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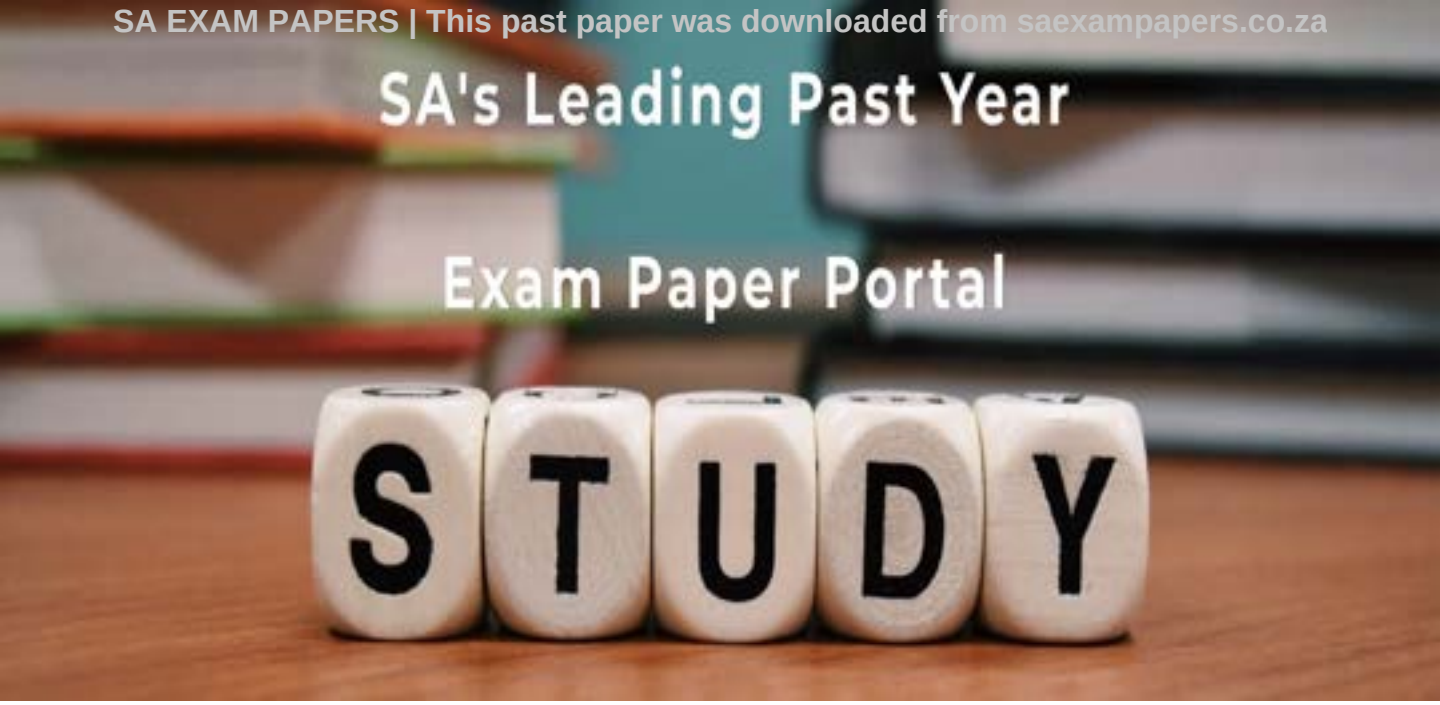

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GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

JUNE EXAMINATION
JUNIE EKSAMEN
GRADE/*GRAAD* 12

2024

MARKING GUIDELINES/*NASIENRIGLYNE*

TECHNICAL SCIENCES/
TEGNIESE WETENSKAPPE

(PAPER/*VRAESTEL* 1)

