Basic Education

KwaZulu-Natal Department of Basic Education
REPUBLIC OF SOUTH AFRICA

PHYSICAL SCIENCES: PHYSICS (P1)

PREPARATORY EXAMINATION

SEPTEMBER 2015

NATIONAL SENIOR CERTIFICATE

GRADE 12

MARKS: 150

TIME: 3 hours

This question paper consists of 16 pages and 3 data sheets

INSTRUCTIONS AND INFORMATION

1. This question paper consists of TEN questions.
2. 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 sub-questions, for example between QUESTION 2.1 and QUESTION 2.2.
6. You may use 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 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

Four options are provided 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, for example 1.12 D

1.1 A truck of mass ***2m*** collides with a car of mass ***m***. If the truck exerts a force of magnitude ***F*** on the car during the collision, then the magnitude of the force that the car exerts on the truck is ...

A 0
B ½F.
C F.
D 2F. (2)

1.2 The net work done on a car to increase its velocity from 0 to ***v*** is W .The net work done to increase its velocity from ***v*** to ***2v*** is ...

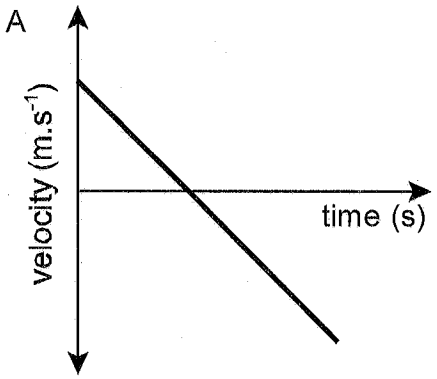
A W.
B 2W.
C 3W.
D 4W. (2)

1.3 Ball X has a mass, M, and ball Y has a mass of 2M, but they are the same size. Both balls are dropped simultaneously from the same height. Which statement is TRUE about the motion of the balls.

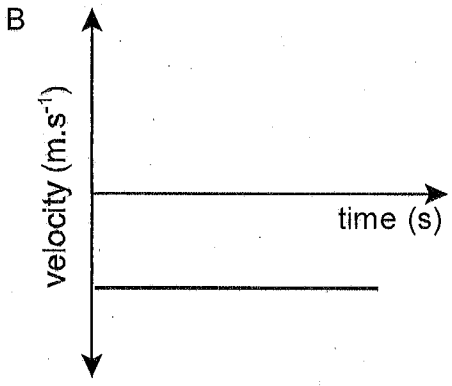
A Y reaches the ground first.
B X will reach the ground first.
C X will hit the ground with a greater speed than Y.
D X and Y will reach the ground at the same time. (2)

1.4 A ball is thrown vertically upwards and then falls back below its original position. Which **ONE** of the following velocity-time graphs best represents the motion of the ball?

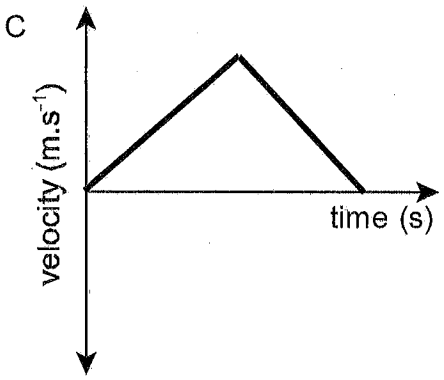
A



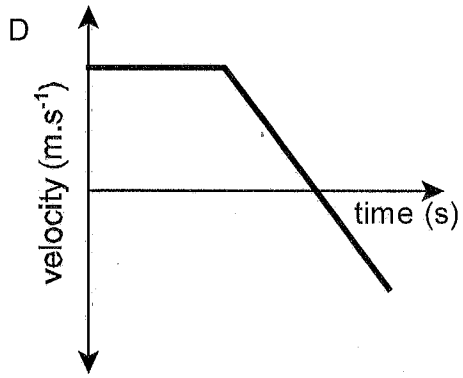
B



C



D



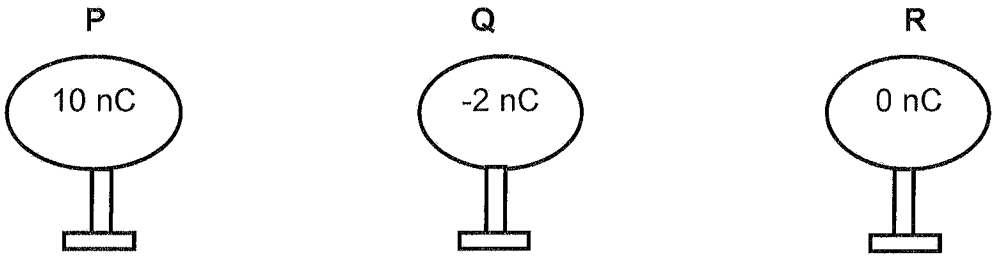
1.5 An astronomer observes that on Earth the spectral lines from a nearby galaxy shifts from their true frequencies to higher frequencies. He concludes that this galaxy is ....

A moving away from Earth and is blue shifted
B moving away from Earth and is red-shifted.
C moving towards Earth and is blue-shifted.
D moving towards Earth and is red-shifted. (2)

1.6 Two ohmic resistors, **X** and **Y,** are connected in parallel. The resistance of resistor **Y** is much greater than the resistance of resistor **X**.
What will be the equivalent resistance of the parallel combination?

