**NATIONAL
SENIOR CERTIFICATE/**
*NASIONALE
SENIOR SERTIFIKAAT*

GRADE/*GRAAD* 12

SEPTEMBER 2021

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

MARKS/*PUNTE*: 150

QUESTION/*VRAAG* 1

1.1 D ✓✓ (2)

1.2 D ✓✓ (2)

1.3 A ✓✓ (2)

1.4 B ✓✓ (2)

1.5 C ✓✓ (2)

1.6 A ✓✓ (2)

1.7 C ✓✓ (2)

1.8 A ✓✓ (2)

1.9 A ✓✓ (2)

1.10 C ✓✓ (2)

[20]

QUESTION/*VRAAG 2*

2.1   F ✓ Net force / *Netto krag*

2.2   A ✓ Impulse / *Impuls*

2.3   G ✓ Stress / *Druk*

2.4   B ✓ Thrust / *Stukrag*

2.5   C ✓ Optic axis / *Optiese-as*

2.6   I ✓ Electric motor / *Elektriese motor*

2.7   E ✓ Tension / *Spanning*

2.8   D ✓ Capacitor / *Kapasitor*   (8 x 1)   **[8]**

QUESTION/*VRAAG 3*

3.1

	Action force / Aksie krag	**Reaction force / Reaksie krag**	
3.1.1	Weight of the boy *Gewig van seun*	Force of boy on the earth *Krag van die seun op die aarde* ✓	(1)
3.1.2	Normal force of ground on the trolley *Normaalkrag van die grond op die trollie*	Force of the trolley on the ground. *Krag van die trollie op die grond.* ✓	(1)

3.2   West / *Weswaarts* ✓   (1)

3.3   When object **A** exerts a force on object **B**, object **B** simultaneously exerts an
         oppositely directed force of equal magnitude on object **A**. ✓✓
         *Indien voorwerp **A** 'n krag op voorwerp **B** uitoefen, sal voorwerp **B** gelyktydig*
         *dieselfde grootte krag in die teenoorgestelde rigting op voorwerp **A***
         uitoefen. ✓✓   (2)
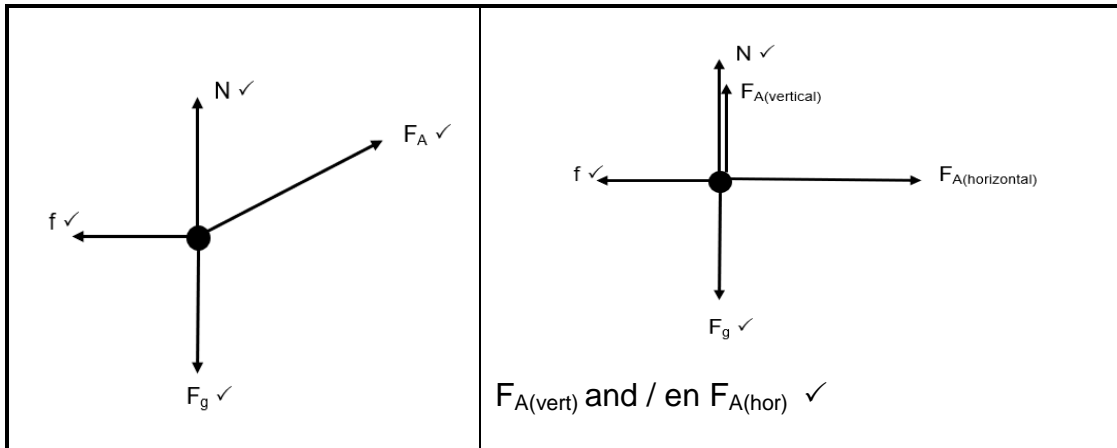   **[5]**

QUESTION/*VRAAG* **4**

4.1 When a non-zero <u>resultant force acts</u> on an object, the object <u>accelerates in the direction of the resultant force</u>. This <u>acceleration is</u> <u>directly proportional to the resultant force</u> and <u>inversely proportional to the mass of the object</u>. ✓✓

Indien 'n nie-nul <u>resulterende krag toegepas</u> word op 'n voorwerp met massa (m), <u>versnel die voorwerp in die rigting van die krag</u>. Hierdie <u>versnelling is direk eweredig aan die resulterende krag</u> en <u>omgekeerde eweredig aan die massa van die voorwerp.</u> ✓✓ (2)

