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## LIMPOPO

PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

## DEPARTMENT OF EDUCATION

## NATIONAL SENIOR CERTIFICATE

## GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)
PREPARATORY EXAMINATIONS SEPTEMBER 2016 MEMORANDUM

MARKS: 150
TIME: 3 hours

This memorandum consists of 10 pages.

## QUESTION 1

1.1 D $\checkmark \checkmark$
1.2 $A \checkmark \checkmark$
1.3 C $\checkmark \checkmark$
$1.4 \mathrm{~B} \checkmark \checkmark$
$1.5 \quad C \checkmark \checkmark$
1.6 A $\checkmark \checkmark$
1.7 $\mathrm{D} \checkmark \checkmark$
$1.8 \mathrm{D} \checkmark \checkmark$
$1.9 \mathrm{~B} \checkmark \checkmark$
1.10 $\mathrm{A} \checkmark \checkmark$

## QUESTION 2

2.1
2.1.1 When a net force $\left(F_{\text {net }}\right)$ is applied to an object (of mass, $m$ ) it accelerates in the direction of the (net) force. The acceleration (a) is directly proportional to the (net) force and inversely proportional to the mass of the object. $\checkmark \checkmark$ (2 or 0 ) OR
The net force acting on an object is equal to the rate of change of momentum of the object (in the direction of the force). $\checkmark \checkmark$ (2 or 0 )
2.1.2

(Accept the components of $F_{g}$ INSTEAD of $F_{g}$ but not both $F_{g}$ and the components. No arrows $=3 / 4$; forces not touching dots $=3 / 4$ )
2.1.3 (a)

$$
\begin{equation*}
F_{\mathrm{f}}=\mu_{\mathrm{k}} \mathrm{~F}_{\mathrm{N}}^{\checkmark}=\mu_{\mathrm{k}}\left(\mathrm{mg} \operatorname{Cos} 30^{\circ}\right)=0,2 \stackrel{\checkmark}{(33,95)}=6,79 \mathrm{~N}^{\checkmark} \tag{3}
\end{equation*}
$$

(b) Positive marking from 2.1.3 a

$$
\begin{align*}
& \mathrm{F}_{\mathrm{g} / /}=\mathrm{mg} \sin 30^{\circ}=(4)(9,8) \sin 30=19,6 \mathrm{~N} \\
& \mathrm{~F}_{\mathrm{net}}=\mathrm{ma}_{\mathrm{R}}=\mathrm{F}+\mathrm{F}_{\mathrm{f}}+\mathrm{F}_{\mathrm{g} / /} \\
& \checkmark \\
& (4)(0,43)=\mathrm{F}+(-6,79)+(-19,6)^{\checkmark}  \tag{5}\\
& \mathrm{F}=28,11 \mathrm{~N}
\end{align*}
$$

2.2 $\mathrm{F}=\frac{\mathrm{G} \mathrm{m} / \mathrm{m}_{2}}{\mathrm{r}^{2}}=\frac{6,67 \times 10^{-11} \times 2000 \times 6 \times 10^{24}}{\left(6.5 \times 10^{6}\right)^{2}}=18944,34 \mathrm{~N}$

## QUESTION 3

Any sign convention is accepted, i.e. learners may also work with upwards as positive 3.1 3.1.1 $9,8\left(\mathrm{~m} . \mathrm{s}^{-2}\right)$ - object is falling through the air.
3.1.2 $t_{x}=(0,5+0,5)=1 \mathrm{~s}$
$3.2\left\{\begin{array}{l}\text { The area under the graph represents the displacement. } \\ \text { displacement }=\text { area }=1 / 2 \text { base } \times \text { height }=1 / 2 \times(-0,5) \times 3,9=-0,98 \mathrm{~m}\end{array}\right.$

$$
\begin{equation*}
\text { height }=0,98 \mathrm{~m} \quad \checkmark \tag{3}
\end{equation*}
$$

## 3.3

3.3.1 From the graph, downward motion as POSITIVE.

$$
\begin{align*}
& \quad \checkmark  \tag{3}\\
& v_{f}=v_{i}+a \Delta t^{\checkmark} \\
&=\frac{-4,9+(+9,8)(1,7)}{11,76 \mathrm{~m}^{-1} \checkmark} \\
&=\mathrm{s}^{-1}
\end{align*}
$$

