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## PREPARATORY EXAMINATION 2018 MARKING GUIDELINES

PHYSICAL SCIENCES: PHYSICS (PAPER 1) (10841)

13 pages

## GAUTENG DEPARTMENT OF EDUCATION <br> PREPARATORY EXAMINATION - 2018

PHYSICAL SCIENCES: PHYSICS (Paper 1)

## MARKING GUIDELINES

## QUESTION 1

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

## QUESTION 2

2.1 The total mechanical energy (sum of the potential energy and kinetic energy) in a system remains constant as long as the only forces acting are conservative forces. $\checkmark \checkmark$
2.2 At point $A$ Emech $=E_{p}+E_{k} \checkmark$

$$
\begin{aligned}
& =m g h+0 \\
& =50 \times 9,8 \times 5 \\
& =2450 \mathrm{~J}
\end{aligned}
$$

At point $B \quad E_{\text {mech }}=E_{p}+E_{k}$

$$
2450=0+1 / 2 m v_{i}^{2} \checkmark
$$

$$
\begin{equation*}
v_{i}=9,899 \mathrm{~m} \cdot \mathrm{~s}^{-1} \checkmark \tag{4}
\end{equation*}
$$

2.3 The total linear momentum of a closed system remains constant (is conserved). $\checkmark \checkmark$
2.4.1

$$
\begin{align*}
\Sigma_{\mathrm{p}(\text { before })} & =\Sigma_{p(\text { after })} \\
m_{d} \mathrm{v}_{\mathrm{d}}+m_{w} \mathrm{v}_{\mathrm{w}} & =\left(m_{d}+m_{\mathrm{w}}\right) \mathrm{v}_{\mathrm{c}} \\
50 \times 9,899+0 \vee & =(50+60) \mathrm{v}_{\mathrm{c}} \checkmark \\
\mathrm{v}_{\mathrm{c}} & =4,4995 \\
\mathrm{v}_{\mathrm{c}} & =4,50 \mathrm{~m} \cdot \mathrm{~s}^{-1} \checkmark \tag{3}
\end{align*}
$$

2.4.2 Impulse, $\Delta \mathrm{p}=\mathrm{m}_{\mathrm{d}} \Delta \mathrm{v}$

$$
\begin{align*}
& =50 \times(9,899-4,4995) \\
& =269,98 \mathrm{~kg} \cdot \mathrm{~m} \cdot \mathrm{~s}^{-1} \tag{2}
\end{align*}
$$

2..4.3 $W_{\text {net }}=\Delta \mathrm{E}_{\mathrm{k}} \quad=\mathrm{F}_{\text {net }} \mathrm{x} \Delta \mathrm{x} \operatorname{Cos} \theta$

$$
\begin{align*}
E_{k f}-E_{k i} & =F_{\text {net }} \times \Delta x \operatorname{Cos} \theta \checkmark \\
0-1 / 2 \times 110 \times 4,50^{2} \checkmark & =60 \times \Delta x \operatorname{Cos} 180^{\circ} \checkmark \\
\Delta x & =18,56 \mathrm{~m} \checkmark \tag{4}
\end{align*}
$$

## QUESTION 3

3.1 "free fall" is the motion of a body when the only force acting on the body is gravity/pull due to gravity/its weight. $\checkmark \checkmark$
$3.2 \quad \mathrm{vf}^{2}=\mathrm{v}_{\mathrm{i}}{ }^{2}+2 \mathrm{a} \Delta \mathrm{y} \checkmark$
$v_{f}=\left(10^{2}+(2 \times 9,8 \times 20)\right) \checkmark$

$$
\begin{equation*}
=22,181 \mathrm{~m} \cdot \mathrm{~s}^{-1} \checkmark \tag{3}
\end{equation*}
$$

$3.3 \quad v_{f}=v_{i}+a \Delta t \checkmark$

$$
\begin{align*}
\Delta \mathrm{t} & =\frac{22,181-10}{9,8} \checkmark \\
& =1,243 \mathrm{~s} \checkmark \tag{3}
\end{align*}
$$

