Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

JUNE 2018

TECHNICAL SCIENCES P1

MARKS: **150**

TIME: **3 hours**

JTPHSCE1

This question paper consists of 16 pages including a 2-page data sheet and a graph paper.

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 SHEET.
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. Data sheet and periodic table 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 A.

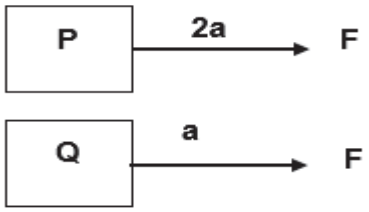
1.1 The SI unit for momentum is …

A N
B $kg.m.s^{-1}$
C $m.s^{-2}$
D m (2)

1.2 The driver of a car, travelling East, places a book on the dashboard in front of him while travelling at a **constant speed.** If the car stops suddenly, in which direction will the book move?

A East
B West
C North
D South (2)

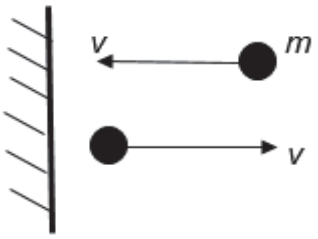
1.3 Two identical forces, each of magnitude F newton, act at the same time on two different objects P and Q. The acceleration of P is twice the acceleration of Q.



The magnitude of the mass of P is … the mass of Q.

A half
B same as
C twice
D thrice (2)

1.4 A ball with a mass *m,* travelling West, hits a wall with a velocity of *v*. It bounces back with the same velocity.



The change in momentum of the ball will be…

A mv west
B mv east
C 2mv west
D 2mv east (2)

1.5 Which action stated below requires NO work to be done on that specific object?

A Lifting an object from the floor to the ceiling.
B Moving an object along the floor against friction.
C Decreasing the speed of an object until it comes to rest.
D Holding an object stationary above the ground. (2)

1.6 Current in a semiconductor is caused by …

A electrons
B holes
C both electrons and holes
D Ions (2)

1.7 A force which changes the shape and size of a body is called …

A restoring force
B normal force
C frictional force
D deforming force (2)

1.8 The internal restoring force per unit area of a body is called …

A stress
B strain
C bulk modulus
D Young's modulus (2)

1.9 A brick is dropped from a certain height above the ground. Which **ONE** of the following combinations of kinetic energy and mechanical energy is correct regarding the brick while it is falling? Ignore the air resistance.

	Kinetic Energy	**Mechanical energy**
A	Decreases	Decreases
B	Increases	Increases
C	Decreases	Remains constant
D	Increases	Remains constant

(2)

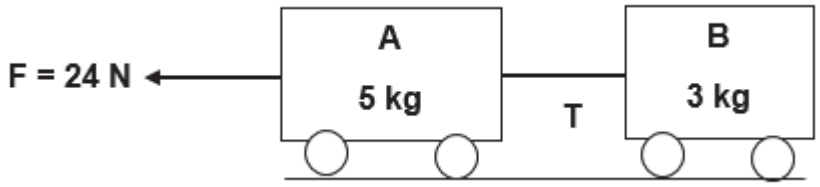
1.10 Which **ONE** of the following is the pressure exerted by a mercury column of height 76 cm if the density of mercury is 13,6 $g.cm^{-3}$?

A 50 kPa
B 101 kPa
C 150 kPa
D 200 kPa

(2)
[20]

QUESTION 2 (Start on a new page)

Trolley **A**, of mass **5 kg** and trolley **B** of mass **3 kg, both initially at rest on a frictionless surface,** are joined by a light string of negligible mass. A force **F** of **24 N** is applied on trolley **A** as shown in the diagram.



