Education and Sport Development

Department of Education and Sport Development
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NORTH WEST PROVINCE

NATIONAL SENIOR CERTIFICATE

GRADE 12

TECHNICAL SCIENCES P1

MID YEAR EXAMINATION 2018

MARKS : 150

TIME : 3 hours

This question paper consists of 15 pages including 2 data sheets

INSTRUCTIONS AND INFORMATION

1. This question paper consists of EIGHT questions. Answer ALL the questions in the ASWER BOOK.
2. Start EACH question on a NEW page .
3. Number the questions according to the numbering system used in this question paper.
4. Leave ONE line between two sub-questions, e.g between QUESTION 2.1 and QUESTION 2.2.
5. You may use a non-programmable calculator.
6. You may use appropriate mathematical instruments.
7. You are advised to use the attached DATA SHEETS.
8. Show ALL formulae and substitutions in ALL calculations
9. Round off your FINAL numerical answers to a minimum of TWO decimal places.
10. Give brief motivations, discussions etc where required.
11. Write neatly and legibly.

QUESTION 1

1.1 The net force acting on an object is equal to the …

A. mass of an object.
B. acceleration of an object.
C. change in momentum of an object.
D. rate of change in momentum of an object. (2)

1.2 A log of wood is attached to a cart by means of a light inelastic rope. A horse pulls the cart along a rough, horizontal road with an applied force F. The total system accelerates initially with an acceleration of magnitude **a** in FIGURE 1. The forces acting on the cart during the acceleration are indicated in FIGURE 2.

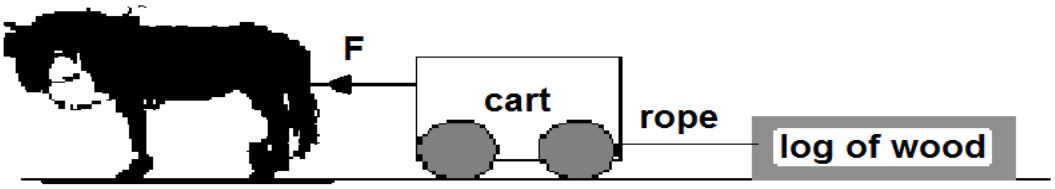


Figure 1

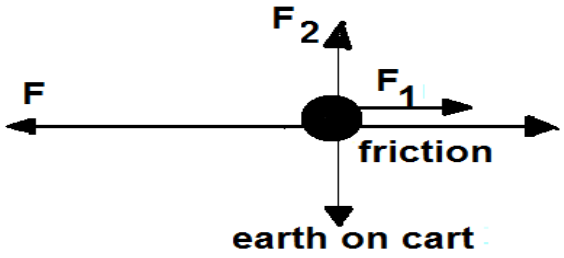


Figure 2

Which of the following combinations would be the most appropriate labels F_1 and F_2.?

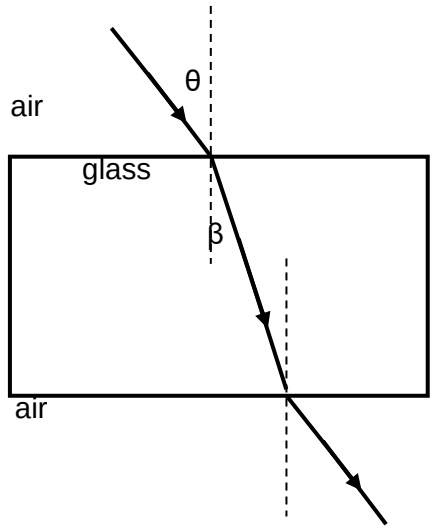
	F_1	F_2
A.	Force of log on cart.	Reaction force of force on cart.
B.	Force of log on cart.	Force of road on cart.
C.	Force of rope on log of wood.	Reaction force of earth on cart.
D.	Force of rope on log of wood	Force of road on cart.

