Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

SEPTEMBER 2018

TECHNICAL SCIENCES P1

MARKS: **150**

TIME: **3 hours**

* T S C E 1 *

This question paper consists of 18 pages including 2 information sheets.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions

1. Write your FULL NAME and SURNAME in the appropriate spaces on the ANSWER BOOK.
2. Answer ALL the questions.
3. Start each question on a NEW page in the answer book.
4. Non-programmable calculators may be used.
5. Appropriate mathematical instruments may be used.
6. Number the answers correctly according to the numbering system used in this question paper.
7. Show ALL formulae and substitutions in ALL calculations.
8. Round off your FINAL numerical answers to a minimum of TWO decimal places.
9. Give brief motivations, discussions, et cetera where required.
10. TWO DATA SHEETS are attached for your use.
11. Write neatly and legibly.

QUESTION 1: (MULTIPLE-CHOICE QUESTIONS)

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A–D) next to the question number (1.1–1.10.) in the ANSWER BOOK, for example 1.11 E.

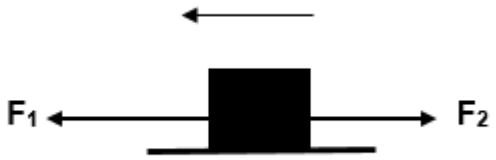
1.1 The property of a body to resist any change in its state of motion or rest is its…

A mass.
B force.
C inertia.
D acceleration. (2)

1.2 The rate at which velocity changes is ...

A displacement.
B acceleration.
C force.
D energy. (2)

1.3 The figure below shows forces **F_1** and **F_2** that are applied on an object placed on a frictionless surface. The object accelerates in the direction of the arrow indicated above the object.



Which ONE of the following statements is correct?

A $F_1 = F_2$
B $F_1 > F_2$
C $F_1 < F_2$
D $F_1 + F_2 = 0$ (2)

1.4 In the equation $F_{net}\,\Delta t = \Delta p$, the product $F_{net}\Delta t$ represents …

A change in momentum.
B force per unit time.
C impulse.
D rate of change of momentum. (2)

1.5 The work done to lift an object of mass 10 kg to a height 10 m in 5 s is 980 J. The work done to lift the same object through the same distance in 10 s is …

A 490 J
B 980 J
C 1470 J
D 1960 J (2)

1.6 The property of a body to regain its original shape and size when the deforming force is removed is known as ...

A stress.
B strain.
C elasticity.
D plasticity. (2)

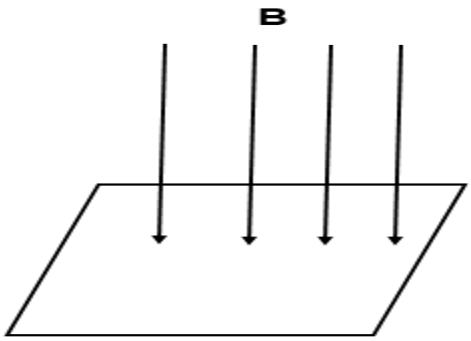
1.7 Steel balls of equal masses are dropped into test tubes with motor oils of different viscosities. Which **ONE** of the following has the highest viscosity?

A B C D (2)

1.8 The capacitance of a parallel plate capacitor is **C** when the area of the plate is **A**. What would be the capacitance if the area of the plates is doubled?

A Halved
B Doubled
C Tripled
D Quadrupled (2)

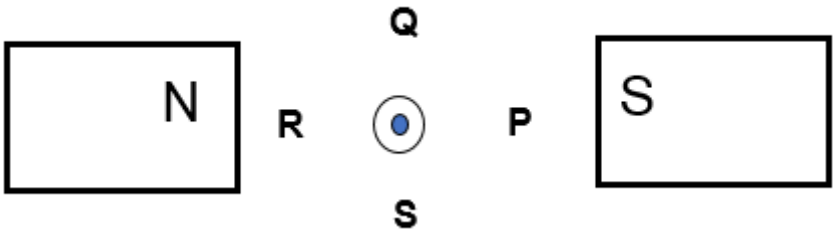
1.9 A magnetic flux density **B** acts perpendicular to a surface as shown in the diagram.



How would the magnetic flux **change** if the value of **B** increases?

