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**NATIONAL SENIOR CERTIFICATE/  
NASIONALE SENIOR SERTIFIKAAT**

**GRADE/GRAAD 12**

**JUNE/JUNIE 2023**

**TECHNICAL SCIENCES P1/TEGNIESE WETENSKAPPE V1  
MARKING GUIDELINE/NASIENRIGLYN**

**MARKS/PUNTE: 150**

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This marking guideline consists of pages 11./  
*Hierdie nasienriglyn bestaan uit 11 bladsye.*

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**QUESTION/VRAAG 1**

1.1 B ✓✓

1.2 A ✓✓

1.3 A ✓✓

1.4 C ✓✓

1.5 B ✓✓

1.6 D ✓✓

1.7 A ✓✓

1.8 B ✓✓

1.9 B ✓✓

1.10 A ✓✓

(10 x 2) [20]

**QUESTION/VRAAG 2**

2.1 The rate of change in velocity. ✓✓ (2)

2.2.1 Choose right as positive/Kies regs as positief  
Learner A/Leerder A:

$$\begin{aligned}
 F_{net} &= ma \\
 F_{net} &= F_a \cos \theta + F_f \quad \left. \vphantom{F_{net}} \right\} \text{ Any one } \checkmark \\
 F_{net} &= -8 \cos 60^\circ + 0,3 \checkmark\checkmark \\
 F_{net} &= -3,7 \text{ N} \\
 F_{net} &= 3,7 \text{ N } \checkmark \text{ to the right/na regs } \checkmark
 \end{aligned}$$

**OR/OF**Choose left as positive/Kies links as positief

$$\begin{aligned}
 F_{net} &= ma \\
 F_{net} &= F_a \cos \theta + F_f \quad \left. \vphantom{F_{net}} \right\} \text{ Any one } \checkmark \\
 F_{net} &= 8 \cos 60^\circ + (-0,3) \checkmark\checkmark \\
 F_{net} &= 3,7 \text{ N } \checkmark \text{ to the right/na regs } \checkmark
 \end{aligned} \quad (5)$$

2.2.2  $F_{net} = ma \checkmark$ 

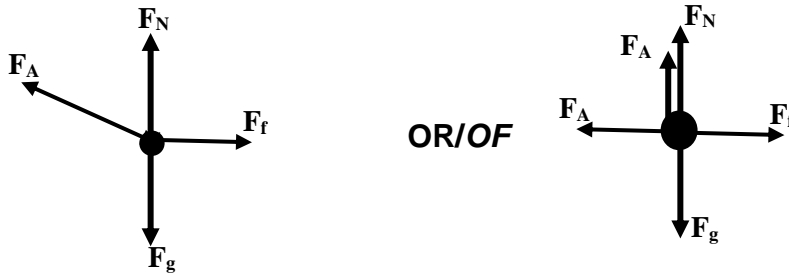
$$3,7 = 12a \checkmark$$

$$a = 0,31 \text{ m} \cdot \text{s}^{-2} \checkmark \quad (3)$$

2.2.3 Newton's Second Law/*Newton se Tweede Wet* ✓✓ (2)

2.2.4 When the net force is exerted on an object with mass  $m$ , ✓ the object will accelerate in the direction of the net force. ✓  
*Indien 'n netto krag op voorwerp met massa  $m$  uitgeoefen word, ✓ versnel die voorwerp in die rigting van die netto krag. ✓* (2)

2.2.5



Marking criteria/Nasienkriteria	Labels /Byskrifte	Marks/ Punte
Correct direction and label of Normal force <i>Korrekte rigting en byskrif van Normale krag</i>	$N/F_N$	1
Correct direction and label of gravitational force <i>Korrekte rigting en byskrif van gravitasiekrag</i>	$F_g/w$	1
Correct direction and label of frictional force <i>Korrekte rigting en byskrif van die wrywingskrag</i>	$F_f/f$	1
Correct direction and label of the applied force by <i>Korrekte rigting en byskrif van die toegepaste krag</i>	$F/F_T/F_A$	1

(4)

2.3.1 INCREASE / VERHOOG ✓ (1)

2.3.2 DECREASE / VERLAAG ✓ (1)

[20]

## QUESTION/VRAAG 3

- 3.1 3.1.1 When object A exerts a force on object B, ✓ object B simultaneously exerts an oppositely directed force of equal magnitude on object A ✓