(2)

1.3 A passenger is standing in a moving bus, facing forward and he suddenly falls forward. This implies that the bus's…

A. velocity increased.
B. velocity decreased.
C. velocity remains the same but it turned left.
D. velocity remains the same but it turned right. (2)

1.4 A ray of light strikes a glass block at an angle θ as shown below. The ray passes through the glass block and emerges on the opposite side.



At what angle to the normal does the ray emerge from the glass block?

A. θ
B. β
C. 90^o - θ
D. 90^o- β (2)

1.5 Which one of the following terms best describe the term stress?

A. Ratio of force to the cross-sectional area.
B. Ratio of the increase in length to the original length.
C. Ratio of strain to the applied force.
D. Ratio of force to the original length. (2)

1.6 The SI unit for power is…

A. pascal.
B. newton.
C. joules.
D. $m.s^{-2}$. (2)

1.7 A force that acts perpendicular to the surface is ...

A. frictional force.
B. applied force.
C. tension.
D. normal force. (2)

1.8 An object with mass 20g is moving at constant velocity.
What will be its F_{net}?

A. 196N
B. 0.196N
C. 0N
D. 20N (2)

1.9 The visible spectrum is made up of seven colours in order of increasing wavelength. Which one has the highest frequency?

A. Red
B. Blue
C. Green
D. Violet (2)

1.10 Speed of light is ...

A. $3x10^9\ m \cdot s^{-1}$.
B. $3x10^8\ m \cdot s^{-1}$.
C. $3x10^7\ m \cdot s^{-1}$.
D. $3x10^6\ m \cdot s^{-1}$. (2)

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QUESTION 2 (Start this question on a new page).

Match the information in COLUMN A with the information in COLUMN B by writing only the letter (A-P) next to the question number (2.1 -2.10)

COLUMN A	COLUMN B
2.1. Inertia	A. Viscosity
2.2. The force that must be overcome to move a stationary object.	B. Deforming force
2.3. Acceleration	C. Static friction
2.4. The property of the fluid to oppose relative motion between the two adjacent layers.	D. The property of a body to resist change in its state of rest or constant motion.
2.5. The force that changes the size of the body.	E Rate of change of velocity.
2.6. When the angle of incidence is greater than the critical angle, the ray of light reflects back into the original medium.	F Normal force
2.7. Mechanical energy.	G Total internal reflection
2.8. Work is done on an object when	H. Sum of kinetic energy and gravitational potential energy.
2.9. When body A exerts a force on body B , body B simultaneously exerts the same amount of force but in opposite direction on body A.	I. Energy is conserved
2.10. Law of reflection	J. An object is displaced in the direction of the net force.
	K. Newton's first law
	L. The incident ray, the reflected ray and the normal all lie in the same plane.
	M. Newton's third law

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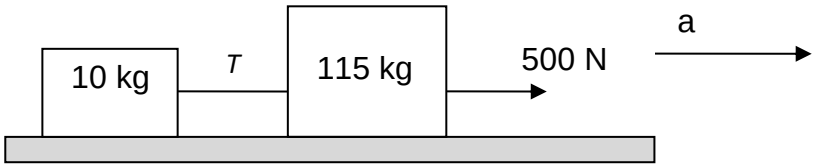
QUESTION 3 (Start on a new page)

Two crates of masses 10 kg and 115 kg respectively, are connected with an inelastic rope of negligible mass as shown in the diagram below. A horizontal force of 500 N is applied as shown and the two crates accelerate across a horizontal floor. Together the two crates experience a frictional force of magnitude 450 N. One third of this frictional force acts on the 10 kg crate and two thirds on the 115 kg crate.