A greater than **X**
B greater than **Y**
C less than each of **X and Y**
D less than **Y** and greater than **X** (2)

1.7 Three metal spheres, **P, Q** and **R**, are on insulated stands carrying charges as shown in the diagram below.

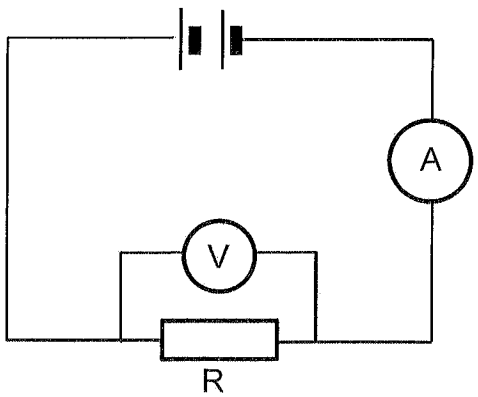


Q moves towards **P** and touches **P. Q** is then moved towards **R** and touches **R**, after which **Q** is returned to its original position. The charges on **P , Q** and **R** , in nC , are now ...

	P	Q	R
A	+6 nC	-4 nC	-4 nC
B	+6 nC	+4 nC	+4 nC
C	+ 4 nC	-2 nC	-2 nC
D	+ 4 nC	+ 2 nC	+2 nC

(2)

1.8 In the accompanying diagram the battery and the meters have negligible internal resistance. The resistance of **R** does not change.



How do the readings on the ammeter and voltmeter change, if at all, when an additional resistor is connected in parallel with **R**?

	VOLTMETER	AMMETER
A	decrease	increase
B	remain the same	decrease
C	increase	decrease
D	remain the same	increase

(2)

1.9 The energy of a photon of light is directly proportional to the ...

A speed of light.
B wave length of the light.
C frequency of the light
D intensity of the light. (2)

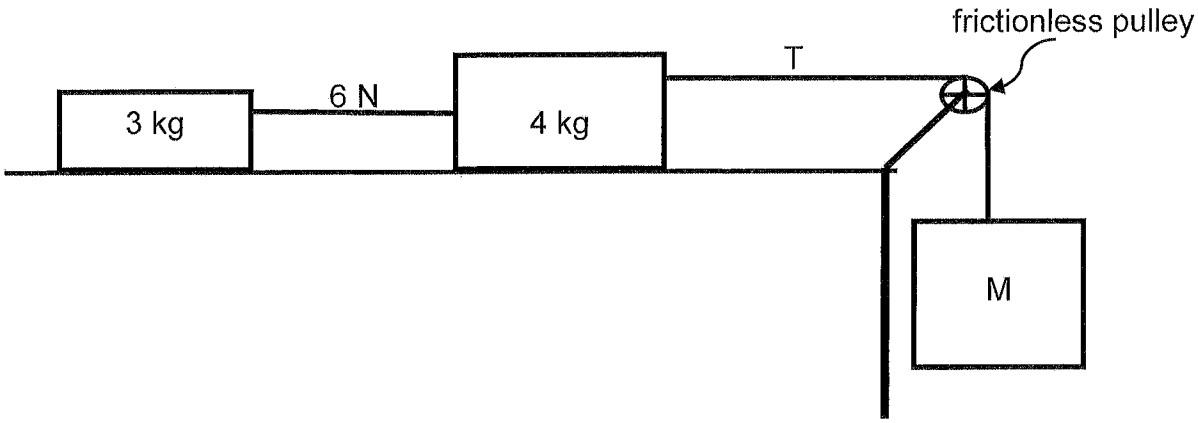
1.10 When light passes through a cold gas, gas atoms absorb energy and electrons move from the ground state to higher energy levels. The spectrum observed is ...

A a continuous spectrum.
B an absorption spectrum.
C a emission spectrum.
D a dark spectrum. (2)

[20]

QUESTION 2

Three blocks each of mass 3 kg, 4 kg and M kg respectively, are connected by a string. The surface and the pulley are both frictionless. The tension in the string between the 4 kg and 3 kg block is 6 N as shown in the diagram below. Ignore the effects of air friction.



2.1 State Newton's 2nd law of motion in words. (2)

2.2 Draw a labelled free-body diagram showing ALL the forces acting on the **4 kg block**. (4)

2.3 Calculate the:

2.3.1 Acceleration of the 3 kg block. (3)

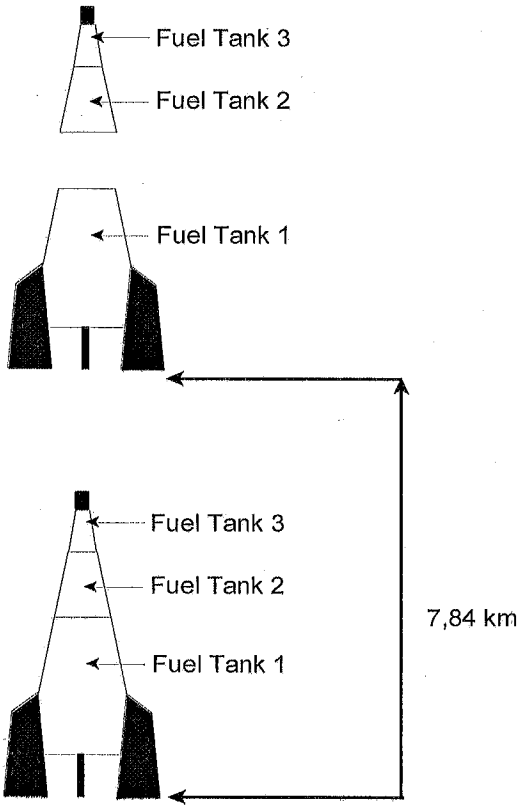
2.3.2 Tension, T, in the string connecting the 4kg and block M. (4)

2.3.3 Mass, M. (4)
[17]

QUESTION 3

A space rocket consists of a number of fuel tanks. As each fuel tank is emptied it is detached and released from the rocket.