4.2

$F_{A(vert)}$ and / en $F_{A(hor)}$ ✓ (4)

4.3
$f_k = \mu_k N$ ✓ $\qquad$ $F_g = N + F_v$
$f_k = (0,2)(473,28)$ ✓ $\qquad$ $(60)(9,8) = N + 200 \sin 35°$
$f_k = 94,66$ N ✓ $\qquad$ $N = 473,28$ N ✓ (4)

4.4
$F_{net} = ma$ ✓
$F_{A(hor)} + f_k = ma$
$(200 \cos 35^0) + (-94,66) = (60)(a)$ ✓
$a = 1,15$ m.s^{-2} ✓ (3)

4.5 Decreases ✓
$F_{horizontal}$ of 200 N and f_k decrease as the angle increases.
Decrease in $F_{horizontal}$ is greater than decrease in f_k. ✓
∴ F_{net} decreases.
$F_{net} \propto a$ ✓
Neem af ✓
F_{hor} van 200 N en f_k neem af soos hoek groter word.
Afname in F_{hor} is groter as afname in f_k. ✓
∴ F_{net} neem af
$F_{net} \propto a$ ✓ (3)

[16]

QUESTION/*VRAAG* 5

5.1   5.1.1   Yes / *Ja* ✓   (1)

       5.1.2 $p_i = mv = 20\,000$ kg.m.s^{-1}
$K = \frac{1}{2}mv^2 = 200\,000$ J
     $\frac{1}{2}(mv)v = 200\,000$ ✓
     $\frac{1}{2}(20\,000)\,v = 200\,000$
           $v = 20$ m.s^{-1} ✓ due east/ooswaarts ✓   (4)

       5.1.3   **Mark positive from Ques 5.1.2**
            Merk positief van Vraag 5.1.2

OPTION/*OPSIE* 1	OPTION/*OPSIE* 2	OPTION/*OPSIE* 3
$K = \frac{1}{2}mv^2$ $200\,000 = \frac{1}{2}\,m\,20^2$ ✓ $m = 1\,000$ kg ✓	$p = mv$ $20\,000 = m\,(20)$ ✓ $m = 1\,000$ kg ✓	$\frac{1}{2}mv^2 = 200\,000 \ldots$ $mv = 20\,000$ $v = \frac{2\,000}{m}$ $\frac{1}{2}m(\frac{2000}{m})^2 = 200\,000$ ✓ $m = 1\,000$ kg ✓

                                                                   (2)

5.2   5.2.1   Total linear momentum of an isolated system remains constant. ✓✓
            Totale lineêre momentum van 'n geïsoleerde sisteem bly konstant.   (2)

       5.2.2   **Right – Positive / *Regs – Positief***
           $\Sigma\,p_i = \Sigma\,p_f$ Any one / *Enige een* ✓
           $\Sigma\,p_i = (m_P + m_R)v_f + m_Q v_f$
           0 ✓ $= (6)(2)$ ✓ $+(3 + 2)\,(v)$
           $v = 2,4$ m.s^{-1} left / *links* ✓   (4)
                                                                 [13]

QUESTION/*VRAAG 6*

6.1   6.1.1   Rate of transfer of energy / Rate at which work is done. ✓✓
                  Tempo waarteen energie omgesit word. /Tempo waarteen arbeid
                  verrig word. ✓✓   (2)

        6.1.2   P = Fv ✓
                  P = (300)(0,5) ✓
                  P = 150 W ✓   (3)

        6.1.3

OPTION/*OPSIE* **1**	**OPTION/***OPSIE* **2**
$P = \frac{W}{\Delta t}$ ✓	$\Delta x = v\,\Delta t = (0,5)(50) = 25$ m ✓
$150 = \frac{W}{50}$ ✓	$W = F\,\Delta x\cos\theta$
	$W = (300)(25)(1)$ ✓
W = 7 500 J ✓	W = 7 500 J ✓

                                                                                                        (3)

        6.1.4   7500 J ✓
                  Crate moves with constant velocity ✓
                  Krat beweeg met 'n konstante snelheid ✓   (2)