3.1 State *Newton's second law of motion* in words. (2)

3.2 Draw a labelled free body diagram showing ALL the forces acting on the 115 kg crate. (5)

3.3 Calculate the:

3.3.1 Normal force exerted on the 115 kg crate (2)

3.3.2 Magnitude of the acceleration of the crates (7)

3.3.3 Magnitude of the tension **T** in the rope (2)

3.4 The rope now breaks whilst the applied force remains the same. Briefly describe how the velocity of the 10 kg crate will be affected. (2)

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QUESTION 4 (Start on a new page)

Head-on collisions lead to fatal injuries in many cases. Car A, which has mass of 2 200 kg and is travelling at a velocity of 14 $m \cdot s^{-1}$ in an eastern direction loses control and crashes head-on with a second oncoming car, Car B of mass 1 200 kg, which is travelling at a velocity of 40 $m \cdot s^{-1}$ in a western direction. The two cars become entwined with the impact and continue to move together (as wreckage).

4.1 During collision sound and heat are released. What type of collision is described here? Write ONLY: ELASTIC or INELASTIC collision. (1)

4.2 State the principle of conservation of linear momentum. (2)

4.3 Calculate the velocity of the wreckage after the collision. (5)

4.4 A learner states that it is less dangerous to be in a heavier car during a collision. Answer the following questions relating to this statement

4.4.1 How will the change in momentum of the heavier car A compare to that of the lighter car B. (1)

4.4.2 Use principles of Physics and explain why the statement made by the learner could be correct. (4)

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QUESTION 5 (Start on a new page)

A brick of 1,9 kg falls vertical downwards from a 2,65 m high scaffold. Assume all the effects of friction are ignorable.

5.1 State the principle of conservation of mechanical energy. (2)

5.2 Calculate the:

5.2.1 Mechanical energy of the brick at the point while it is on the scaffold (3)

5.2.2 Speed of the stone after it has fallen for 1,5 m (5)

5.2.3 Speed with which the stone hit the ground (6)

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QUESTION 6 (Start on a new page)

6.1 A load of 50 kN causes a tensile stress of 6 MPa in a round plastic bar The original length of the bar is 200 mm. Young's modulus for a plastic bar is 70 GPa.

Calculate the:

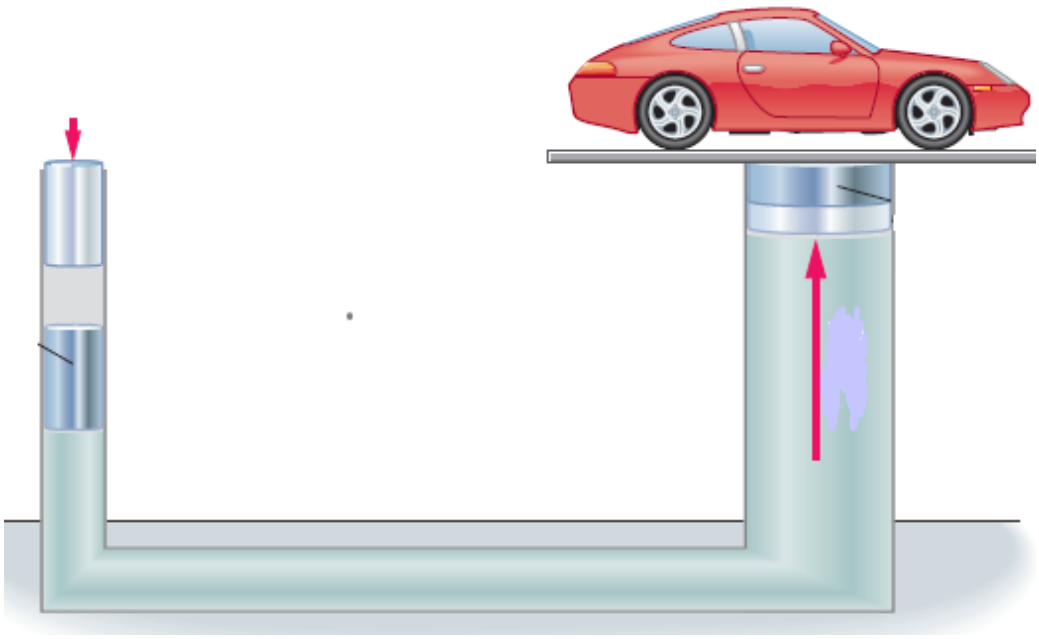
6.1.1 Diameter of the bar (6)