A rocket travelling vertically upwards at 392 $m \cdot s^{-1}$ releases its first tank (tank 1) at a height of 7,84 km above the surface of Earth.



Assume that the acceleration due to gravity at this height is 9,8 $m \cdot s^{-2}$ and neglect the effects of air friction.

3.1 For **tank 1**, calculate the:

3.1.1 Maximum height reached. (5)

3.1.2 Velocity, 80 seconds after it is released. (3)

3.2 Sketch a velocity- time graph for the motion of **tank 1** from the moment it leaves the rocket until it reaches the Earth surface.

Indicate the following on the graph:

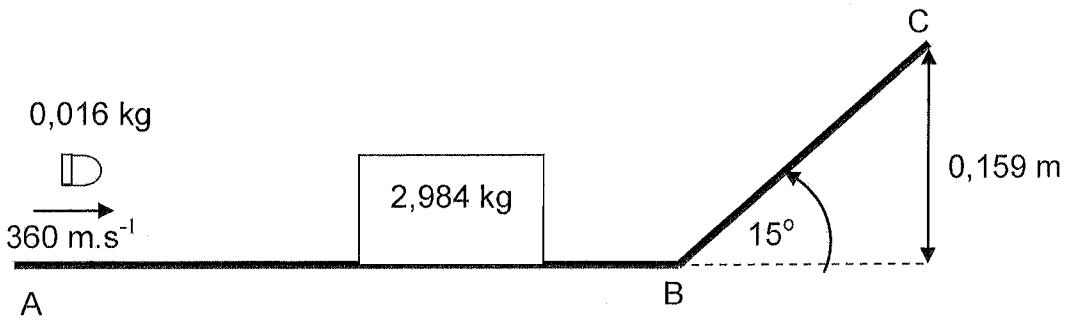
- The initial velocity at which **tank 1** is released.
- The time taken for **tank 1** to reach maximum height.
- The velocity of **tank 1** at t = 80 seconds after its release. (5)

[13]

QUESTION 4

A block is at rest on a frictionless surface **AB**. The surface **BC** makes an angle of 15° with the horizontal as shown below.

A bullet of mass 0,016 kg, moving at a velocity of 360 $m \cdot s^{-1}$, enters a stationary block of mass 2,984 kg. The bullet does not exit the block.



4.1 State the Law of Conservation of Linear momentum in words. (2)

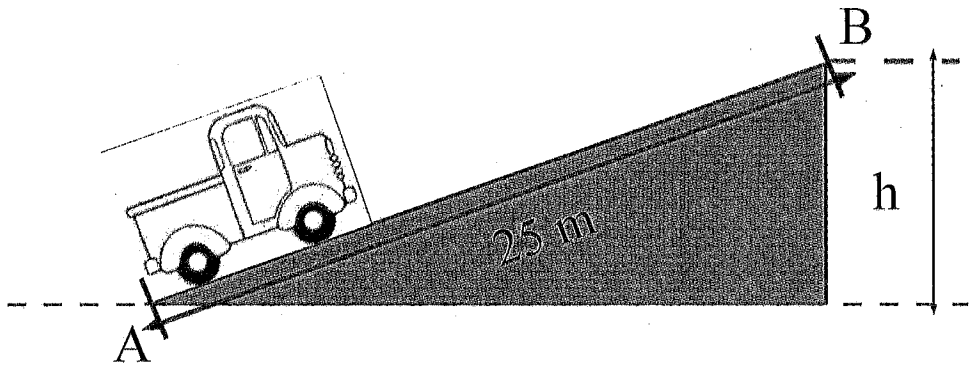
4.2 Show by calculation that the bullet- block combination has a velocity of 1,92 $m.s^{-1}$. (4)

At point **B** the kinetic energy of the bullet- block system is 5,52 J and its potential energy at point C is 4,67J. A constant frictional force acts on the block as it moves from point B to point C through a distance of 0,61 m.

4.3 Calculate the co- efficient of kinetic friction for the bullet- block combination on the surface if it reaches a height of 0,159 m. (8)
[14]

QUESTION 5

The diagram below shows a truck of mass 12 000 kg free-wheeling (with the engine switched off) , up a straight inclined road of length 25 m as shown below.



On reaching the incline, at point **A**, the truck is moving at 25 $m \cdot s^{-1}$ and on reaching point **B**, the truck is moving at 20 $m \cdot s^{-1}$.

The truck experiences a constant frictional force of magnitude 3 400 N as it moves up the incline.