13 pages/*bladsye*

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QUESTION/*VRAAG* 1

1.1 B ✓✓

1.2 C ✓✓

1.3 A ✓✓

1.4 A ✓✓

1.5 B ✓✓

1.6 D ✓✓

1.7 B ✓✓

1.8 D ✓✓

1.9 D ✓✓

1.10 B ✓✓ (20)

QUESTION/*VRAAG* 2

2.1 D ✓
2.2 A ✓
2.3 B ✓
2.4 E ✓
2.5 C ✓ (5)

QUESTION/*VRAAG* 3

3.1 3.1.1 Inertia/*Traagheid* ✓

3.1.2 Inertia is directly proportional to the mass ✓✓
OR
An increase in mass increases the inertia of an object ✓✓

Traagheid is direk eweredig aan die massa ✓✓
OF
'n Toename in massa verhoog die traagheid van 'n voorwerp ✓✓

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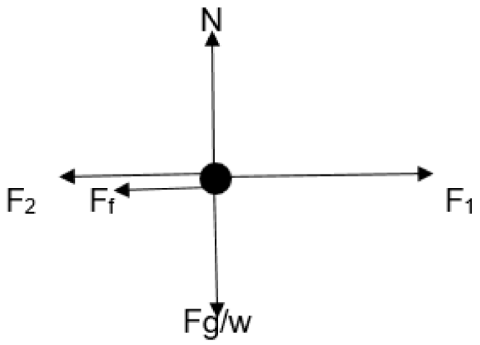
3.1.3 The person and the bus were both at rest. ✓The bus moving acts as a net/resultant force ✓ pulling the feet which are in contact with it forward, while the upper body wants to remain at rest. Causing the person to fall backward. ✓
Die persoon en die bus was albei in rus. ✓ Die bus wat beweeg dien as 'n netto/resultante krag ✓ dit trek die voete wat daarmee in aanraking is vorentoe, terwyl die bolyf in rus wil bly. Die beweging laat die persoon agteroor val. ✓ (3)

3.2 3.2.1 When a net/resultant force is applied to an object of mass, m, it accelerates the object in the direction of the net force. The acceleration is directly proportional to the net/resultant force and inversely proportional to the mass of the object. ✓✓

Wanneer 'n netto/resultante krag op 'n voorwerp met massa, m, toegepas word, versnel dit die voorwerp in die rigting van die netto krag. Die versnelling is direk eweredig aan die netto/resultante krag en omgekeerd eweredig aan die massa van die voorwerp. ✓✓

(2)

3.2.2



(5)

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	Accepted labels/*Aanvaarde byskrifte* (1 mark per label)
F_g	w/F_w/$F_{Earth\ on\ block/aarde\ op\ die\ blok/}$weight/*Gewig/*mg/78.4N/gravitational force/ *gravitasiekrag*
F_1	F_A/$F_{Applied/toegepas/}$F
F_2	F_A/$F_{Applied/toegepaste\ krag/}$15N
F_f	f/f_k/(kinetic)friction (*kinetiese) wrywing*
N	F_N/Normal force *Normale krag*/$F_{Normal/normaal}$
	<u>Notes/*Aantekeninge*</u> Mark awarded for labels and arrows. Do not penalise for length of arrows since drawing is NOT to scale, but F_2 must be larger than F_f. Penalise by a mark for each additional force. If everything is correct, but no arrows OR if force(s) do not make contact with the dot: Max 4/5. If force diagram is drawn instead of free-body diadram: Max 0/5. *Punt toegeken vir byskrifte en pyle.* *Moenie penaliseer vir lengte van pyle nie, aangesien tekening volgens skaal is nie, maar F_2 moet groter wees as F_f.* *Penaliseer met 'n punt vir elke bykomende krag.* *As alles korrek is, maar geen pyle nie OF as krag(te) nie kontak maak met die kolletjie nie: Maks 4/5.* *As kragdiagram in plaas van vryliggaam-diadrama geteken word: Maks 0/5.*

3.2.3 0 N ✓ (1)

3.2.4 N = mg
N = 8 x 9,8 ✓
N = 78,4 N ✓
+ ve
$f_k = \mu_k N$ ✓
f_k = 0,3 ✓ x 78,4
f_k = 23,52 N ✓ (to the left) (5)

3.2.5 **+ve**
$F_{net/netto}$ = ma ✓
$F_1 + (-F_2) + (-F_f)$ = ma
F_1 –15 – 23,52 = 0 ✓
F_1 = 38,52N to the right ✓ *Rigting van beweging* (3)