3.4 Ball rises $19 \mathrm{~m} \checkmark$ after the bounce hence

$$
\begin{array}{ll}
v_{f}^{2} & =v_{i}^{2}+2 a \Delta y \\
0^{2} & =v_{i}^{2}+2(9,8)(-19) \checkmark \\
v_{i} & =19,298 \mathrm{~m} \cdot \mathrm{~s}^{-1} \checkmark
\end{array}
$$

$$
\begin{align*}
t_{u p} & =\frac{v_{f}-v_{i}}{a} \\
& =\frac{0-(-19,298}{9,8} \\
& =1,969 \mathrm{~s} \tag{3}
\end{align*}
$$

3.5 The decrease in the magnitudes of the velocities, hence the loss in kinetic energy shows that the collision between the ball and the ground is inelastic $\sqrt{ }$ and energy is lost through sound and heat $\checkmark$

### 3.6 Down is positive



## Upward is positive

| 19,30 m $\cdot \mathrm{s}^{-1}$ |  | Marking criteria |  |
| :---: | :---: | :---: | :---: |
|  |  | Graph starts at $10 \mathrm{~m} \cdot \mathrm{~s}^{-1}$ | $\checkmark$ |
|  |  | Graph ends at $22,18 \mathrm{~m} \cdot \mathrm{~s}^{-1}$ | $\checkmark$ |
|  |  | 1,243 s indicated | $\checkmark$ |
|  | 1,24 s | Graph starts at -19,30 m $\cdot \mathrm{s}^{-1}$ | $\checkmark$ |
| -10 m•s ${ }^{-1}$ |  | Graph ends at v =0 (time 3,212 s) | $\checkmark$ |
|  |  | Negative slope for both graph sections | $\checkmark$ |

(6)

## QUESTION 4

4.1 The net/total work done on an object is equal to the change in the object's kinetic energy $\checkmark \checkmark$ (OR the work done on an object by a resultant/ net force is equal to the change in the object's kinetic energy )
4.2

## OPTION 1


$\mathrm{F}_{\mathrm{g}} /$ w/force of earth on object $\checkmark$

OPTION 2

4.3
4.3.1

## OPTION 1

OPTION 2

$$
\begin{aligned}
\mathrm{vf}_{\mathrm{f}}^{2} & =\mathrm{v}_{\mathrm{i}}^{2}+2 \mathrm{a} \Delta \mathrm{x} \checkmark \\
& =0^{2}+2 \times 2 \times 8 \checkmark \\
& =5,657 \mathrm{~m} \cdot \mathrm{~s}^{-1} \\
\mathrm{v}_{\mathrm{f}} & \mathrm{E}_{\mathrm{k}} \\
& =1 / 2 \mathrm{mv}^{2} \checkmark \\
& =0,5 \times 40 \times 5,657^{2} \checkmark \\
& =640,03 \mathrm{~J} \checkmark
\end{aligned}
$$

OPTION 1

$$
\begin{aligned}
\Delta x & =v_{i} \Delta t+1 / 2 a \Delta t^{2} \checkmark \\
8 & =0 x \Delta t+0.5 x 2 x \Delta t \checkmark \\
\Delta t & =2,828 \\
V_{f} & =v_{i}+a \Delta t \\
& =0+2 \times 2,838 \checkmark \\
& =5,657 \mathrm{~m} \cdot \mathrm{~s}^{-1}
\end{aligned}
$$

$$
\mathrm{E}_{\mathrm{k}} \quad=1 / 2 m v^{2} \checkmark
$$

$$
=0,5 \times 40 \times 5,657^{2} \checkmark
$$

$$
\begin{equation*}
=640,03 \mathrm{~J} \tag{5}
\end{equation*}
$$

## POSITIVE MARKING FROM 4.3.1 \& 4.3.2

$4.3 .{ }^{\wedge}{ }^{-} W_{\text {net }}$

$$
=\Delta \mathrm{E}_{K} \sqrt{ }
$$

$$
\begin{aligned}
W_{g}+W_{f} & =E_{K f}-E_{K i} \\
1568+W_{f} \checkmark & =640,03-0 \checkmark
\end{aligned}
$$

$$
\begin{equation*}
\therefore W_{f}=-927,97 \mathrm{~J} \checkmark \tag{4}
\end{equation*}
$$

4.3.4 $W_{f}=F_{f} \Delta x \cos \theta \checkmark$

$$
\begin{align*}
927,97 & =F_{f} \times 8 \cos 180^{\circ} \checkmark \\
F_{f} & =-115,996 \mathrm{~N} \\
& =115,996 \mathrm{~N} \checkmark \tag{3}
\end{align*}
$$