Wanneer voorwerp A 'n krag uitoefen op voorwerp B, ✓ sal voorwerp B gelyktydig 'n gelyke maar teenoorgestelde krag op voorwerp A indien. ✓

(2)

- 3.1.2 For crate B/vir Krat B  
(Let right be + / Regs is +)

$$\left. \begin{aligned} F_{net} &= ma \\ F_{net} &= F_{AonB} - F_{fk} \\ F_{AonB} - F_{fk} &= ma \\ F_{AonB} - F_{fk} &= ma \end{aligned} \right\} \begin{array}{l} \text{Any one/} \\ \text{Enige een} \\ \checkmark \end{array}$$

$$\begin{aligned} F_{AonB} - 25,3 \checkmark &= 30 \times 2,3 \checkmark \\ F_{AonB} &= 94,3 \text{ N} \end{aligned}$$

$$\left. \begin{aligned} F_{BonA} &= -F_{AonB} \\ F_{BonA} &= -94,3 \text{ N} \end{aligned} \right\} \begin{array}{l} \text{Any one } \checkmark / \text{Enige een} \\ \checkmark \end{array}$$

$$F_{BonA} = 94,3 \text{ N } \checkmark \text{ left/links } \checkmark$$

OR/OF

(Let left be + / Links is +)

$$\left. \begin{aligned} F_{net} &= ma \\ F_{net} &= -F_{AonB} + F_{fk} \\ -F_{AonB} + F_{fk} &= ma \\ -F_{AonB} + F_{fk} &= ma \end{aligned} \right\} \begin{array}{l} \text{Any one /} \\ \text{Enige een} \end{array}$$

$$\begin{aligned} -F_{AonB} + 25,3 \checkmark &= 30 \times (-2,3) \checkmark \\ F_{AonB} &= 94,3 \text{ N} \end{aligned}$$

$$\left. \begin{aligned} -F_{BonA} &= F_{AonB} \\ -F_{BonA} &= 94,3 \text{ N} \end{aligned} \right\} \begin{array}{l} \text{Any one } \checkmark / \text{Enige een} \\ \checkmark \end{array}$$

$$F_{BonA} = 94,3 \text{ N } \checkmark \text{ left/links } \checkmark$$

(6)  
[8]

**QUESTION/VRAAG 4**

- 4.1 4.1.1 Impulse is the product of the net force acting on an object, ✓ and the time the force acts on the object. ✓  
*Impuls is die produk van die netto krag wat op 'n voorwerp inwerk, ✓ en die tyd wat die netto krag op die voorwerp inwerk. ✓* (2)

4.1.2 **OPTION 1/OPSIE 1**Towards the batsman + / *In die rigting van kolwer +*

$$\Delta p = m v_f - v_i \checkmark$$

$$\Delta p = (0,175) (-30 - 12) \checkmark$$

$$\Delta p = -7,35 \text{ N} \cdot \text{s} \checkmark$$

$$\Delta p = 7,35 \text{ N} \cdot \text{s} \checkmark \text{ away from the batsman / weg vanaf kolwer} \checkmark$$

**OPTION 2/OPSIE**Towards the batsman - / *in die rigting van die kolwer -*

$$\Delta p = m v_f - v_i \checkmark$$

$$\Delta p = (0,175) (30 - (-12)) \checkmark$$

$$\Delta p = 7,35 \text{ N} \cdot \text{s} \checkmark$$

$$\Delta p = 7,35 \text{ N} \cdot \text{s} \checkmark \text{ away from the batsman/weg vanaf die kolwer} \checkmark$$
 (5)

4.1.3 **POSITIVE MARKING FROM 4.1.2/ POSITIEWE MERK VAN 4.1.2**

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

$$F_{net} (0,05) = 7,35 \checkmark$$

$$F_{net} = 147 \text{ N} \checkmark$$

**OR/OF**

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

$$F_{net} (0,05) = -7,35 \checkmark$$

$$F_{net} = -147 \text{ N} \checkmark$$
 (3)

4.1.4 From  $F_{net} = \frac{\Delta p}{\Delta t} \checkmark$ 

- $F_{net} \propto \Delta p$  if  $\Delta p$  is constant/ ✓
  - crumple zones increase the time ✓
  - $F_{net}$  decreases. ✓
  - $F_{net} \propto \Delta p$  as  $\Delta p$  konstant is. ✓
  - vermeerder tyd a.g.v. frommelsones ✓
  - $F_{net}$  verminder ✓
- (4)