3.3.2

| Upwards as - $\begin{aligned} \Delta \mathrm{y} & =\mathrm{v}_{\mathrm{i}} \Delta \mathrm{t}+\frac{1}{2} \mathrm{a} \Delta \mathrm{t}^{2} \\ & =\frac{(-4,9)(1,7)+1 / 2(+9,8)(1,7)^{2}}{\checkmark} \\ & =5,83 \mathrm{~m} \end{aligned}$ | Upwards as + $\begin{aligned} \Delta \mathrm{y} & =\mathrm{v}_{\mathrm{i}} \Delta \mathrm{t}+\frac{1}{2} \mathrm{a} \Delta \mathrm{t}^{2} \quad \checkmark \\ & =\left(\underline{4,9)(1,7)+1 / 2(-9,8)(1,7)^{2}}\right. \\ & =-5,83 \\ \Delta y & =5,83 \mathrm{~m} \quad \checkmark \end{aligned}$ | $\checkmark$ |
| :---: | :---: | :---: |

## OR


3.4


## QUESTION 4

4.1

N/ F $/$ / Normal Force

w/ $\mathrm{F}_{\mathrm{g}}$ / Weight / Gravitational force
4.2 $\quad F_{\text {net }}=F_{\text {applied }}+F_{f}=0,30+(-0,86)=-0,56 \mathrm{~N}=0,56 \mathrm{~N}$ opposite direction of motion/ to the left
4.3 Work Energy theorem states that, 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.
4.4

$$
\begin{aligned}
W_{\text {NET }} & =\Delta E_{K} \\
F_{\text {net }} \Delta x \operatorname{Cos} \Theta{ }^{\prime} & =1 / 2 \mathrm{mv}_{\mathrm{f}}^{2}-1 / 2 \mathrm{mv}_{\mathrm{i}}^{2} \\
0,56 \Delta \mathrm{Cos} 180 & =1 / 2(0,8)(0,2)^{2}-1 / 2(0,8)(1,2)^{2} \\
(0,56) \times(\Delta x) \times(-1) & =0,016-0,576 \\
\Delta \mathrm{x} & =1 \mathrm{~m} \checkmark
\end{aligned}
$$

OR

$$
\begin{align*}
W_{N C} & =\Delta E_{K}+\Delta E_{P} \checkmark \\
\mathrm{f} \Delta \mathrm{x} \operatorname{Cos} 180+\mathrm{F}_{\mathrm{APPL}} \Delta \mathrm{x} \operatorname{Cos} 0 \checkmark & =1 / 2 \mathrm{mv}_{\mathrm{f}}^{2}-1 / 2 \mathrm{mv}_{\mathrm{i}}^{2}+0 \\
0,86 \cdot \Delta x \operatorname{Cos} 180+0,3 \cdot \Delta x \operatorname{Cos} 0 & =1 / 2(0,8)\left(0,2^{2}\right)-1 / 2(0,8) 1,2^{2} \\
\hline(-0,86+0,3) \cdot \Delta x & =0,016-0,576 \\
\Delta \mathrm{x} & =1 \mathrm{~m} \checkmark \tag{4}
\end{align*}
$$

4.5 Friction OR applied force (note: symbols not accepted)

## QUESTION 5

5.1 Impulse is the product of the resultant/net force acting on an object and the time the resultant/net force acts on the object.

## 5.2

5.2.1

## OPTION 1

Take direction towards lef positive

$v=100 / 1250=0,08 \mathrm{~m} \cdot \mathrm{~s}^{-1}$, left
$\checkmark$

## OPTION 2

Take direction towards right as positive

$$
\begin{aligned}
& \Sigma p_{i}=\Sigma p_{f} \\
& \left.0=M v_{\text {cannon }}+m v_{\text {ball }}\right\} \text { Any one } \\
& 0^{\checkmark}=(1250) v+\underline{1,25(80)} \\
& v=100 / 1250=-0,08 \mathrm{~m}^{-1} \\
& v=0,08 \mathrm{~m} \cdot \mathrm{~s}^{-1} \text {, left } \checkmark
\end{aligned}
$$

(5)

## OPTION 1

Take direction towards left as positive

$$
\begin{aligned}
& F_{\text {net }} \Delta t \stackrel{\checkmark}{=} m \Delta v=m v_{f}-m v_{i} \\
& F(1,0)^{\boldsymbol{r}}=(1250)((0)-(0,08)) \\
& \mathrm{F}=-100 \mathrm{~N} \\
& F_{\text {net }}=100 \mathrm{~N}^{\checkmark} \\
& \text { OR } \\
& v_{f}=v_{i}+a \Delta t \\
& \frac{0=0,08+a(1,0)}{a=-0,08} \checkmark \\
& F_{\text {net }}=m \times a \\
& =1250 \times(-0,08)=-100 \mathrm{~N} \\
& =100 \mathrm{~N} \checkmark
\end{aligned}
$$

