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**GRADE/GRAAD 12**

**JUNE 2024**

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

**MARKS/PUNTE: 150**

This marking guideline consists of 12 pages./  
*Hierdie nasienriglyn bestaan uit 12 bladsye.*



**SA EXAM  
PAPERS**

**QUESTION/VRAAG 1**

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



**QUESTION/VRAAG 2**

- 2.1 2.1.1 An object continues in its state of rest or uniform (moving with constant) velocity ✓ unless it is acted upon by a net (resultant) force. ✓

*'n Voorwerp bly in rus of bly beweeg teen 'n uniforme (konstante) snelheid ✓ tensy 'n netto (resultante) krag daarop dit inwerk. ✓* (2)

- 2.1.2 Gravitational force/Gravitasiekrag ✓ (1)

2.1.3

| <b>OPTION 1 / OPSIE 1</b>                                                                                                | <b>OPTION 2 / OPSIE 2</b>                                                                                                                     |
|--------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| $F_{\text{net}} = ma$<br>$F_{\text{net}} = 0 \checkmark$<br>$F_H + f_k = 0$                                              | $F_{\text{net}} = ma$<br>$F_{\text{net}} = 0 \checkmark$<br>$F_H + f_k = 0$                                                                   |
| $50\cos 60^\circ + f_k = 0 \checkmark$<br>$f_k = -25 \text{ N}$                                                          | $50\cos 60^\circ + f_k = 0 \checkmark \quad f_k = -25 \text{ N}$                                                                              |
| $f_k = \mu_k F_N \checkmark$<br>$25 = \mu_k [(10 \times 9,8) - 50\sin 60^\circ] \checkmark$<br>$\mu_k = 0,46 \checkmark$ | $F_N = mg - F_v$<br>$F_N = mg - F\sin\theta$<br>$F_N = \frac{10 \times 9,8}{2} = \frac{50\sin 60^\circ}{2} \checkmark$<br>$= 54,69 \text{ N}$ |
| <b>OPTION 3 / OPSIE 3</b><br>$F_H = -f_k \checkmark$<br>$F_H = -50\cos 60^\circ \checkmark$<br>$\mu_k = 0,46 \checkmark$ | $f_k = \mu_k F_N \checkmark$<br>$25 = \mu_k [(10 \times 9,8) - 50\sin 60^\circ] \checkmark \quad f_k = -25 \text{ N}$                         |

(5)

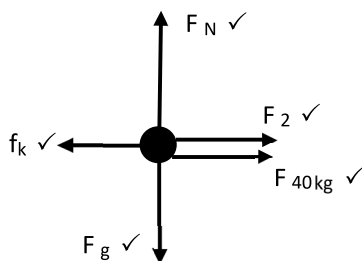


- 2.2 2.2.1 When a force is exerted on an object, the object will accelerate in the direction of the force. ✓ This acceleration is directly proportional to the force, and indirectly proportional to the mass of the object. ✓

*Indien 'n krag op 'n voorwerp inwerk sal die voorwerp versnel in die rigting van die krag. ✓ Hierdie versnelling is direk eweredig aan die krag op die voorwerp en omgekeerd eweredig aan die massa van die voorwerp. ✓*

(2)

2.2.2



| Acceptable labels/ aanvaarbare byskrifte                                                                    | MARK/<br>PUNT |
|-------------------------------------------------------------------------------------------------------------|---------------|
| $F_g/F_w$ /weight/gravitational force<br>$F_g/F_w$ /gewig/gravitasiekrag                                    | ✓             |
| $f_k / F_f$ /Frictional force<br>$f_k / F_f$ /Wrywingskrag                                                  | ✓             |
| $F_N/N$ /Normal Force<br>$F_N/N$ /Normaalkrag                                                               | ✓             |
| $F_2$ / applied force on object 2<br>$F_2$ /toegepaste krag op voorwerp 2                                   | ✓             |
| $F_{40\text{ kg}}$ / applied force on 40 kg object<br>$F_{40\text{ kg}}$ /toegepaste krag op 40 kg voorwerp | ✓             |