A Increases
B Decreases
C Remains the same
D Decreases then increases (2)

1.10 The diagram below shows a conductor which is moved in a magnetic field. In which direction would one move the conductor so that the current in the conductor flows out of the plane of the paper?

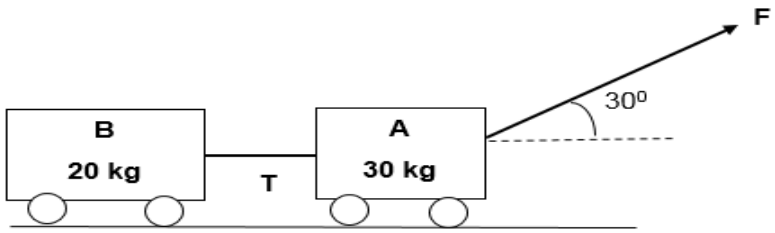


A Towards **P**
B Towards **Q**
C Towards **R**
D Towards **S** (2)

[20]

QUESTION 2

A builder connected two trolleys by using a light string as shown in the diagram below. He places bricks in the trolleys. Trolley **A** then has a mass of 30 kg and trolley **B** has a mass of 20 kg. He pulls the trolleys over a frictionless surface with a force **F = 500 N** acting at an angle of 30° to the horizontal.



Force of friction on trolley **A** is 8,8 N and on **B** is 39,4 N.

2.1 State Newton's Second Law of motion in words. (2)

2.2 Name TWO contact forces in the above diagram. (2)

2.3 Draw the free-body diagram of ALL the forces acting on trolley **A**. (5)

2.4 Calculate the acceleration of trolleys. (6)

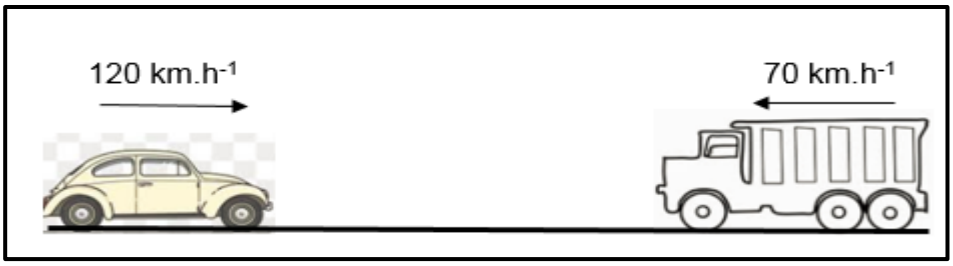
2.5 Calculate the tension **T** on the string. (3)

2.6 The tension experienced by trolley **B** is equal to the tension experienced by trolley **A.** Name and state the law that supports this statement. (3)

[21]

QUESTION 3

A car of mass 800 kg travels due east with a velocity of 120 km.h^{-1} and collides head on with a construction truck of mass 2500 kg that travels with a velocity of 70 km.h^{-1} due west. After the collision, the car and the truck move together.



3.1 Define *momentum*. (2)

3.2 State the law of conservation of momentum. (2)

3.3 Calculate the velocity of the car and truck combination after the collision. (5)

3.4 The car was fitted with an airbag. Explain how the airbag reduces the fatal injuries on a driver. (3)

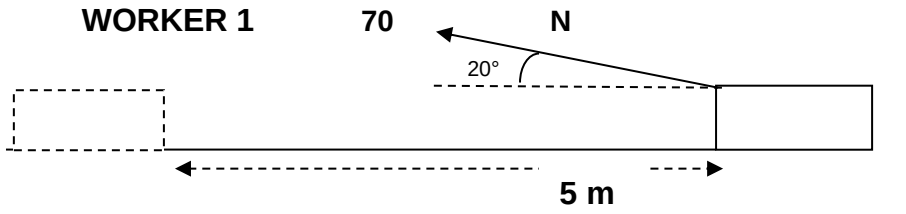
[12]

