly and legibly.

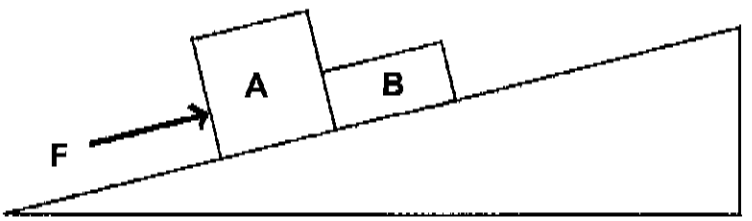
QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are given as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A – D) next to the question number (1.1 – 1.10) in the ANSWER BOOK.

1.1 A learner is sitting on a chair. According to Newton's *Third Law of Motion*, the reaction force to the learner's weight, **w** is the force of the …

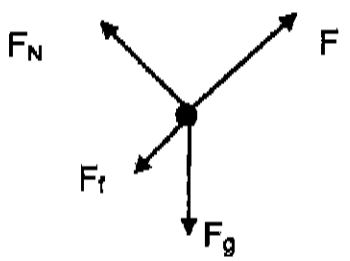
A learner on the chair.
B chair on the learner.
C earth on the learner.
D learner on the earth. (2)

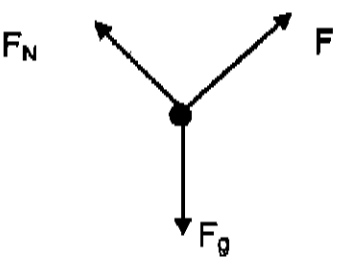
1.2 Two objects, **A** and **B**, are in contact with each other on an inclined plane. A horizontal force, **F**, is applied parallel to the incline, and pushes on the objects as shown in the diagram below.

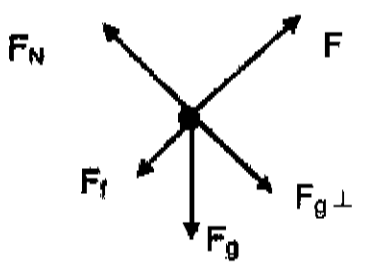


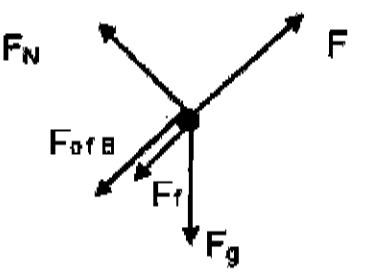
The magnitude of kinetic frictional force acting on the objects cannot be ignored.

Which ONE of the following is the correct free body diagram for block **A**?

A


B


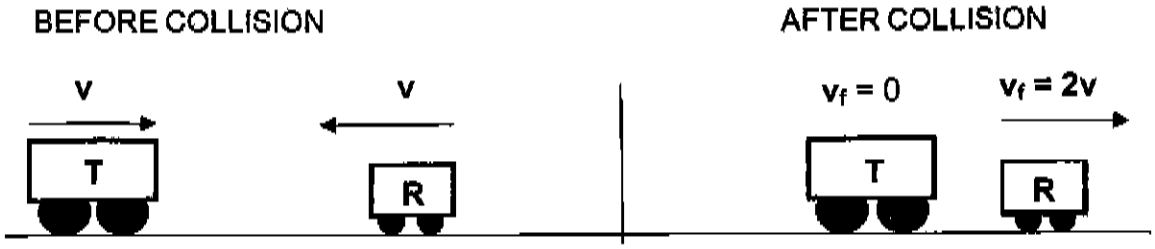
C


D


(2)

1.3 Trolley **T**, mass 3m, moving to the right with a speed **v** collides head-on with trolley **R**, mass m, moving to the left with speed **v**. Immediately after the collision, trolley **R** moves to the right with a speed **2v** and trolley **T** is at rest. Refer to the diagram below.

Ignore the effects of friction.

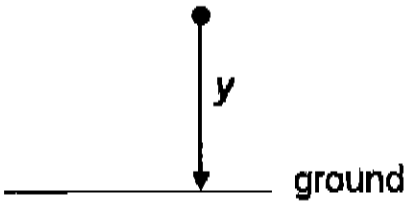


Which of the following combinations is CORRECT?

	MECHANICAL ENERGY	MOMENTUM
A	Conserved	Conserved
B	Conserved	Not conserved
C	Not conserved	Not conserved
D	Not conserved	Conserved

(2)

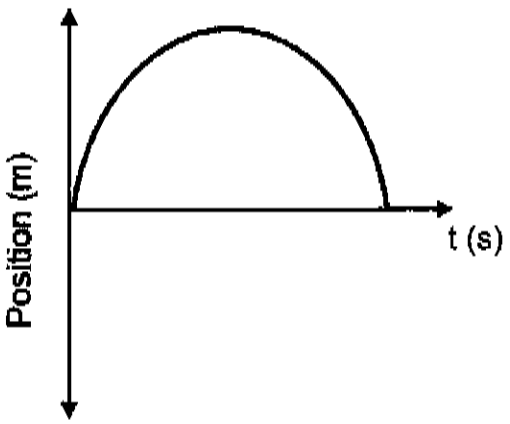
1.4 A small stone is dropped from a height **y** above the ground as shown in the diagram below. It strikes the ground after time **t**.



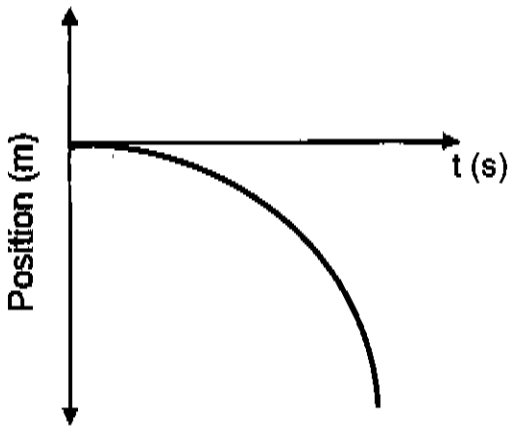
Take UPWARDS AS THE POSITIVE. Ignore the effects of air resistance.

Which of the following diagrams shows the correct position-time graph for the motion of the stone?

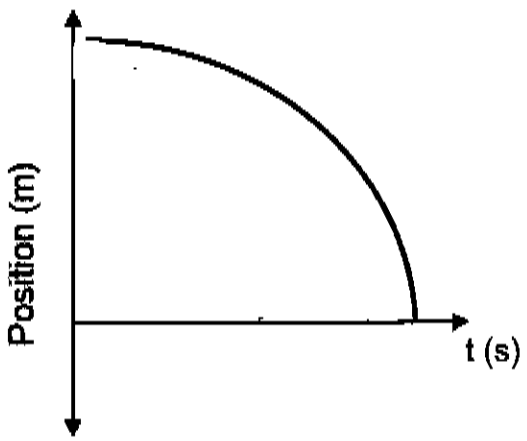
A



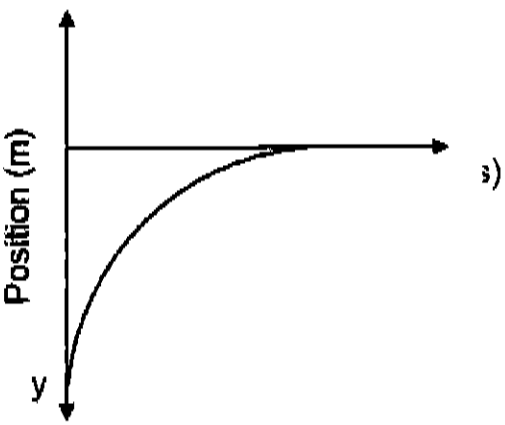
B



C



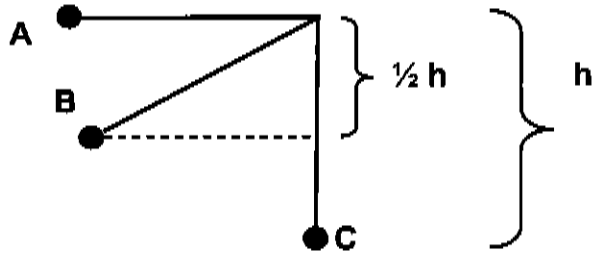
D



(2)

1.5 A pendulum bob is raised to position **A** at a height **h** above the lowest point of its swing, **C**. It is released from point **A**, and swings through points **B** with speed v_B and **C** with speed v_C.

