



education

Department of
Education
FREE STATE PROVINCE

**PREPARATORY EXAMINATION
VOORBEREIDENDE EKSAMEN**

GRADE 12/GRAAD 12

**PHYSICAL SCIENCES P1 (PHYSICS)
FISIESE WETENSKAPPE V1 (FISIKA)**

SEPTEMBER 2014

MEMORANDUM

MARKS/PUNTE: 150

**This memorandum consists of 11 pages.
Hierdie memorandum bestaan uit 11 bladsye.**

SECTION A

QUESTION 1/VRAAG 1

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

TOTAL SECTION A/TOTAAL AFDELING A: 20

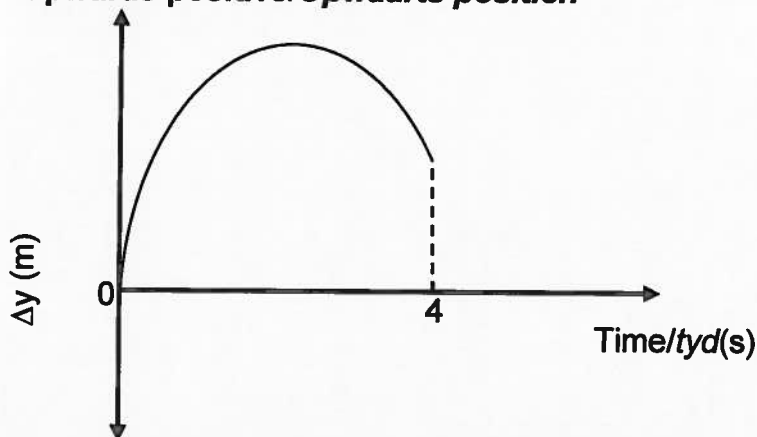
SECTION B/AFDELING B

QUESTION 2/VRAAG 2

2.1.1	Upwards positive/Opwaarts positief: $v_f = v_i + a \Delta t \checkmark$ $0 = 30 \checkmark + - 9,8 \Delta t$ $\Delta t = 3,06 \text{ s} \checkmark$	Downwards positive/Afwaarts positief: $v_f = v_i + a \Delta t \checkmark$ $0 = - 30 \checkmark + 9,8 \Delta t$ $\Delta t = 3,06 \text{ s} \checkmark$	(3)
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2.1.2	Upwards positive/Opwaarts positief: $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $= 30(4) \checkmark + \frac{1}{2}(-9,8)(4)^2 \checkmark$ $= 41,6 \text{ m}$ Height /Hoogte = 41,6 m $\checkmark$	Downwards positive/Afwaarts positief: $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $= - 30(4) \checkmark + \frac{1}{2}(9,8)(4)^2 \checkmark$ $= - 41,6 \text{ m}$ Height /Hoogte = 41,6 m $\checkmark$	(4)
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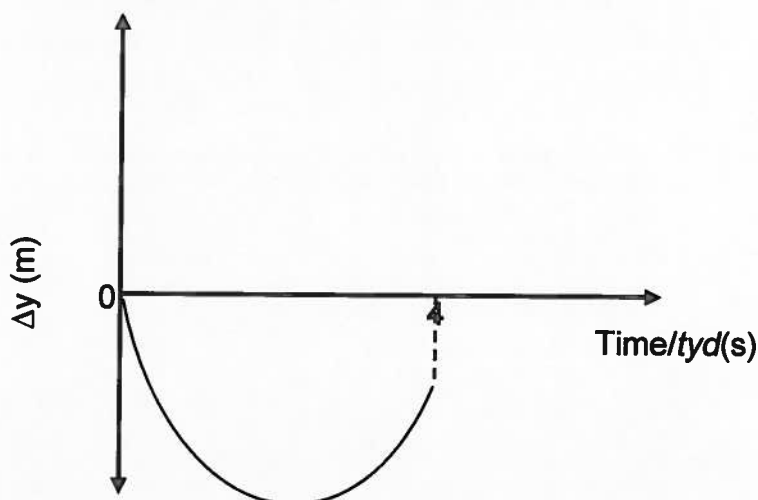
2.2 **OPTION 1/OPSIE 1**
Upwards positive/Opwaarts positief:



Criteria for graph/Kriteria vir grafiek:	Marks/Punte
Shape of first part of graph up till maximum height. Vorm van eerste deel van grafiek tot by maksimum hoogte.	✓
Shape of second part of graph and above zero height at $t = 4 \text{ s}$. Vorm van tweede deel van grafiek en bokant zero hoogte by $t = 4 \text{ s}$	✓
Ground not zero position (provided everything else is correct): $\frac{1}{2}$ Grond nie zero posisie (indien die res korrek is): $\frac{1}{2}$	(2)