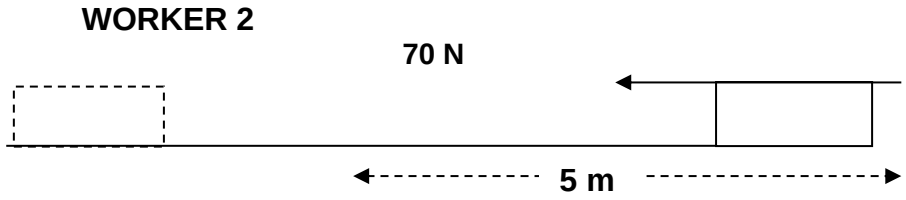
QUESTION 4

The figures below show two workers, pulling concrete blocks of mass 100 kg on the same surface. (Ignore force of friction)

WORKER 1: pulled the block horizontally across the ground surface for 5 m by applying a force of 70 N at an angle 20° with the horizontal.

WORKER 2: pulled the same block over the same distance by applying a force of 70 N horizontally.





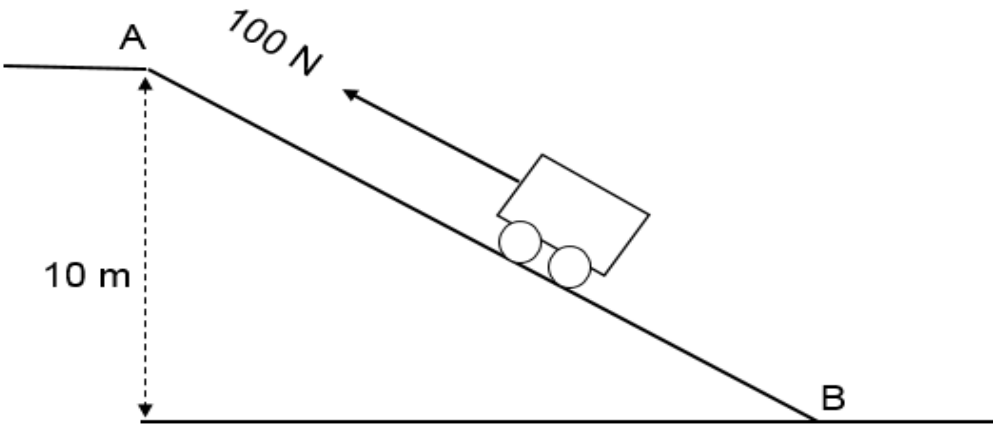
4.1 Define the term *work*. (2)

4.2 Calculate the work done by WORKER 1 to pull the block over a distance 5 m. (3)

4.3 Is the work done by **WORKER 2** GREATER THAN, LESS THAN or EQUAL TO the work done by **WORKER 1**? (1)
[6]

QUESTION 5

A trolley of mass 10 kg filled with bricks of mass 40 kg is pulled up the incline with a force of 100 N. The trolley and its contents move at a constant velocity of 5 $m.s^{-1}$ up the incline. (IGNORE FRICTION.)



5.1 Define the term *power*. (2)

5.2 Calculate the power generated to pull the trolley and its contents up the incline. (3)

At point **A**, which is 10 m above the ground, the bricks are offloaded and then released. The trolley moves down the inclined plane and reaches point **B**.

5.3 At what point will the gravitational potential energy of the trolley be maximum? (2)

5.4 Calculate the velocity of the trolley when it reaches point **B**. (4)

5.5 Name and state the law used to answer QUESTION 5.4. (3)
[14]

QUESTION 6

6.1 Grade 12 students carry out an experiment to find out how far a spring stretches when loads are added to it. The results obtained are used to draw the following graph. The unloaded length of the spring is 15 cm.

FORCE vs EXTENSION

6.1.1 What is the extension of the spring when the applied force is 3 N? (1)

6.1.2 When an object of unknown mass 'm' is hung on the spring, the length of the spring is 1,7 cm. Calculate the mass 'm'. (4)

6.1.3 Define the term *strain*. (2)

6.1.4 Calculate strain for a force of 5 N by using the information given in the graph. (4)

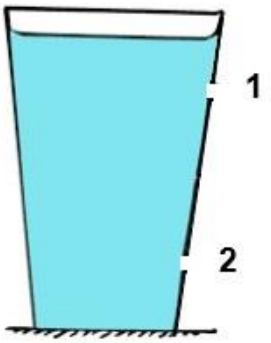
6.2 A steel wire has a strain of $3,6 \times 10^{-4}$ and the modulus of elasticity is 2×10^{11}Pa.