Ignore frictional effects.



What is the relationship between the speed v_B and speed v_C?

A $v_B = \frac{v_C}{\sqrt{2}}$

B $v_B = \sqrt{0,5}\, v_C$

C $v_B = 0,5\, v_C$

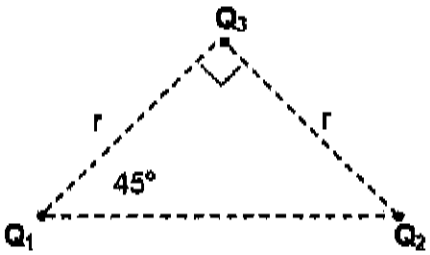
D $v_B = \frac{\sqrt{2}}{v_C}$ (2)

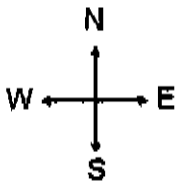
1.6 An astronomer views the line spectrum from a star. Which of the following describes the effect of the Doppler shift on the line spectrum if the star is moving *towards* earth?

The line spectrum ...

A appears dimmer.
B appears larger.
C is shifted towards the red end of the spectrum.
D is shifted towards the blue end of the spectrum. (2)

1.7 Point charges Q_1, Q_2 and Q_3 are arranged at the corners of a right-angled triangle, as shown in the diagram below. The charges on Q_1, Q_2 and Q_3 are unknown. The distance between Q_1 and Q_3 is r. The distance between Q_2 and Q_3 is also r. Charge Q_3 experiences a resultant electrostatic force to the **WEST**.



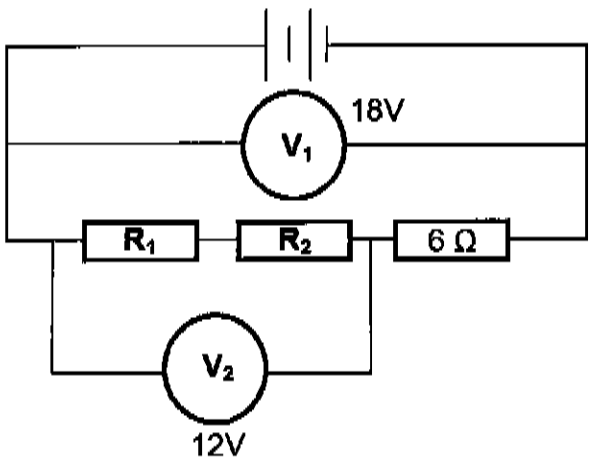


Which of the following combinations of charges could be possible for charges Q_1, Q_2 and Q_3?

	Q_1	Q_2	Q_3
A	NEGATIVE	POSITIVE	POSITIVE
B	POSITIVE	POSITIVE	POSITIVE
C	NEGATIVE	NEGATIVE	NEGATIVE
D	POSITIVE	NEGATIVE	POSITIVE

(2)

1.8 In the circuit diagram below three resistors, R_1, R_2 and a 6 Ω are connected in series. $R_1 = R_2$ and the internal resistance of the cell and connecting wires may be ignored. V_1 reads 18V and V_2 reads 12V.

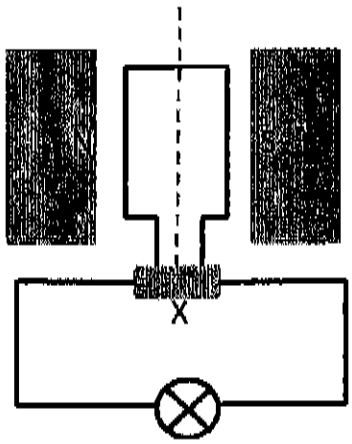


Which of the following is the possible values for R_1 and R_2?

A 4 Ω
B 6 Ω
C 12 Ω
D 18 Ω

(2)

1.9 The diagram below is a simplified version of an electric generator connected to a light bulb. Component **X** is either a split ring or slip rings.

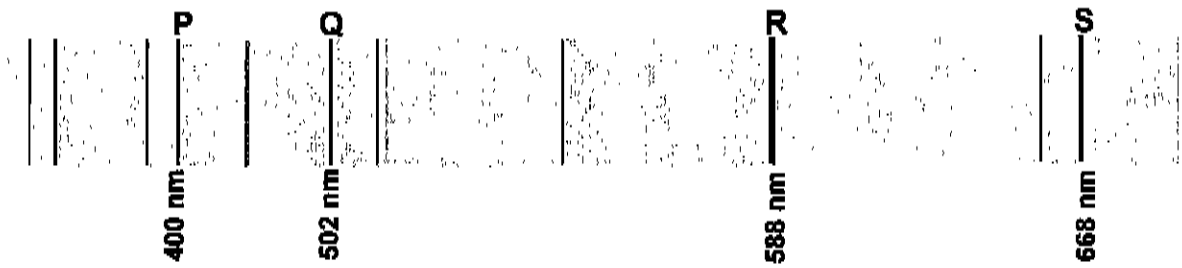


Which of the following options for this generator is correct?

	Energy conversion taking place	Type of current generated	Component X
A	mechanical to electrical	slip ring	AC
B	mechanical to electrical	split ring	AC
C	electrical to mechanical	slip ring	DC
D	electrical to mechanical	split ring	DC

(2)

1.10 The diagram below shows some principle lines, **P**, **Q**, **R** and **S** in the line emission spectrum of helium with corresponding wavelengths in nm.



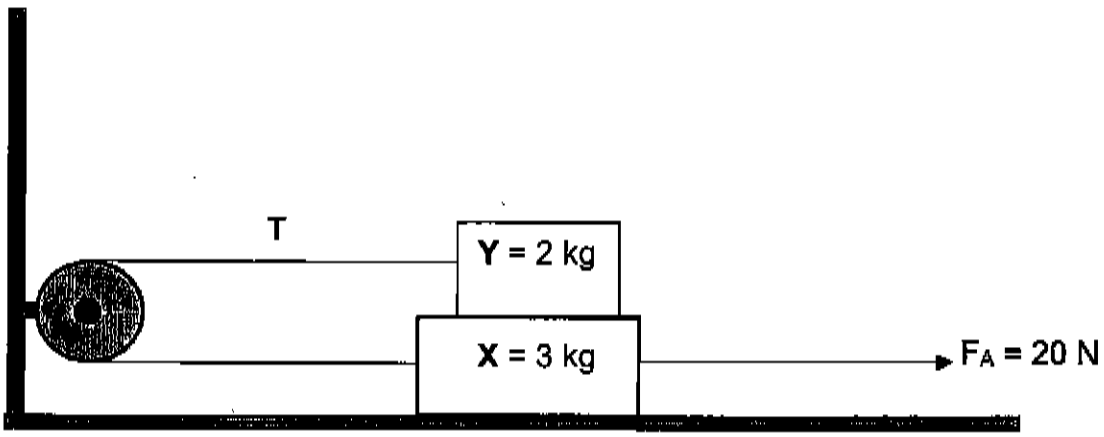
Which ONE of the spectral lines represents the *lowest energy* change of an electron within a helium atom?

