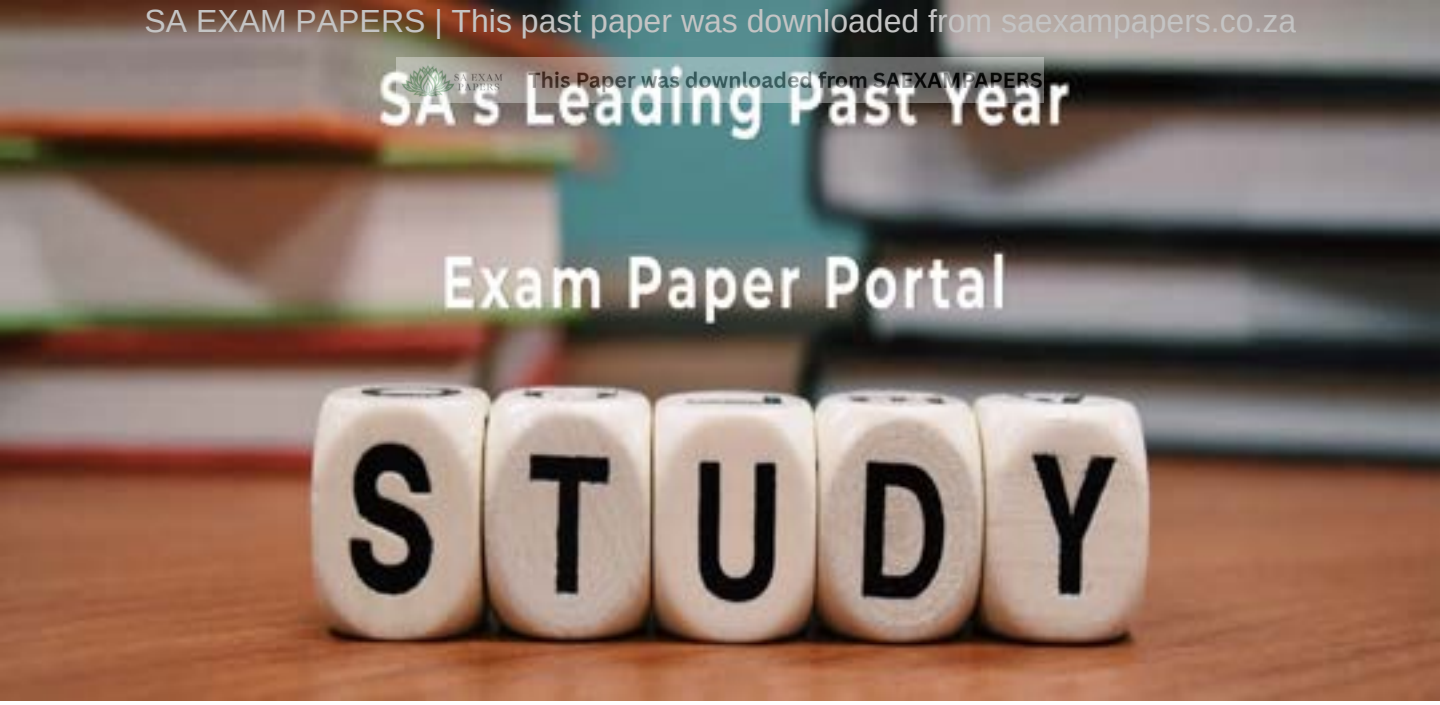


LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

JUNE 2026

MARKING GUIDELINE/ MERK RIGLYNE

MARKS: 150

These marking guidelines consist of 15 pages

 please turn over

QUESTION/VRAAG 1

1.1 A✓✓

1.2 B✓✓

1.3 C✓✓

1.4 B✓✓

1.5 B ✓✓

1.6 B ✓✓

1.7 D ✓✓

1.8 A ✓✓

1.9 B ✓✓

1.10 D ✓✓

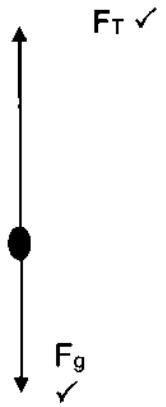
(2 x 10 =20)