- 4.2 4.2.1 The total linear momentum of an isolated system remains constant (in magnitude and direction). (✓✓)  
*Die totale lineêre momentum van 'n geïsoleerde sisteem bly konstant/word behou (in grootte en rigting). (✓✓)* (2)

4.2.2 **OPTION 1 Right + / OPSIE 1 Regs +**

$$\begin{aligned} \sum p_{\text{before}} &= \sum p_{\text{after}} \checkmark \\ m_1 v_{1i} + m_2 v_{2i} &= m_1 v_{1f} + m_2 v_{2f} \\ (2)(3) + (3,5)(0) \checkmark &= (2)(-1) + 3,5v \checkmark \\ v &= 2,29 \text{ m} \cdot \text{s}^{-1} \checkmark \\ v &= 2,29 \text{ m} \cdot \text{s}^{-1}; \text{right/regs} \checkmark \end{aligned}$$

**OPTION 2 Left + / OPSIE 1 Links +**

$$\begin{aligned} \sum p_{\text{before}} &= \sum p_{\text{after}} \checkmark \\ m_1 v_{1i} + m_2 v_{2i} &= m_1 v_{1f} + m_2 v_{2f} \\ (2)(-3) + (3,5)(0) \checkmark &= (2)(1) + 3,5v \checkmark \\ v &= -2,29 \text{ m} \cdot \text{s}^{-1} \checkmark \\ v &= 2,29 \text{ m} \cdot \text{s}^{-1}; \text{right/regs} \checkmark \end{aligned} \quad (5)$$

**[21]**

**QUESTION/VRAAG 5**

- 5.1 Work done is the product of the applied force on an object and the displacement in the direction of the force. ✓✓  
*Die arbeid verrig is die produk van die toegepaste krag op die voorwerp en die verplasing in die rigting van die krag.* ✓✓ (2)
- 5.2.1  $F_f = \mu_k F_N$  ✓  
 $F_f = (0,14)(9,8)(8)$  ✓  
 $F_f = 10,976 \text{ N}$  ✓ (3)
- 5.2.2  $W_f = F_f \Delta x \cos \theta$  ✓  
 $W_f = (10,976)(4) \cos 0^\circ$  ✓  
 $W_f = 43,904 \text{ J}$  ✓ (3)
- 5.3 0 J ✓ (1)
- 5.4 5.4.1 Power is the rate at which work is done or expended. ✓✓  
*Drywing is die tempo waarteen arbeid verrig word of energie gebruik word.* (2)
- 5.4.2  $P = \frac{W}{\Delta t}$  ✓  
 $P = \frac{480\,000}{30}$  ✓  
 $P = 16\,000 \text{ W}$  ✓  
 $hp = \frac{16\,000}{746}$  ✓  
 $hp = 21,45 \text{ hp}$  ✓ (5)

**[16]****QUESTION/VRAAG 6**

- 6.1 Total mechanical energy remains constant in an isolated system. ✓✓  
*Die totale meganiese energie in 'n geïsoleerde sisteem bly konstant.* (2)
- 6.2  $M_E = E_K + E_p$  ✓  
 $= \frac{1}{2} mv^2 + mgh$   
 $= \frac{1}{2} (2,5)(0)^2 + (2,5)(9,8)(10)$  ✓  
 $= 245 \text{ J}$  ✓ (4)
- 6.3 6.3.1 No / Nee ✓ (1)
- 6.3.2 The force applied and the direction of motion are perpendicular to each other, ✓ so no work is done on the object. ✓  
*Die toegepaste krag en die rigting van beweging is loodreg op mekaar, ✓ so geen arbeid word op die voorwerp verrig nie.* ✓ (2)

**[9]**



**QUESTION/VRAAG 7**

- 7.1 Strain is the ratio of change in the dimension/length of objects to the original dimension/length ✓✓  
*Rekking is die verhouding van verandering in dimensie/lengte van voorwerpe tot die oorspronklike dimensie/lengte. ✓✓*

**Accept/aanvaar**

The change in length over the original length of an object. ✓✓

*Die verandering in lengte van die voorwerp tot die oorspronklike lengte van 'n voorwerp. ✓✓*

(2)

