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**

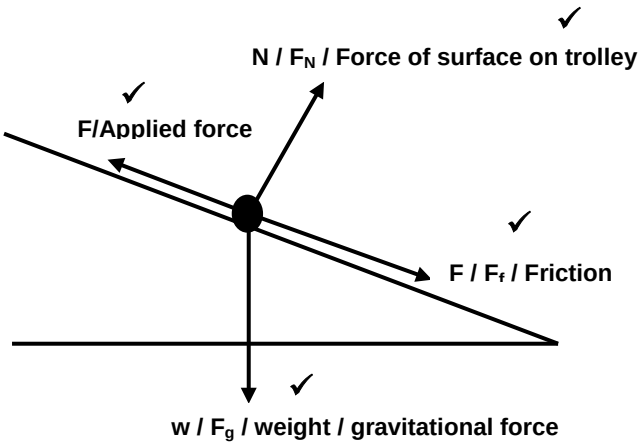
1.1 D✓✓ (2)
1.2 A✓✓ (2)
1.3 C✓✓ (2)
1.4 B✓✓ (2)
1.5 C✓✓ (2)
1.6 A✓✓ (2)
1.7 D✓✓ (2)
1.8 D✓✓ (2)
1.9 B✓✓ (2)
1.10 A✓✓ (2)
**[20]**

**QUESTION 2**

2.1

2.1.1 When a net force ($F_{net}$) 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. ✓✓(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). ✓✓(2 or 0) (2)

2.1.2




(4)

(Accept the components of $F_g$ INSTEAD of $F_g$ but not both $F_g$ and the components. No arrows = ¾; forces not touching dots = 3/4)

2.1.3 (a) $F_f = \mu_k F_N = \mu_k (mg \cos 30^o) = 0,2\ (33,95) = 6,79\ N$ (3)

(b) **Positive marking from 2.1.3 a**

$F_{g//} = mg\sin 30^0 = (4)(9,8)\sin 30 = 19,6\ N$

$F_{net} = ma_R = F + F_f + F_{g//}$

$(4)\ (0,43) = F + (-6,79) + (-19,6)$

$F = 28,11\ N$ (5)

2.2 $F = \frac{G m_1 m_2}{r^2} = \frac{6,67 \times 10^{-11} \times 2000 \times 6 \times 10^{24}}{(6.5 \times 10^6)^2} = 18944,34$ N (4)

**[18]**

## QUESTION 3

Any sign convention is accepted, i.e. learners may also work with upwards as positive

3.1

3.1.1 9,8 ($m.s^{-2}$) – object is falling through the air. (2)

3.1.2 $t_x = (0,5 + 0,5) = 1$ s (1)

3.2 The area under the graph represents the displacement.

displacement = area = ½ base x height = ½ x (–0,5) x 3,9 = –0,98 m

height = 0,98 m (3)

3.3

3.3.1 From the graph, downward motion as POSITIVE.

$v_f = v_i + a\Delta t$
$= \underline{-4,9 + (+9,8)\ (1,7)}$
$= 11,76\ m{\cdot}s^{-1}$ (3)

3.3.2

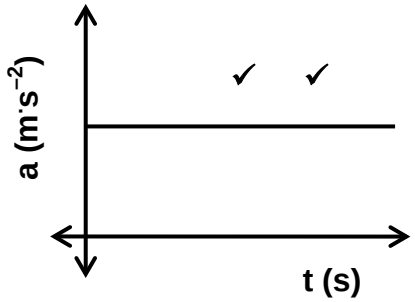
| **Upwards as -** | **Upwards as +** |
|---|---|
| $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ | $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ |
| $= \underline{(-4,9)\ (1,7) + ½\ (+9,8)\ (1,7)^2}$ | $= \underline{(4,9)\ (1,7) + ½\ (-9,8)\ (1,7)^2}$ |
| $= 5,83$ m | $= -5,83$ |
| | $\Delta y = 5,83$ m |