QUESTION/VRAAG 2

2.1 When a (non-zero) net/resultant force acts on an object, the object will accelerate in the direction of the (net) force at an acceleration that is directly proportional to the (net) force and inversely proportional to the mass of the object.✓✓

Wanneer 'n (nie-nul) resulterende/netto krag op 'n voorwerp inwerk, versnel die voorwerp in die rigting van die krag teen 'n versnelling direk eweredig aan die (netto)krag en omgekeerd eweredig aan die massa van die voorwerp.✓✓ (2)

2.2



ACCEPTED SYMBOLS/AANVAARDE SIMBOLE		
T	Tension/ Tension force	*Spanning/Spanningskrag/F_s*
F_g	w, weight/Gravitational force/ $F_{Earth\ on\ M}$	*Gewing/Gravitasiekrag/ $F_{Aarde\ op\ M}$*
Notes: • Mark awarded for label and arrow • Do not penalize for length of arrows • Any additional force/s: -1 • If force(s) do not make contact with the body: -1 mark • -1 mark if all arrowheads are omitted but correctly labelled.		*Notas:* • *Punt toegeken vir pyl en pylpunt* • *Addisionele krag/te:-1* • *As kragte nie kontak maak met kol nie: -1* • *-1 punt as alle kragte teenwoordig is en benoem maar geen pylpunte nie.*
		(2)

2.3

Consider M:		Consider N:
$F_{net} = ma$	✓Any one	$F_{net} = ma$
T - Fg = ma		F_g - T = ma
T - m(9,8) = ma ✓		2m(9,8) - T = 2ma✓
T = 9,8m + ma ….(1)		T = 19,6m -2ma…(2)

(1) = (2)

✓ Equating

9,8m +ma = 19,6m - 2ma

a = 3,267 m·s^{-2} clockwise ✓ (5)

2.4

$f_k = \mu_k N$ ✓

= m(9,8)(0,17) ✓

= 1,666 m

Consider P

$F = ma$

F_g +(-T) = ma

7(9,8) - T = 7(0,42) ✓

T = 65,66

Carry over mark

Consider M

T - f_k = m(0,42)

65,66 - 1,666m✓ = m(0,42) ✓

m = 31,4765 kg ✓

(6)

2.5 INCREASE ✓

From $f_k = N\,\mu_k$, f_k will increase ✓

Therefore, according to T = f_k + ma ✓, **T** increases. (3)

[18]

QUESTION/ VRAAG 3

3.1 The gravitational force the Earth exerts on any object on or near its surface. ✓✓

Die gravitasiekrag wat die Aarde op enige voorwerp naby die oppervlak.✓✓ (2)

3.2 $F_g = \frac{Gm_1m_2}{r^2}$ ✓ $F_g = \frac{Gm_1m_2}{r^2}$

$F_{gA} = \frac{GM(1200)}{r^2}$ ✓ $F_{gB} = \frac{GM(2500)}{r^2}$ ✓

$F_{gA} = F_{gB}$ ✓ (equating)

$$\frac{GM(1200)}{(r_E + r_A)^2} = \frac{GM(2500)}{(r_E + 2r_A)^2}$$

✓ either

$\sqrt{1200}(r_E + 2r_A) = \sqrt{2500}(r_E + r_A)$

$\sqrt{1200}(6{,}38 \times 10^6) + 2\sqrt{1200}(r_A) = \sqrt{2500}(6{,}38 \times 10^6) + \sqrt{2500}(r_A)$

r_A = 5 081 949,63 m or ($5{,}08 \times 10^6$ m) ✓ (6)

3.3 DOUBLED ✓

F_g α mass of object ✓ (2)