## QUESTION 5

5.1 The Doppler effect is 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. $\checkmark$
5.2 For car $\mathbf{A} ; \quad F_{\mathrm{L}} \quad=\quad\left(\frac{\mathrm{v} \pm \mathrm{v}_{\mathrm{L}}}{\mathrm{v} \pm \mathrm{v}_{\mathrm{s}}}\right) \mathrm{f}_{\mathrm{s}}, \checkmark \quad \mathrm{v}_{\mathrm{s}}=\frac{284,4}{3,6}=79 \mathrm{~m} \cdot \mathrm{~s}^{-1} \checkmark$

$$
\begin{align*}
& =\quad\left(\frac{340+0}{340-79} \checkmark\right) 1200 \checkmark \\
& =1563,218 \mathrm{~Hz} . \tag{5}
\end{align*}
$$

5.3 For car B; $F_{L}=\left(\frac{v \pm v_{L}}{v \pm v_{s}}\right) f_{s}$,

$$
\begin{align*}
& 1600 \checkmark=\left(\frac{340+0}{340-v_{\mathrm{s}}} \checkmark\right) 1170 \checkmark \\
& v_{\mathrm{s}}=91,375 \mathrm{~m} \cdot \mathrm{~s}^{-1} \checkmark \tag{4}
\end{align*}
$$

5.4 With sound

- The velocity of sound in air is comparable with speed of the ambulance. $\checkmark$ The change in frequency will therefore be significant hence a noticeable change. $\checkmark$

With light

- The velocity of light is too high compared to the speed of the ambulance. The change in frequency will be insignificant hence no noticeable change.


## QUESTION 6

6.1 What is the relationship between the potential difference across a resistor and the current through the resistor? $\checkmark \checkmark$
6.2


| Marking criteria |  |
| :--- | :--- |
| Components except voltmeter <br> connected in series. | $\checkmark$ |
| Voltmeter connected across R. | $\checkmark$ |
| All symbols correct. | $\checkmark$ |

6.3 6.3.1 Potential difference $(V)^{\checkmark}$
6.3.2 Current $(I) \checkmark$
6.3.3 Temperature of the fixed resistor $\checkmark$
6.4 Take readings quickly/ allow time between readings so that resistor cools $\checkmark$
$6.5 \quad 6.5 .1$

| Potential difference/V $\checkmark$ | 0 | 1 | 2 | 3 | 4 | 5 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| current/A $\checkmark$ | 0 | 0,29 | 0,6 | 0,9 | 1,22 | 1,48 |

All values paired correctly

### 6.5.2

Graph of voltage vs current for a fixed resistor


## Marking criteria

Axes labelled $\checkmark$
Scales on both axes correct $\checkmark$
At least 3 plots correct $\checkmark$
Straight line $\checkmark$ passing through the origin
6.5.3 The current through the resistor is directly proportional to the potential difference across the resistor if the temperature of the resistor is kept constant. $\checkmark \checkmark$
6.5.4 - If V vs I as drawn above, gradient represents magnitude of the resistance of the resistor.

- If I vs $V$ is plotted, then gradient represents the reciprocal of the resistance of the resistor.


## QUESTION 7

7.1

$$
\begin{align*}
R_{\text {ext }} & =\frac{V}{l} \checkmark \quad(V=\text { terminal } p d) \\
& =\frac{12}{1,2} \checkmark \\
& =10 \Omega \tag{3}
\end{align*}
$$

7.2 Option 1

$$
\begin{aligned}
\frac{1}{\mathrm{R}_{/ /}} & =\frac{1}{\mathrm{R}_{4}}+\frac{1}{\mathrm{R}_{6}} \\
\mathrm{R}_{/ /} & =\frac{4 \times 6}{4+6} \\
& =2,4 \Omega
\end{aligned}
$$

$$
R=R_{T}-R_{/ / \checkmark}
$$

$$
=10-2,4
$$

$$
=7,6 \Omega \checkmark
$$

## Option 3

$$
\begin{aligned}
\varepsilon & =I\left(R_{\text {ext }}+r\right)^{\checkmark} \\
& =1,2(2,4+R 1,5) \checkmark \\
13,8 & =1,2 R+4,68 \checkmark \\
R & =7,6 \Omega \checkmark
\end{aligned}
$$