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

5.2 Is the frictional force a conservative or non-conservative force? (1)

5.3 Calculate the:

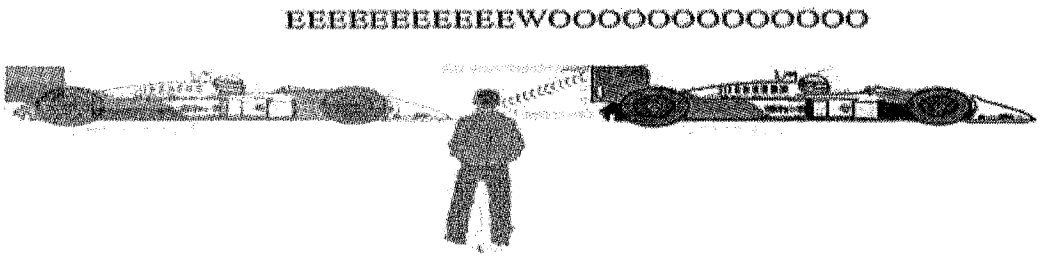
5.3.1 Work done by the frictional force. (3)

5.3.2 Net work done on the truck on moving from the bottom of the incline to the top of the incline. (4)

5.4 Calculate the height, **h**, reached by the truck. (5)
[15]

QUESTION 6

A grade 12 learner visits a motor racing event. He wants to determine the speed at which the vehicles are passing him. He notices that as the vehicles pass him the sound of the engine changes. He measures the frequency as the vehicles approach him and as they move away from him.



6.1 Name the phenomenon observed. (1)

6.2 What will be the change in frequency observed by the racing car driver? Answer INCREASE, DECREASE or ZERO. Give reason for your answer. (2)

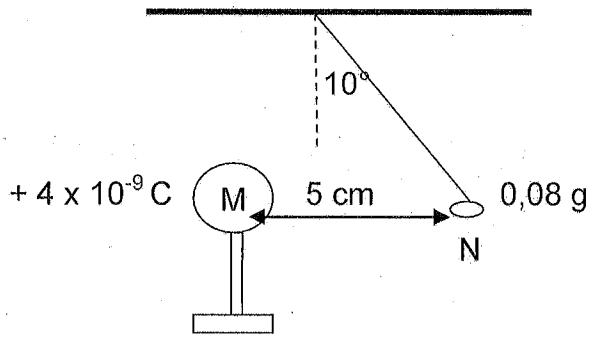
6.3 The car emits sound waves at a frequency of 2500 Hz. As the car approaches him, the learner observes an increase of 535 Hz in the frequency reading. Calculate the speed of the car.

Assume that the speed of sound in air is 340 $m \cdot s^{-1}$. (5)

6.4 State TWO uses of the Doppler flow meter in humans. (2)
[10]

QUESTION 7

7.1 M is a positive charge of +4 x 10^{-9} C, mounted on an insulated stand. Charge N is suspended from a light, inelastic string. M is brought closer to N which is repelled horizontally until the string makes an angle of 10° with the vertical. The centres are now on the same horizontal level and 5 cm apart. The mass of N is 0,08 g.



7.1.1 Define electric field at a point. (2)

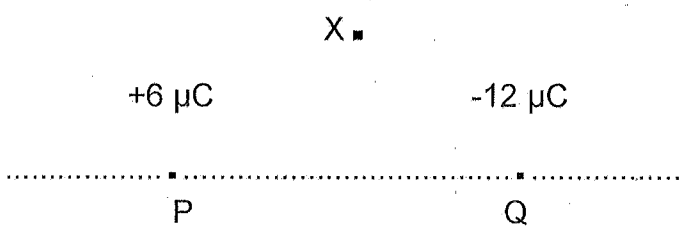
7.1.2 Calculate the magnitude of the electric field strength where N is, due to the electric field caused by M. (4)

7.1.3 Calculate the magnitude of the:

7.1.3.1 electrostatic force exerted on N. (4)

7.1.3.2 charge on N. (4)

7.2 Two charged object, P and Q, carry charges of +6 µC and -12 µC respectively as shown in the diagram below.



7.2.1 Draw an electric field pattern between P and Q. (3)

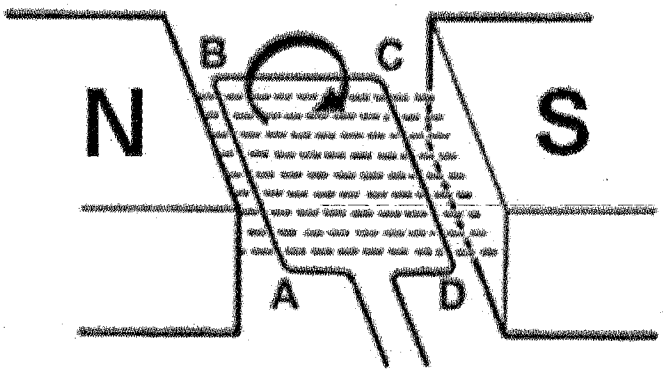
7.2.2 When an electron is released at point X between P and Q as shown above, it accelerates.

7.2.2.1 Will the acceleration of the electron be uniform or non-uniform? (1)

7.2.2.2 Give reason for your answer in 7.2.2. (1)
[19]

QUESTION 8

Generators are used at electrical power stations to produce electricity to be distributed across the national grid.