(5)

| Notes/Notas                                                                                           |
|-------------------------------------------------------------------------------------------------------|
| ✓One mark awarded for each label and arrow.<br><i>Een punt toegekem vir elke byskrif en pylpunt</i>   |
| • Do not penalise for length of arrows.<br><i>Moet nie penaliseer vir die lengte van die pyle nie</i> |
| • Any additional forces: Maks -1<br><i>Enige addisionele krag: Maks -1</i>                            |

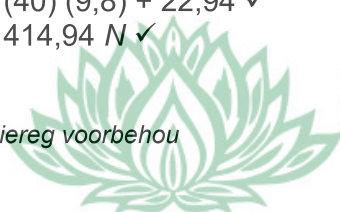
2.2.3  $F_1(y) = F_1 \sin \theta$   
 $= 40 \sin 35$  ✓  
 $= 22,94 \text{ N}$  ✓

(2)

2.2.4 **POSITIVE MARKING FROM 2.2.3/POSITIEWE MERK VAN 2.2.3**

$$\begin{aligned}
 FN &= Fg + F_1(y) \\
 &= mg + F_1(y) \\
 &= (40)(9,8) + 22,94 \text{ ✓} \\
 &= 414,94 \text{ N ✓}
 \end{aligned}$$

(2)



## 2.2.5 POSITIVE MARKING FROM 2.2.4/POSITIEWE MERK VAN 2.2.4

$$\begin{aligned}
 f_k &= \mu_k F_N \\
 &= \mu_k (F_g - F_{1(y)}) \\
 &= \mu_k (mg - F_{1(y)}) \quad \checkmark \\
 &= (0,04) (414,94) \quad \checkmark \\
 &= 16,60 \text{ N} \quad \checkmark \text{ left/links} \quad \checkmark
 \end{aligned}
 \tag{4}$$

2.2.6 For 40 kg block/Vir 40 kg blok

$$\begin{aligned}
 \checkmark \left\{ \begin{aligned} F_{net} &= F_1(x) - F_{10 \text{ kg}} - f_k \\ ma &= F_1 \cos \theta - F_{10 \text{ kg}} - f_k \end{aligned} \right. \\
 40a &= 40 \cos 35 - F_{10 \text{ kg}} - 16,60 \quad \checkmark
 \end{aligned}$$

For 10 kg block/Vir 10 kg blok

$$\begin{aligned}
 F_{net} &= F_{40 \text{ kg}} + F_2 - f_k \\
 ma &= F_{40 \text{ kg}} + F_2 - f_k \\
 10a &= F_{40 \text{ kg}} + 20 - 2,5 \quad \checkmark
 \end{aligned}$$

$$\begin{aligned}
 40a + 10a &= 40 \cos 35 - F_{10 \text{ kg}} - 16,60 + F_{40 \text{ kg}} + 20 - 2,5 \quad \checkmark \\
 a &= 0,67 \text{ m} \cdot \text{s}^{-2} \quad \checkmark
 \end{aligned}
 \tag{5}$$

$$2.2.7 \quad \text{Increase/Neem toe} \quad \checkmark \checkmark \tag{2}$$

$$2.3 \quad 2.3.1 \quad 50 \text{ N} \quad \checkmark \text{ to the left/na links} \quad \checkmark \tag{2}$$

2.3.2 John's mass is greater than Mary's mass.  
 Therefore, John's inertia is greater than Mary's inertia.  $\checkmark$   
 John's force on Mary is equal to Mary's force on John.  $\checkmark$   
 Therefore, John's acceleration is less than Mary's acceleration.  $\checkmark$

*John se massa is groter as Mary se massa.*  
*Dus is John se traagheid groter as Mary se traagheid.*  $\checkmark$   
*John se krag op Mary is gelyk aan die krag van Mary op John.*  $\checkmark$   
*Dus is die versnelling van John minder as die versnelling van Mary.*  $\checkmark$  (3)

**[35]**

## QUESTION/VRAAG 3

- 3.1 3.1.1 The product of the net force acting on an object ✓ and the time the force acts on the object. / ✓  
*Die produk van die netto krag wat op 'n voorwerp inwerk ✓ en die tyd wat die krag op die voorwerp uitoefen. ✓* (2)

