



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 $E_{\text{mech}} = E_p + E_k$ ✓
 $= mgh + 0$
 $= 50 \times 9,8 \times 5$ ✓
 $= 2\,450 \text{ J}$
 At point B $E_{\text{mech}} = E_p + E_k$
 $2\,450 = 0 + \frac{1}{2}mv_i^2$ ✓
 $v_i = 9,899 \text{ m}\cdot\text{s}^{-1}$ ✓ (4)

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

POSITIVE MARKING FROM 2.2

$$\begin{aligned}
 2.4.1 \quad \Sigma p_{\text{(before)}} &= \Sigma p_{\text{(after)}} \\
 m_d v_d + m_w v_w &= (m_d + m_w) v_c \\
 50 \times 9,899 + 0 \checkmark &= (50 + 60) v_c \checkmark \\
 v_c &= 4,4995 \\
 v_c &= 4,50 \text{ m} \cdot \text{s}^{-1} \checkmark
 \end{aligned} \tag{3}$$

$$\begin{aligned}
 2.4.2 \quad \text{Impulse, } \Delta p &= m_d \Delta v \\
 &= 50 \times (9,899 - 4,4995) \checkmark \\
 &= 269,98 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1} \checkmark
 \end{aligned} \tag{2}$$

$$\begin{aligned}
 2.4.3 \quad W_{\text{net}} = \Delta E_k &= F_{\text{net}} \times \Delta x \cos \theta \\
 E_{kf} - E_{ki} &= F_{\text{net}} \times \Delta x \cos \theta \checkmark \\
 0 - \frac{1}{2} \times 110 \times 4,50^2 \checkmark &= 60 \times \Delta x \cos 180^\circ \checkmark \\
 \Delta x &= 18,56 \text{ m} \checkmark
 \end{aligned} \tag{4}$$

[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. $\checkmark\checkmark$ (2)

$$\begin{aligned}
 3.2 \quad v_f^2 &= v_i^2 + 2a\Delta y \checkmark \\
 v_f &= (10^2 + (2 \times 9,8 \times 20)) \checkmark \\
 &= 22,181 \text{ m} \cdot \text{s}^{-1} \checkmark
 \end{aligned} \tag{3}$$

$$\begin{aligned}
 3.3 \quad v_f &= v_i + a\Delta t \checkmark \\
 \Delta t &= \frac{22,181 - 10}{9,8} \checkmark \\
 &= 1,243 \text{ s} \checkmark
 \end{aligned} \tag{3}$$

3.4 Ball rises 19 m $\checkmark$ after the bounce hence

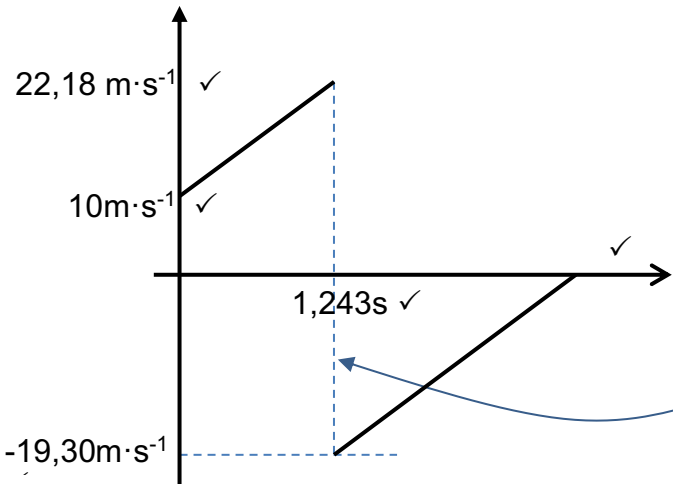
$$\begin{aligned}
 v_f^2 &= v_i^2 + 2a\Delta y \\
 0^2 &= v_i^2 + 2(9,8)(-19) \checkmark \\
 v_i &= 19,298 \text{ m} \cdot \text{s}^{-1} \checkmark
 \end{aligned}$$