8.1 Give the NAME and the FUNCTION of the components that should be connected to the ends of the coil in this AC generator to ensure it functions correctly. (2)

8.2 In which direction will the current flow through the coil when it is in the pictured position? State either ABCD or DCBA. (1)

8.3 It takes the coil 0,01 milliseconds (ms) to rotate through 90° and its maximum induced emf is 50 V.

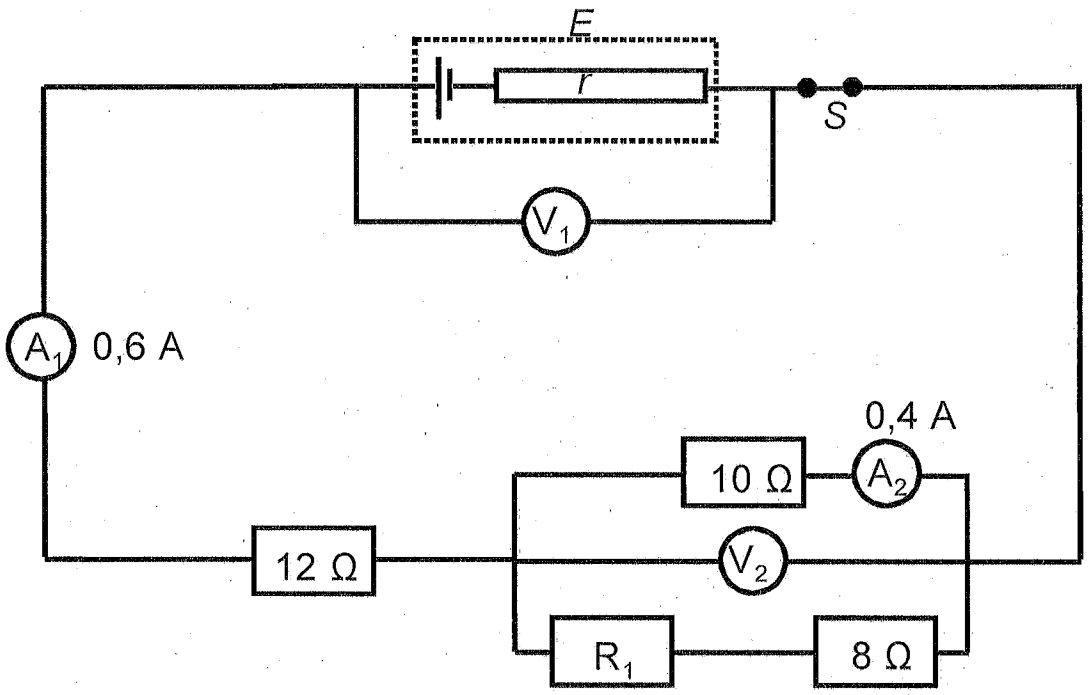
8.3.1 Calculate V_{rms}. (3)

8.3.2 Sketch a graph of voltage vs time for the first 0,07 ms of this AC generator's operation, beginning with the pictured position at time = 0 s. (4)

[10]

QUESTION 9

Consider the following circuit.



When switch *S* is closed the reading on the meters are:

- V_1 decreases by 3V
- A_1 is 0,6 A
- A_2 is 0,4 A

The battery has an emf, *E*, and an internal resistance, *r*.

9.1 Calculate the:

9.1.1 Resistance of R_1 (5)

9.1.2 Internal resistance of the battery (3)

9.1.3 Emf of the battery (6)

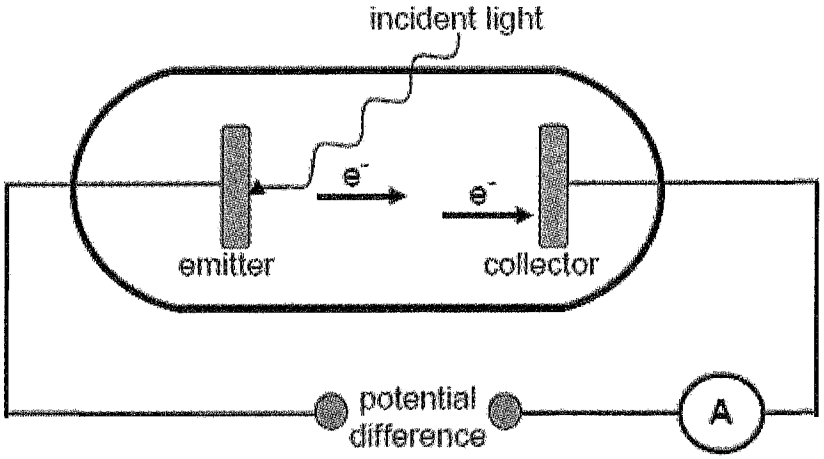
9.1.4 Power dissipated due to the internal resistance of the battery (3)

9.2 The 10 Ω resistor is now removed, how will the voltmeter V_1 change? Write down only INCREASES,DECREASES or REMAINS THE SAME. Explain your answer. (3)

[20]

QUESTION 10

In an investigation to determine the effect of frequency and intensity of light on the current generated in a photocell, the apparatus was set up as represented in the diagram below. Light of various frequencies and intensities was shone onto a photosensitive metal plate used as the cathode and the ammeter measures the current in the circuit.



Some of the results of the experiment are recorded below:

Trial	Frequency (Hz)	Intensity (Cd)	Current (A)
A	$4{,}00 \times 10^{14}$	10	0
B	$4{,}50 \times 10^{14}$	10	0
C	$5{,}00 \times 10^{14}$	10	0
D	$5{,}01 \times 10^{14}$	10	20
E	$5{,}01 \times 10^{14}$	20	40
F	$6{,}50 \times 10^{14}$	10	30

10.1 Name the phenomenon in this investigation. (1)

10.2 What information does this phenomenon, supply about the nature of light? (1)

10.3 In experiments A to C no current is observed, but in experiments E to F current is observed. Explain this observation. (2)

