GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

PREPARATORY EXAMINATION

2018

MARKING GUIDELINES

PHYSICAL SCIENCES: PHYSICS (PAPER 1) (10841)

13 pages

GAUTENG DEPARTMENT OF EDUCATION

PREPARATORY EXAMINATION – 2018

PHYSICAL SCIENCES: PHYSICS
(Paper 1)

MARKING GUIDELINES

QUESTION 1

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

[20]

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. ✓✓ (2)

2.2 At point A $E_{mech} = E_p + E_k$ ✓

$= mgh + 0$
$= 50 \times 9,8 \times 5$ ✓
$= 2\,450$ J

At point B $E_{mech} = E_p + E_k$
$2\,450 = 0 + \frac{1}{2} mv_i^2$ ✓
$v_i = 9,899\ m \cdot s^{-1}$ ✓ (4)

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

POSITIVE MARKING FROM 2.2

2.4.1 $\Sigma p_{(before)} = \Sigma p_{(after)}$

$m_d v_d + m_w v_w = (m_d + m_w)v_c$
$50 \times 9{,}899 + 0$ ✓ $= (50 + 60)v_c$ ✓
$v_c = 4{,}4995$
$v_c = 4{,}50\ m \cdot s^{-1}$ ✓ (3)

2.4.2 Impulse, $\Delta p = m_d \Delta v$
$= 50 \times (9{,}899 - 4{,}4995)$ ✓
$= 269{,}98\ kg \cdot m \cdot s^{-1}$ ✓ (2)

2..4.3 $W_{net} = \Delta E_k = F_{net} x \Delta x \cos\theta$

$E_{kf} - E_{ki} = F_{net} x \Delta x \cos\theta$ ✓
$0 - \frac{1}{2} \times 110 \times 4{,}50^2$ ✓ $= 60 \times \Delta x \cos 180^0$ ✓
$\Delta x = 18{,}56\ m$ ✓ (4)
[17]

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. ✓✓ (2)

3.2 $v_f^2 = v_i^2 + 2a\Delta y$ ✓
$v_f = (10^2 + (2 \times 9{,}8 \times 20))$ ✓
$= 22{,}181\ m \cdot s^{-1}$ ✓ (3)

3.3 $v_f = v_i + a\Delta t$ ✓

$$\Delta t = \frac{22{,}181 - 10}{9{,}8}$$ ✓

$= 1{,}243\ s$ ✓ (3)

3.4 Ball rises 19 m ✓ after the bounce hence

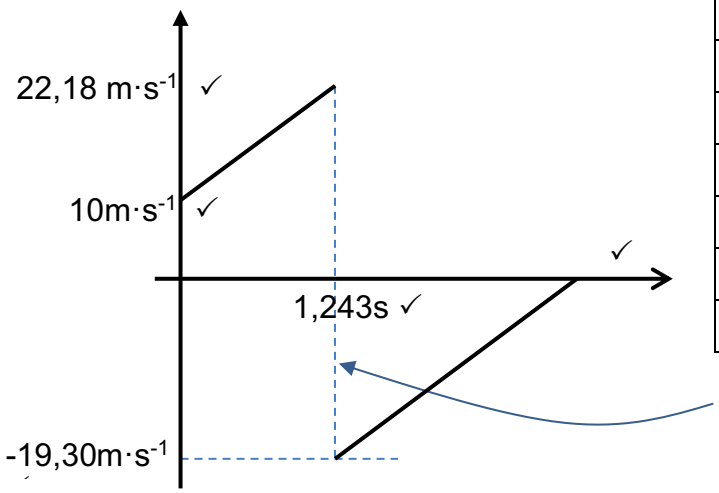
$v_f^2 = v_i^2 + 2a\Delta y$
$0^2 = v_i^2 + 2(9{,}8)(-19)$ ✓
$v_i = 19{,}298\ m \cdot s^{-1}$ ✓

$$t_{up} = \frac{v_f - v_i}{a} = \frac{0 - (-19{,}298}{9{,}8} = 1{,}969\ s$$

(3)

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✓and energy is lost through sound and heat✓ (2)