A **P**
B **Q**
C **R**
D **S**

(2)
[20]

QUESTION 2 (Start on a new page.)

2.1 A horizontal force F_A of magnitude 20 N is applied to block **X**, mass 3 kg on a table. Block **Y**, mass 2 kg, is resting on block **X**. The two blocks are joined by a thin inextensible string of negligible mass which runs over a frictionless pulley, fixed to the wall. Block **X** experiences a kinetic frictional force of 1,2 N with the surface of the table. There is no friction between block **X** and block **Y**. The tension in the string is **T** when block **X** accelerates to the right.

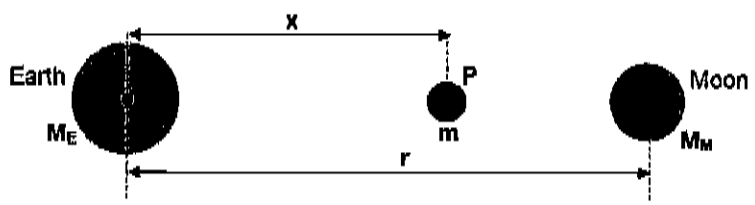


2.1.1 State Newton's *Second Law of Motion* in words. (2)

2.1.2 Draw a labelled, free-body diagram showing ALL the forces acting on block **X**. (6)

2.1.3 Calculate the magnitude of the tension **T** in the string. (6)

2.2 A learner wants to calculate the distance between the Earth (mass $M_E = 5{,}97 \times 10^{24}$ kg) and the Moon (mass $M_M = 7{,}35 \times 10^{22}$ kg) where the net gravitational force is zero. To achieve this, the learner placed a third mass '**m**' at point '**P**' as shown in the diagram below. The distance between the centres of the Earth and the Moon is '**r**'.



2.2.1 State Newton's *Law of Universal Gravitation* in words. (2)

2.2.2 Use the law of gravitation to show that **r** and **x** are related by the following equation:

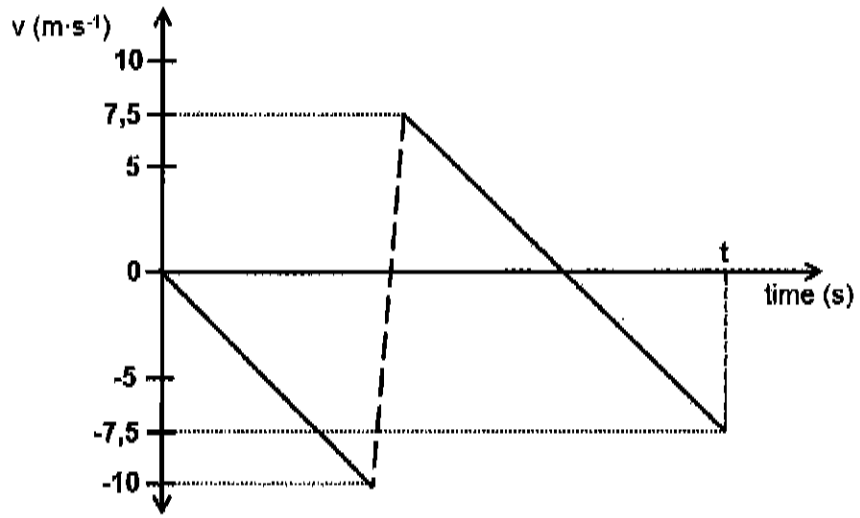
$$r^2 - 2rx + 0{,}988x^2 = 0$$ (4)

[20]

QUESTION 3 (Start on a new page.)

A ball of mass 0,2 kg is dropped vertically from the top of a building to a concrete floor below. The ball bounces off the floor. The velocity versus time graph below shows the motion of the ball. Ignore the effects of air friction.

DOWNWARD MOTION IS TAKEN AS NEGATIVE.



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

Use the graph to answer the following questions.

3.2 Write down the number of times the ball hits the floor. (1)

3.3 Calculate the height:

3.3.1 From which the ball was dropped (4)

3.3.2 Reached by the ball after the first bounce (3)

3.4 Determine the magnitude of the displacement of the ball from the moment it was dropped until time **t**. (1)
[11]

QUESTION 4 (Start on a new page.)

The table below shows how the momentum of a single train coach **A** changes with time just before and just after a head-on collision with another coach **B**.

p ($kg \cdot m \cdot s^{-1}$) of coach **A**	30 000	30 000	14 000	14 000
time (s)	20	20,1	20,2	20,3

Coach **B** has a mass of 9 000 kg and was initially travelling at 1,5 $m \cdot s^{-1}$ west.
You may assume that the net external force acting on the system is zero.

4.1 Write down a word / term for the underlined words above. (1)

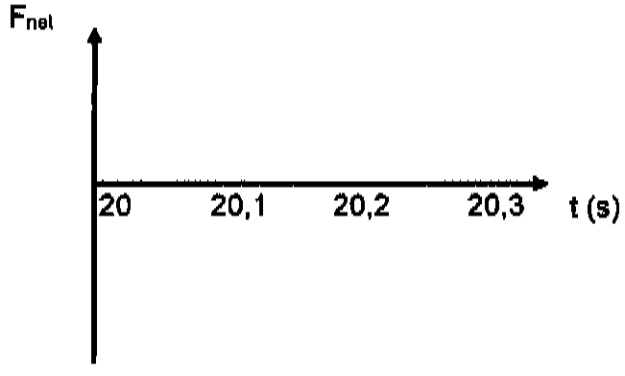
Use the information in the table to answer the following questions.

4.2 Calculate the magnitude of the:

4.2.1 Net average force acting on engine coach **A** during the collision (4)

4.2.2 Velocity of coach **B** just after collision (4)

4.3 Redraw the net force vs time graph below in your answer book and complete the graph for coach **A**. The time values are on the graph.

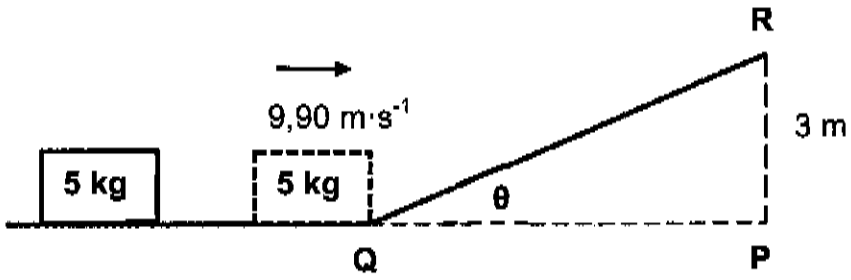


(3)
[12]

QUESTION 5 (Start on a new page.)

5.1 In an experiment, a rough inclined plane **QR** has been constructed to stop a moving 5 kg block. The block reaches point **Q** with a speed 9,90 $m \cdot s^{-1}$. The block comes to a stop at point **R** which is 3 m above level **QP**.