OPTION 2/OPSIE 2

Downwards positive/Afwaarts positief:



Criteria for graph/Kriteria vir grafiek:	Marks/Punte
Shape of first part of graph up till maximum height. <i>Vorm van eerste deel van grafiek tot by maksimum hoogte.</i>	✓
Shape of second part of graph and above zero height at $t = 4$ s. <i>Vorm van tweede deel van grafiek en bokant zero hoogte by $t = 4$ s</i>	✓
Ground not zero position (provided everything else is correct): $\frac{1}{2}$ <i>Grond nie zero posisie (indien die res korrek is): $\frac{1}{2}$</i>	(2)

2.3

Positive marking from 2.1.2/ Positiewe merk vanaf 2.1.2. Upwards positive/Opwaarts positief: $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $0 = (24)^2 + 2(-9,8)\Delta y$ ✓ $\Delta y = 29,39$ m Total displacement = $-41,6 + \sqrt{29,39}$ <i>Totale verplasing</i> $= -12,21$ m $= 12,21$ m ✓ downwards ✓ / afwaarts	Positive marking from 2.1.2/ Positiewe merk vanaf 2.1.2 Downwards positive/Afwaarts positief: $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $0 = (-24)^2 + 2(9,8)\Delta y$ ✓ $\Delta y = -29,39$ m Total displacement = $41,6 - \sqrt{29,39}$ <i>Totale verplasing</i> $= 12,21$ m ✓ downwards ✓ / afwaarts	(5)
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2.4 Inelastic✓

The velocity/speed with which the ball bounces from the ground is less than/differs from the velocity/speed at which the ball strikes the ground. ✓
The kinetic energy is not conserved/changes. ✓

Onelasties

*Die snelheid/speed waarmee die bal vanaf die grond bons is minder as/verskillend van die snelheid waarmee dit die grond tref.
Die kinetiese energie word dus nie behou nie/verander.*

(3)
[17]

QUESTION 3/VRAAG 3

- 3.1 Newton's First Law of motion. ✓ A body will remain in its state of rest or motion at constant velocity ✓ unless a non-zero resultant/net force acts on it. ✓

Newton se Eerste bewegingswet. 'n Liggaam sal in sy toestand van rus of konstante snelheid beweging volhard tensy 'n nie-nul resultante/netto krag daarop inwerk.

(3)

- 3.2 A system in which no net external forces are acting on the spaceship. ✓✓

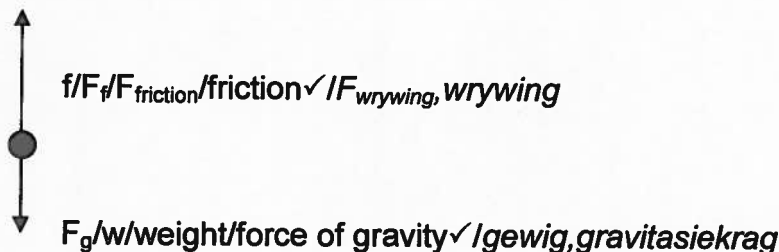
'n Sisteem waarin geen netto eksterne kragte op ruimtetuig inwerk nie.

(2)

- 3.3 $F_{\text{net}} \Delta t = \Delta p$
 $F_{\text{net}} \Delta t = mv_f - mv_i$ ✓
 $(12\,000)(30) \checkmark = 3500(v_f - v_i)$
 $\Delta v = 102,86 \text{ m} \cdot \text{s}^{-1}$ ✓

(3)

- 3.4



(2)

- 3.5 $F_{\text{net}} = ma$ ✓
 $w + f = ma$ }
 $(3500)(9,8) \checkmark + f = 3500 \left(\frac{100 - 800}{20} \right) \checkmark \checkmark$
 $f = -156\,800 \text{ N}$
 $\therefore f = 156\,800 \text{ N} \checkmark$

(5)
[15]

QUESTION 4/VRAAG 4

- 4.1 Newton's Second Law of motion. ✓ When a resultant/net force acts on an object, the object will accelerate in the direction of the net force at an acceleration which is directly proportional to ✓ the force and inversely proportional to the mass of the object. ✓

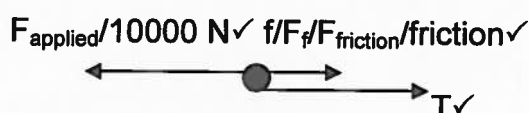
Newton se Tweede bewegingswet. Indien 'n resulterende/netto krag op 'n voorwerp inwerk, versnel die voorwerp in die rigting van die netto krag met 'n versnelling wat direk eweredig is aan die krag en omgekeerd eweredig aan die massa van die voorwerp.