2.1 Draw a free body diagram showing all the forces acting on trolley **A**. (4)

2.2 State Newton's Second Law of motion. (2)

2.3 Calculate the acceleration of trolley **A**. (4)

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

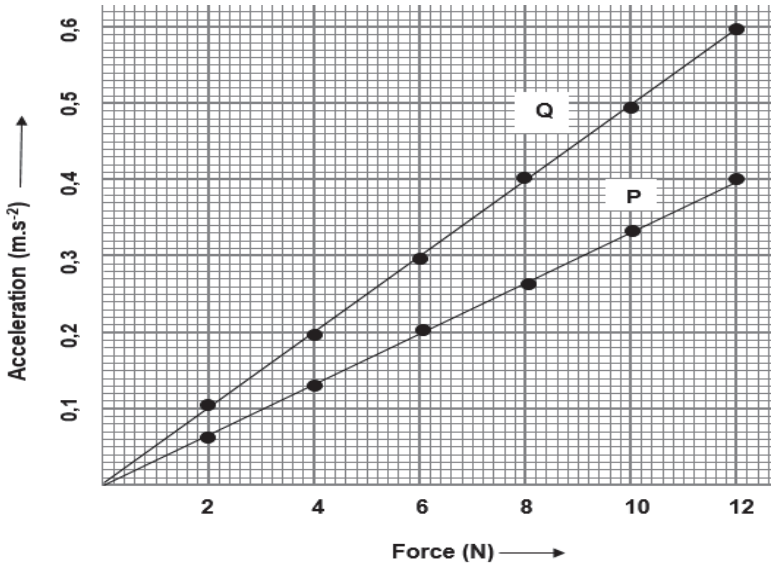
2.5 What would happen to the value of **T** if:
(Write down only INCREASES, DECREASES or REMAINS THE SAME)

2.5.1 The force **F** is acting at an angle 30^0 horizontally. (1)

2.5.2 The mass of trolley A is decreased. (1)
[15]

QUESTION 3 (Start on a new page)

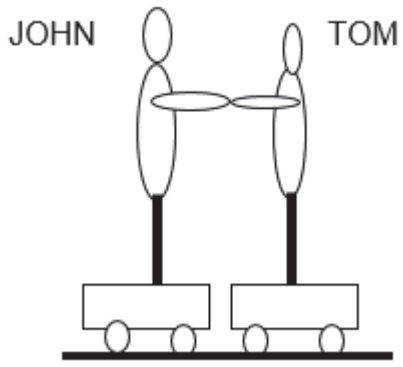
3.1. A learner investigates the relationship between force and acceleration on two different objects **P** and **Q**. He obtained the following graphs.



3.1.1 Which **one** of the objects (**P** or **Q**) has a higher mass? Explain. (2)

3.1.2 Calculate the mass of **P**. (4)

3.2. John and Tom stand on stationary trolleys on a frictionless surface as shown in the diagram below. John weighs 60 kg, including the mass of the trolley. Tom weighs 45 kg, including the mass of the trolley. They push against each other and Tom moves to left with an acceleration of 0,2 $m.s^{-2}$.



3.2.1 Calculate the force exerted by John on Tom. (3)

3.2.2 What is the magnitude of the force exerted by Tom on John? (1)

3.2.3 Name and state the law used to answer QUESTION 3.2.2 above. (3)

[13]

QUESTION 4 (Start on a new page)

A nail of mass 5 g is held horizontally and is hit with a hammer. The hammer exerts 7 N force on the nail and was in contact with the nail for 0,005 s.

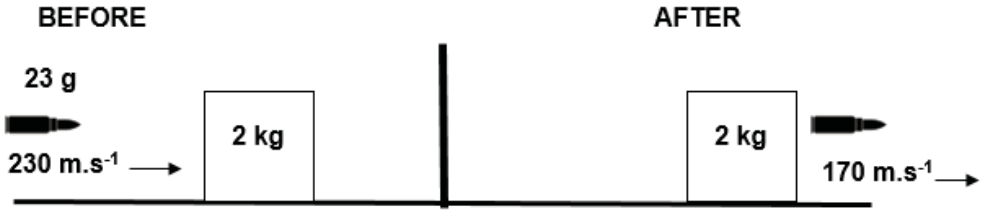
4.1 Define *impulse*. (2)

4.2 Calculate the impulse on the nail. (3)

4.3 Calculate the velocity of the nail after the blow. (4)
[9]

QUESTION 5 (Start on a new page)

A 23 g bullet travelling at 230 $m.s^{-1}$ penetrates a 2 kg block of wood which is at rest on a frictionless surface. The bullet emerges cleanly at 170 $m.s^{-1}$. The collision is inelastic.