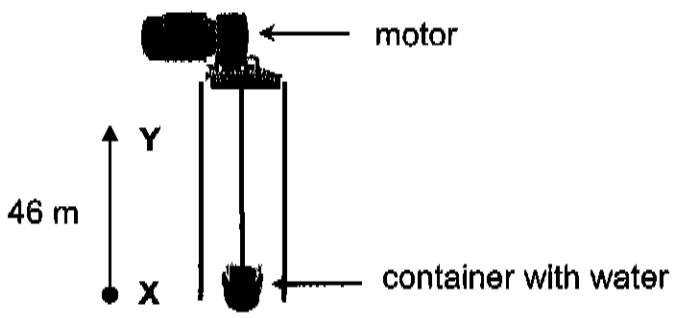
The frictional force between the surface **QR** and the block is 18 N.



5.1.1 Define a *non-conservative force*. (2)

5.1.2 Use energy principles and calculate the angle **θ** of slope **QR**. (7)

5.2 A motor is used to lift a container of water up a vertical shaft with a steel cable. The total mass of the container and the water is 987 kg. The container is lifted from rest from point **X** and passes point **Y** at a height 46 m. At point **Y** the container has a speed of 0,9 $m \cdot s^{-1}$.
You may ignore frictional effects and the mass of the steel cable.

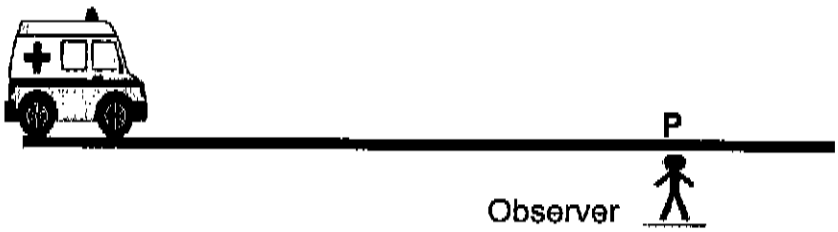


5.2.1 State the *work-energy theorem* in words. (2)

5.2.2 Use the work-energy theorem to calculate the work done by the motor in lifting the container from point **X** to **Y**. (4)
[15]

QUESTION 6 (Start on a new page.)

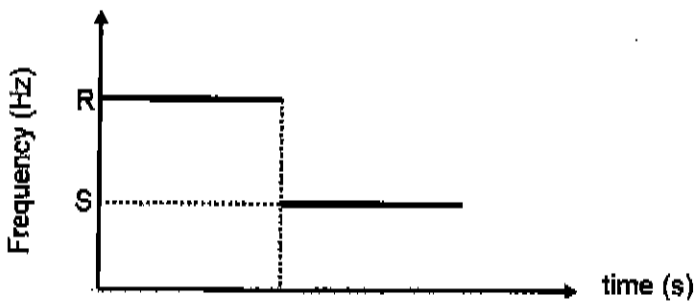
An ambulance is travelling at a constant speed along a straight horizontal road with its siren emitting a sound of frequency 800 Hz. A stationary observer standing at point **P** next to the road, hears the siren frequency of 910 Hz as the ambulance approaches. The ambulance passes point **P** and continues at the same speed. Take the speed of sound in air to be 340 $m \cdot s^{-1}$.



6.1 State the *Doppler effect.* (2)

6.2 Calculate the speed of the ambulance. (5)

6.3 A detector at point **P** measures the siren's frequency and the results are shown in the graph below.



6.3.1 Write down frequency **R**. (1)

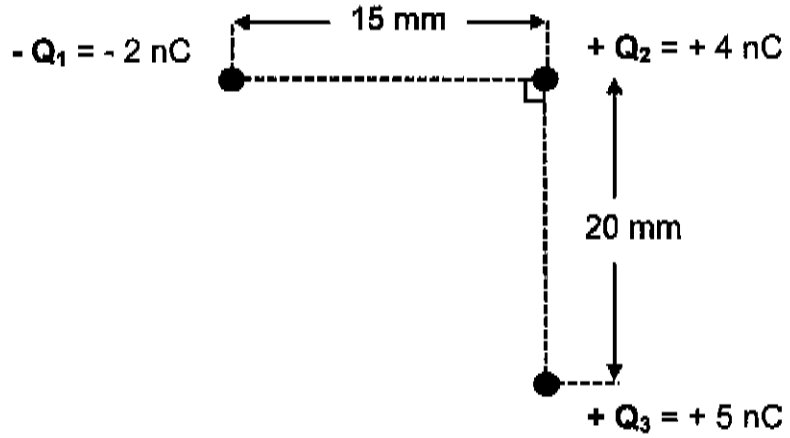
6.3.2 Calculate the value of **S** on the graph. (4)

6.4 What frequency will the observer hear when the ambulance is at point **P**? (1)

[13]

QUESTION 7 (Start on a new page.)

7.1 Point charges **- Q_1**, **+ Q_2** and **+ Q_3** are arranged at the corners of a right-angled triangle, as shown in the diagram below.

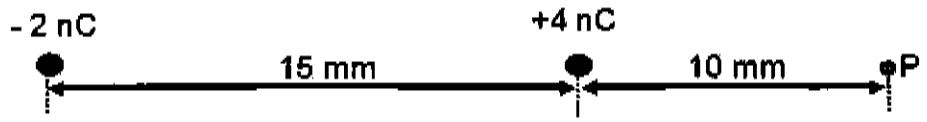


7.1.1 State *Coulomb's law* in words. (2)

7.1.2 Draw a force diagram to show the forces acting on charge **+ Q_2** due to charge **- Q_1** and **+ Q_3**. (2)

7.1.3 Calculate the magnitude of the net force acting on Q_2 due to Q_1 and Q_3 if Q_1 = - 2 nC, Q_2 = + 4 nC and Q_3 = +5 nC. (5)

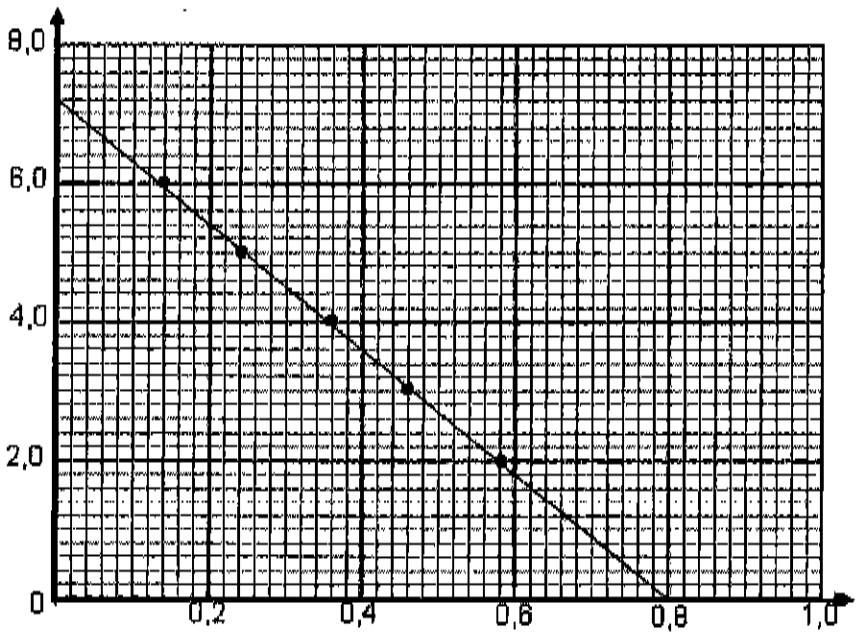
7.2 A – 2 nC charge is 15 mm to the left of a + 4 nC charge as shown in the diagram below. Point **P** is 10 mm to the right of the + 4 nC charge.