[10]

QUESTION 4/ VRAAG 4

4.1 The product of an object's mass and its velocity. ✓✓

Die produk van 'n voorwerp se massa en snelheid. ✓✓ (2)

4.2 Take East as positive. / West may be taken as positive

$$\Sigma p_i = \Sigma p_f \checkmark$$

$$(m_c + m_{CB})v_i = mv_c + mv_{CB}$$

$$(120 + 4,5)(0) = 120\ v_{CB} + 4,5(95) \checkmark$$

$$v_{CB} = -3,5625$$ (4)

∴ Velocity of the canon= 3,56 m·s^{-1}✓westwards /*wes*✓(accept left/*aanvaar links*)

4.3 The net (or resultant) force acting on an object is equal to the rate of change of momentum of the object in the direction of the net force. ✓✓

Die netto (of resultante) krag wat op 'n voorwerp inwerk is gelyk aan die tempo van verander van die momentum van die voorwerp, in die rigting van die netto krag. ✓✓ (2)

4.4.1 $F_{net}\Delta t = \Delta p$

$= m\Delta v$

$= m(v_f - v_i)$

✓ ANY one

$= 120((-3,5625) - 0)$✓

$= -427,5$

$=$ 427,5 N·s west /*wes*✓ (Range : 427,2 – 427,5 N·s) (4)

4.4.2 $v_f = v_i + a\Delta t$

$0 = (-3,5625) + a(2,5)$ ✓

$a = 1,425$

Carry over

$F_{net} = ma$ ✓

$= 120(1,425)$ ✓v

$= 171$ N

∴ frictional force = 171 N Eastwards /*Oos*✓ (Accept Right)

(range: 171 - 172,3 N)

OPTION 2: Using ENERGY PRINCIPLES

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

$= (-3,5625)(2,5) + \frac{1}{2}(1,425)(2,5)^2$

$\Delta x = -4,453125 \text{ m}$

$W_{net} = \Delta E_k$ ✓

$f_k (4,43125)(\cos 180°) = \frac{1}{2}(120)[0^2 - (3,5625)^2$ ✓

$f_k (-4,453125) = -7461,484375$

∴ f_k = 171 N Eastward/ *Oos* ✓ (4)

4.5 $v_f = v_i + at$

6,7 = 7 + a(2,5) ✓

a = -0,12 m·s^{-2}

F_{net} = ma ✓

= 3,5(-0.12) ✓

= -0,42

Frictional force is 0,42 N westwards/*wes* ✓ (4)

4.6 $\sum p_i = \sum p_f$

$mv + mv = mv + mv$ ✓ ANY one

(3,5)(6,7) + m(0) ✓ = (3,5)(6,22) + (m)(4,24) ✓

m = 0,396 kg ✓ (4)

[23]

QUESTION/VRAAG 5

5.1 Motion during which the only force acting on an object is the gravitational force./Motion of an object under the influence of the gravitational force only.✓✓

Beweging waartydens die enigste krag wat op 'n voorwerp inwerk, gravitasiekrag is/ Beweging van 'n voorwerp slegs onder die invloed van gravitasiekrag. ✓✓ (2)

5.2
- Constant (positive) acceleration downward at 9,8 $m \cdot s^{-2}$ for 2,2 s as it is falling. ✓
- Between 2,2 - 2,8s the ball is in contact with the ground and experiences an upward acceleration of 50 $m \cdot s^{-2}$. ✓
- From 2,8 - 3,4 the object is moving upward at a constant acceleration of 9,8 $m \cdot s^{-2}$ downward / decelerate/negative acceleration.✓

(3)

5.3.1 $v_f = v_i + a\Delta t$✓

$= 0 + (9,8)(2,2)$✓

$= 21,56\ m \cdot s^{-1}$ ✓ (3)