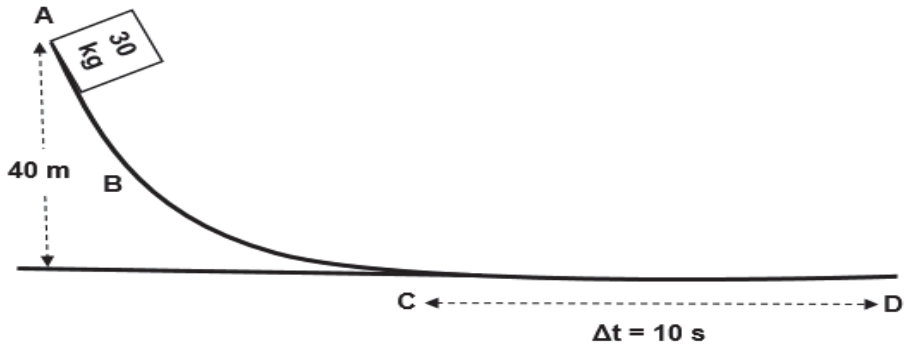
5.1 State law of conservation of linear momentum in words. (2)

5.2 Calculate the velocity of the block immediately after the bullet emerges from it. (4)

5.3 Explain whether the kinetic energy is conserved or not in the above collision. (2)
[8]

QUESTION 6 (Start on a new page)

6.1 A box of mass 30 kg is initially at rest at **A** which is 40 m above the ground as shown in the diagram below. The box travels along the frictionless curved section **ABC** and along the frictional horizontal section **CD**. The box takes 10 s from point **C** before it comes to stop at point **D**.



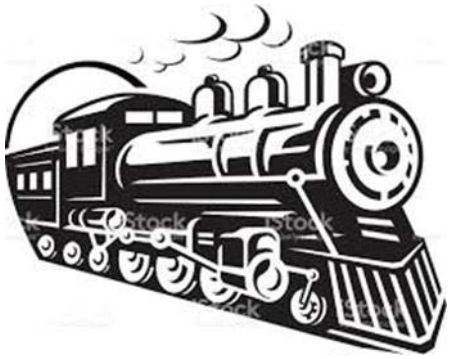
6.1.1 State the law of conservation of mechanical energy in words. (2)

6.1.2 Calculate the potential energy of the box at **A.** (3)

6.1.3 Calculate the speed of the box at **C.** (4)

6.1.4 Calculate the frictional force experienced by the box from **C** to **D**. (4)

6.2 A locomotive engine of mass 10 000 kg travels along a straight level track with a constant speed of 55 $m.s^{-1}$. The forward force exerted by the engine is 3181 N.



6.2.1 Define the term *power*. (2)

6.2.2 Calculate the power generated by the locomotive engine in horsepower (hp). (4)

6.2.3 Write down the magnitude of the frictional force. Give a reason for your answer. (2)

[21]

QUESTION 7 (Start on a new page)

A construction worker pushes a concrete block of mass 100 kg on a rough surface by applying a force **F** as shown in the diagram.

The block accelerates at 0,5 $m.s^{-2}$ through a distance of 5 m.

The coefficient of kinetic friction between the block and the surface is 0, 15.

7.1 Define the term *work*. (2)

7.2 Calculate the magnitude of force **F** applied on the block. (6)

7.3 Calculate the work done by the construction worker. (3)

[11]

QUESTION 8 (Start on a new page)

8.1 Grade 12 students carry out an experiment to find out how a spring stretched when loads were added on it. The results were tabulated as follows.

Load (N)	0	1	2	3	4	5
Length (mm)	50	58	66	74	82	90
Extension (mm)	-	8	16	24	32	40

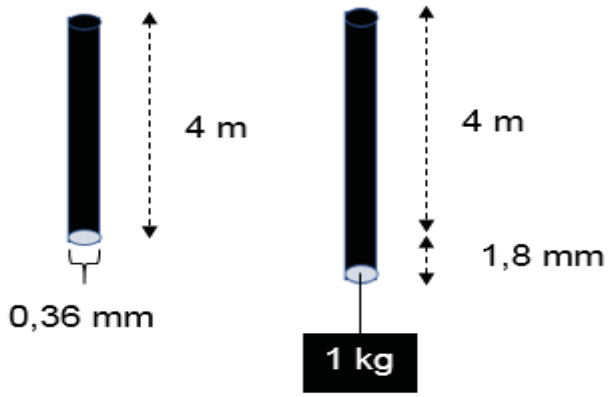
8.1.1 What is the length of the spring when not stretched? (1)