Calculate the net electric field at point **P**. (5)
[14]

QUESTION 8 (Start on a new page.)

A group of learners conduct an experiment to determine the emf (ε) and internal resistance (r) of a battery. The data obtained from the experiment is used to plot points on graph paper and draw a line of best fit. The graph of one of the learners is given below. The x and y axes have not been labelled.



8.1 Explain the term *internal resistance*. (1)

8.2 Write down ONE factor which must be kept constant during this experiment. (1)

Using the graph:

8.3 Provide a label for the y-axis. (1)

8.4 Write down the quantity represented by the gradient? (1)

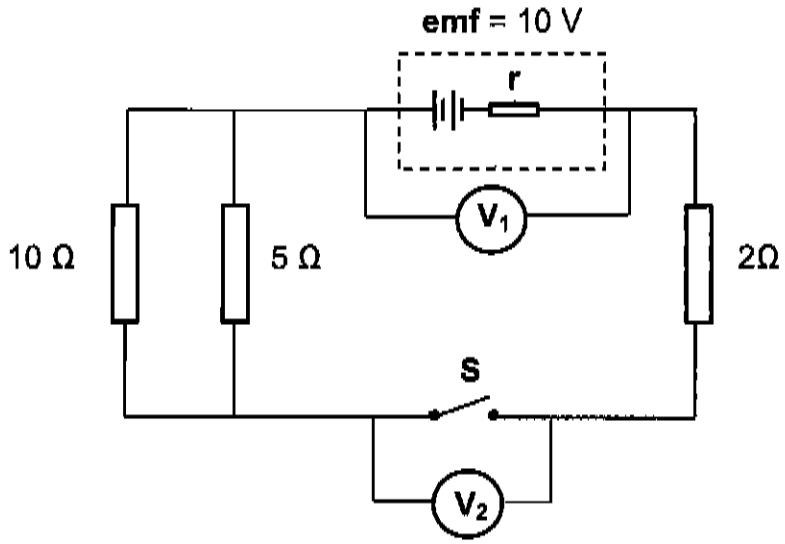
8.5 Write down the emf of the battery. (1)

8.6 Calculate the internal resistance of the battery. (4)

8.7 Determine the value of V_{int} when the graph reaches 0,8 on the x-axis. (1)
[10]

QUESTION 9 (Start on a new page.)

9. A circuit is connected as shown below. The battery has an **emf** of 10 V and an unknown internal resistance **r**. A voltmeter V_1 is connected across the battery and another voltmeter V_2 is connected across the switch **S**. The connecting wires have negligible internal resistance.



Switch **S** is initally open.

9.1 Write down the reading on voltmeter V_2. (1)

Switch **S** is now **closed**. The reading on voltmeter V_1 is 8 V.

9.2 What is the reading on V_2? (1)

9.3 Calculate the total external resistance of the circuit. (3)

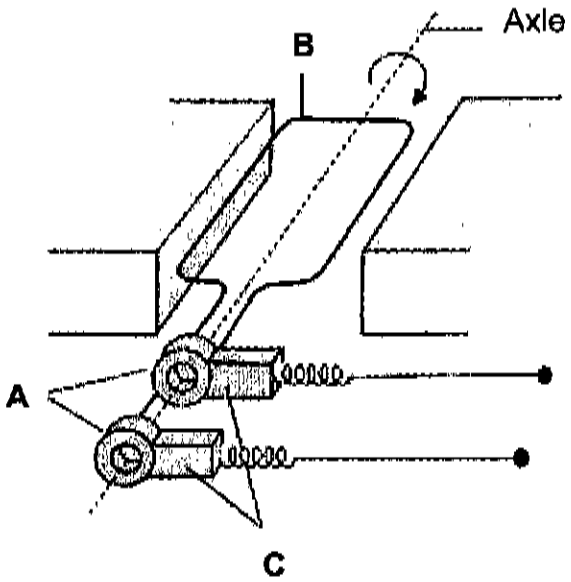
9.4 Calculate the internal resistance, **r**, of the battery. (5)

9.5 How will the reading on the voltmeter V_1 be affected if the 5 Ω resistor was removed? (Choose from: INCREASES, DECREASES or STAYS THE SAME.) (1)

9.6 Explain your answer to Question 9.5. (3)
[14]

QUESTION 10 (Start on a new page.)

The diagram below shows an AC generator. The main components are labelled **A**, **B** and **C**.



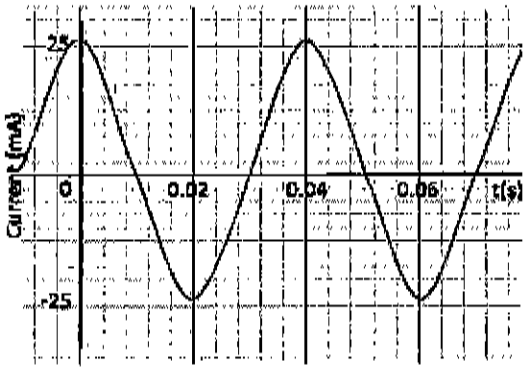
10.1 Write down the name of the components labelled:

10.1.1 **A** (1)

10.1.2 **B** (1)

10.2 Write down the function of component **C**. (1)

The graph below represents the output current vs time for an AC generator.



Use the graph above to answer the following questions.

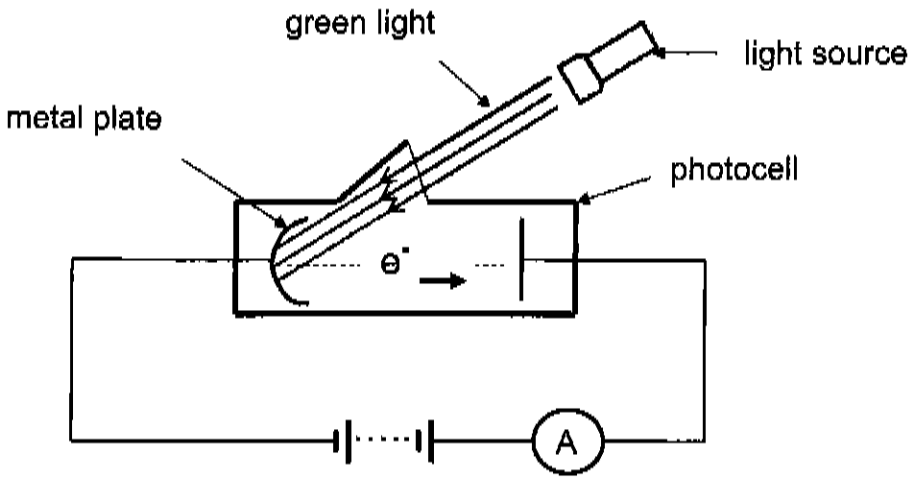
10.3 At what position was the coil relative to the magnetic field of the generator for the current output to be a maximum?
(Choose from: PERPENDICULAR or PARALLEL.) (1)

10.4 Calculate the rms current (I_{rms}) for this generator. (3)

10.5 Calculate the average power dissipated by a 100 Ω resistor connected across the terminals of the generator. (3)
[10]

QUESTION 11 (Start on a new page.)

In an investigation, the metal plate of a photocell, shown below, is irradiated with green, blue and violet light.



The results of the investigation are shown in the table below.