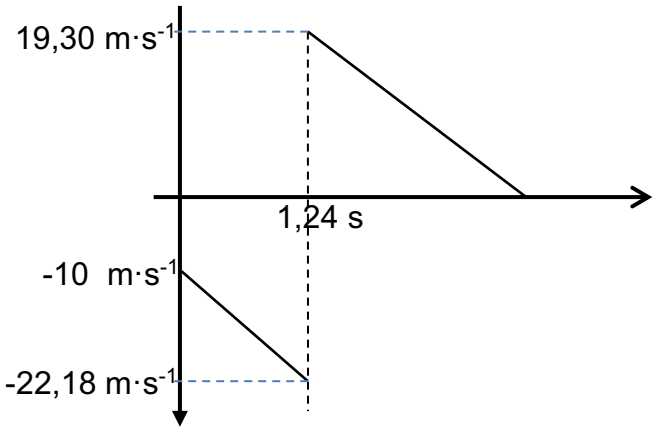
3.6 Down is positive



Marking criteria	
Graph starts at 10 m·s^{-1}	✓
Graph ends at 22,18 m·s^{-1}	✓
1,243 s indicated	✓
Graph starts at -19,30 m·s^{-1}	✓
Graph ends at v =0, (time 3,212 s)	✓
Positive slope for both graph sections	✓

Accept if this line is tilted

Upward is positive



Marking criteria	
Graph starts at 10 m·s^{-1}	✓
Graph ends at 22,18 m·s^{-1}	✓
1,243 s indicated	✓
Graph starts at -19,30 m·s^{-1}	✓
Graph ends at v =0 (time 3,212 s)	✓
Negative slope for both graph sections	✓

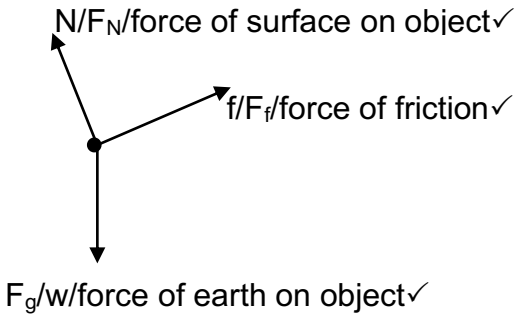
(6)
[19]

QUESTION 4

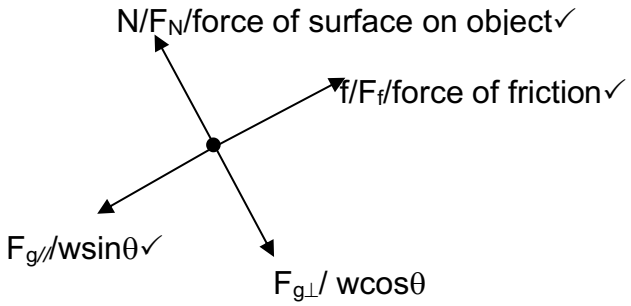
4.1 The net/total work done on an object is equal to the change in the object's kinetic energy ✓✓ (OR the work done on an object by a resultant/ net force is equal to the change in the object's kinetic energy) (2)

4.2

OPTION 1



OPTION 2



(3)

4.3

4.3.1

OPTION 1

$v_f^2 = v_i^2 + 2a\Delta x$ ✓

$= 0^2 + 2 \times 2 \times 8$ ✓

$v_f = 5{,}657 \text{ m·s}^{-1}$

$E_k = \frac{1}{2} mv^2$ ✓

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

$= 640{,}03 \text{ J}$ ✓

OPTION 2

$\Delta x = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓

$8 = 0 \times \Delta t + 0.5 \times 2 \times \Delta t$ ✓

$\Delta t = 2{,}828$

$V_f = v_i + a\Delta t$

$= 0 + 2 \times 2{,}838$ ✓

$= 5{,}657 \text{ m·s}^{-1}$

$E_k = \frac{1}{2} mv^2$ ✓

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

$= 640{,}03 \text{ J}$

(5)

4.3.2

OPTION 1

$W_g = F_{g//}\Delta x \cos\theta$ ✓

$= (mg \sin\theta)\, \Delta x \cos\theta$

$= 40 \times 9{,}8 \times \sin 30^0 \times 8 \times \cos 0^0$ ✓

$= 1\,568 \text{ J}$ ✓

OPTION 2

$h = 8 \sin 30^0 = 4 \text{ m}$

$E_p = mgh$ ✓

$= 40 \times 9{,}8 \times 4$ ✓

$= 1568 \text{ J}$ ✓

(4)

POSITIVE MARKING FROM 4.3.1 & 4.3.2

4.3.3 $W_{net} = \Delta E_K$ ✓

$W_g + W_f = E_{Kf} - E_{Ki}$

$1\,568 + W_f$ ✓ $= 640{,}03 - 0$ ✓

$\therefore W_f = -927{,}97 \text{ J}$ ✓

(4)