(3)

4.2 $f_{s(max)} = \mu_s F_N$ ✓
 $= 0,35(500)(9,8)$ ✓
 $= 1715 \text{ N}$ ✓

(3)

4.3



(3)

4.4 Left positive: /links positief: }
 Car: $F_{\text{net}} = ma$ ✓
 $T + f = ma$
 $T - (0,2)(500)(9,8) = 500(3,04)$ ✓
 $T = 2500 \text{ N}$ ✓

OR/OF

Truck/Trok: $F_{\text{net}} = ma$ } ✓
 $F_{\text{applied}}/F_{\text{toegepas}} + T + f = ma$ }
 $10\,000 + T - (0,2)(1500)(9,8) = 1\,500(3,04)$ ✓
 $T = -2500 \text{ N}$
 $\therefore T = 2500 \text{ N}$ ✓

(5)
[14]

QUESTION 5/VRAAG 5

- 5.1 Yes, ✓ no other forces other than the gravitational force is acting on the block. ✓

Ja, geen ander krag behalwe gravitasiekrag werk op die blok in nie. (2)

5.2 $W_{\text{net}} = \Delta K$ ✓
 $= \frac{1}{2}(3)(6^2) - 0$ ✓
 $= 54 \text{ J}$ ✓

(3)

5.3

OPTION 1/ OPSIE 1

$$(U + K)_A = (U + K)_B \text{ ✓}$$

$$(3)(9.8)(6) + 0 \text{ ✓} = (3)(9.8)h + \frac{1}{2}(3)(6^2) \text{ ✓}$$

$$h = 4,16 \text{ m} \text{ ✓}$$

OPTION 2/ OPSIE 2

$$W_{\text{net}} = \Delta E_k / \Delta K \text{ ✓}$$

$$(3)(9.8)\Delta y \cos 0^\circ \text{ ✓} = \frac{1}{2}(3)(6^2) - 0 \text{ ✓}$$

$$\Delta y = 1,84 \text{ m}$$

$$\therefore h = 6 - 1,84$$

$$= 4,16 \text{ m} \text{ ✓}$$

(4)

Positive marking from 5.3/ Positiewe merk vanaf 5.3

5.4

OPTION 1/ OPSIE 1

$$W_{\text{nc}} = \Delta U + \Delta K \text{ ✓} / W_{\text{nc}} = \Delta E_p + \Delta E_k$$

$$(f)(5) \cos 180^\circ \text{ ✓} = (3)(9.8)(1) - (3)(9.8)(4,16) \text{ ✓} + \frac{1}{2}(3)(2)^2 - \frac{1}{2}(3)(6)^2 \text{ ✓}$$

$$f = 28,18 \text{ N} \text{ ✓}$$

OPTION 2/ OPSIE 2

$$W_{\text{net}} = \Delta E_k / \Delta K \text{ ✓}$$

$$W_f + W_g = \Delta K \text{ ✓}$$

$$(f)(5) \cos 180^\circ \text{ ✓} + (3)(9.8)(4,16 - 1) \cos 0^\circ \text{ ✓} = \frac{1}{2}(3)(2)^2 - \frac{1}{2}(3)(6)^2 \text{ ✓}$$

$$f = 28,18 \text{ N} \text{ ✓}$$

(5)
[14]

QUESTION 6/VRAAG 6

- 6.1 Red shift is a shift in the spectra of distant stars ✓ towards the longer wave lengths/red end of the spectrum. ✓

Rooi verskuiwing is 'n verskuiwing in die spektra van verafgeleë sterre na die langer golflengte/rooi kant van die spektrum. (2)

- 6.2 Moving away from the earth ✓
 The wavelength of the light coming from the distant star has increased/ shift towards longer wavelengths. ✓

Beweeg weg van die aarde af.
Die golflengte van die lig komende van die ster het toeneem/verskuif na die langer golflengtes. (2)

- 6.3.1 The difference between the speed of the car and the speed of light is very large.✓ The frequency shift/increase is too small to observe.✓

Die verskil tussen die spoed van die kar en die van lig is baie groot. Die frekwensieskuif toename is dus te klein om waar te neem.