## OPTION 2

Take direction towards right as positive

$$
\begin{aligned}
F_{\text {net } \Delta t} & \stackrel{\checkmark}{m} m v=m v_{f}-m v_{i} \\
F_{\text {net }}(1,0)^{\checkmark} & =(1250)((0)-(-0,08)) \\
F_{\text {net }} & =100 \mathrm{~N} \checkmark
\end{aligned}
$$

## QUESTION 6

## 6.1

6.1.1 The Doppler Effect is the change in the observed 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. $\checkmark \checkmark$ (2 or 0) OR
The change in the (observed) frequency when there is relative motion between the source and the observer. $\checkmark \checkmark$
(2 or 0)
6.1.2 away
(1)
6.1.3

$$
\begin{align*}
& f_{L}=\frac{v \pm v_{L}}{v \pm v_{s}} f_{s} \checkmark \\
& 88=\frac{340-0}{340+v_{s}} \checkmark \times 90 \\
& v_{s}=7,73 \mathrm{~m} \cdot \mathrm{~s}^{-1} \checkmark \tag{5}
\end{align*}
$$

## (note: it is not necessary to show the zero)

6.2
6.2.1 Red Shift occurs when absorption lines are shifted towards smaller $\quad \checkmark \checkmark$
frequencies (or larger wavelengths) (which is the red end of the spectrum)(2)
6.2.2 absorption (spectrum)
6.2.3 $\mathrm{F}^{\checkmark}$. fastest galaxy/highest velocity

## QUESTION 7

7.1


| $\checkmark$ | direction |
| :--- | :--- |
| $\checkmark$ | pattern |
| $\checkmark$ | field lines do not touch |

7.2 The magnitude of the electrostatic force exerted by one point charge $\left(Q_{1}\right)$ on another point charge $\left(\mathrm{Q}_{2}\right)$ is directly proportional to the product of the (magnitudes of the) charges $\sqrt{ }$ and inversely proportional to the square of the distance ( $r$ ) between them.
7.3

$$
\begin{align*}
\mathrm{F} & =\frac{\mathrm{KQ}_{1} \mathrm{Q}_{2}}{\mathrm{r}^{2}} \checkmark \\
4 \times 10^{-3} \mathrm{~N} & =\frac{9 \times 10^{9} \times \mathrm{Q} \times \mathrm{Q}}{\left(6 \times 10^{-3}\right)^{2}} \\
\mathrm{Q} & =(-) 4 \times 10^{-9} \mathrm{C} \tag{4}
\end{align*}
$$

7.4

$$
\begin{align*}
& \mathrm{E}=\frac{\mathrm{kQ}}{\mathrm{r}^{2}} \checkmark \\
& \checkmark \quad \checkmark \\
& 4,44 \times 10^{5}=9 \times \frac{10^{9}\left(4 \times 10^{-9}\right)}{(\mathrm{r})^{2}} \\
& \mathrm{r}=9 \times 10^{-3} \mathrm{~m}  \tag{5}\\
& \mathrm{~d}(\mathrm{or} \mathrm{r})=9 \times 10^{-3} \mathrm{~m}-6 \times 10^{-3} \mathrm{~m}=3 \times 10^{-3} \mathrm{~m}=3 \mathrm{~mm}
\end{align*}
$$

## QUESTION 8

8.1 Emf is the total potential difference across an electric circuit when the switch is open.
OR
Emf is the energy supplied per coulomb of charge/unit charge moving through the battery

## 8.2

8.2.1 Internal Resistance // lost volts (used up by internal r)
8.2.2 $0(\mathrm{~V}) /$ zeró
8.2.3

$$
\begin{align*}
& \mathrm{R}=\frac{\mathrm{V}}{\mathrm{I}} \quad \checkmark \quad\left(\text { or } \mathrm{I}=\frac{\mathrm{V}}{\mathrm{R}}\right. \text { ) } \\
& \mathrm{I}=\frac{4,5}{5}=0,9 \mathrm{~A} \\
& \frac{1}{R_{\mathrm{p}}}=\frac{1}{\mathrm{r}_{1}}+\frac{1}{\mathrm{r}_{2}}=\frac{1}{20}+\frac{1}{30}=\frac{2+3}{60}=\frac{5}{60} \\
& \mathrm{R}_{\mathrm{p}}=12 \Omega \\
& \mathrm{R}_{\text {ext }}=12+43=55 \Omega \\
& \text { Emf }=I(R+r)=0,9\left(55^{\checkmark}+5\right)=0,9 \times 60=54 \mathrm{~V} \checkmark \tag{7}
\end{align*}
$$