6.2.1 State Hooke's law. (2)

6.2.2 Calculate the stress. (3)
[16]

QUESTION 7

Ayanda made two identical holes at points **1** and **2** in a plastic container filled with water as shown in the diagram.

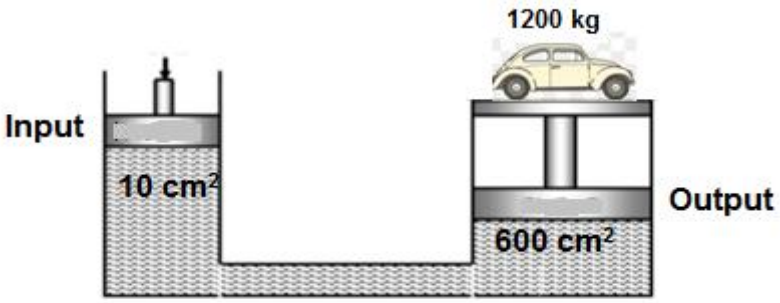


7.1.1 Define the term *pressure*. (2)

7.1.2 Is the pressure of water at point **1** GREATER THAN, LESS THAN or EQUAL TO the pressure of water at point **2**? Explain your answer. (3)

7.1.3 Why is the water from the hole at point **2** forced out farther than the water from hole at point **1**? (2)

7.2 Andile, the auto mechanic is raising a 1200 kg car on her hydraulic lift so that she can work underneath. The area of the input piston is 10 cm^2 and the output piston has an area of 600 cm^2.



7.2.1 State Pascal's Law. (2)

7.2.2 Calculate the force that must be exerted on the input piston to lift the car. (4)

[13]

QUESTION 8

The ability of capacitors to store charge makes them essential components in electrical appliances. Users are often warned of the dangers associated with capacitors inside appliances.

8.1 What is a capacitor? (2)

8.2 Briefly explain why it can be dangerous to touch a charged capacitor. (2)

8.3 A certain parallel plate capacitor consists of two identical aluminium plates, each of area $2 \times 10^{-4}\ m^2$. The plates are separated by a distance of 0,03 mm, with air occupying the space between the plates.

8.3.1 Calculate the capacitance of the capacitor. (3)

8.3.2 Calculate the charge stored on the plates of the capacitor when connected to a 6 V battery. (3)

[10]

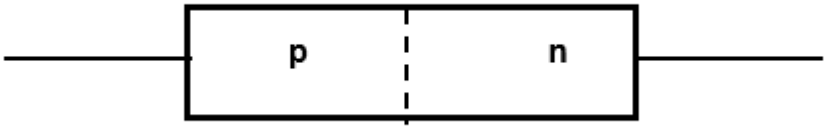
QUESTION 9

9.1 An n-type semiconductor is made by adding impurity atoms to a pure semiconductor material.

9.1.1 How many valence electrons does the impurity atom have in its outer shell? (1)

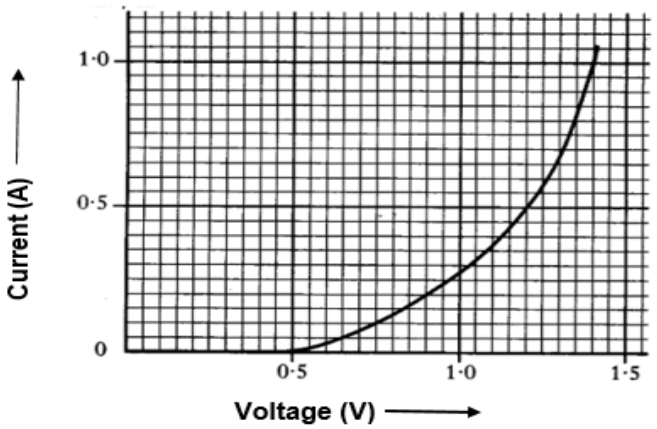
9.1.2 What will the net charge be on the semiconductor after the addition of the impurity atoms? (1)

9.2 The diagram below represents a **p-n** junction diode.



Draw a diagram showing the p-n junction diode connected to a battery so that the junction is reverse bias. (2)

9.3 The following graph shows the relationship between current and potential difference for a diode when it is forward biased.