(2)

6.3.2 $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ **OR/OF** $f_L = \frac{v}{v - v_s} f_s$ ✓

$$\therefore f_L = \frac{340}{340 - 77,78} \checkmark (1200) \checkmark$$

$$= 1555,95 \text{ Hz} \checkmark$$

(4)
[10]

QUESTION 7/VRAAG 7

- 7.1 Electrostatic force experienced✓ per unit positive charge✓ at that point./Die elektrostatiese krag ervaar per eenheid positiewe lading by daardie punt.

(2)

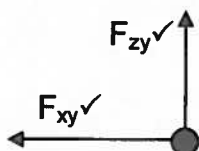
7.2 $E_1 = \frac{kQ}{r^2} \checkmark$

$$= \frac{9 \times 10^9 \times 12 \times 10^{-9}}{0,3^2} \checkmark$$

$$= 1,2 \times 10^3 \text{ N.C}^{-1} \checkmark$$

(3)

7.3



Note: No deduction of marks for labels.

Let wel: Geen punte aftrek vir byskrifte nie.

(2)

7.4

$$F_{ZY} = \frac{kQ_Y Q_Z}{r^2} \checkmark$$

$$= \frac{9 \times 10^9 \times 8 \times 10^{-9} \times 10 \times 10^{-9}}{0,4^2} \checkmark$$

$$= 4,5 \times 10^{-6} \text{ N}$$

$$F_{\text{net}}^2 = F_{XY}^2 + F_{ZY}^2$$

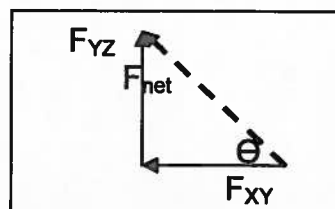
$$= (9,6 \times 10^{-6})^2 + (4,5 \times 10^{-6})^2 \checkmark$$

$$F_{\text{net}} = 1,06 \times 10^{-5} \text{ N}$$

$$\tan \theta = \frac{4,5 \times 10^{-6}}{9,6 \times 10^{-6}} \checkmark$$

$$\theta = 25,11^\circ$$

$\therefore F_{\text{net}} = 1,06 \times 10^{-5} \text{ N} \checkmark$, 295,11°/ 25,11° North of West/Noord van wes 25,11° upwards from negative x-axis ✓/opwaarts vanaf negatiewe x - as



(6)
[13]

QUESTION 8/VRAAG 8

- 8.1 21 J of work done /energy transfered✓ per coulomb/unit charge✓ that is moved between two points in an electric field./ 21 J arbeid verrig/energie oorgedra per coulomb/eenheid lading wat tussen twee punte in 'n elektriese veld beweeg. (2)

8.2.1

$$I = \frac{V_i}{r} \checkmark$$

$$= \frac{3}{1} \checkmark$$

$$= 3 \text{ A}$$

$$V = IR$$

$$= (3)(3) \checkmark$$

$$= 9 \text{ V}$$

$$V_2 = 21 - 9$$

$$= 12 \text{ V} \checkmark$$

$V_i = 24 - 21$
 $= 3 \text{ V}$

(2)

8.2.2

**Positive marking from 8.2.1/
Positiewe merk vanaf 8.2.1
OPTION 1 / OPSIE 1**

$$R = \frac{V}{I}$$

$$= \frac{21}{3} \checkmark$$

$$= 7 \Omega$$

$$R_p = 7 - 3 \checkmark$$

$$= 4 \Omega$$

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} \checkmark$$

$$\frac{1}{4} \checkmark = \frac{1}{6} + \frac{1}{R} \checkmark$$

$$\therefore R = 12 \Omega$$

$$V_p = 21 - 9$$

$$= 12 \text{ V}$$

$$P = \frac{V^2}{R}$$

$$P = \frac{12^2}{12} \checkmark$$

$$= 12 \text{ W} \checkmark$$

OPTION 2 / OPSIE 2

$$E = I(R + r)$$

$$24 = 3(R + 1) \checkmark$$

$$R = 7 \Omega$$

$$R_p = 7 - 3 \checkmark$$

$$= 4 \Omega$$

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} \checkmark$$

$$\frac{1}{4} \checkmark = \frac{1}{6} + \frac{1}{R} \checkmark$$

$$\therefore R = 12 \Omega$$

Ratio of current in parallel
branches: 2:1/Verhouding van stroom in
paralelle vertakking: 2:1

$$I_R = 1 \text{ A}$$

$$P = IR^2$$

$$= (1) \checkmark (12) \checkmark$$

$$= 12 \text{ W} \checkmark$$

(4)

(8)

8.3

Increase✓/vergroot

Total resistance in circuit decrease.✓/Totale weerstand in stroombaan verklein.