3.1.2 **OPTION 1 Away from batsman / OPSIE 1 Weg van die kolwer**

$$\begin{aligned}\Delta p &= m v_f - v_i \checkmark \\ &= (0,175) (-30 - 12) \checkmark \\ &= -7,35 \text{ N} \cdot \text{s} \checkmark \\ &= 7,35 \text{ N} \cdot \text{s} \checkmark \text{ away from the batsman/weg van die kolwer} \checkmark\end{aligned}$$

**OPTION 2 Towards the batsman / OPSIE 2 Na die kolwer**

$$\begin{aligned}\Delta p &= m v_f - v_i \checkmark \\ &= (0,175) (30 - (-12)) \checkmark \\ &= 7,35 \text{ N} \cdot \text{s} \checkmark \\ &= 7,35 \text{ N} \cdot \text{s} \checkmark \text{ away from the batsman/weg van die kolwer} \checkmark\end{aligned}$$
 (5)

3.1.3 **POSITIVE MARKING FROM 3.1.2/POSITIEWE MERK VAN 3.1.2**

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

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

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

OR /OF

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

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

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

- 3.1.4  $F_{\text{net}} \propto \frac{1}{\Delta t}$  ✓ if  $\Delta p$  is constant ✓  
 crumple zones increase the time ✓  
 $F_{\text{net}}$  decreases. ✓

$$\begin{aligned}F_{\text{net}} &\propto \frac{1}{\Delta t} \checkmark \text{ as } \Delta p \text{ konstant is.} \checkmark \\ \text{Frommelsones veroorsaak } &\underline{\text{toename in tyd}} \checkmark \\ F_{\text{net}} &\underline{\text{neem af.}} \checkmark\end{aligned}$$
 (4)

- 3.2 3.2.1 The total linear momentum of an isolated system ✓ remains constant (in magnitude and direction). ✓

*Die totale lineêre momentum van 'n geïsoleerde sisteem ✓ bly konstant (in grootte en rigting). ✓* (2)

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

$$\sum p_{before} = \sum p_{after} \checkmark$$

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

$$(2)(3) + (3,5)(0) \checkmark = (2)(-1) + 3,5v \checkmark$$

$$v = 2,29 \text{ m} \cdot \text{s}^{-1} \checkmark$$

$$v = 2,29 \text{ m} \cdot \text{s}^{-1}; \text{right/regs} \checkmark$$

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

$$\sum p_{before} = \sum p_{after} \checkmark$$

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

$$(2)(-3) + (3,5)(0) \checkmark = (2)(1) + 3,5v \checkmark$$

$$v = -2,29 \text{ m} \cdot \text{s}^{-1} \checkmark$$

$$v = 2,29 \text{ m} \cdot \text{s}^{-1}; \text{right/regs} \checkmark$$

(5)  
[21]

**QUESTION/ VRAAG 4**

- 4.1 4.1.1 The product of the force applied on an object ✓ and the displacement in the direction of the force. ✓

*Die produk van die krag wat op 'n voorwerp toegepas word ✓ en die verplasing in die rigting van die krag. ✓* (2)

$$\begin{aligned} 4.1.2 \quad W_F &= F \Delta x \cos \theta \quad \checkmark \\ &= (50) \checkmark (10) \cos 0^\circ \quad \checkmark \\ &= 500 \text{ J} \quad \checkmark \end{aligned} \quad (4)$$

$$\begin{aligned} 4.1.3 \quad W_f &= f \Delta x \cos \theta \\ &= (20) \checkmark (10) \cos 180^\circ \quad \checkmark \\ &= -200 \text{ J} \quad \checkmark \end{aligned} \quad (3)$$

- 4.1.4 **POSITIVE MARKING FROM 4.1.2 TO 4.1.3 FOR OPTION 1**  
**POSITIEWE MERK VAN VRAAG 4.1.2 NA 4.1.3 VIR OPSIE 1**

**OPTION/OPSIE 1**

$$\begin{aligned} W_{net} &= W_F + W_f \\ &= 500 \checkmark + (-200) \checkmark \\ &= 300 \text{ J} \quad \checkmark \end{aligned}$$