3.2.6 DECREASES ✓/*NEEM AF* (1)

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QUESTION/*VRAAG* 4

4.1 The total linear momentum of an isolated system remains constant (is conserved) in magnitude and direction. ✓✓

OR/*OF*

The total linear momentum before collision in an isolated system remains the same as the total momentum after collision. ✓✓

Die totale lineêre momentum in 'n geïsoleerde sisteem bly konstant in grootte en rigting. ✓✓

OR/*OF*

Die totale lineêre momentum voor botsing in 'n geïsoleerde sisteem bly dieselfde as die totale momentum na botsing. ✓✓ (2)

4.2 **OPTION/*OPSIE* 1 <u>Take east as positive(+) *Neem oos as positief*</u>**

Total momentum before = Total momentum after
Totale momentum voor = Totale momentum na

$\Sigma p_x = \Sigma p_y$
$M_x v_{ix} + m_y v_{iy} = (m_x + m_y)\, v_f$ } ✓

$(m)(-25) + (m)(10)$ ✓ $= (2\ m)\ v_f$ ✓

$v_f = -7.5\ m \cdot s^{-1}$

$v_f = 7.5\ m \cdot s^{-1}$ west/*wes* ✓ (–1 if no units, no direction/*–1 vir geen eenhede of rigting nie*)

OPTION/*OPSIE* 2 <u>Take west as positive(+) *Neem wes as positief*</u>

Total Momentum before = Total momentum after
Totale momentum voor = Totale momentum na

$\Sigma p_x = \Sigma p_y$
$m_x v_{ix} + m_y v_{iy} = (m_x + m_y)\, v_f$ } ✓

$(m)(25) + (m)(-10)$ ✓ $= (2\ m) v_f$ ✓

$v_f = 7{,}5\ m \cdot s^{-1}$ west/*wes* ✓ (4)

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4.3 An inelastic collision is one on which the **total momentum is conserved** ✓and the **total kinetic energy is not conserved**. ✓

'n Onelastiese botsing is een waar die totale momentum behoue bly ✓en die totale kinetiese energie nie bewaar word nie. ✓ (2)

4.4 4.4.1 The product of the net force acting on an object and the time the net force acts on the object. ✓✓

Die produk van die netto krag wat op 'n voorwerp inwerk en die tyd wat die netto krag op die voorwerp inwerk.✓✓ (2)

4.4.2 60/3,6 = 16,67 $m \cdot s^{-1}$

$F_{net}\Delta t = \Delta p = m(v_f - v_i)$ ✓
$\underline{F_{net}(0,03)}$ ✓ = 5 000✓ (0 – 16,67) ✓
F_{net} = -2 778 333,33N
F_{net} = **2 778 333,33N** (2778.33KN) ✓opposite direction of motion✓ *in die teenoorgestelde rigting van beweging* (6)

4.4.3 **2 778 333,33N** (2778.33 KN) direction of motion ✓ *rigting van beweging*

4.4.4 Newton's third law of motion ✓. When object A exerts a force on object B, object B simultaneously exerts an oppositely directed force of equal magnitude on object A. ✓✓
Newton se derde bewegingswet ✓. Wanneer voorwerp A 'n krag op voorwerp B uitoefen, oefen voorwerp B gelyktydig 'n teenoorgestelde gerigte krag van gelyke grootte op voorwerp A uit. ✓✓ (3)

4.4.5 Arrestor beds increase the friction between the sand and the tires, ✓ increasing the time it takes ✓ for the truck to come to a stop. This reduces the net force on the truck, making it safer for trucks. ✓

Sagte sandbanke (afritte) verhoog die wrywing tussen die sand en die bande, ✓*wat die tyd wat dit neem verleng* ✓*vir die trok om tot stilstand te kom. Dit verminder die netto krag op die vragmotor, wat dit veiliger maak vir vragmotors.* ✓ (3)