$ \begin{aligned} t_{\text{up}} &= \frac{v_f - v_i}{a} \\ &= \frac{0 - (-19,298)}{9,8} \\ &= 1,969 \text{ s} \end{aligned} $
--

(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 $\checkmark$ and energy is lost through sound and heat $\checkmark$ (2)

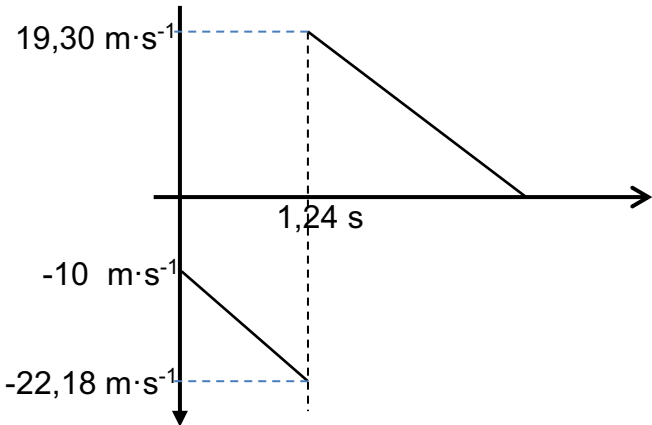
3.6 Down is positive



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

Accept if this line is tilted

Upward is positive



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

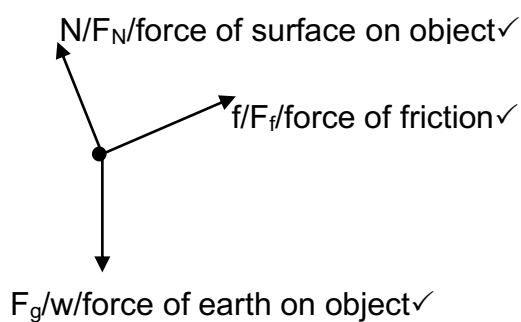
(6)
[19]

QUESTION 4

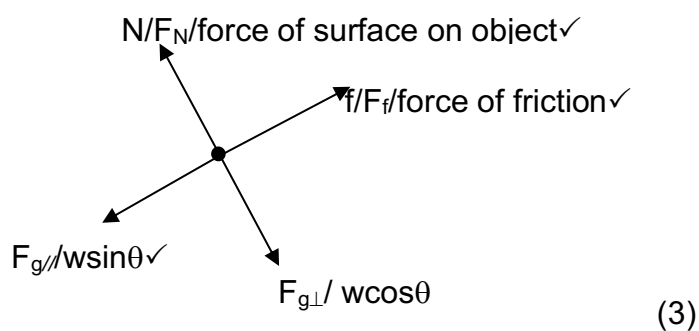
- 4.1 The net/total work done on an object is equal to the change in the object's kinetic energy ✓✓ (OR the work done on an object by a resultant/ net force is equal to the change in the object's kinetic energy) (2)

4.2

OPTION 1



OPTION 2



4.3

4.3.1

OPTION 1

$$\begin{aligned}
 v_f^2 &= v_i^2 + 2a\Delta x \checkmark \\
 &= 0^2 + 2 \times 2 \times 8 \checkmark \\
 v_f &= 5,657 \text{ m}\cdot\text{s}^{-1} \\
 E_k &= \frac{1}{2} mv^2 \checkmark \\
 &= 0,5 \times 40 \times 5,657^2 \checkmark \\
 &= 640,03 \text{ J} \checkmark
 \end{aligned}$$

OPTION 2

$$\begin{aligned}
 \Delta x &= v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark \\
 8 &= 0 \times \Delta t + 0,5 \times 2 \times \Delta t \checkmark \\
 \Delta t &= 2,828 \\
 V_f &= v_i + a \Delta t \\
 &= 0 + 2 \times 2,828 \checkmark \\
 &= 5,657 \text{ m}\cdot\text{s}^{-1} \\
 E_k &= \frac{1}{2} mv^2 \checkmark \\
 &= 0,5 \times 40 \times 5,657^2 \checkmark \\
 &= 640,03 \text{ J}
 \end{aligned}$$