6.2   6.2.1   Total mechanical energy of an isolated system remains
                  constant. ✓✓
                  Totale meganiese energie van 'n geïsoleerde sisteem bly konstant.
                  ✓✓   (2)

        6.2.2 $(ME)_A = (ME)_B$
                  $(U + K)_A = (U+K)_B$ ⎤
                  $(mgh + \frac{1}{2}mv^2)_A = (mgh + \frac{1}{2}mv^2)_B$ ⎦   Any one / *Enige een* ✓
                  $(2)(9,8)(10) + 0 = 0 + \frac{1}{2}(2)(v)^2$ ✓✓
                  $v = 14$ m.s^{-1} ✓   (4)

        6.2.3 $(ME)_A = (ME)_C$
                  $(U + K)_A = (U+K)_B$ ⎤   Any one / *Enige een* ✓
                  $(mgh + \frac{1}{2}mv^2)_A = (mgh + \frac{1}{2}mv^2)_C$ ⎦
                  $(2)(9,8)(10) + 0 = (2)(9,8)(h)$ ✓ $+ \frac{1}{2}(2)(7)^2$ ✓
                  $h = 7,5$ m ✓   (4)

                                                                                                      [20]

QUESTION/*VRAAG* 7

7.1   7.1.1   Hooke's law states that, <u>within the limit of elasticity</u>, <u>stress is directly proportional to the strain</u>. ✓✓
Hooke se wet sê dat <u>binne die grense van elastisiteit, druk eweredig aan die rekking is</u>.   (2)

7.1.2 $\sigma = \dfrac{F}{A}$ ✓

$\sigma = \dfrac{500}{0,01}$ ✓

σ = 50000 Pa ✓   (3)

7.1.3 $K = \dfrac{\sigma}{\varepsilon}$ ✓

$200 \times 10^9 = \dfrac{50000}{\varepsilon}$ ✓

$\varepsilon = 2,5 \times 10^{-7}$ ✓

$\varepsilon = \dfrac{\Delta l}{L}$ ✓

$2,5 \times 10^{-7} = \dfrac{\Delta l}{0,9}$ ✓

$\Delta l = 2,25 \times 10^{-7}$ m ✓   (6)

7.1.4   Decreases / *Neem af* ✓   (1)

7.2   As the temperature increases the viscosity decreases. ✓✓/
Soos die temperatuur toeneem, neem die viskositeit af. ✓✓   (2)

7.3   7.3.1 $\dfrac{F_1}{A_1} = \dfrac{F_2}{A_2}$ ✓

$\dfrac{F_1}{0,04} = \dfrac{1200 \times 9,8}{0,7}$ ✓✓

F_1 = 672 N ✓   (4)

7.3.2   Hydraulic brakes / car lifts / hydraulic jacks / forklifts / dentist chairs (ANY TWO) ✓✓
Hidroliese remme / motorhysers / vurkhyser / tandarts-stoele (ENIGE TWEE) ✓✓   (2)

[20]

QUESTION/*VRAAG* 8

8.1   8.1.1   Same as the object / *Dieselfde as die voorwerp* ✓   (1)

       8.1.2   50 + 50 = 100 cm ✓✓   (2)

8.2   8.2.1   48,8$^{°}$ ✓   (1)

       8.2.2   The ray will be totally reflected on the water. ✓✓
               Die straal sal heeltemal op die water weerkaats word. ✓✓   (2)

       8.2.3   Total internal reflection/*Totale interne weerkaatsing* ✓   (1)

8.3   8.3.1   24 cm away on the other side of the lens ✓/
               24 cm weg op die ander kant van die lens ✓   (1)

       8.3.2   20 mm ✓   (1)

       8.3.3   Real / *Reëel* ✓   (1)

       8.3.4   Cameras / projectors / spectacles / lighthouse / telescope /
             microscope
             (ANY ONE) ✓
             Kameras / projektors / brille / lighuis / teleskoop / mikroskoop
             (ENIGE EEN) ✓   (1)

                                                       [11]

QUESTION/*VRAAG* **9**

9.1   9.1.1   Gamma rays/*Gamma-strale* ✓   (1)