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QUESTION/*VRAAG* 5

5.1 Refraction is the bending of light when it pases from one medium to another✓✓

Refraksie is die verandering in rigting van n golf wanneer dit die vlak tussen twee materiale tref. ✓✓ (2)

5.2 5.2.1
1. incident ray/*invallende straal* ✓
2. refracted ray/*gebroke straal* ✓
3. emergent ray/*uitvallende straal* ✓ (3)

5.2.2 Θ_1: angle of incidence/ *invalshoek* ✓
Θ_2: angle of refraction/*brekingshoek* ✓
Θ_4: angle of emergence/*uitvalshoek* ✓ (3)

5.2.3 $\Theta_1 = \Theta_4$ ✓ **(Equal /Gelyk)** (1)

5.3 5.3.1 Dispersion/*Dispersie* ✓

Physical phenomenon in which (**white) light (splits)breaks into its component colors** ✓ ✓
*Fisiese verskynsel**waarin (wit) lig in sy samestellende kleure verdeel*** ✓ *wanneer dit deur 'n **driehoekige glasprisma** beweeg.* ✓ (3)

5.3.2 **Violet light has a shorter wavelength** ✓ compared to red light, therefore violet light rays are **refracted more than the red light rays.** ✓

OR

Red light has longer wavelength ✓ compared to violet light, therefore red light rays are **refracted less than the violet light rays.** ✓
Violet (ligpers) lig het 'n korter golflengte ✓*in vergelyking met rooi lig, daarom word violetligstrale meer gebreek as die rooi ligstrale.* ✓

OF

Rooi lig het langer golflengte ✓*in vergelyking met violet lig, daarom word rooi ligstrale minder gebreek as die violet ligstrale.* ✓ (2)

5.4 Electromagnetic radiation has a **wave nature** ✓ and
A **particle nature** ✓ OR

Electromagnetic radiation is propagated **in the form of transverse** ✓ waves in small **energy packages called photons.** ✓
(Accept the dual nature and move at a constant speed in a particular medium)

*Elektromagnetiese straling het 'n **golfgeaardheid** ✓en 'n **deeltjie-aard** ✓ OF*

*Elektromagnetiese straling word in **die vorm van transversale golwe*** (2)

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voortgeplant ✓ *in* ***klein energiepakkette wat fotone*** *genoem word.* ✓

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QUESTION/*VRAAG* 6

6.1 The maximum force that can be applied to the body so that the body regains its original form completely upon removal of the force. ✓✓

Die maksimum krag wat op die liggaam toegepas kan word sodat die liggaam sy oorspronklike vorm heeltemal herwin indien die krag verwyder word. (2)

6.2 $A = S^2$

$= (54{,}78 \times 10^{-3})^2$ ✓

$= 3 \times 10^{-3}$ ✓

$\sigma = \frac{F}{A}$ ✓ +ve

$= 4 \times 10^4 / 3 \times 10^{-3}$ ✓

$= 1{,}33 \times 10^7$ Pa ✓

AFRIKAANS ONLY: $\sigma = \frac{F}{A}$ ✓

$= 4 \times 10^4$ ✓$/ 54{,}78 \times 10^{-3}$ ✓✓

$= 730193{,}50$ N.m^{-2} ✓ (5)

6.3 $K = \frac{\sigma}{\varepsilon}$ ✓ +ve

$2 \times 10^{11} = 1{,}33 \times 10^7 / \varepsilon$ ✓

$= 6{,}6 \times 10^{-5}$ ✓

AFRIKAANS ONLY: $K = \frac{\sigma}{\varepsilon}$ ✓

$2 \times 10^{11} = 730193{,}5 / \varepsilon$ ✓

$= 3{,}65 \times 10^{-6}$ (3)

6.4 $\sigma = \frac{F}{A}$ ✓ Positive marking from 6.2

$= 5 \times 10^8 \times 3 \times 10^{-3}$ ✓

$= 15 \times 10^5$ N ✓

$W = mg$

$15 \times 10^5 = m(9{,}8)$ ✓

$m =$ **153 061,22 kg** ✓ $(1.531 \times 10^4 kg)$ (5)

