testpapers.co.za

GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

GAUTENG DEPARTMENT OF EDUCATION

PREPARATORY EXAMINATION

2021

11101

TECHNICAL SCIENCES

PAPER 1

TIME: 3 hours

MARKS: 150

15 pages + 2 information sheets

11101E

X05

INSTRUCTIONS AND INFORMATION

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

QUESTION 1: MULTIPLE CHOICE QUESTIONS

Four possible options are provided as answers to the following questions. Each question has only ONE correct answer. Choose the best answer and write only the letter (A–D) next to the question number (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 D.

1.1 A car is driven along a horizontal road at constant velocity. Which of the following statements is true?

A The forces acting on the car are not in equilibrium.

B There are no forces acting on the car.

C The resultant force acting on the car is zero.

D There is no frictional force acting on the car. (2)

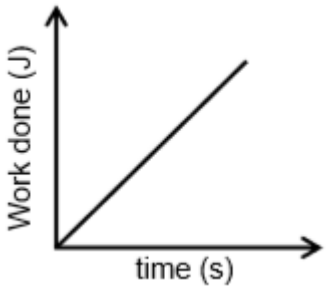
1.2 A ball, moving horizontally, hits a wall with a speed 2v. The ball then bounces back horizontally with a speed v, as shown in the diagram below.

Which of the following combinations regarding the linear momentum and the total kinetic energy of the ball for the collision above is correct?
Assume that the ball-wall system is isolated.

	LINEAR MOMENTUM	TOTAL KINETIC ENERGY
A	Conserved	Not Conserved
B	Conserved	Conserved
C	Not Conserved	Not Conserved
D	Not Conserved	Conserved

(2)

1.3 The graph below represents the relationship between the work done on an object and the time taken.



The gradient of the graph represents …

A power.

B acceleration.

C potential energy.

D stress. (2)

1.4 Which of the following is the SI unit of strain?

A Newton

B Joule

C Pascal

D It has no unit (2)

1.5 What does "W" on the label of an oil container designated SAE 50W-30 stand for?

A Warm

B Winter

C Weight

D Waterless (2)

1.6 The pressure of a liquid at rest increases when … the depth.

A increasing

B decreasing

C either increasing or decreasing

D neither increasing nor decreasing (2)

1.7 Define the dielectric in a capacitor.

A Dielectric is a conductor that can be polarised by an applied electric field.

B Dielectric is a conductor that can change the polarity of the circuit.

C Dielectric is an insulator that can be polarised by an applied electric field.

D Dielectric is a glass between two plates. (2)

1.8 The heat generated by a resistor with resistor R and a current I is W. How much heat is generated in the same resistor if double the current flows through the resistor?

A 1.5 W

B 2 W

C 4 W

D 6 W (2)

1.9 Two learners are doing an experiment by stretching a slinky spring between them and observing the wave formed by the spring. Which of the pairs regarding wavelength and speed is correct as the frequency is doubled?

	WAVELENGTH …	SPEED …
A	is halved	remains the same
B	remains the same	is doubled
C	is halved	is halved
D	remains the same	remains the same

(2)

1.10 When a ray of light travels from one medium to another and the direction of the ray remains the same, then …

A one medium is less optically dense than the other.

B the angle between the incident ray and the normal is 90^0.

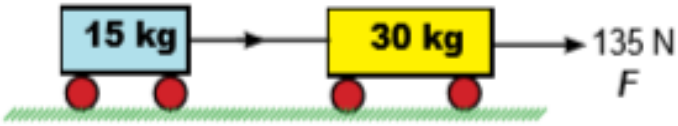
C one medium is air and the other is water.

D the direction of the ray is from water to air. (2)

[20]

QUESTION 2 (Start on a new page.)

Two trollies of mass 15 kg and 30 kg respectively are resting on a smooth horizontal surface and are connected by a light inextensible string. A constant force F = 135N, is applied to the 30 kg box, as shown below.



2.1 Name and state in words the law that is represented above. (3)

2.2 Draw a free-body diagram of the 30 kg trolley. (4)

2.3 Calculate:

2.3.1 The acceleration of the 30 kg trolley (3)

2.3.2 The tension on the string (3)

2.4 The same trollies move on a rough surface and the coefficient of kinetic friction for blocks of the 15 kg trolley and of the 30 kg trolley are 0,1 and 0,2 respectively.

Calculate:

2.4.1 The magnitude of the acceleration of the system of the blocks (6)

2.4.2 How will this tension be compared to the tension when the trollies were moving on a smooth surface? Write only INCREASE, REMAINS THE SAME or DECREASE. (1)

[20]

QUESTION 3 (Start on a new page.)

A man sitting in a stationary boat in the middle of a lake, wants to reach the shore, 60 m away. The man throws an object of mass 1 kg horizontally at a speed of 10 $m \cdot s^{-1}$ in the direction shown in the diagram below.

The mass of the man is 40 kg and the mass of the boat is 60 kg. The effects of air resistance and friction between the water and the boat can be ignored.