5.3.2 OPTION 1:

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

$= 0 + \frac{1}{2}(9,8)(2,2)^2$ ✓

$= 23,716$ m

The height is 23,716 m ✓

OPTION 2:

$\Delta y = v_f\Delta t - \frac{1}{2} a\Delta t$ ✓

$= (21,56)(2,2) - \frac{1}{2}(9,8)(2,2)^2$ ✓

$= 23,716$ m

The height is 23,716 m ✓

(3)

5.3.3 Calculate v at 2,8 s

$v_f = v_i + a\Delta t$

$= \underline{21,56 + (-50)(0,6)}$ ✓

$= -8,44\ m\cdot s^{-1}$

Calc v at 3.4 s

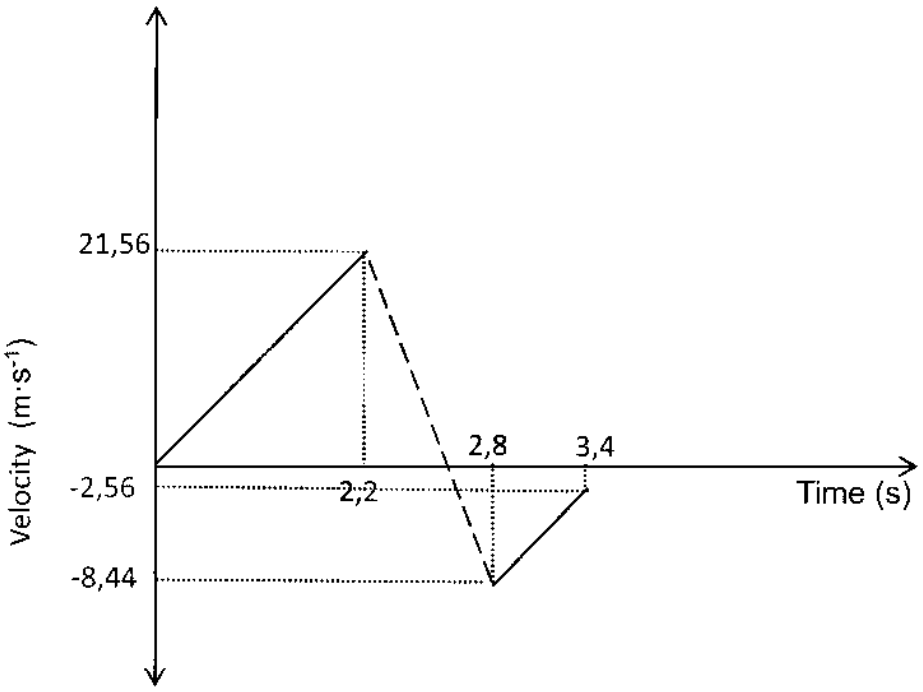
$v_f = v_i + a\Delta t$ ✓

$= \underline{-8,44}$ ✓ + $\underline{(9,8)(0,6)}$ ✓

$= -2,56\ m\cdot s^{-1}$

The velocity is $2,56\ m\cdot s^{-1}$ upward ✓ (5)

5.4



Marking Criteria/Nasien riglyne

- Start from zero; straight line with positive gradient up to 2,2s ✓
- velocity at 2,2s is $21,56\ m\cdot s^{-1}$ ✓
- velocity at 2,8s is $-8,44\ m\cdot s^{-1}$ ✓
- velocity at 3,4s is $-2,56\ m\cdot s^{-1}$ ✓
- Slopes of both lines are equal (same gravitational acceleration) ✓

(5)

[21]

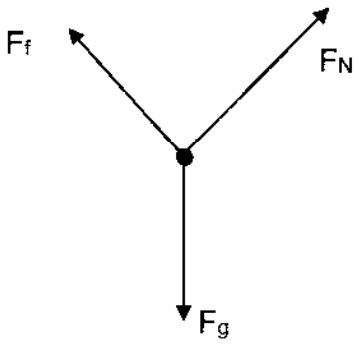
QUESTION 6/ VRAAG 6

6.1 A force for which the work done in moving an object between two points is independent of the path taken.✓✓

'n krag waarvoor die arbeid verrig om 'n voorwerp tussen twee punte te beweeg, onafhanklik is van die roete wat gevolg word. ✓✓