(5)

4.3.2

OPTION 1

$$\begin{aligned}
 W_g &= F_g / \Delta x \cos \theta \checkmark \\
 &= (mg \sin \theta) \Delta x \cos \theta \\
 &= 40 \times 9,8 \times \sin 30^\circ \times 8 \times \cos 0^\circ \checkmark \\
 &= 1\,568 \text{ J} \checkmark
 \end{aligned}$$

OPTION 2

$$\begin{aligned}
 h &= 8 \sin 30^\circ = 4 \text{ m} \\
 E_p &= mgh \checkmark \\
 &= 40 \times 9,8 \times 4 \checkmark \\
 &= 1568 \text{ J} \checkmark
 \end{aligned}$$

(4)

POSITIVE MARKING FROM 4.3.1 & 4.3.2

$$4.3.3 \quad W_{\text{net}} = \Delta E_K \checkmark$$

$$\begin{aligned}
 W_g + W_f &= E_{Kf} - E_{Ki} \\
 1\,568 + W_f \checkmark &= 640,03 - 0 \checkmark \\
 \therefore W_f &= -927,97 \text{ J} \checkmark
 \end{aligned}$$

(4)

$$4.3.4 \quad W_f = F_f \Delta x \cos \theta \checkmark$$

$$\begin{aligned}
 927,97 &= F_f \times 8 \cos 180^\circ \checkmark \\
 F_f &= -115,996 \text{ N} \\
 &= 115,996 \text{ N} \checkmark
 \end{aligned}$$

(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**; $F_L = \left(\frac{v \pm v_L}{v \pm v_s} \right) f_s, \checkmark \quad v_s = \frac{284,4}{3,6} = 79 \text{ m} \cdot \text{s}^{-1} \checkmark$

$$= \left(\frac{340 + 0}{340 - 79} \right) 1200 \checkmark$$

$$= 1563,218 \text{ Hz. } \checkmark \quad (5)$$

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

$$1600 \checkmark = \left(\frac{340 + 0}{340 - v_s} \right) 1170 \checkmark$$

$$v_s = 91,375 \text{ m} \cdot \text{s}^{-1} \checkmark \quad (4)$$

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. ✓

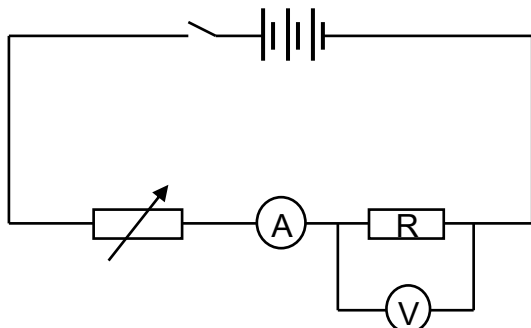
With light

- 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)