10.4 The results of experiments E to F are compared. Identify:

10.4.1 Independent variable. (1)

10.4.2 Dependent variable. (1)

10.5 Compare the results of experiments E and F. Explain the difference in results. (2)

10.6 Write down the threshold frequency for the metal used as cathode. (1)

10.7 Calculate the maximum kinetic energy of an emitted electron in experiment F. (3)
[12]

TOTAL MARKS: [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	$6,67 \times 10^{-11}\ N{\cdot}m^2{\cdot}kg^{-2}$
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	$9,11 \times 10^{-31}\ kg$
Mass of Earth *Massa van Aarde*	M	$5,98 \times 10^{24}\ kg$
Radius of Earth *Straal van Aarde*	R_E	$6,38 \times 10^{3}\ km$

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* $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{av} = Fv_{av}$ / $P_{gemid} = Fv_{gemid}$	

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* $E = h\frac{c}{\lambda}$
$E = W_o + E_{k(max)}$ 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 $\varepsilon = I(R + r)$ emk $\varepsilon = I(R + r)$
$R_s = R_1 + R_2 + \ldots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$	$q = I\Delta t$
$W = Vq$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$

ALTERNATING CURRENT/*WISSELSTROOM*

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

KwaZulu-Natal Department of Basic Education

REPUBLIC OF SOUTH AFRICA

PHYSICAL SCIENCES: (PHYSICS) P1

PREPARATORY EXAMINATION

SEPTEMBER 2015

MEMORANDUM

NATIONAL SENIOR CERTIFICATE

GRADE 12

MARKS : 150

TIME : 3 Hrs

This memorandum consists of 14 pages.

QUESTION 1

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

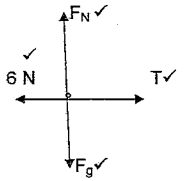
[20]

QUESTION 2

2.1 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 net force and inversely proportional to the mass of the object. ✓

(2)

2.2



(4)

2.3.1

Option 1	Option 2
$F_{res} = F_a + (-F_r)$ ✓ $ma = F_a + (-F_r)$ $3a = 6 + 0$ ✓ $a = 2\ m.s^{-2}$ ✓	$F_{net} = ma$ ✓ $6 = 3.a$ ✓ $a = 2\ m.s^{-2}$ ✓

(3)

2.3.2 **(positive marking from 2.3.1)**

Option 1	Option 2
$F_{res} = F_a + (-F_r)$ ✓ $ma = F_a + (-F_r)$ 4 x 2 ✓= T + (- 6) ✓ T = 14 N✓	$F_{net} = T - 6$ ✓ $ma = T - 6$ ✓ 4 x 2 = 14 N ✓ T = 14 N✓

(4)

2.3.3 **(positive marking from 2.3.2)**

Option 1	Option 2
$F_{res} = F_a + (-F_r)$ ✓ $ma = mg + (- T)$ ✓ m2 = m . 9,8 + (- 14) ✓ 7,8m = 14 m = 1,79 kg✓	$F_{net} = ma$ ✓ $W - T = 2m$ ✓ $9,8m - T = 2m$ ✓ 7,8m = 14 m = 1,79 kg ✓

(4)

[17]

QUESTION 3

3.1.1

Option 1 – upward as positive	Option 2 - upward as negative
$v_f^2 = v_i^2 + 2a\Delta y$ ✓ 0 ✓ $= 392^2 + 2\ (-9,8)\ \Delta y$ ✓ $\Delta y = 7840m$ ✓ The total height reached is 7840 + 7840 = 15 680 m ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓ 0 ✓ $= (-392)^2 + 2\ (9,8)\ \Delta y$ ✓ $\Delta y = 7840m$ ✓ The total height reached is 7840 + 7840 = 15 680 m ✓

(5)

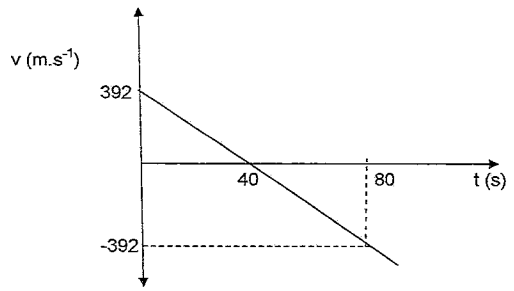
3.1.2

Option 1 – upward as positive	Option 2 - upward as negative
$v_f = v_i + a\Delta t$ ✓ $= 392 + (- 9,8)\ (80)$ ✓ $v_f = - 392m.s^{-1}$ The fuel tank is moving down at $392m.s^{-1}$ ✓	$v_f = v_i + a\Delta t$ ✓ $= (-392) + (9,8)\ (80)$ ✓ $v_f = 392m.s^{-1}$ The fuel tank is moving down at $392m.s^{-1}$ ✓

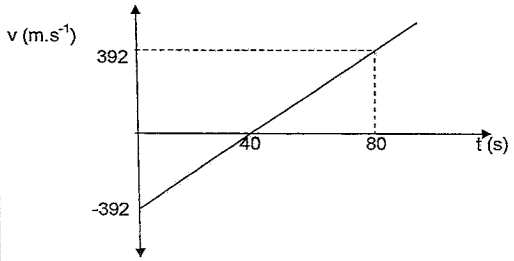
(3)

3.2

Option 1 - upward as positive



Option 2 - upward as negative



Criteria for marking the graph	Marks
Correct shape – straight line	✓
Graph starts at - 392 m·s^{-1} or + 392 m·s^{-1}	✓
Graph passes x – axes at 40 s	✓
The line is extended beyond 80 s	✓
Correct labelling of axes	✓

(5)
[13]