- 7.2 Hooke's law states that, within the limit of elasticity, stress is directly proportional to the strain. ✓✓

*Hooke se wet bepaal dat spanning, in die grens van elastisiteit, direk eweredig aan die rekking is. ✓✓*

(2)

7.3 7.3.1  $\delta = \frac{F}{A} \checkmark$   
 $1 \times 10^6 \checkmark = \frac{F}{2 \times 10^{-3}} \checkmark$

$F = 2\,000\text{ N} / 2\text{ kN} \checkmark$

(4)

7.3.2  $\varepsilon = \frac{\Delta L}{L} \checkmark$   
 $\varepsilon = \frac{1 \times 10^{-3}}{50} \checkmark$   
 $\varepsilon = 2 \times 10^{-5} \checkmark$

**NOTE:** Penalise if units are included (final answer).

**LET WEL:** *Penaliseer indien eenhede by finale antwoord gegee is.*

(3)

7.3.3  $K = \frac{\delta}{\varepsilon} \checkmark$   
 $K = \frac{1 \times 10^6}{2 \times 10^{-5}} \checkmark$   
 $K = 5 \times 10^{10} \text{ N} \frac{\text{m}^{-2}}{\text{Pa}} \checkmark$

(3)

**[14]**

**QUESTION/VRAAG 8**

- 8.1 Viscosity is a physical property of fluids. It shows the resistance to flow. ✓✓  
*Viskositeit is 'n fisiese eienskap van vloeistowwe. Dit toon die weerstand teen vloeï.*  
*(Viskositeit is 'n fisiese eienskap van vloeistof om die relatiewe beweging tussen twee aangrensende vlakke teen te werk.)* (2)
- 8.2 5W-30 SAE is the oil that behaves as an SAE 5 oil at low temperatures, ✓ and behaves as an SAE 30 at high temperatures. ✓  
*5W-30 SAE is die olie wat as 'n SAE 5 olie by lae temperature werk ✓ en sy gedrag by hoë temperature is soos 'n SAE 30 olie. ✓*

**OR/OF**

5: Viscosity grade at cold temperature, W: Winter 30: Viscosity rate at 100 °C  
*5: Viskositeit grade by kouer temperatuur, W: Winter 30: Viskositeit by 100 °C.* (2)

- 8.3 B ✓✓ (2)
- 8.4 In summer South Africa has high temperature; B has a higher viscosity ✓ at higher temperatures. ✓  
*In die somer is Suid-Afrika se temperatuur hoog; B het 'n hoër viskositeit ✓ by hoër temperature.* ✓ (2)

- 8.5 Single/mono-grade oil is graded at one temperature, ✓✓ while multigrade oil is graded at two temperatures. ✓✓  
*Enkel/mono-graad olie word gegradeer by een temperatuur, ✓✓ terwyl multigraad by twee temperature gegradeer word. ✓✓*

**OR/OF**

- Single /Monograde oil is the engine oil that is designed to function at either low temperatures or high temperatures and is not be suitable for engines with changing temperatures. For example, SAE 40 oil is a monograde oil. ✓✓
- *Enkel/monograad olie is die enjin-olie wat ontwerp is om te funksioneer by of lae temperature of hoë temperature en is nie geskik vir enjintemperature wat baie verander nie.* ✓✓
- Multi-grade oil is an engine oil that is designed to cope with the increasing engine temperatures. It behaves as a low viscosity oil at lower temperatures and as a high viscosity oil at high temperatures. For example, 20W50 SAE is an engine oil that behaves as SAE 20 when the engine is cold, and as a SAE 50 when the engine heats up. ✓✓  
*Multigraad-olie is 'n enjin-olie wat ontwerp is om met die toenemende enjintemperature te werk. Dit tree op as 'n lae viskositeit olie by lae temperature en as 'n hoë viskositeit olie by hoë temperature. Byvoorbeeld, 20W50 SAE is 'n olie wat as SAE 20 werk wanneer die enjin koud is, en as 'n SAE 50 wanneer die enjin opgewarm is.*

(4)  
[12]

## QUESTION/VRAAG 9

- 9.1 Hydraulics is a field in applied sciences and engineering ✓ dealing with mechanical properties of liquids. ✓  
*Hidroulika is 'n studieveld in toegepaste wetenskappe en ingenieurswese ✓ wat die meganiese eienskappe van vloeistowwe behandel. ✓*