(2)

6.2



Note:

$F_f \perp F_N$

ACCEPTED SYMBOLS/AANVAARDE SIMBOLE		
F_N	Normal Force	*Normaalkrag*
f	f_k, kinetic friction/ frictional force	*Wrywingskrag/ kinetiese wrywing*
F_g	w, weight/Gravitational force/ $F_{earth\ on\ truck}$	*Gewing/Gravitasiekrag/* $F_{aarde\ op\ die\ trok}$
Notes: • Mark awarded for label and arrow • Do not penalize for length of arrows • Any additional force/s: -1 • If force(s) do not make contact with the body: -1 mark • -1 mark if all arrowheads are omitted but correctly labelled.		*Notas:* • *Punt toegeken vir pyl en pylpunt* • *Addisionele krag/te:-1* • *As kragte nie kontak maak met kol nie: -1* • *-1 punt as alle kragte teenwoordig is en benoem maar geen pylpunte nie.*

(3)

6.3 *Calculate velocity at B*

$$E_{MA} = E_{MB}$$

$$mgh + 1/2\ mv^2 = mgh + 1/2\ mv^2$$

$$\underline{(65)(9{,}8)(75) + 1/2(65)(4)^2}\checkmark = \underline{(65)(9{,}8)(45) + 1/2\ (65)(v^2)}\checkmark$$

$$v_B = 24{,}5764\ m{\cdot}s^{-1}$$

Any one ✓

$$E_{MA} = E_{MB}$$

$$mgh + 1/2\ mv^2 = mgh + 1/2\ mv^2$$

$$\underline{(65)(9{,}8)(15) + 1/2(65)(v^2)}\checkmark = \underline{(65)(9{,}8)(50) + 1/2(65)(0^2)}\checkmark$$

$$v_C = 26{,}19\ m{\cdot}s^{-1}$$

$W_{nc} = \Delta E_k + \Delta E_p$ ✓

$= 1/2m\ (v_C^2 - v_B^2) + mg(h_C - h_B)$

$= \underline{1/2(65)(26{,}19^2 - 24{,}5764^2)}$ ✓ + $\underline{(65)(9{,}8)(15\text{-}45)}$ ✓

$= -16\ 447{,}708$ J✓

(7)

[12]

QUESTION/VRAAG 7

7.1 Doppler effect ✓ (1)

7.2 $f_L = (\frac{v+v_L}{v \pm v_s})f_s$ ✓

$f_L = (\frac{v}{v - v_s})f_s$

$f_L = (\frac{340}{340 - 19,4})370$ ✓

= 392,389 Hz✓ (3)

7.3 $f_L = (\frac{v+v_L}{v})f_s$ ✓

$f_L = (\frac{340-19,4}{340+0})(2000)$ ✓

f_L = 1 885,8824 Hz ✓ (3)

7.4 LOWER THAN ✓ (1)

7.5 Red shift ✓

As stars move away, wavelengths increase✓.

Spectral lines shift to the red side/lower frequency of the spectrum.✓ (3)

[11]

QUESTION/VRAAG 8

8.1 The magnitude of the electrostatic force exerted by one (stationary) point charge (Q1) on another (stationary) point charge (Q2) is directly proportional to the product of the magnitudes of the charges and inversely proportional to the square of the distance (r) between them ✓✓

Die grootte van die elektrostatiese krag wat een puntlading (Q_1) op 'n ander puntlading (Q_2) uitoefen, is direk eweredig aan die produk van die groottes van die ladings en omgekeerd eweredig aan die kwadraat van die afstand (r) tussen hulle. ✓✓ (2)