**OPTION/OPSIE 2**

$$\begin{aligned} F_{net} &= 50 - 20 = 30 \text{ N} \\ W_{net} &= F_{net} \Delta x \cos \theta \\ &= (30) \checkmark (10) \cos 0^\circ \quad \checkmark \\ &= 300 \text{ J} \quad \checkmark \end{aligned} \quad (3)$$



4.2 4.2.1



| Acceptable labels<br><i>Aanvaarbare byskrifte</i>                                 | MARK<br>PUNT |
|-----------------------------------------------------------------------------------|--------------|
| $F_g/F_w$ /weight/gravitational force<br>$F_g/F_w$ /gewig/gravitasiekrag          | ✓            |
| $F_T$ /tension/ force of rope on engine<br>$F_T$ /spanning/ krag van tou op enjin | ✓            |

**Notes/Notas**

- ✓ One mark awarded for label and arrow.
- ✓ *Een punt toegeken vir byskrif en pylpunt*

- Do not penalise for length of arrows.
- *Moet nie penaliseer vir die lengte van die pyle nie*

- Any additional forces: Max -1
- *Enige addisionele kragte: Maks -1*

(2)

$$\begin{aligned}
 4.2.2 \quad P_{ave} &= F_{ave} v \quad \checkmark \\
 P_{ave} &= mgv \\
 7350 \quad \checkmark &= (1\,500)(9,8)v \quad \checkmark \\
 v &= 0,5 \, m \, s^{-1} \quad \checkmark
 \end{aligned}$$

(4)

$$\begin{aligned}
 4.2.3 \quad W_F &= F \Delta x \cos \theta \quad \checkmark \\
 W_F &= (1\,500)(9,8) \quad \checkmark \cos 0^\circ \quad \checkmark \\
 W_F &= 7350 \, J \quad \checkmark
 \end{aligned}$$

(3)

$$\begin{aligned}
 4.2.4 \quad E_p &= mgh \quad \checkmark \\
 E_p &= (1\,500)(9,8)(0,5) \quad \checkmark \\
 E_p &= 7\,350 \, J \quad \checkmark
 \end{aligned}$$

(3)

**[24]**

**QUESTION/VRAAG 5**

- 5.1 Within the limit of elasticity, stress is directly proportional to strain ✓✓/  
*Binne die grense van elasticiteit is druk eweredig aan rekking ✓✓* (2)

5.2 5.2.1  $\delta = \frac{F}{A}$  ✓

$$\delta = \frac{3\,500}{5 \times 10^{-5}} \checkmark$$

$$\delta = 7 \times 10^7 \text{ Pa } \checkmark \quad (3)$$

5.2.2  $\varepsilon = \frac{\Delta l}{L}$  ✓

$$\varepsilon = \frac{12}{3\,350} \checkmark$$

$$\varepsilon = 3,582 \times 10^{-3} \checkmark \quad (3)$$

- 5.2.3 **POSITIVE MARKING FROM /POSITIEWE MERK VAN 5.2.1 and/en 5.2.2**

$$K = \frac{\sigma}{\varepsilon} \checkmark$$

$$K = \frac{7 \times 10^7}{3,582 \times 10^{-3}} \checkmark$$

$$K = 1,95 \times 10^{10} \text{ Pa } \checkmark \quad (3)$$

- 5.3 Clay, putty, wax, bread dough (any TWO) ✓✓/  
*Klei, putty, was, brooddeeg (Enige TWEE)* (2)  
**[13]**



## QUESTION/VRAAG 6

6.1 6.1.1 It is the thrust acting on the unit area around that point. ✓✓/  
*Dit is die stukrag op die eenheidsoppervlakte rondom daardie punt ✓✓* (2)

6.1.2  $P = \frac{F}{A}$  ✓

$$P = \frac{(250)(9,8)}{(3,15 \times 10^4)(10)^6}$$
 ✓

$$P = 7,78 \times 10^4 \text{ Pa}$$
 ✓ (4)

6.2 6.2.1  $P = \rho gh$  ✓

$$P = (1\,000)(9,8) \quad (2,5 - 0,9)$$
 ✓

$$P = 1,57 \times 10^4 \text{ Pa}$$
 ✓ (4)