QUESTION 4

4.1 The total linear momentum of a closed system remains constant (is conserved). ✓✓(2)

4.2

Option 1

$\Sigma p_{before} = \Sigma p_{after}$

$(m_b + m_B)\, v_f = m_b v_{bi} + m_{Bi} v_{Bi}$ ✓

$\underline{(0{,}016 + 2{,}984)\, v_f}$ ✓ $= \underline{0{,}016 \times 360 + 0}$ ✓

$v_f = 1{,}92\ m.s^{-1}$ ✓

Option 2

$\Sigma p_{pi} = \Sigma p_{pf}$

$m_1 v_{i1} + m_2 v_{i2} = (m_1 + m_2)\, v$ ✓

$(0{,}016)\ (360)$ ✓ $+ (2{,}984)\ (0)$ ✓ $= 3v$

$v_f = 1{,}92\ m.s^{-1}$ ✓

Option 3

$E_k = \frac{1}{2}mv^2$ ✓

$5{,}52$ ✓ $= \frac{1}{2}\ (3)\ v^2$ ✓

$v_f^{\,2} = 3{,}68$

$v_f = 1{,}92\ m.s^{-1}$ ✓

(4)

4.3

Option 1

$F_N = mg\cos\Theta$ ✓

$= 3 \times 9{,}8 \times \cos 15°$ ✓

$= 28{,}398\ N$

$W_{fr} = 4{,}67 - 5{,}52$

$= -0{,}85\ J$ ✓

$F_{friction} = \frac{W_{friction}}{\Delta x \cos 180°}$ ✓

$= \frac{-0{,}85}{0{,}61}$

$= 1{,}393\ N$ ✓

$\mu_k = \frac{F_{fr}}{F_N}$ ✓

$= \left[\frac{1{,}393}{28{,}398}\right]$ ✓

$= 0{,}049$ ✓

Option 2

$W_{fr} = 4{,}67 - 5{,}52$

$= -0{,}85\ J$ ✓

$W_{fr} = F_{fr} \cos 180° \Delta x$ ✓

$-0{,}85 = \underline{F_f (-1)\ (0{,}61)}$ ✓

$F_f = 1{,}393\ N$

$F_f = \mu_k N$ ✓

$1{,}393$ ✓ $= \mu_k (mg\cos\Theta)$ ✓

$1{,}393 = \mu_k (3 \times 9{,}8 \cos 15°)$✓

$\mu_k = 0{,}049$ ✓

Option 3

$W_{nc} = \Delta K + \Delta U$ ✓

$F\Delta x \cos\Theta = (K_f - K_i) + (U_f - U_i)$ ✓

$F(0{,}61)(-1) = (0 - 5{,}52) + (4{,}67 - 0)$ ✓

$F_f = 1{,}393\ N$

$F_f = \mu_k N$ ✓

$1{,}393$ ✓ $= \mu_k (mg\cos\Theta)$ ✓

$1{,}393 = \mu_k (3 \times 9{,}8 \cos 15°)$✓

$\mu_k = 0{,}049$ ✓

(8)
[14]

QUESTION 5

5.1 The net/total work done on an object is equal to the change in the object's kinetic energy

OR

The work done on an object by a resultant/net force is equal to the change in the object's kinetic energy. ✓✓ (2)

5.2 non – conservative ✓ (1)

5.3.1 $W_{friction} = F_{friction} \times Cos\theta \Delta x$ ✓

$= 3400 \times Cos\ 180^0 \times 25$ ✓

$W_{friction} = -85000J$ ✓ (3)

5.3.2 $W_{net} = \Delta k$ ✓

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

$= \underline{\frac{1}{2}(12000)(20)^2}$ ✓ $- \underline{\frac{1}{2}(12000)(25)^2}$ ✓

$= -351\ 0000\ J$ ✓ (4)

5.4 **positive marking from 5.3.2**

Option 1	**Option 2**
$E_p + W_{friction} = W_{net}$ ✓	$W_{net} = W_g + W_f + W_N$ ✓
$\underline{mgh + 85000}$ ✓ $= 3\ 510000$ ✓	$-351\ 0000$ ✓ $= \underline{-mgh - 85000 + 0}$ ✓
$\underline{12000 \times 9,8 \times h}$ ✓ $= 3\ 425000$	$3\ 425000 = \underline{(12\ 000)(9,8)h}$ ✓
$h = 29,12$ m ✓	$h = 29,12$ m ✓

(5)

[15]

QUESTION 6

6.1 Doppler Effect ✓ (1)

6.2 Zero ✓, no relative motion ✓. (2)

6.3 $f_L = \left[\frac{v \pm v_l}{v \pm v_s}\right] f_s$ ✓

3035 ✓ $= \left[\frac{340 + 0}{340 - v_s}\right]$ ✓ 2500 ✓

$v_s = 59,9\ m.s^{-1}$ ✓ (5)

6.4 Determine the heartbeat of fetus. ✓
Determine whether the arteries are narrowed. ✓ (2)

[10]

QUESTION 7

7.1.1 The electrostatic force experienced per unit positive charge placed at that point. ✓✓(2)

7.1.2 $E = \frac{kQ}{r^2}$ ✓

$= \frac{(9 \times 10^9)(4 \times 10^{-9})}{(5 \times 10^{-2})^2}$ ✓ ✓

$= 1,44 \times 10^4 \text{ N.C}^{-1}$ ✓ (4)