Total current increase✓ (and through 3 Ω resistor)./Totale stroom vegroot

Therefore: Power increase according to $P = I^2 R$ for R (3Ω) staying constant.✓/

Daarom: Drywing vergroot ooreenstemmend met $P = I^2 R$ vir R (3 Ω) bly konstant.

(4)

[18]

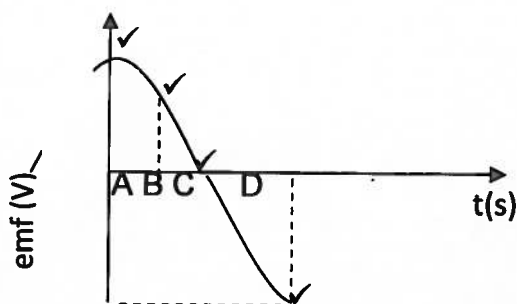
QUESTION 9/VRAAG 9

9.1.1 Electromagnetic Induction✓ / *elektromagnetiese induksie* (1)

9.1.2 Maximum✓ / maksimum (1)

9.1.3 A✓
The rate of change in the magnetic flux✓ is a maximum✓ at position C. / Die tempo van verandering in die magnetiese vloed is 'n maksimum by punt C. (3)

9.1.4



Mirror image of graph
also correct.
*Spieëlbeeld van grafiek
ook korrek.*

(4)

9.2.1 AC voltages can be stepped up or down by making use of transformers✓ for different users. OR
Electrical energy can be transmitted over long distances✓ with low current and high voltage. (ANY ONE)
WS spanning kan m.b.v transformators verhoog of verlaag word vir verskillende gebruikers OF
Elektriese energie kan oor lang afstande oorgedra word deur lae stroom en hoë spanning. (ENIGE EEN) (1)

9.2.2 $P_{\max} = V_{\max} I_{\max} \checkmark$
 $300 \checkmark = 80(I_{\max}) \checkmark$
 $(I_{\max}) = 3,75 \text{ A}$
 $I_{\text{rms}} = \frac{I_{\max}}{\sqrt{2}}$
 $= \frac{3,75}{\sqrt{2}} \checkmark$
 $= 2,65 \text{ A} \checkmark$ (5)

9.2.3 $T = \frac{1}{f} \checkmark$
 $= \frac{1}{0,05} \checkmark$
 $= 20 \text{ Hz} \checkmark$

(3)
[18]

QUESTION 10/VRAAG 10

10.1.1 Line emission (spectrum)✓ / Lynemissie(spektrum)

(1)

10.1.2 Driffractation grating✓ / Diffraksierooster

Prism / Prisma

(Any one/ Enige een)

(1)

10.2 The frequency of red ✓light is smaller than the threshold frequency✓ of the metal used in photo cell. / Die frekwensie van rooi lig is kleiner as die drumpelfrekwensie van die metaal gebruik in fotosel.

OR/OF

The energy of the photon of red light is lower✓ than the work function ✓ of the metal used in photo cell. / Die energie van die foton van rooi lig is minder as die werksfunksie vir die metaal gebruik in fotosel.

(2)

10.3.1 The minimum energy✓ needed for an electron to be set free from the surface of a metal.✓ / Die minimum energie nodig om 'n elektron uit die oppervlak van 'n metaal vry te stel.

(2)

10.3.2

OPTION 1 / OPSIE 1

$$E = hf_0 \checkmark$$

$$= (6,63 \times 10^{-34})(1,1 \times 10^{15}) \checkmark$$

$$= 7,29 \times 10^{-19} \text{ J}$$

$$E = h \frac{c}{\lambda}$$

$$= \frac{6,63 \times 10^{-34} \times 3 \times 10^8}{450 \times 10^{-9}} \checkmark$$

$$= 4,42 \times 10^{-19} \text{ J}$$

No, ✓ $E_{\text{photon}}/E_{\text{foton}} < \text{Work Function} \checkmark$ / Werksfunksie

OPTION 1 / OPSIE 1

$$c = \lambda f \checkmark$$

$$3 \times 10^8 \checkmark = \lambda \times 10^{-9} (f) \checkmark$$

$$f = 6,67 \times 10^{14}$$

$$f_0 = 1,1 \times 10^{15} \text{ (given/gegee)}$$

No, ✓ $f_{\text{photon}}/f_{\text{foton}} < f_0 \text{ (cut-off f)} \checkmark$

(5)

[11]

TOTAL SECTION B/TOTAAL AFDELING B: 130

GRAND TOTAL/GROOTTOTAAL: 150