**OR**

| **Upwards as -** | **Upwards as +** |
|---|---|
| $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓ | ✓ $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ |
| = (- 4,9) (0,7) + ½ (+9,8) $(0,7)^2$ ✓ | = (4,9) (0,7) + ½ (- 9,8) $(0,7)^2$ ✓ |
| = 5,83 m ✓ | = - 5,83 |
| | Δ y = 5,83 m ✓ |

(3)

3.4

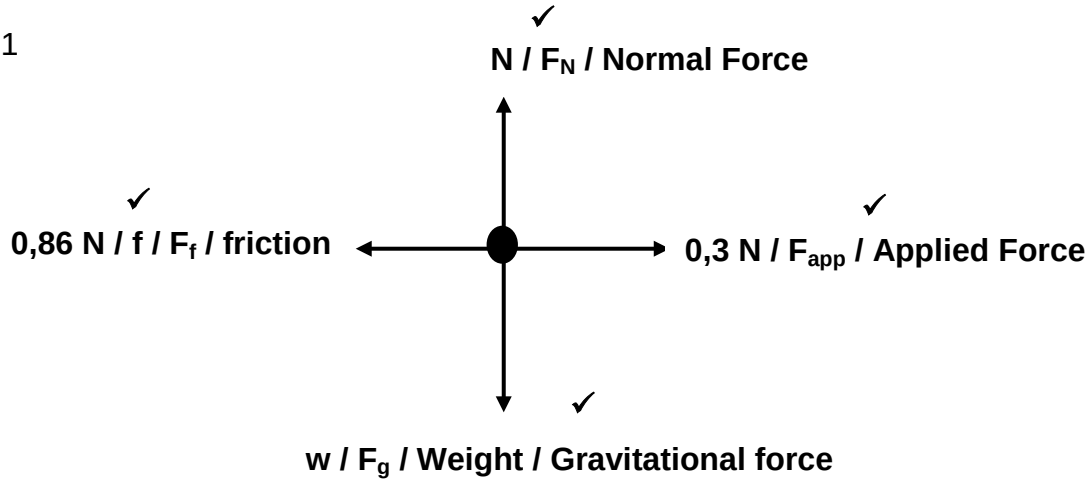



(2)

**[14]**

**QUESTION 4**

4.1




(4)

4.2 $F_{net} = F_{applied} + F_f = 0,30 + (–0,86) = –0,56$ N = 0,56 N opposite direction of motion/ to the left (3)

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. (2)

4.4

$$W_{NET} = \Delta E_K$$
$$F_{net}\ \Delta x \cos\theta = \tfrac{1}{2} mv_f^2 - \tfrac{1}{2} mv_i^2$$
$$0,56\ \Delta x \cos 180 = \tfrac{1}{2}(0,8)(0,2)^2 - \tfrac{1}{2}(0,8)(1,2)^2$$
$$(0,56) \times (\Delta x) \times (-1) = 0,016 - 0,576$$
$$\Delta x = 1 \text{ m}$$

**OR**

$$W_{NC} = \Delta E_K + \Delta E_P$$
$$f\ \Delta x \cos 180 + F_{APPL}\ \Delta x \cos 0 = \tfrac{1}{2} mv_f^2 - \tfrac{1}{2} mv_i^2 + 0$$
$$0,86.\ \Delta x \cos 180 + 0,3.\ \Delta x \cos 0 = \tfrac{1}{2}(0,8)(0,2^2) - \tfrac{1}{2}(0,8)\,1,2^2$$
$$(-0,86 + 0,3).\ \Delta x = 0,016 - 0,576$$
$$\Delta x = 1 \text{ m}$$

(4)

4.5 Friction **OR** applied force (**note: symbols not accepted**) (1)

**[14]**

## 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. ✓✓ (2 or 0)

5.2

5.2.1

**OPTION 1**
**Take direction towards left as positive**

$\Sigma p_i = \Sigma p_f$ ✓
$0 = Mv_{cannon} + mv_{ball}$ ✓ Any one
$0$ ✓ $= (1250)\ v + \underline{1,25\ (-80)}$ ✓