ONLY FOR AFRIKAANS MARKERS

$\sigma = \frac{F}{A}$ ✓ Positiewe merk vanaf 6.2

$= 5 \times 10^8 \times 54{,}78 \times 10^{-3}$ ✓

$= 2{,}739 \times 10^7$ N ✓

$W = mg$

$2{,}739 \times 10^7 = m(9{,}8)$ ✓

$m = 279487{,}96$ Kg ✓ $(2{,}795 \times 10^6$ kg) (5)

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QUESTION/*VRAAG* 7

7.1 The normal force exerted by a liquid at rest on a given surface which is in contact with it. ✓✓
Die normaalkrag wat 'n vloeistof in rus uitoefen op 'n gegewe oppervlak wat daarmee in kontak is. ✓✓ (2)

7.2 The viscosity increases with a decrease in temperature. The oil becomes too thick to flow. ✓✓
Die viskositeit neem toe met 'n afname in temperatuur. Die olie word te dik om te vloei. ✓✓ (2)

7.3 Test tube A will have the lowest viscosity. ✓
The oil flows faster ✓ around the bearing in A and the bearing travelled the furthest distance in test tube A. ✓
Proefbuis A sal die laagste viskositeit hê. ✓
Die olie vloei vinniger ✓ *om die peiling in A en die peiling het die verste afstand in proefbuis A* ✓ *afgelê.* ✓ (3)

7.4 Winter ✓ (1)

7.4.2 20W-50 viscosity grade means it flows like a 20 weight oil from start up in winter, but provides the protection of a 50 weight once the engine reaches full operating temperature. ✓✓
20W-50-viskositeitsgraad beteken dit vloei soos 'n 20-gewig-olie vandat die motorenjin begin draai in die winter, maar bied die beskerming van 'n 50-gewig sodra die enjin volle werkstemperatuur bereik. ✓✓ (2)
[10]

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QUESTION/*VRAAG* 8

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

8.2 $F_1/A_1 = F_2/A_2$ ✓

$2200/0,03 = F/0,5$ ✓

$F = 3\,666,67$ N ✓ (3)

8.3 Car lifts ✓ Hydraulic brakes ✓ Dentist chairs Bulldozer's working systems (any two.)
Hydraulic power brakes on automobiles, Hydraulic lifts used to lift heavy loads, Car jacks.
Motorhysbak (domkrag) ✓ *Hidrouliese remme* ✓ *Tandartsstoele, Stootskraper se werkstelsels (enige twee.)*
Hidrouliese kragremme op motors, Hidrouliese hysbakke wat gebruik word om swaar vragte op te lig, motordomkragte. (2)

8.4 Liquids are generally incompressible ✓
Vloeistowwe is oor die algemeen onsaampersbaar (1)

8.5.1

OPTION/*OPSIE* 1	OPTION/*OPSIE* 2
Area πr^2 $r^2 = \frac{\text{Area}}{\pi}$ **Any one/ *Enige een* ✓** $r = \sqrt{\frac{2,83\times10^{-3}}{\pi}}$ ✓ $r = 0,03$ m ✓	$\text{Area} = \frac{\pi d^2}{4}$ $d^2 = \frac{\text{Area}\times 4}{\pi}$ **Any one/ *Enige een* ✓** $d = \sqrt{\frac{2,83\times10^{-3}\times 4}{\pi}}$ ✓ $d = 0,06$ m $d = 60$ mm $r = 0,03$ m ✓

(3)

8.5.2 Stay the same./*Bly dieselfde* ✓ (1)

8.6 **OPTION/ OPSIE 1**

$P = \rho g h$ ✓
$= (1000)(9,8)(20)$ ✓
$= 196\,000$ Pa ✓
$P_{change/verander} = 196\,000 - 49\,000$ ✓
$= 147000$ Pa ✓ (5)

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OPTION /OPSIE 2

$P = \rho g h$ ✓

$P = \rho g \underline{\Delta h}$

$= (1000)(9,8)(20$✓-5✓$)$ ✓

$= 147000$ Pa ✓

[17]