Colour	Wavelength (nm)	Reading on ammeter
green	560	No
blue	500	Yes
violet	430	Yes

11.1 Define the *work function* of a metal. (2)

11.2 Explain why no current is registered when green light is used. (2)

11.3 What effect will increasing the **intensity** of light have on the reading of the ammeter when blue light is used? (Choose from INCREASES, DECREASES or STAYS THE SAME.) (1)

11.4 Explain your answer to Question 11.3. (2)

11.5 Calculate the energy of a photon of blue light. (4)
[11]

TOTAL: 150

DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 1 (PHYSICS)

TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Acceleration due to gravity	g	$9,8\ m{\cdot}s^{-2}$
Universal gravitational constant	G	$6,67 \times 10^{-11}\ N{\cdot}m^2{\cdot}kg^{-2}$
Speed of light in a vacuum	c	$3,0 \times 10^{8}\ m{\cdot}s^{-1}$
Planck's constant	h	$6,63 \times 10^{-34}\ J{\cdot}s$
Coulomb's constant	k	$9,0 \times 10^{9}\ N{\cdot}m^2{\cdot}C^{-2}$
Charge on electron	e	$1,6 \times 10^{-19}\ C$
Electron mass	m_e	$9,11 \times 10^{-31}\ kg$
Mass of the earth	M_E	$5,98 \times 10^{24}\ kg$
Radius of the earth	R_E	$6,38 \times 10^{6}\ m$

TABLE 2: FORMULAE

MOTION

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

FORCE

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

WORK, ENERGY AND POWER

$W = F\Delta x\cos\theta$	$U = mgh$ or $E_P = mgh$
$K = \frac{1}{2}mv^2$ or $E_k = \frac{1}{2}mv^2$	$W_{net} = \Delta K$ or $W_{net} = \Delta E_k$ $\Delta K = K_f - K_i$ or $\Delta E_k = E_{kf} - E_{ki}$
$W_{nc} = \Delta K + \Delta U$ or $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{ave} = Fv_{ave}$ / $P_{gem} = Fv_{gem}$	

WAVES, SOUND AND LIGHT

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

ELECTROSTATICS

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

ELECTRIC CIRCUITS

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

ALTERNATING CURRENT

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

END

GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

PREPARATORY EXAMINATION
VOORBEREIDENDE EKSAMEN

2019

MARKING GUIDELINES
NASIENRIGLYNE

10841
PHYSICAL SCIENCES: PHYSICS (PAPER 1) /
FISIESE WETENSKAPPE*: *FISIKA (VRAESTEL 1)

12 pages / *bladsye*

GAUTENG DEPARTMENT OF EDUCATION /
GAUTENGSE DEPARTEMENT VAN ONDERWYS

PREPARATORY EXAMINATION /
VOORBEREIDENDE EKSAMEN

PHYSICAL SCIENCE: PHYSICS /
FISIESE WETENSKAPPE: FISIKA
(Paper 1 / ***Vraestel 1*****)**

MARKING GUIDELINES /
NASIENRIGLYNE

QUESTION / ***VRAAG*** **1**

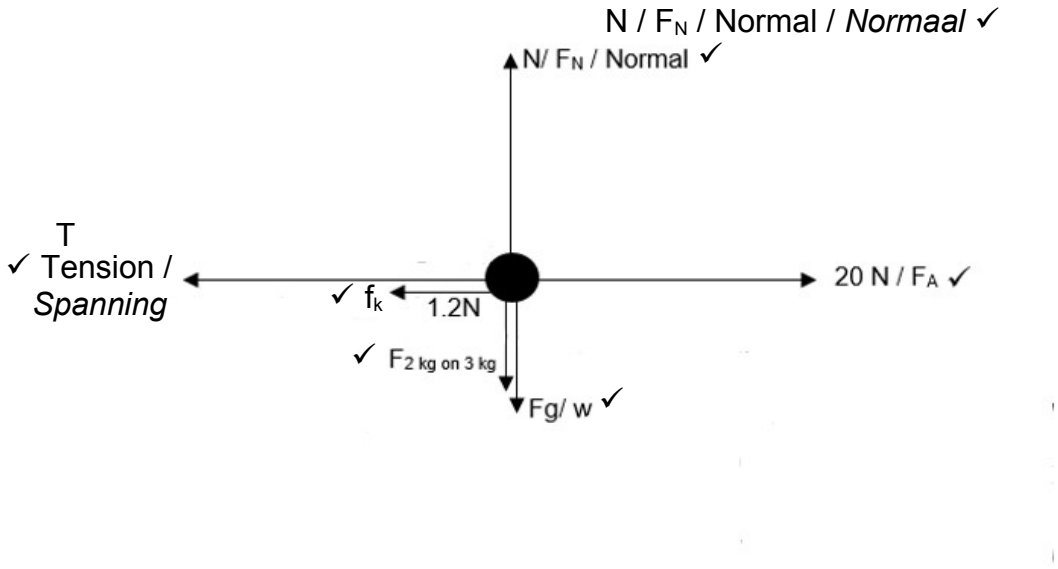
1.1	D✓✓	2
1.2	D✓✓	2
1.3	D✓✓	2
1.4	B✓✓	2
1.5	A✓✓	2
1.6	D✓✓	2
1.7	A✓✓	2
1.8	B✓✓	2
1.9	A✓✓	2
1.10	D✓✓	2

[20]

QUESTION / *VRAAG* 2

2.1.1 When a net force acts on an object, the object will accelerate in the direction of the force✓ and the acceleration is directly proportional to the force and inversely proportional to the mass✓ of the object.
OR
The net (or resultant) force acting on an object is equal to the rate of change of momentum of the object in the direction of the net force. ✓✓
Wanneer 'n netto krag op 'n voorwerp inwerk sal die voorwerp versnel in die rigting van die netto krag. Die versnelling is direk eweredig aan die krag en omgekeerd eweredig aan die massa van die voorwerp.
OF
Die netto krag wat inwerk op 'n voorwerp is gelyk aan die tempo van verandering van momentum van die voorwerp in die rigting van die netto krag. 2

2.1.2



6

2.3 **3 kg block / *3 kg blok***
F_{net} = ma✓
F_A –T – f_k = 3a
20 – T– 1.2 = 3a✓
18,8 – T = 3a
T = 18,8 – 3a……(1)
2 kg block / *2 kg blok*
F_{net} = ma
T = 2a✓.....(2)
18,8 – 3a = 2a Set the two equations equal ✓ *Stel die twee vergelykings gelyk aan mekaar*
a= 3,76 m·s^{-2}
T = 2(3.76) ✓= 7,52 N✓ 6

2.2.1 Each body in the universe attracts every other body with a force that is directly proportional to the product of their masses✓ and inversely proportional to the square of the distance between their centres. ✓
Elke liggaam in die heelal trek elke ander liggaam aan met 'n krag wat direk eweredig is aan die produk van hul massas en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle middelpunte. 2

2.2.2 To the right as positive. *Neem na regs as positief*

Force attracting m to earth, $F_E = -G\frac{mM_E}{x^2}$

Krag wat m aantrek na aarde

Force attracting m to moon, $F_M = G\frac{mM_M}{¿¿}$

✓ for both correct expressions. / *vir albei korrekte stellings*

Krag wat m aantrek na die maan

Net force on m, $F_E + F_M = -G\frac{mM_E}{x^2} + ¿ \quad G\frac{mM_M}{¿¿}$ ✓

Netto krag op m

$-G\frac{mM_E}{x^2} + ¿ \quad G\frac{mM_M}{¿¿}$

$r^2 - 2rx + 0{,}99x^2 = 0$ ✓ 4

[20]