6.1.2 Strain (3)

6.1.3 Change in length (3)

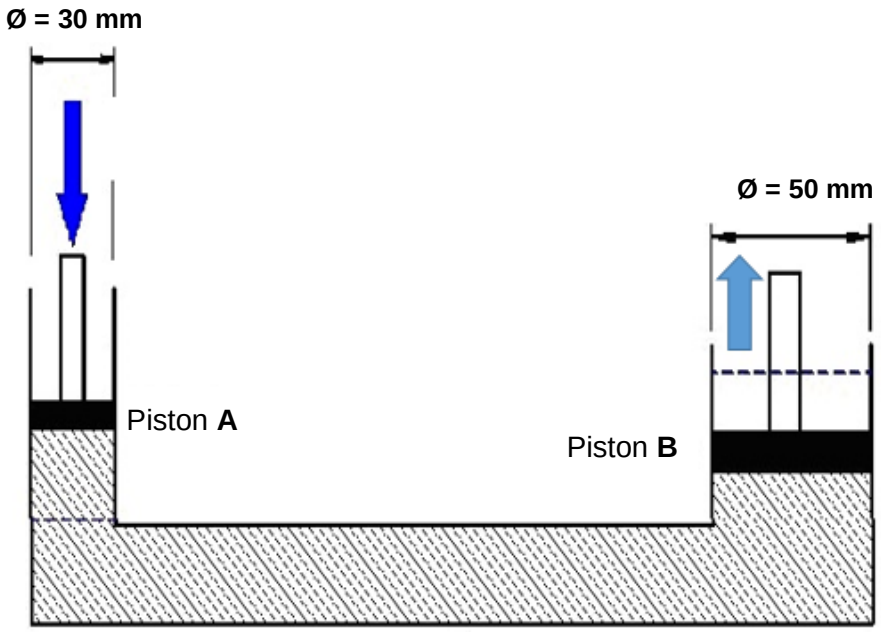
6.2 Define the term viscosity. (2)

6.3 A hydraulic lift is shown in the diagram below. The output piston of this lift has a surface area of $6,5\times10^{-3}$ m^2 and the input piston has a surface area of $5,13\times10^{-4}$ m^2.



Calculate the force required to lift the side of the car if the lift experiences a weight of 450 N at that point. (4)

6.4 A hydraulic system is shown in the diagram below. Piston **A** and Piston **B** have a diameter of 30 mm and 50 mm respectively. Input force $\mathbf{F_1}$ is 9 kN.



Use the given specifications and calculate the area of Piston **A**. (3)

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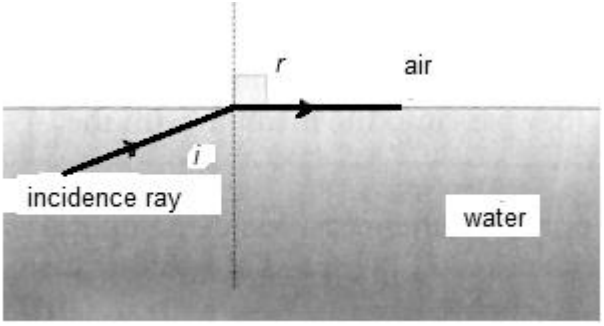
QUESTION 7 (Start on a new page)

7.1 Define the term refraction. (2)

7.2 What happens to the speed of light as it moves from air to glass?
Write ONLY: SPEEDS UP, SLOWS DOWN or REMAINS the SAME. (1)