8.2 Yes ✓✓ (2)

8.3 Yes ✓✓ (2)

8.4 $$Q_{new} = \frac{(-12 + 4 + 2)\mu C}{3}$$

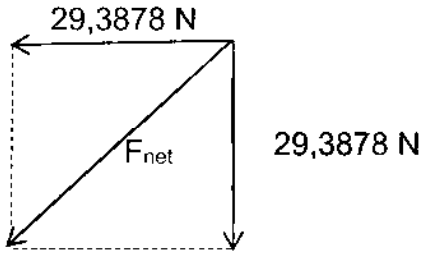
$$= -2\ \mu C$$

$$F = \frac{kQ_1Q_2}{r^2} \checkmark$$

$$F_{Q_2 on Q_1} = \frac{(9x10^9)(2x10^{-6})(2x10^{-6})}{(3{,}5x10^{-3})^2} \checkmark$$

$$= 29{,}3878\ N \text{ south}$$

$F_{Q_3 on Q_1}$ = 29,3878 N, West ✓



$$F_{net} = \sqrt{(29{,}3878)^2 + (29{,}3878)^2} \checkmark$$

$$= 41{,}5606\ N \checkmark$$

(5)

8.5 The electric field at a point is the electrostatic force experienced per unit positive charge placed at that point. ✓✓

Die elektriese veld by 'n punt is die elektrostatiese krag wat per eenheidspositiewe-lading wat by daardie punt geplaas is, ondervind word. ✓✓ (2)

8.6 $E = \frac{kQ}{r^2}$ ✓

$E = \frac{kQ_1}{r^2} + \frac{kQ_2}{r^2}$

$E_{net} = \frac{(9x10^9)(2x10^{-6})}{(2x10^{-3})^2}$ ✓ + ✓ $\frac{(9x10^9)(12x10^{-6})}{(2x10^{-3})^2}$ ✓

$= 9x10^9$ N·C^{-1}✓, westwards/*wes*✓ (6)

[19]

QUESTION/VRAAG 9

9.1 The maximum energy provided by a battery per unit charge passing through it.✓ ✓

Die maksimum energie wat 'n battery lewer ***per*** *eenheidslading wat daardeur vloei.*✓ ✓ (2)

9.2 7,5 V✓ ✓ (2)

9.3.1 $V_{internal} = Ir$

7,5 - 5,25 = 7,01r ✓

r = 0,321 Ω

Carry over mark

$\mathcal{E} = I(R + r)$

7,5 = 7,01(R + 0,321) ✓

R = 0,7489Ω

$\frac{1}{R_p} = \frac{1}{x} + \frac{1}{x}$ ✓

$\frac{1}{0,7489}$ ✓ $= \frac{1}{x} + \frac{1}{x}$

x = 1,4978 Ω✓

OR

$R_p = \frac{R_1 R_2}{R_1 + R_2}$ ✓

0,7489✓ $= \frac{(x)(x)}{x + x}$

x = 1,4978 Ω✓ (5)

9.3.2 The parallel connection causes total resistance to decrease ✓
Total current in the circuit increases ✓
Internal volts will increase ($V_{internal}$=Ir) ✓
From $\mathcal{E} = I(R + r)$, for a constant $\mathcal{E}$ ✓, $V_{external}$ decreases

Die partallel konneksie veroorsaak die totale weerstand om af te neem ✓
Totale weerstand in die stroombaan neem toe ✓
Interne volts (V_{intern}) neem toe ✓
Van $\mathcal{E} = I(R + r)$,vir 'n konstante $\mathcal{E}$, sal $V_{ekstern}$ afneem ✓

(4)

9.3.3 $$P = \frac{V^2}{R}\checkmark$$
$$P = \frac{(3{,}39)^2}{1{,}4978}\checkmark$$

P = 7,673W✓

(3)

[16]

GRAND TOTAL/GROOTTOTAAL: 150