QUESTION / *VRAAG* 3

3.1 The motion of an object in the force of gravity only. ✓✓
Die beweging van 'n voorwerp in gravitasiekrag alleen. 2

3.2 2 / twice✓ *twee maal* 1

3.3.1

OPTION / *OPSIE* 1
$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$(-10)^2$ ✓ $= 0^2 + (2)(-9{,}8)\Delta y$ ✓
$\therefore \Delta y = -5{,}1$ m
i.e. h = 5,1 m ✓

OPTION / *OPSIE* 2
$v_f = v_i + a\Delta t$ ✓
$-10 = 0 + (-9{,}8)\Delta t$ ✓
$\therefore \Delta t = 1{,}02$ s

$\Delta y = y = \left(\frac{0-10}{2}\right) x 1{,}02$ ✓
$= -5{,}1$ m
$\therefore$ h = 5,1 m ✓

OPTION / *OPSIE* 3
$v_f = v_i + a\Delta t$ ✓
$-10 = 0 + (-9{,}8)\Delta t$ ✓
$\therefore \Delta t = 1{,}02$ s

$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$
$\Delta y = 0 + (\frac{1}{2})(-9{,}8)(1{,}02)^2$ ✓
$= -5{,}1$ m
$\therefore$ h = 5,1 m ✓

4

OPTION / *OPSIE* 4
$W_{net} = \Delta K$
$W_{grav} = \Delta K$ } any one ✓
$mgh\cos\theta = \frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2$
$(0{,}2)(9{,}8)h(1)$ ✓ $= (\frac{1}{2})(0{,}2)(10)^2 - 0$ ✓

$\therefore$h = 5,1 m ✓

OPTION / *OPSIE* 5
$(U + K)_i = (U + K)_f$
$(mgh + \frac{1}{2} mv^2)_i = (mgh + \frac{1}{2} mv^2)_f$ } ✓

$((0{,}2)(9{,}8)h + 0)$ ✓ $= (0 + (\frac{1}{2})(0{,}2)(10)^2)$ ✓

$\therefore$h = 5,1 m ✓

3.3.2

OPTION / *OPSIE* 1	**OPTION / *OPSIE* 2**
$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $(0)^2 = 7.5^2 + (2)(-9,8)\Delta y$ ✓ $\therefore \Delta y = 2.87$ m ✓ i.e. h = 2.87 m	$v_f = v_i + a\Delta t$ $0 = 7.5 + (-9,8)\Delta t$ ✓ $\therefore \Delta t = 0.77$ s $\Delta y = v_i\Delta t + ½ a\Delta t^2$ $\Delta y = 7.5\ (0.77) + (½)(-9,8)(0.77)^2$ ✓ $= 2.87$ m✓ $\therefore$ h = 2.87 m
OPTION / *OPSIE* 3 $W_{net} = \Delta K$ $W_{grav} = \Delta K$ ✓ $mghcos\theta = ½ mv_f^2 - ½ mv_i^2$ $(0,2)(9,8)h(-1) = (½)(0,2)(0)^2 - (½)(0,2)(7.5)^2$ ✓ $\therefore h = 2.87$ m ✓	

3.4 5,1 m✓ 1

[11]

QUESTION / *VRAAG 4*

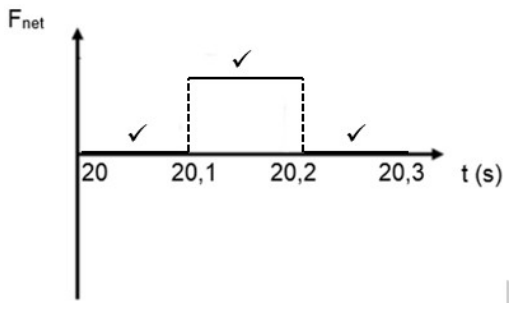
✓

4.1 Isolated (system) or closed system 1
Geïsoleerde sisteem of geslote sisteem

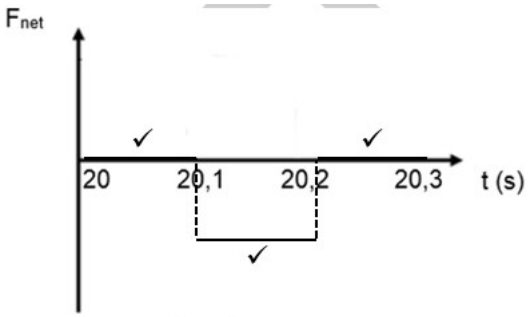
4.2.2 $F_{net}\Delta t = \Delta p$ ✓ 4
F_{net} (0,1) ✓ = 14 000 – 30 000✓
F_{net} = -160 000 N
F_{net} = 160 000 N✓

4.2.2 $\Sigma p_i = \Sigma p_f$ 4
$m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$ Any one / *Enige een* ✓
$30\ 000 + (9000)(-1.5)$ ✓ $= 14\ 000 + (9000)(v_{Bf})$ ✓
$v_{Bf} = 0.28$ m·s^{-1} ✓

4.3 3



OR / OF



[12]

QUESTION / *VRAAG* 5

5.1 5.1.1 A force for which the work done in moving an object between two points depends on the path taken. ✓✓
'n Krag waarvoor die arbeid verrig om 'n voorwerp tussen twee punte te beweeg, is afhanklik van die roete wat gevolg word. 2

5.1.2 $W_{nc} = \Delta E_p + \Delta E_k$ ✓
$f\Delta x \cos\theta = \Delta E_p + \Delta E_k$
$18 \times \Delta x \cos 180^0$ ✓$= 5\times9.8\times(3-0)$ ✓ + ½ x $5\times(0-9.90^2)$ ✓
$\Delta x = 5.4458$ (m) ✓
$\theta = \sin^{-1}\left(\frac{3}{5.4458}\right)$ ✓
$\theta = 33.43^0$ ✓ 7

5.2 5.2.1 The <u>work</u> done on an object by a <u>net force</u>✓ is equal to the <u>change in the object's kinetic energy</u>.✓ OR
The <u>net work</u> done on an object by a <u>force</u>✓ is equal to the <u>change in the object's kinetic energy</u>.✓ OR
The <u>net work</u>✓ done on an object is <u>equal to the change in the object's kinetic energy.</u> ✓
Die netto arbeid verrig op 'n voorwerp deur 'n netto krag is gelyk aan die verandering in die voorwerp se kinetiese energie.
Of
Die arbeid verrig deur 'n netto krag is gelyk aan die verandering in die voorwerp se kinetiese energie.
Of
Die netto arbeid verrig op 'n voorwerp is gelyk aan die verandering in die voorwerp se kinetiese energie. 2

5.2.2 $W_{net} = \Delta E_k$✓
$W_{fg} + W_{FA} = F_g\Delta x\cos\theta + W_{app} = ½\ mv_{f2} - ½\ mv_{i2}$
<u>$(987)(9.8)(46)\cos180^0$</u> ✓+ W_{app} = <u>$½\ (987)(0.9)^2 - 0$</u>✓
$W_{FA} = 445339.34$ J✓ 4
[15]

QUESTION / *VRAAG* 6

6.1 The change in frequency (or pitch) of the sound detected by a listener, ✓ because the sound source and the listener have different velocities relative to the medium of sound propagation. ✓

Die verandering in die waarneembare frekwensie van die klankgolwe as gevolg van die relatiewe beweging tussen die snelhede van die luisteraar en die klank se voortplanting. 2