7.1.3.1 $F = mg$ ✓

$= (0,08 \times 10^{-3})(9,8)$ ✓

$= 7,84 \times 10^{-4}$ N

$F_Q = 7,84 \times 10^{-4}$ ✓ x tan 10°

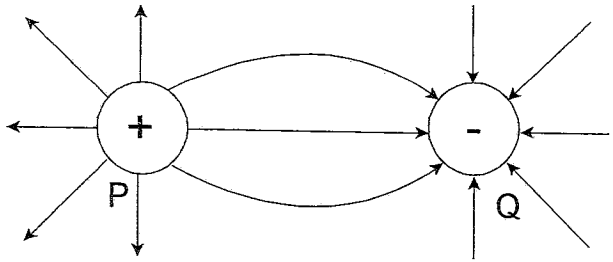
$= 1,38 \times 10^{-4}$ N ✓ (4)

7.1.3.2

Option 1	**Option 2**
$E = \frac{F}{q}$ ✓	$F = \frac{kqQ}{r^2}$ ✓
$1,44 \times 10^4$ ✓ $= \frac{1,38 \times 10^{-4}}{q}$ ✓	$1,38 \times 10^{-4}$ ✓ $= \frac{(9 \times 10^9)\, q\, (4 \times 10^{-9})}{(5 \times 10^{-2})^2}$ ✓
$q = 9 \times 10^{-9}$ C	$3,45 \times 10^{-7} = 36q$
Charge on N is $q = 9 \times 10^{-9}$ C ✓	$q = 9 \times 10^{-9}$ C
	Charge on N is $q = 9 \times 10^{-9}$ C ✓

(4)

7.2.1



Criteria for marking	Marks
Correct shape	✓
Correct direction	✓
Field lines not touching each other or entering the spheres	✓

7.2.2.1 non – uniform (1)

7.2.2.2 the electric field is non-uniform. (1)
[19]

QUESTION 8

8.1 Slip ring commutator✓. Ensure continuous rotation of the coil. ✓ (2)

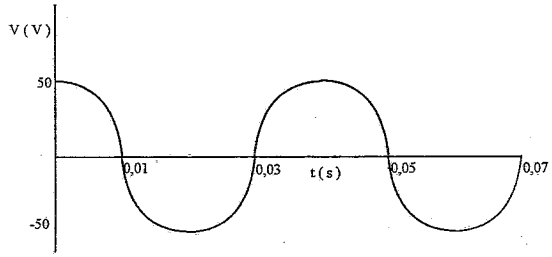
8.2 ABCD ✓ (1)

8.3.1 $V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓

$= \frac{50}{\sqrt{2}}$ ✓

= 35,36 V ✓ (3)

8.3.2



Criteria for marking	Marks
Graph starts at 50 V	✓
Correct shape	✓
Time interval (0,01 ms for 90° rotation)	✓
The graph ends at (0,07,0)	✓

(4)
[10]

QUESTION 9

9.1.1 $V_2 = IR$ ✓
= 0,4 x 10 ✓
= 4V ✓

NB: Positive marking from 9.1.1 to 9.1.4

$R_1 + 8$ ✓ $= \frac{4}{0,2}$ ✓

= 20Ω

R_1 = 12 Ω✓ (5)

9.1.2

Option 1	Option 2
$R_{int} = \frac{V_{lost}}{I}$ ✓	$V_1 = Ir$ ✓
$= \frac{3}{0,6}$ ✓	3 = 0,6r ✓
= 5 Ω ✓	r = 5 Ω ✓

(3)

9.1.3

Option 1	Option 2
$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓	$V = IR_T$ ✓
$= \frac{1}{10} + \frac{1}{20}$	= 0,6 ✓ (12 + 6,67) ✓
$\frac{1}{R_p} = \frac{3}{20}$	= 11,2 V
R_p = 6,67 Ω✓	emf = V + V_1 ✓
R_{ext} = 12 + 6,67	= 11,2 ✓+ 3
= 18,67 Ω ✓	= 14,2 V ✓
emf = I (r + R) ✓	
= 0,6 (5 + 18,67) ✓	
= 14,2 V ✓	

(6)

9.1.4 $P = VI$ ✓
$= 3 \times 0,6$ ✓
$= 18\ W$ ✓ (3)

9.2 Increase, ✓
- R_T increases ✓
- I_{main} decreases
- V_{lost} decreases } ✓
- V_{ext} increases (Emf is constant)

OR

the total resistance will increase✓ thus increasing the potential difference✓.

OR

from Ohm's Law: resistance is directly proportional to potential difference✓✓

OR

R is directly proportional to V ✓✓ (3)

[18]

QUESTION 10

10.1 Photoelectric effect ✓ (1)

10.2 particle nature (of light) OR dual nature (of light) ✓ (1)

10.3 the frequency of light is higher than✓ the threshold frequency in D to F and (photo) electrons are emitted. ✓ (2)

10.4.1 frequency OR intensity ✓ (1)

10.4.2 current ✓ (1)

10.5 Current is directly proportional to the intensity✓, double the current double the intensity✓.

OR

As current increases the intensity increases. ✓✓ (2)

10.6 $5,01 \times 10^{14} Hz$ (1)

10.7 $hf = hf_0 + E_k$ ✓

$(6,63 \times 10^{-34})(6,5 \times 10^{14}) = (6,63 \times 10^{-34})(5,01 \times 10^{14}) + E_k$ ✓

$E_k = 9,8787 \times 10^{-20}\ J$ ✓ (3)

[12]

TOTAL: 150