Option 2

$$
\begin{aligned}
\frac{1}{R_{/ /}}= & \frac{1}{R_{4}}+\frac{1}{R_{6}} \\
R_{/ /} & =\frac{4 \times 6}{4+6} \\
& =2,4 \Omega \\
V_{/ /} \quad & R_{/ / l} \\
= & 2,4 \times 1,2 \\
& =2,88 \Omega \\
V_{R} \quad & =12-2,88 \\
& =9,12 \\
\mathrm{R} \quad & =\frac{V_{R}}{\mathrm{I}}=\frac{9,12}{1,2} \\
& =7,6 \Omega
\end{aligned}
$$

### 7.3 Option 1

| $\mathrm{V}_{\mathrm{r}}=\mathrm{Ir}$ | $=1,2 \times 1,5=1,8 \mathrm{~V} \checkmark$ |
| ---: | :--- |
| $\therefore$ emf | $=\mathrm{V}_{\mathrm{T}}+\mathrm{V}_{\mathrm{r}}$ |
|  | $=12+1,8 \checkmark$ |
|  | $=13,8 \mathrm{~V} \checkmark$ |

## Option 2

$$
\begin{aligned}
& \mathrm{V}_{/ /}=\mathrm{IR}_{/ /}=(1,2)(2,4)=2,88 \mathrm{~V} \checkmark \\
& V_{R}=I R=(1,2)(7,6)=9,12 \vee \checkmark \\
& V_{r}=1,8 \mathrm{~V} \\
& \text { emf }=V_{/ /}+V_{R}+V_{r} \\
& =2,88+9,12+1,88 \\
& =13,8 \mathrm{~V} \text { } \\
& \text { (max }=3 \text { marks) }
\end{aligned}
$$

7.4 Increase $\checkmark$
7.5 - Total resistance decreases $\checkmark$

- Current increases $\checkmark$


## QUESTION 8

8.1 DC (generator) $\checkmark$
8.2 split ring commutator $\checkmark$
8.3 a to b $\checkmark$
8.4 rms current is that a.c. current that would have the same effect as its dc equivalent $\checkmark \checkmark$ OR ( $\left.I_{\text {rms }}=\frac{V_{\text {max }}}{\sqrt{2}}\right)$
8.5

$$
\begin{align*}
\mathrm{V}_{\mathrm{rms}} & =\frac{\mathrm{V}_{\max }}{\sqrt{2}}=\frac{8}{\sqrt{2}}=5,657 \mathrm{~V}  \tag{2}\\
\mathrm{I}_{\mathrm{rms}} & =\frac{\mathrm{V}_{\text {rms }}}{\mathrm{R}} \checkmark \\
& =\frac{5,657}{5} \checkmark \\
& =1,131 \mathrm{~A} \checkmark \tag{4}
\end{align*}
$$

8.6.1


## Marking guideline

- Starts max
- All quarters positive $\checkmark$
- 1 cycle $\checkmark$
8.6.2 No $\checkmark$
8.6.3 induced emf drives current through the conductors $\checkmark$ such that emf and current are in phase, $\checkmark$ therefore shape of graphs is the same.


## QUESTION 9

9.1 The photoelectric effect is a phenomenon whereby electrons are ejected $\checkmark$ from a metal surface when light (EM radiation) with a frequency equal to or greater than the threshold frequency of the metal is shone on it.
9.2 Work function is the minimum energy that an electron in the metal needs to be emitted from the metal surface.
9.3 E $=h f_{o}=h \frac{c}{\lambda_{0}} \checkmark$

$$
\begin{align*}
& =6,63 \times 10^{-34} \checkmark \times \frac{3 \times 10^{8}}{600 \times 10^{-9}} \\
& =3,315 \times 10^{-19} \mathrm{~J} \tag{4}
\end{align*}
$$

9.4 Yes $\checkmark$
9.5 Frequency of blue light is much higher than that of orange light $\checkmark$ making blue light photons carry more than sufficient energy to eject photoelectrons from the metal surface $\checkmark$

OR
Since $W_{0}$ is constant the additional energy is transferred to the photoelectrons as kinetic energy. Therefore the ammeter will register a reading.