6.2 $f_L = \frac{(v \pm v_o)}{(v \pm v_s)} f_s$ ✓

910 ✓ $= \frac{(340+0)}{(340-v_s)}$ ✓ 800✓

$v_s = 41{,}099\ m \cdot s^{-1}$ ✓ 5

6.3 6.3.1 910 Hz✓ 1

6.3.2 $f_L = \frac{(v \pm v_o)}{(v \pm v_s)} f_s$ ✓

$f_L = \frac{340-0}{340+41{,}099}$ ✓ 800 ✓

$= 713{,}73$ Hz ✓ 4

6.4 800 Hz 1

[13]

QUESTION / *VRAAG 7*

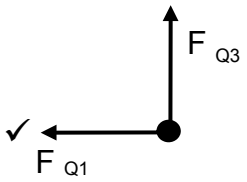
7.1 The magnitude of the electrostatic force exerted by one point charge (Q_1) on another point charge (Q_2) is directly proportional to the product of the magnitudes of the charges✓ and inversely proportional to the square of the distance (r) between them✓

If mass is used in definition $\frac{0}{2}$

Die grootte van die elektrostatiese krag uitgeoefen deur een puntlading op 'n ander puntlading is direk eweredig aan die produk van die groottes van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle.

Indien massas gebruik is in definsie $\frac{0}{2}$ 2

7.2



Arrow and correct label
Pyl en korrekte byskrif

2

7.3

$F_{Q2 \text{ due to } Q3} = \frac{kQ_2Q_3}{r^2} = \frac{9x10^9 x 4x10^{-9} x 5x10^{-9}}{(20x10^{-3})^2} = 4{,}5x10^{-4}$ N

$F_{Q2 \text{ due to } Q1} = \frac{kQ_2Q_1}{r^2} = \frac{9x10^9 x 2x10^{-9} x 4x10^{-9}}{(15x10^{-3})^2} = 3{,}2x10^{-4}$ N

$F_{net} = \sqrt{(4{,}5x10^{-4})^2+(3{,}2x10^{-4})^2} = 5{,}522 \times 10^{-4}$ N ✓

5

7.4 Take the right is positive / *Regs is positief*

$E_{-2nC} = \frac{kQ}{r^2} = \frac{9x10^9 x 2x10^{-9}}{(25x10^{-3})^2}$ = 28 800 (N··C^{-1} to the left / *na links*)

$E_{4nC} = \frac{kQ}{r^2} = \frac{9x10^9 x 4x10^{-9}}{(10x10^{-3})^2}$ = 360 000(N·C^{-1} to the right / *na regs*)

E_{net} = E_{2nC} - E_{4nC} ✓ This mark is for subtracting / *Punt vir aftrek*.
= 360 000 - 28 000
= 331 200 N·C^{-1} to the right / *na regs* ✓

5

[14]

QUESTION / *VRAAG* 8

8.1 Resistance within / offered by the cell✓ 1
Weerstand gebied deur die sel self.

8.2 Temperature✓ 1
Temperatuur

8.3 Volts (V) ✓ Potential difference / *Potensiaal verskil* 1

8.4 Internal resistance / *interne weerstand* ✓OR / *OF* r 1

8.5 7,2 V✓ 1

8.6 slope / helling = ΔV / ΔI✓ 3
= 0 - 7,2 ✓ / 0,8 – 0 ✓
= -9
r = 9 Ω✓

8.7 7,2 V 1
[10]

QUESTION / *VRAAG 9*

9.1 10V ✓ (1)

9.2 0 V✓ OR / *OF* zero (1)

9.3 $\frac{1}{R_p}=\frac{1}{R_1}+\frac{1}{R_2}$

¿ $\frac{1}{10}+\frac{1}{5}$

$R_p=3{,}33$

$R_{ext}=3{,}33+2=5{,}33\,\Omega$

$R_{//} = \frac{R_{10}R_5}{R_{10}+R_5} = \frac{10\,x\,5}{10+5}$ ✓ = 3,333 Ω

R_{ext} = 3,333 + 2 ✓= 5,333 Ω✓ (3)

9.4 $R_{ext}=\frac{V_{ext}}{I}$ ✓

$I=\frac{V_{ext}}{R_{ext}}=\frac{8}{5.333}=1.5(A)$ ✓

$emf=IR\,ext+Ir$ ✓

$10=8+1.5\,r$ ✓

$r=1.33\Omega$ ✓

Option / *Opsie* 2

$V_{//} = I_cR_{//}$ ✓= 1,5 ✓x 3,333 = 4,9995 V

V_s = 1,5 x 2 = 3 V

$V_{ext} = V_{//}+V_s$ = 4,9995 +3 =7,9995 V

$V_{int} = \varepsilon - V_{ext}$ ✓= 10-7,9995✓ = 2,00 V

$r = \frac{V_{int}}{I}=\frac{2}{1.5}=1,334\Omega$

(5)

9.5 increases ✓ (Negative marking)
vermeerder (negatiewe nasien)
Circuit resistance increases ✓ therefore (circuit) current decreases✓ lost volts decreases / V_{int} decreases.✓
Stroombaan se weerstand vermeerder ✓ daarom sal die stroom afneem ✓ en die verlore volts sal verminder of die Vintern sal verminder. ✓ (4)

[14]

QUESTION / *VRAAG* 10

10.1 10.1.1 Slip rings ✓
Sleepringe (1)

10.1.2 coil / solenoid ✓
spoel / solenoid (1)

10.2 Connects the generator to the external circuit.
OR Generated current exits the generator through C. ✓
OR Allows movement and conductivity between coil and external circuit.

Verbind die generator aan die eksterne stroombaan
OF Gegenereerde stroom verlaat generator deur D
OF Laat beweging toe en geleiding tussen spoel en eksterne stroombaan (1)

10.3 parallel✓ (1)

10.4 $I_{max\ /\ maks}$ = 25 A

$I_{rms} = \frac{I_{max}}{\sqrt{2}}$ ✓

$= \frac{25}{\sqrt{2}}$ ✓

= 17,678 A ✓ (3)

10.5 Positive marking from 10.4
P_{av} / gem = $I_{rms\ /\ wgk}^2$ x R ✓
= $17,678^2$ x100 ✓
= $3,125 \times 10^4$ W ✓ (3)
[10]

QUESTION / *VRAAG* 11

11.1 Is the minimum energy that an electron in the metal needs to be emitted from the metal surface. ✓✓
Dit is die minimum energie wat 'n elektron in die metaal benodig om vrygestel te word uit die metaal se oppervlakte. 2

11.2 Frequency of green light is <u>below threshold frequency</u> (f_o). ✓✓
OR
Energy of green light lower than work function.
OR
Too low frequency.

Frekwensie van groen lig is onder die drumpelfrekwensie
OF
Energie van groen lig is laer as die werksfunksie.
Of
Die frekwensie is te laag. 2

11.3 INCREASE ✓
Vermeerder 1

11.4 <u>more photons strike the metal per unit time</u>✓ <u>hence more electrons ejected per unit time</u>✓ thus rate of flow of charge increases hence increased current reading.

Meer fotone tref die metaal per eenheid tyd daarom word meer elektrone vrygestel per eenheid tyd dus vermeerder die vloei van die lading dus word die stroom lesing verhoog. 2

11.5 $E = hf$
$= h\frac{c}{\lambda}$ ✓ any one / *enige een*
$= 6{,}02 \times 10^{-34}$ ✓ x $\frac{3.0 \times 10^{8}}{500 \times 10^{-9}}$ ✓
$= 3{,}6 \times 10^{-19}$ J ✓ 4

[11]