4.3.4 $W_f = F_f \Delta x \cos\theta$ ✓

$927{,}97 = F_f \times 8 \cos 180^0$ ✓

$F_f = -115{,}996 \text{ N}$

$= 115{,}996 \text{ N}$ ✓

(3)

[21]

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. ✓✓ (2)

5.2 For car **A**; $F_L = (\frac{v \pm v_L}{v \pm v_s})f_s$, ✓ $v_s = \frac{284,4}{3,6} = 79\ m \cdot s^{-1}$✓

$= (\frac{340 + 0}{340 - 79}$ ✓$)1200$ ✓

$= 1563,218$ Hz. ✓ (5)

5.3 For car **B;** $F_L = (\frac{v \pm v_L}{v \pm v_s})f_s$,

1600 ✓ $= (\frac{340 + 0}{340 - v_s}$ ✓$)1170$✓

$v_s = 91,375\ m \cdot s^{-1}$ ✓ (4)

5.4 With sound

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

With light

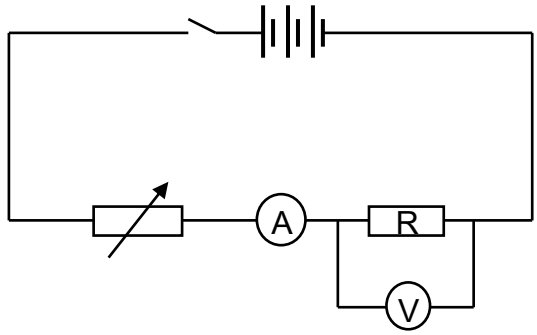
- The velocity of light is too high compared to the speed of the ambulance. ✓ The change in frequency will be insignificant hence no noticeable change. ✓ (4)

[15]

QUESTION 6

6.1 What is the relationship between the potential difference across a resistor and the current through the resistor? ✓✓ (2)

6.2



Marking criteria	
Components except voltmeter connected in series.	✓
Voltmeter connected across R.	✓
All symbols correct.	✓

(3)

6.3 6.3.1 Potential difference (*V*) ✓ (1)

6.3.2 Current (*I*) ✓ (1)

6.3.3 Temperature of the fixed resistor ✓ (1)

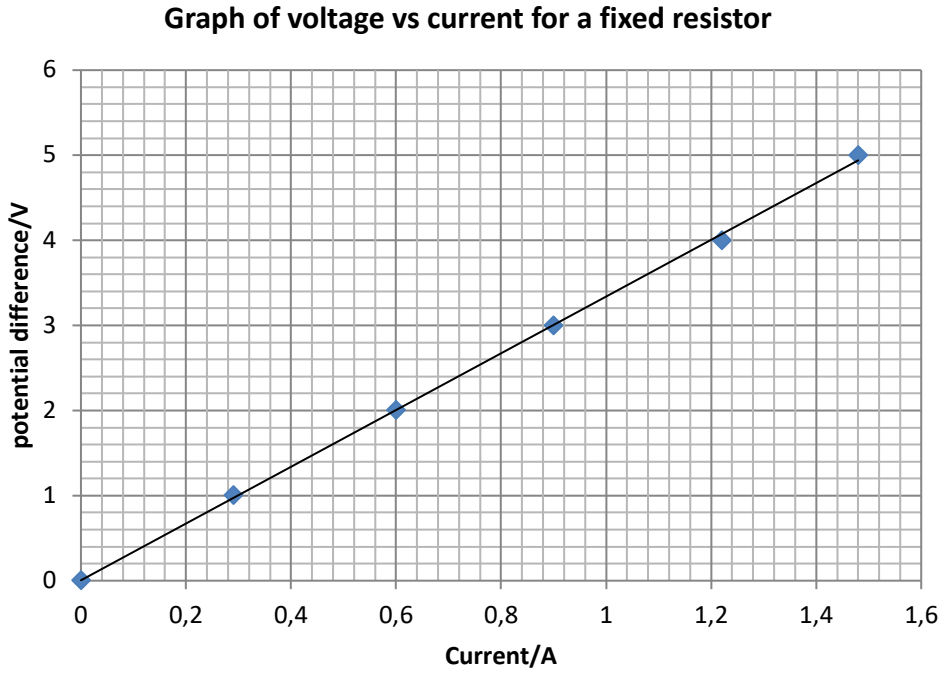
6.4 Take readings quickly/ allow time between readings so that resistor cools✓ (1)

6.5 6.5.1

Potential difference/V ✓	0	1	2	3	4	5
current/A ✓	0	0,29	0,6	0,9	1,22	1,48

All values paired correctly ✓ (3)

6.5.2



Marking criteria
Axes labelled ✓
Scales on both axes correct ✓
At least 3 plots correct ✓
Straight line✓ passing through the origin

(4)

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. ✓✓ (2)

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. (1)

[19]

QUESTION 7 (Start on a new page.)