7.3 In the diagram below, a light ray passes from water to material air.
The critical angle of water is 48,6º.



7.3.1 Define the term critical angle. (2)

7.3.2 Which range of angles will make it possible for total internal reflection to occur? (2)

7.3.3 What OTHER condition is necessary for internal reflection to take place? (2)

7.3.4 Give TWO applications of total internal reflection. (2)

7.3.5 The angle of incidence is now changed to 55^0. Redraw the above diagram showing the effect of this change. (4)

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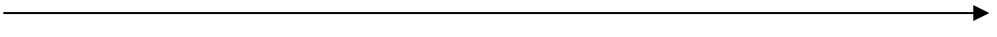
QUESTION 8: (Start on a new page)

8.1 What makes electromagnetic waves unique when compared to other waves? (1)

8.2 A learner arranged the following electromagnetic waves according to the increasing order of wavelengths. This learner is wrong. Arrange these electromagnetic waves correctly according to their increasing wavelengths. (5)



Infra red	Visible light	microwaves	Gamma rays	X-rays

8.3 Which one the waves listed in QUESTION 8.2 has the greatest penetrating ability? Give a reason why this wave has the greatest penetrating ability. (3)

8.4 The wavelength of X-rays produced by an X-ray machine is 0.015nm. Calculate the energy of these X-ray photons. (5)

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QUESTION 9: (Start on a new page)

9.1 Give ONE medical use of a convex lens (1)

9.2 Image of convex lens depends upon the position of the object .

Draw a ray diagram to show how an image is formed when the object is placed on 2F. (5)

9.3 Describe the nature of the object formed. (3)

[9]

TOTAL : 150

DATA FOR TECHNICAL SCIENCES GRADE 12

GEGEWENS VIR TEGNIESE WETENSKAPPE GRAAD 12

TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES*

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekragversnelling*	g	9,8 $m \cdot s^{-2}$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	$3,0 \times 10^{8}$ $m \cdot s^{-1}$
Planck's constant *Planck se konstante*	h	$6,63 \times 10^{-34}$ $J \cdot s$
Coulomb's constant *Coulomb se konstante*	k	$9,0 \times 10^{9}$ $N \cdot m^{2} \cdot C^{-2}$
Charge on electron *Lading op electron*	-e	$-1,6 \times 10^{-19}$ C
Electron mass *Elektronmassa*	m_e	$9,11 \times 10^{-31}$ kg

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

FORCE/*KRAG*

$F_{net} = ma$	$p = mv$
$f_s^{max} = \mu_s N$	$f_k = \mu_k N$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$F_g = mg$
Torque = F x r $\perp$	MA = $\frac{L}{E} = \frac{e}{l}$

WORK, ENERGY AND POWER/*ARBEID,ENERGIE EN DRYWING*

$W = F\Delta x\cos\theta$	$U = mgh$ or/*of* $E_P = mgh$
$K = \frac{1}{2}mv^2$ or/*of* $E_k = \frac{1}{2}mv^2$	$W_{net} = \Delta K$ or/*of* $W_{net} = \Delta E_k$ $\Delta K = K_f - K_i$ or/*of* $\Delta E_k = E_{kf} - E_{ki}$
$W_{nc} = \Delta K + \Delta U$ or/*of* $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{ave} = Fv_{ave}$ / $P_{gemid} = Fv_{gemid}$	$M_E = E_k + E_p$

ELASTICITY, VISCOSITY AND HYDRAULICS/*ELASTISITEIT, VISKOSITEIT EN HIDROULIKA*

$\sigma = \frac{F}{A}$	$\varepsilon = \frac{\Delta\ell}{L}$
$\frac{\sigma}{\varepsilon} = K$	$\frac{F_1}{A_1} = \frac{F_2}{A_2}$

WAVES, SOUND AND LIGHT/ GOLWE,KLANK EN LIG

$v=f\lambda$	$T = \frac{1}{T}$
$n_i \sin\theta_i = n_r \sin\theta_r$	$n = \frac{c}{n}$