### 8.2.4 Positive marking from Q 8.2.3

$\mathrm{R}=\frac{\mathrm{V}}{\mathrm{I}} \quad \checkmark$
Therefore, $\quad V_{P}=I \times R_{P}=0,9 \times 12=10,8 \mathrm{~V}$
$\left(O R V_{P}=49,5-V_{43}=49,5-(0,9 \times 43)=10,8 \mathrm{~V}\right)$
$I_{30 \Omega}=\frac{\mathrm{V}_{30 \Omega}}{\mathrm{R}}=\frac{10^{\checkmark}, 8}{30} \overleftarrow{=0,36 \mathrm{~A}^{\checkmark}}$
8.3 Decrease. $\checkmark$ Total resistance in the circuit increases. ${ }^{\checkmark}$ Current decreases. Hence, power decreases.

## QUESTION 9

9.1 Internal resistance in the opposition to the flow of charge in a cell/ an ammeter (in an electric circuit.)
9.2
$9.2 .13 V^{\checkmark}$
9.2.2 'lost' volts $=3,0-2,0=1 V^{\checkmark} \quad$ OR $1 \mathrm{~V} \checkmark \checkmark$
9.2.3 $r$ can be found by finding the gradient of the graph

$$
\begin{aligned}
\text { gradient } & =\frac{\Delta \mathrm{I}}{\Delta \mathrm{~V}} \checkmark \\
& =\frac{0,4-0,6}{1-0} \\
& =\frac{-0,2}{1} \\
& =-0,2 \Omega^{-1} \\
\mathrm{R}_{\mathrm{int}} & =5 \Omega
\end{aligned}
$$

(other correct values from the graph can be used for the calculation) (3)

QUESTION 10
10.1 10.1.1 (split - ring) commutator $\checkmark$
10.1.2 coil $\checkmark$
$10.2 \quad 10.2 .1 \quad \mathrm{~V}_{\mathrm{rms}}=\frac{\mathrm{V}_{\text {max }}{ }^{\checkmark}}{\sqrt{2}}$

$$
\begin{equation*}
200=\frac{V_{\max } \checkmark}{\sqrt{2}} \quad \mathrm{~V}_{\max }=282,84 \mathrm{~V} \tag{3}
\end{equation*}
$$



$$
\begin{align*}
& \mathrm{OR}  \tag{4}\\
& \mathrm{P}=\frac{\mathrm{V}^{2}}{\mathrm{R}}{ }^{\text {ris }} \text { Therefore, } \mathrm{R}=\frac{240^{2^{\checkmark}}}{2200}=26,18 \Omega \\
& \mathrm{~V}=\mathrm{IR} \\
& 200=I(26,18) \\
& \mathrm{I}=7,64 \mathrm{~A} \\
& \mathrm{P}=\mathrm{VI}=200 \stackrel{\checkmark}{(7,64)=1527,88 \mathrm{~W}^{\checkmark}}
\end{align*}
$$

## QUESTION 11

11.1

$$
\begin{equation*}
E=h f=\frac{h^{\checkmark}}{\lambda}=\frac{6,63 \times 10^{-34} \times 3 \times 10^{8}}{510 \times 10^{-9} \checkmark}=3,9 \times 10^{-19^{\checkmark}} \mathrm{J} \tag{4}
\end{equation*}
$$

OR

$$
\begin{align*}
& c=f \times \lambda \\
& 3 \times 10^{8}=f \times 510 \times 10^{-9} \\
& f=5,88 \times 10^{14}  \tag{4}\\
& E=h f=6,63 \times 10^{-34} \times 5,88 \times 10^{14}=3,9 \times 10^{-19} \mathrm{~J} \checkmark
\end{align*}
$$

11.2 Positive marking from 11.1

Caesium. Its work function is less than the energy of a photon of green light.
$11.3 \quad$ Positive marking from 11.1 and 11.2

$$
\begin{align*}
E & =h f=W_{0}+E k^{\checkmark} \\
E k & =E-W_{0} \\
& =3,9 \times 10^{-19}-3.36 \times 10^{-19} \\
& =5,4 \times 10^{-20} \mathrm{~J} \checkmark \tag{3}
\end{align*}
$$

11.4
11.4.1 remain the same
11.4.2 remain the same
11.4.3 remain the same