7.1 $R_{ext} = \frac{V}{I}$ ✓ (V = terminal pd)

$= \frac{12}{1,2}$ ✓

$= 10\ \Omega$ ✓ (3)

7.2 Option 1

$\frac{1}{R_{//}} = \frac{1}{R_4} + \frac{1}{R_6}$ ✓

$R_{//} = \frac{4x6}{4+6}$ ✓

$= 2,4\ \Omega$

$R = R_T - R_{//}$ ✓

$= 10 - 2,4$

$= 7,6\ \Omega$ ✓

Option 2

$\frac{1}{R_{//}} = \frac{1}{R_4} + \frac{1}{R_6}$

$R_{//} = \frac{4x6}{4+6}$

$= 2,4\ \Omega$

$V_{//} = R_{//}\ I$

$= 2,4 \times 1,2$

$= 2,88\ \Omega$

$V_R = 12 - 2,88$

$= 9,12$

$R = \frac{V_R}{I} = \frac{9,12}{1,2}$

$= 7,6\ \Omega$

Option 3

$\varepsilon = I(R_{ext} + r)$ ✓

$= 1,2\ (2,4 + R\ 1,5)$ ✓

$13,8 = 1,2R + 4,68$ ✓

$R = 7,6\ \Omega$ ✓

(4)

7.3 **Option 1**

$V_r = Ir = 1,2x1,5 = 1,8$ V ✓

$\therefore$ emf $= V_T + V_r$

$= 12 + 1,8$ ✓

$= 13,8$ V ✓

Option 2

$V_{//} = IR_{//} = (1,2)(2,4) = 2,88$ V ✓

$V_R = IR = (1,2)(7,6) = 9,12$ V ✓

$V_r = 1,8$ V

emf $= V_{//} + V_R + V_r$

$= 2,88 + 9,12 + 1,88$

$= 13,8$ V ✓

(max = 3 marks)

(3)

7.4 Increase ✓ (1)

7.5
- Total resistance decreases ✓
- Current increases✓

(2)

[13]

QUESTION 8

8.1 DC (generator) ✓ (1)

8.2 split ring commutator ✓ (1)

8.3 a to b ✓ (1)

8.4 rms current is that a.c. current that would have the same effect as its dc equivalent ✓✓ OR ($I_{rms} = \frac{V_{max}}{\sqrt{2}}$) (2)

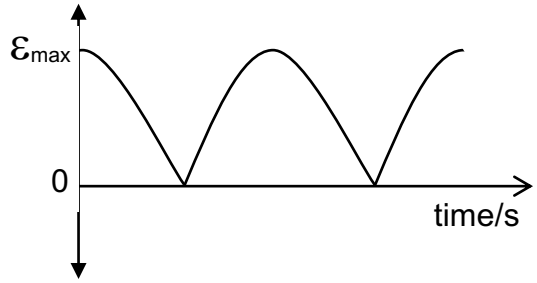
8.5 $V_{rms} = \frac{V_{max}}{\sqrt{2}} = \frac{8}{\sqrt{2}} = 5{,}657$ V ✓

$I_{rms} = \frac{V_{rms}}{R}$ ✓

$= \frac{5{,}657}{5}$ ✓

$= 1{,}131$ A ✓ (4)

8.6.1



Marking guideline
- Starts max ✓
- All quarters positive ✓
- 1 cycle ✓

(3)

8.6.2 No ✓ (1)

8.6.3 induced emf drives current through the conductors ✓ such that emf and current are in phase, ✓ therefore shape of graphs is the same. (2)

[15]

QUESTION 9

9.1 The photoelectric effect is a phenomenon whereby electrons are ejected✓ 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. ✓ (2)

9.2 Work function is the minimum energy that an electron in the metal needs to be emitted from the metal surface. ✓✓ (2)

9.3 $E = hf_o = h\frac{c}{\lambda_o}$ ✓

$= 6,63 \times 10^{-34}$ ✓$\times \frac{3\times10^{8}}{600\times10^{-9}}$ ✓

$= 3,315 \times 10^{-19}$ J ✓ (4)

9.4 Yes ✓ (1)

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

OR

Since W_0 is constant the additional energy is transferred to the photoelectrons as kinetic energy. Therefore the ammeter will register a reading. (2)

[11]

TOTAL: 150