## OR/OF

The study of mechanical properties of liquids. ✓ (1 mark if this definition is given.)  
*Die studie van meganiese eienskappe van vloeistowwe. ✓ (1 punt indien hierdie definisie gegee word.)*

(2)

- 9.2 **(Any 2/Enige 2) ✓✓**

Designing hydraulic systems, steering systems, brake systems, power assisted steering, etc. ✓  
*Ontwerp van hidrouliese-stelsels, stuurstelsels, remstelsels, kragstuurstelsels, ens. ✓*

Presses: metal presses, wood presses, ceramic presses, plastic presses, etc. ✓  
*Pers/Drukke: Metaalperse, houtperse, keramiekperse, plastiekperse, ens. ✓*

Machines for industries: metal, wood, textile, paper, etc. ✓  
*Masjiene vir industrieë: Metaal, hout, tekstiel, papier, ens. ✓*

Processing machinery: wood processing, sheet metal processing, etc. ✓  
*Verwerkingsmasjinerie: Houtverwerking, bladmetaal-verwerking, ens.. ✓*

Casting: foaming, blowing, extruding machines, etc. ✓  
*Gieting: Skuim, blaas, ekstrudeer(onttrekkings)masjiene, ens.*

Component finishes: circular tables, revolving distributors, clamping systems, etc. ✓  
*Komponent afrondings: ronde tafels, wentelende verspreiders, vasklampstelsels (saampers), ens. ✓*

(2)

- 9.3.1 Pressure at a particular point as the thrust(force) acting on the unit area around that point ✓✓  
*Druk (in 'n vloeistof) by 'n spesifieke punt is die stukrag(krag) op die eenheidsoppervlakte rondom daardie punt is.*

(2)

$$9.3.2 \quad P = \frac{F}{A} \checkmark$$

$$1,2 \times 10^5 = \frac{F}{8,4 \times 10^{-3}} \checkmark$$

$$F = 1\,008 \text{ N} \checkmark$$

(3)

- 9.3.3 Perpendicular to the diver/Loodreg op die duiker ✓

(1)

$$9.4 \quad \frac{F_s}{A_s} = \frac{F_1}{A_1} \checkmark$$

$$\frac{130}{0,002} = \frac{F_1}{0,025} \checkmark$$

$$F = 1,625 \times 10^3 \text{ N} \checkmark$$

(3)

**[13]**

**QUESTION/VRAAG 10**

- 10.1 10.1.1 Refraction/*Refraksie (Breking)* ✓ (1)
- 10.1.2 Critical angle/*Kritiese hoek* ✓ (1)
- 10.1.3 Total Internal Reflection/*Totale Interne Weerkaatsing* ✓ (1)
- 10.1.4 When light is approaching the less dense medium from the more dense medium ✓✓  
*Wanneer die lig vanaf 'n minder digte medium in 'n meer digte medium beweeg.* ✓✓
- If the incidence angle is larger than the critical angle. ✓✓  
*Indien die invalshoek groter as die kritiese hoek is.* ✓✓ (4)
- 10.1.5 **(Any 3/enige 3)** ✓✓✓
- Fibre optic cables in telecommunications/*Optiese veselkabels in telekommunikasie.*
  - Medical applications/*Mediese toepassings*
  - Decoration/*Versiering*
  - Data transmission/*Data oordrag*
  - Providing internet facilities to entire world/*Verskaf internetfasiliteite aan die hele wêreld.*
- (3)
- 10.2.1 99,5 MHz = 99,5 × 10<sup>6</sup> (Hz) ✓✓ (2)
- 10.2.2 **POSITIVE MARKING FROM 10.2.1/POSITIEWE NASIEN VANAF 10.2.1**  
 $c = f\lambda$  ✓  
 $3 \times 10^8 = 99,5 \times 10^6 \lambda$  ✓  
 $\lambda = 3,01 \text{ m}$  ✓ (3)
- 10.2.3 Shorter/*Korter* ✓  
**NEGATIVE MARKING/NEGATIEWE NASIEN**  
 From  $\lambda = \frac{c}{f}$   
 •  $\lambda \propto \frac{1}{f}$  ✓ if c is the same/as c dieselfde is ✓  
 •  $f_{108} > f_{99,5}$  ✓ (4)
- [17]

**TOTAL/TOTAAL: 150**