6.2.2 Less Than / *Minder as* ✓  
 From/Van  $P = h$  ✓

$P \propto \rho$  ✓ if  $g$  and  $h$  are constant/*Indien  $g$  en  $h$  konstant is*

$$\rho_{\text{petrol}} < \rho_{\text{water}}$$
 ✓ (4)

6.3 6.3.1 In a continuous liquid at equilibrium, the pressure applied at a point ✓  
 is transmitted equally to the other parts of the liquid. ✓  
*In 'n kontinue vloeistof by ewewig is die druk wat by enige punt toegepas word ✓ eweredig na die ander dele van die vloeistof versprei. ✓* (2)

6.3.2  $\frac{F_1}{A_1} = \frac{F_2}{A_2}$  ✓

$$\frac{F_1}{200 \times 10^{-4}} \quad \checkmark = \frac{250}{5 \times 10^{-4}} \quad \checkmark$$

$$F_1 = 10\,000 \text{ N}$$
 ✓ (4)

6.3.3 Liquid adapts to the form of the container.  
 Liquid is not compressible.  
 Liquid applies pressure in all directions. } (Any TWO ✓✓)  
*'n Vloeistof pas by die vorm van die houer aan.*  
*'n Vloeistof kan nie saamgepers word nie.*  
*'n Vloeistof pas druk uit in alle rigtings.* } (Enige TWEE ✓✓) (2)

[22]



**QUESTION/VRAAG 7**

7.1 The bending of light when it passes from one medium to another. ✓✓/  
*Die buiging van lig wanneer dit van een medium na 'n ander beweeg.* ✓✓ (2)

7.2 7.2.1 Incident ray/*Invalsstraal* ✓ (1)

7.2.2 Normal/*Normaal* ✓ (1)

7.3 The angle of incidence in the denser medium ✓ such that the refracted ray just passes through the surface of separation of the two mediums. ✓

**OR**

The angle of incidence in the optically dense medium ✓ for which the angle of refraction is  $90^\circ$ . ✓

*Die invalshoek in die digter medium* ✓ sodat die *gebreekte straal net deur die oppervlakte van skeiding van die twee mediums beweeg.* ✓

**OF**

*Die invalshoek in die opties digte medium* ✓ waarvoor *die brekingshoek  $90^\circ$  is.* ✓ (2)

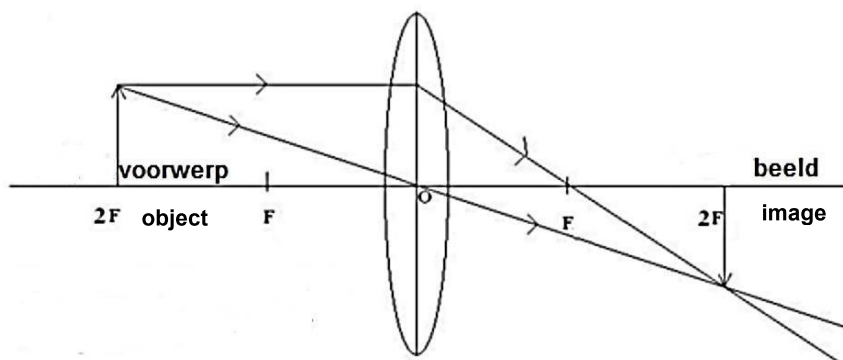
7.4 Total Internal Reflection/*Totale Interne Weerkaatsing* ✓ (1)

7.5 GREATER THAN / *GROTER AS* ✓ (1)

7.6 The ray moves from a more dense to a less dense medium ✓ and will therefore be refracted away from the normal ✓ which will increase the angle.

*Die straal beweeg van 'n digter medium na 'n minder digter medium* ✓ en sal dus *weg van die normaal* ✓ gebuig word en die hoek sal dus vergroot. (2)

7.7

**Marking guidelines/Nasiemriglyne**

- Object at  $2F$  / *Voorwerp by  $2F$*  ✓
- Image at  $2F$  / *Beeld by  $2F$*  ✓
- Ray goes through optic centre / *Straal gaan deur optiese middelpunt* ✓
- Ray parallel with main axis / *Straal parallel aan die hoof-as* ✓
- Image the same size as object / *Beeld net so groot soos die voorwerp* ✓ (5)

**[15]****TOTAL/TOTAAL: 150**