       9.1.2   To sterilise medical equipment/treatment of cancer/Detection of radioactive tracers (ANY ONE) ✓
Om mediese apparat se steriliseer/behandeling van kanker/Opsporing van radioaktiwiteit (ENIGE EEN) ✓   (1)

9.2   9.2.1   Wave packets/quantum packets are called photons. ✓✓
Pakkies liggolwe/deeltjies word fotone genoem. ✓✓   (2)

9.2.2

OPTION/*OPSIE* **1**	**OPTION/***OPSIE* **2**
$c = f\lambda$ ✓ $3 \times 10^8 = f(1 \times 10^{-10})$ ✓ $f = 3 \times 10^{18}$ Hz ✓ $E = hf$ $E = (6,63 \times 10^{-34})(3 \times 10^{18})$ ✓ $E = 1,99 \times 10^{-15}$ J ✓	$E = \dfrac{hc}{\lambda}$ ✓ $E = \dfrac{6,63 \times 10^{-34} \times 3 \times 10^8}{1 \times 10^{-10}}$ ✓✓✓ $E = 1,99 \times 10^{-15}$ J ✓

                                                                       (5)

                                                                             [9]

QUESTION/*VRAAG* 10

10.1   10.1.1   A capacitor is a device for storing electrical charge. ✓✓/
             'n Kapasitor is 'n toestel wat elektriese lading stoor. ✓✓   (2)

       10.1.2

$$C = \frac{\varepsilon_o A}{d}$$

$$480 \times 10^{-9} = \frac{8,85 \times 10^{-12} \times A}{0,012 \times 10^{-3}}$$

$$A = 0,65 \text{ m}^2 \checkmark$$ (3)

       10.1.3   Decreases / *Neem af* ✓   (1)

10.2   10.2.1 $R_s = 3 + 6 = 9 \ \Omega$ ✓

$$\frac{1}{R//} = \frac{1}{R1} + \frac{1}{R2} \qquad\qquad \textbf{OR/OF} \quad R// = R_1R_2/R_1+R_2$$

$$\frac{1}{R//} = \frac{1}{9} + \frac{1}{9} \checkmark \qquad\qquad\qquad\qquad = \ 9 \times 9/(9+9)$$

$$R_{//} = 4,5 \ \Omega \checkmark \qquad\qquad\qquad\qquad\quad = 4,5 \ \Omega \qquad (3)$$

       10.2.2

$$W = \frac{V^2}{R} t \checkmark$$

$$W = \frac{24^2}{4,5} \times 120 \checkmark$$

$$W = 15\ 360 \text{ J} \checkmark$$ (3)

[12]

QUESTION/*VRAAG* 11

11.1   11.1.1   The process of generating electricity from motion. ✓✓/
             Die proses waarby elektrisiteit deur beweging opgewek word. ✓✓   (2)

       11.1.2   Galvanometer needle deflects. ✓
             Galvanometer se naald wyk af. ✓   (1)

       11.1.3   No deflection ✓/*Geen afwyking*
             A current is induced only when there is a relative motion. ✓
             'n Stroom word slegs geïnduseer indien daar 'n relatiewe beweging
             is. ✓   (2)

11.2 $\varepsilon = - N\frac{\Delta\phi}{\Delta t}$ ✓

$$\varepsilon = (2)\frac{(50-38)}{0,42} \checkmark$$

$$\varepsilon = 57,14 \text{ V} \checkmark$$ (3)

[8]

QUESTION/*VRAAG* 12

12.1 12.1.1 $\dfrac{V_s}{V_p} = \dfrac{N_s}{N_p}$ ✓

$\dfrac{9}{230} = \dfrac{N_s}{400}$ ✓

$N_s = 15{,}65 \approx 16$ ✓ (3)

12.1.2 Step down / *Verlagings* ✓ (1)

12.2 12.2.1 Electromagnetic induction / Faradays law ✓
Elektromagnetiese induksie / Faraday se wet ✓ (1)

12.2.2 Brush / *Borsel* ✓ (1)

12.2.3 Slip rings / *Sleepringe* ✓ (1)

12.2.4 Replace slip rings with a split ring commutator. ✓
Vervang sleepringe met 'n splitring kommutator. ✓ (1)

[8]

TOTAL/*TOTAAL***: 150**