8.1.2 Plot a graph of the data given by placing load on the X-axis and extension on the Y-axis. (4)

8.1.3 Explain elastic limit of a body. (2)

8.1.4 Use the graph, to find the load that would give an extension of 30 mm. (2)

8.2. A steel wire of length 4 m and diameter 0,36 mm extends by 1,8 mm under a load 1 kg.



8.2.1 State Hooke's law in words. (2)

8.2.2 Calculate the stress experienced by the steel wire. (5)

8.2.3 Calculate the strain on the steel wire. (3)

8.2.4 Hence calculate the modulus of elasticity of the steel wire. (3)
[22]

QUESTION 9 (Start on a new page)

9.1. Viscosity is an important property of a liquid and is temperature dependent.

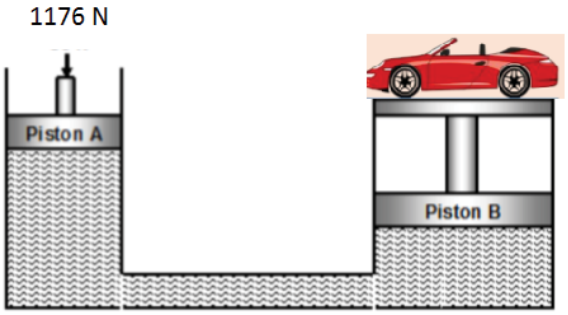
9.1.1 Define viscosity. (2)

9.1.2 What is the effect of temperature on viscosity? (2)

9.1.3 Modern engine oils are specially designed as multi-grades. A typical designation is 20W50 SAE.

Explain the meaning of 20W50 SAE grading. (2)

9.2 A hydraulic system is used to lift a vehicle of mass **m** in an auto garage. The vehicle sits on a piston **B** of area 0,5 m² and a force of 1176 N is applied to a piston **A** of area 0,03 m².



9.2.1 State Pascal's law. (2)

9.2.2 Calculate the force applied to lift the vehicle. (3)

9.2.3 Calculate the mass of the vehicle. (2)

9.2.4 The vehicle is lifted to a height of 120 cm. Calculate the work done to lift the car to this height. (3)

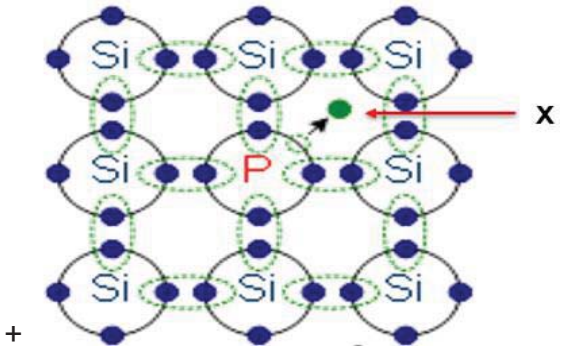
9.2.5 Give any TWO uses (other than the one which is mentioned above) of hydraulics in technology. (2)

[18]

QUESTION 10 (Start on a new page)

10.1 What is a semiconductor? (2)

10.2 An intrinsic semiconductor silicon is doped with pentavalent phosphorous.



10.2.1 What is an intrinsic semiconductor? (2)

10.2.2 Explain the meaning of the word doping. (2)

10.2.3 Name the type of semiconductor produced in the above. (1)

10.2.4 Write down the name of the particle represented by letter **X** (1)

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

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

10.3.2 Explain the working of the p-n junction diode when it is in the forward bias mode. (3)

[13]

TOTAL: 150

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

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekragversnelling*	g	$9,8\ m\cdot s^{-2}$
Coulomb's constant *Coulomb se konstante*	k	$9,0 \times 10^{9}\ N\cdot m^{2}\cdot C^{-2}$
Dielectric constant	ε_0	$8,85 \times 10^{-12}\ F.m^{-1}$

TABLE / *TABEL* 2: FORMULAE / *FORMULES*

FORCE/*KRAG*

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

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* $E_k = \frac{1}{2}mv^2$	
$P_{av} = Fv_{av}$ / $P_{gemid} = Fv_{gemid}$	$P = \frac{W}{\Delta t}$

ELECTROSTATICS/*ELEKTROSTATIKA*

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$V = \frac{W}{q}$	$E = \frac{F}{q}$
$n = \frac{Q}{e}$ or/*of* $n = \frac{Q}{q_e}$	
$C = \frac{Q}{V}$	$C = \frac{\varepsilon_0 A}{d}$

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

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

ELASTICITY / *ELASTISITEIT*

$\sigma = \frac{F}{A}$	$\varepsilon = \frac{\Delta l}{L}$

HYDRAULICS / *HIDROULIKA*

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

NAME: ……..

QUESTION 8.1.2.