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

**OPTION 2**
**Take direction towards right as positive**

$\Sigma p_i = \Sigma p_f$ ✓
$0 = Mv_{cannon} + mv_{ball}$ ✓ Any one
$0$ ✓ $= (1250)\ v + \underline{1,25\ (80)}$ ✓

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

$v = 0,08\ m{\cdot}s^{-1}$, left ✓

(5)

5.3.2

**OPTION 1**
**Take direction towards left as positive**

$F_{net}\Delta t = m\Delta v = mv_f - mv_i$ ✓
$F\ (1,0)$ ✓ $= (1250)\ ((0)-(0,08))$ ✓
$F = -100$ N
$F_{net} = 100$ N ✓

**OR**

$v_f = v_i + a\,\Delta t$
$\underline{0 = 0,08 + a\ (1,0)}$ ✓
$a = -0,08$
$F_{net} = m \times a$ ✓
$= 1250 \times (-0,08) = -100$ N
$= 100$ N ✓

**OPTION 2**
**Take direction towards right as positive**

$F_{net}\Delta t = m\Delta v = mv_f - mv_i$ ✓
$F_{net}\ (1,0)$ ✓ $= (1250)\ ((0) - (-0,08))$ ✓
$F_{net} = 100$ N ✓

(4)

**[11]**

## 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.✓ ✓ (2 or 0)
**OR**
The change in the (observed) frequency when there is relative motion between the source and the observer.✓ ✓ (2 or 0)

6.1.2 away (1)

6.1.3 $$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$$ ✓

$$88 = \frac{340 - 0}{340 + v_s} \times 90$$ ✓ ✓

$v_s = 7{,}73\ m.s^{-1}$ ✓ (5)

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

6.2

6.2.1 Red Shift occurs when <u>absorption lines are shifted towards smaller frequencies</u> ( or larger wavelengths) (which is the red end of the spectrum) ✓✓ (2)

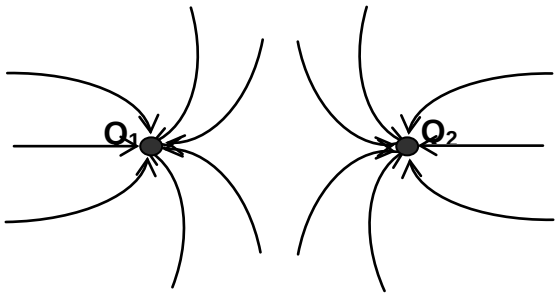
6.2.2 absorption (spectrum) ✓ (1)

6.2.3 F. fastest galaxy/highest velocity ✓ ✓ (2)

**[14]**

## QUESTION 7

7.1




| | |
|---|---|
| ✓ | direction |
| ✓ | pattern |
| ✓ | field lines do not touch |

(3)

7.2 The magnitude of the electrostatic force exerted by one point charge ($Q_1$) on another point charge ($Q_2$) is directly proportional to the product of the (magnitudes of the) charges ✓ and inversely proportional to the square of the distance (r) between them. ✓ (2)

7.3 $$F = \frac{kQ_1Q_2}{r^2}$$ ✓

$$4x10^{-3}\ N = \frac{9 \times 10^9 \times Q \times Q}{(6 \times 10^{-3})^2}$$ ✓ ✓

$$Q = (-)\ 4 \times 10^{-9}\ C$$ ✓ (4)

7.4 $$E = \frac{kQ}{r^2}$$ ✓

$$4{,}44 \times 10^5 = 9 \times \frac{10^9\ (4 \times 10^{-9})}{(r)^2}$$ ✓ ✓

$$r = 9 \times 10^{-3}\ m$$

d (or r) = $9 \times 10^{-3}$ m – $6 \times 10^{-3}$ m = $3 \times 10^{-3}$ m = 3 mm ✓ ✓ (5)

**[14]**

**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 (2)

8.2

8.2.1 Internal Resistance ✓ // lost volts (used up by internal r) (1)

8.2.2 0 (V) / zero ✓ (1)

8.2.3 $R = \frac{V}{I}$ ✓ (or $I = \frac{V}{R}$)