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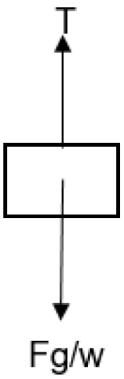
QUESTION/*VRAAG* 9

9.1 Work is the product of the force applied on an object and the displacement in the direction of the force. ✓✓

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

9.2



(2)

	Accepted labels/*Aanvaarde benoemings* (1 mark per label)
F_g	w/F_w/$F_{Earth\ on\ block/aarde\ op\ die\ blok}$/weight/*gewig*/mg/980N/gravitational force/*gravitasiekrag*
T	F_A/$F_{Applied/toegepas}$/F
	<u>Notes/*Aantekeninge*</u> Mark awarded for labels and arrows. Do not penalise for length of arrows since drawing is to scale. Penalise by a mark for each additional force. If everything is correct, but no arrows OR if force(s) do not make contact with the box: Max ½. **If a free-body diagram is drawn instead of force diagram: Max 0/2** *Punt toegeken vir byskrifte en pyle.* *Moenie penaliseer vir lengte van pyle nie, aangesien tekening volgens skaal is.* *Penaliseer met 'n punt vir elke bykomende krag.* *As alles korrek is, maar geen pyle nie OF as krag(te) nie kontak maak met die kolletjie nie: Maks 1/2* *As 'n vryliggaamdiagram in plaas van kragdiagram geteken word: Maks 0/2.*

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9.3 **OPTION/*OPSIE* 1**

$W_T = W_{Fg} = F_g \Delta y \cos\theta$ ✓
$= mg \Delta y \cos\theta$
$= mg \Delta y \cos 0°$
$= 100 \times 9,8 \times 50 \times \cos 0°$ ✓
$= 49\,000$ J
$\therefore W_T = 49\,000$ J ✓ (3)

OPTION/*OPSIE* 2

Work done by Fg (W_{Fg}) = Ep
Arbeid verrig deur Fg (WFg) = Ep
$W_{Fg} = mgh$ ✓
$= (100)(9,8)(50)$ ✓
$W_{Fg} = 49\,000$ J ✓
$\therefore W_T = 49\,000$ J (3)

9.4 9.4.1 The total mechanical energy (sum of gravitational potential energy and kinetic energy) in an isolated system remains constant. ✓✓

Die totale meganiese energie (som van gravitasie potensiële energie en kinetiese energie) in 'n geïsoleerde stelsel bly konstant. ✓✓ (2)

9.4.2 $E_P = mgh$ ✓
$= (100)(9,8)(25)$ ✓
$= 24\,500$ J ✓ (3)

9.4.3 $ME_{i(TOP/BO)} = ME_{f(BOTTOM/ONDER)}$
$mgh_{i(TOP/BO)} + \frac{1}{2}mv^2_{i(TOP/BO)} = mgh_{f(BOTTOM/ONDER)} + \frac{1}{2}mv^2_{f(BOTTOM/ONDER)}$ ✓
$\underline{(100)(9,8)(25)} + \underline{\frac{1}{2}(100)(0)}$ ✓ $= \underline{(100)(9,8)(0)} + \underline{\frac{1}{2}(100)v_f^2}$ ✓
$24\,500 = 50\,v_f^2$
$V_f = 22,14\ m \cdot s^{-1}$ ✓ (4)

9.5 $P_{ave/gem} = Fv_{ave/gem}$ ✓
$= mg \times v_{ave/gem}$
$= (100)(9,8)(8)$ ✓
$= 7840$ w ✓
1hp = 746w
$P_{ave/gem} = \frac{7\,840}{746}$ ✓
$\therefore P_{ave/gem} = 10,51$ hp ✓ (5)

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OPTION/*OPSIE* 2

$F = mg$
$= (100)(9,8)$ ✓
$= 980N$

$P_{ave/gem} = Fv_{ave/gem}$ ✓
$= (980)(8)$ ✓
$= 7\ 840w$ ✓

$1hp = 746w$
$P_{ave/gem} = \frac{7\ 840}{746}$
$\therefore P_{ave/gem} = 10,51\ hp$ ✓ (5)

[21]

TOTAL/*TOTAAL*: 150

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