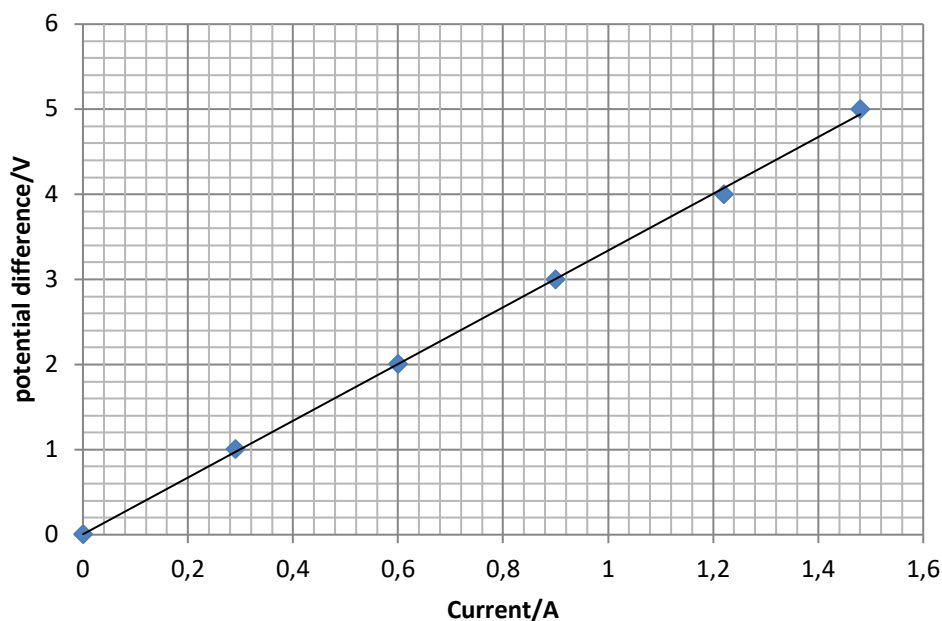
6.5 6.5.1

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

Graph of voltage vs current for a fixed resistor

**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.)

$$7.1 \quad R_{\text{ext}} = \frac{V}{I} \quad \checkmark \quad (V = \text{terminal pd})$$

$$= \frac{12}{1,2} \quad \checkmark$$

$$= 10 \, \Omega \quad \checkmark$$

(3)

7.2 Option 1

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

$$R_{//} = \frac{4 \times 6}{4 + 6} \quad \checkmark$$

$$= 2,4 \, \Omega$$

$$R = R_T - R_{//} \quad \checkmark$$

$$= 10 - 2,4$$

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

Option 2

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

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

$$= 2,4 \, \Omega$$

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

$$= 2,4 \times 1,2$$

$$= 2,88 \, \Omega$$

$$V_R = 12 - \underline{2,88}$$

$$= 9,12$$

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

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

Option 3

$$\varepsilon = I(R_{\text{ext}} + r) \quad \checkmark$$

$$= 1,2 (2,4 + R \, 1,5) \quad \checkmark$$

$$13,8 = 1,2R + 4,68 \quad \checkmark$$

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

(4)

7.3 Option 1

$$V_r = Ir = 1,2 \times 1,5 = 1,8 \text{ V } \checkmark$$

$$\therefore \text{emf} = V_T + V_r$$

$$= 12 + 1,8 \checkmark$$

$$= 13,8 \text{ V } \checkmark$$

Option 2

$$V_{//} = IR_{//} = (1,2)(2,4) = 2,88 \text{ V } \checkmark$$

$$V_R = IR = (1,2)(7,6) = 9,12 \text{ V } \checkmark$$

$$V_r = 1,8 \text{ V}$$

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

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

$$= 13,8 \text{ V } \checkmark$$

(max = 3 marks)

(3)

7.4 Increase $\checkmark$

(1)

- 7.5
- Total resistance decreases $\checkmark$
 - Current increases $\checkmark$

(2)

[13]

QUESTION 8

8.1 DC (generator) ✓ (1)

8.2 split ring commutator ✓ (1)

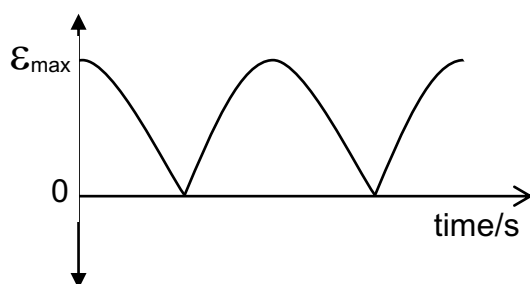
8.3 a to b ✓ (1)

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

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

$$\begin{aligned} I_{\text{rms}} &= \frac{V_{\text{rms}}}{R} \checkmark \\ &= \frac{5,657}{5} \checkmark \\ &= 1,131 \text{ A} \checkmark \end{aligned} \quad (4)$$

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
$$E = hf_0 = h \frac{c}{\lambda_0} \checkmark$$

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

$$= 3,315 \times 10^{-19} \text{ J } \checkmark$$
 (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