$I = \frac{4,5}{5}$ ✓ ✓ = 0,9A

$\frac{1}{R_p} = \frac{1}{r_1} + \frac{1}{r_2} = \frac{1}{20} + \frac{1}{30} = \frac{2+3}{60} = \frac{5}{60}$

$R_p = 12\ \Omega$

$R_{ext} = 12 + 43 = 55\ \Omega$ ✓

Emf = I (R + r) = 0,9 (55 + 5) = 0,9 x 60 = 54 V ✓ ✓ ✓ (7)

8.2.4 **Positive marking from Q 8.2.3**

$R = \frac{V}{I}$ ✓

Therefore, $V_P = I \times R_P = 0,9 \times 12 = 10,8$ V

(OR $V_P = 49,5 - V_{43} = 49,5 - (0,9 \times 43) = 10,8$ V)

$I_{30\Omega} = \frac{V_{30\Omega}}{R} = \frac{10,8}{30}$ ✓ ✓ = 0,36 A

(3)

8.3 Decrease. ✓ Total resistance in the circuit increases. ✓ Current decreases. ✓
Hence, power decreases. (3)

**[17]**

**QUESTION 9**

9.1 Internal resistance in the opposition to the flow of charge in a cell/ an ammeter ✓ ✓
(in an electric circuit.) (2 or 0)

9.2
9.2.1 3 V ✓ (1)

9.2.2 'lost' volts = 3,0 – 2,0 = 1 V ✓ ✓ OR 1 V ✓✓ (2)

9.2.3 r can be found by finding the gradient of the graph

$$\text{gradient} = \frac{\Delta I}{\Delta V} \checkmark$$
$$= \frac{0,4 - 0,6}{1 - 0} \checkmark$$
$$= \frac{-0,2}{1}$$
$$= -0,2\ \Omega^{-1}$$
$$R_{int} = 5\ \Omega \checkmark$$

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

**[8]**

**QUESTION 10**

10.1 10.1.1 (split – ring) commutator ✓ (1)

10.1.2 coil✓ (1)

10.2 10.2.1 $V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓

$200 = \frac{V_{max}}{\sqrt{2}}$ ✓ $V_{max} = 282,84$ V ✓ (3)

10.2.2 $P = \frac{V^2_{rms}}{R}$ ✓ Therefore, $R = \frac{240^2}{2200}$ ✓ $= 26,18\ \Omega$

During load shedding:

$P = \frac{V^2_{rms}}{R} = \frac{200^2}{26,18}$ ✓ $= 1527,88$ W ✓ (4)

**OR**

$P = \frac{V^2_{rms}}{R}$ ✓ Therefore, $R = \frac{240^2}{2200}$ ✓ $= 26,18\ \Omega$

$V = I R$

$200 = I (26,18)$

$I = 7,64$ A

$P = VI = 200\ (7,64) = 1527,88$ W ✓ ✓ (4)

**[9]**

**QUESTION 11**

11.1 $E = hf = \frac{hc}{\lambda} = \frac{6{,}63 \times 10^{-34} \times 3 \times 10^{8}}{510 \times 10^{-9}} = 3{,}9 \times 10^{-19}$ J (4)

**OR**

$c = f \times \lambda$

$3 \times 10^{8} = f \times 510 \times 10^{-9}$

$f = 5{,}88 \times 10^{14}$

$E = hf = 6{,}63 \times 10^{-34} \times 5{,}88 \times 10^{14} = 3{,}9 \times 10^{-19}$ J (4)

11.2 **Positive marking from 11.1**
Caesium. Its work function is less than the energy of a photon of green light. (2)

11.3 **Positive marking from 11.1 and 11.2**

$E = hf = W_0 + Ek$

$Ek = E - W_0$

$= 3{,}9 \times 10^{-19} - 3.36 \times 10^{-19}$

$= 5{,}4 \times 10^{-20}$ J (3)

11.4

11.4.1 remain the same (1)

11.4.2 remain the same (1)

11.4.3 remain the same (1)

**[12]**

**Grand Total: 150**