9.3.1 What is the minimum voltage for this diode to conduct? (2)

9.3.2 What happens to the resistance of the diode if the potential difference is increased above the minimum voltage mentioned in QUESTION 9.3.1? (2)

[8]

QUESTION 10

A kettle is marked 240 V; 1500 W.

10.1 What is the meaning of 1500 W in the specification given above? (2)

10.2 Calculate the resistance of the kettle when operating at the above-mentioned specifications. (4)

10.3 If the kettle takes 3 minutes to boil the water, calculate the amount of electrical energy transferred to the kettle. (4)

[10]

QUESTION 11

11.1 A transformer is used to convert a potential difference of 240 V AC to 12 V AC to run a toy train. The transformer has 300 turns on its secondary coil.

11.1.1 What is a *transformer*? (2)

11.1.2 Calculate the number of turns needed on the primary coil. (3)

11.1.3 Is this a step-up or a step-down transformer? (1)

11.2 Consider a solenoid coil of 11 turns. The solenoid is subjected to a varying magnetic field that changes the magnetic influx uniformly from 5,34 Wb to 2,7 Wb in an interval of 12 s.

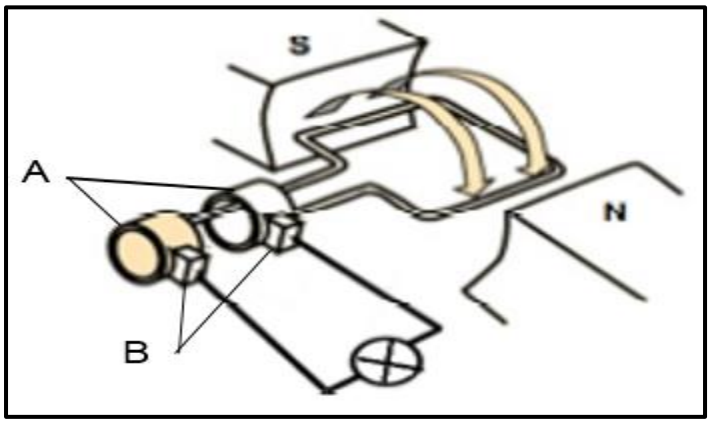
11.2.1 State Faraday's Law of electromagnetic induction. (2)

11.2.2 Calculate the magnitude of the induced emf. (3)

[11]

QUESTION 12

The diagram below shows a generator.



12.1 What type of generator is shown in the diagram? (1)

12.2 What energy conversion takes place in the above generator? (1)

12.3 Name the parts indicated by:

12.3.1 A (1)

12.3.2 B (1)

12.4 Sketch a graph of induced emf versus time for ONE complete rotation of the coil. (3)

12.5 Name any TWO uses of a DC generator. (2)
[9]

TOTAL: 150

DATA FOR TECHNICAL SCIENCES GRADE 12
PAPER 1

GEGEWENS VIR TEGNIESE WETENSKAPPE GRAAD 12
VRAESTEL 1

INFORMATION SHEETS – PAPER 1/*INLIGTINGSBLAD – VRAESTEL* 1

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

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity/ *Swaartekragversnelling*	g	9,8 $m \cdot s^{-2}$

TABLE 2: FORMULAE/*FORMULES*

FORCE/*KRAG*

$F_{net} = ma$	$p = mv$
$f_s^{max} = \mu_s N$	$f_k = \mu_k N$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$F_g = mg$

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

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

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

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

ELECTROSTATICS/*ELEKTROSTATIKA*

$C = \frac{\kappa\varepsilon_o A}{d}$ and $C = \frac{\varepsilon_o A}{d}$	$E = \frac{V}{d}$
$C = \frac{Q}{V}$	

CURRENT ELECTRICITY/*STROOMELEKTISITEIT*

$R = \frac{V}{I}$	$q = I\,\Delta t$
$W = VQ$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$
$R_s = R_1 + R_2 + ...$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + ...$	

ELECTROMAGNETISM/*ELEKTROMAGNETISME*

$\phi = BA$	$\varepsilon = -N\frac{\Delta\phi}{\Delta t}$
$\frac{V_s}{V_p} = \frac{N_s}{N_p}$	