3.1 Write down the *principle of conservation of linear momentum* in words. (2)

3.2 In which direction will the man and boat move after throwing the object? (1)

3.3 Calculate the momentum of the object after it has been thrown.

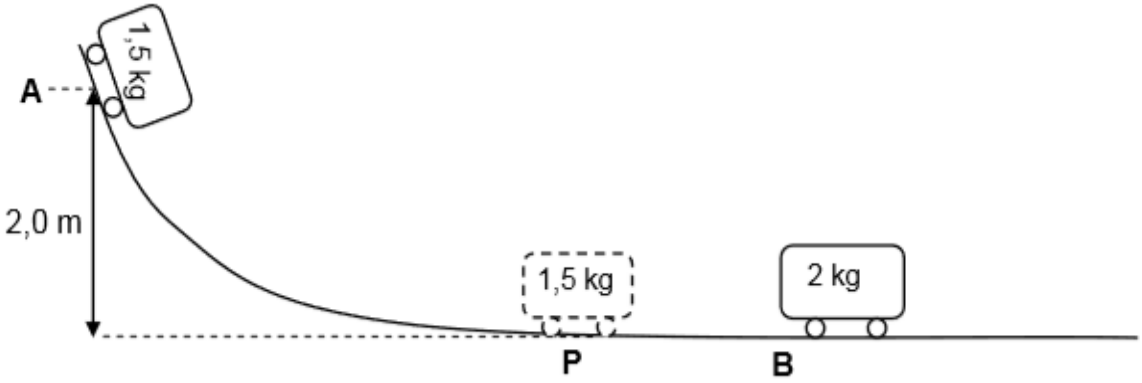
The man's throwing action when throwing the object takes 0,1 s. (3)

3.4 Calculate the average force that the man exerts on the object. (4)

[10]

QUESTION 4 (Start on a new page.)

A trolley of mass 1,5 kg is held stationary at point **A** at the top of a frictionless track. When the 1,5 kg trolley is released, it moves down the track. It passes point **P** at the bottom of the incline and collides with a stationary 2 kg trolley at point **B**. Refer to the diagram below. Ignore air resistance and rotational effects.



4.1 State the *principle of conservation of mechanical energy* in words. (2)

When the two trolleys collide, they stick together and continue moving at constant velocity.

4.2 Use the principle of conservation of mechanical energy to calculate the speed of the 1,5 kg trolley at point **P**. (4)

4.3 Calculate the combined velocity of both trolleys after collision. (4)

4.4 Is the collision elastic or inelastic? Prove your answer by doing the calculations. (4)

[14]

QUESTION 5 (Start on a new page.)

A 4 m long square wire is attached to the ceiling at one end. The square wire has a length of 4 mm. A 40 kg mass piece is attached to the other end of the wire. As a result of this, the length of the wire is stretched by 4 mm. The mass piece does not touch the floor.

5.1 Define the term *stress* in words. (2)

5.2 Calculate:

5.2.1 The stress on the wire (4)

5.2.2 The strain of the wire (4)

5.2.3 The elasticity modulus of the wire (4)

5.3 A round wire made of aluminium has a radius of 1,5 mm and a length of 2,5 m.

Calculate:

5.3.1 The area of the wire (3)

5.3.2 The deformation of the wire if it is stretched by $0,7 \times 10^{-3}$ m. (3)

[20]

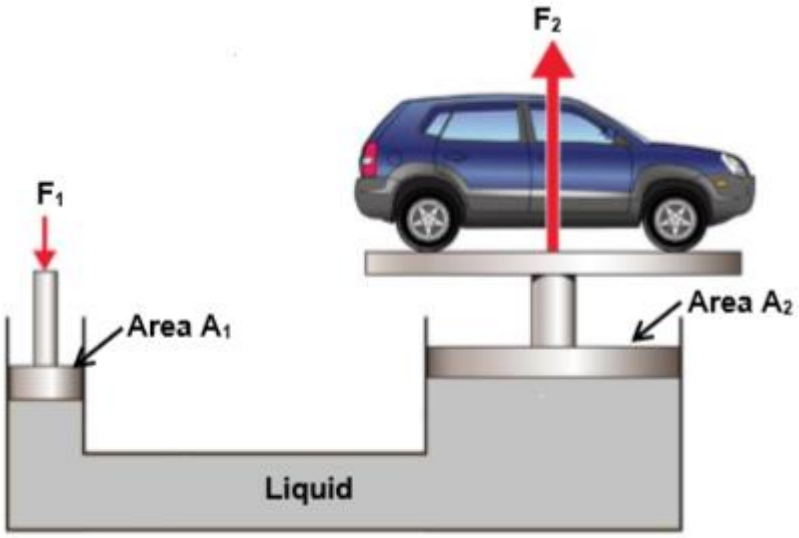
QUESTION 6 (Start on a new page.)

6.1 Fluids are preferred in designing hydraulic machines because of their ability to flow.

6.1.1 Define the term *viscosity*. (2)

6.1.2 What is the effect of temperature on the viscosity of liquids? (1)

6.2 In the diagram below, a car has been lifted by a hydraulic lift in a mechanic's workshop. Piston A_2 lifts a weight of 4 000 N. The areas of pistons A_1 and A_2 are $3{,}8 \times 10^{-3}$ m^2 and $1{,}9 \times 10^{-2}$ m^2 respectively.



6.2.1 Define the term *thrust*. (2)

6.2.2 Which one between thrust or pressure has the same SI unit as force? (1)

6.2.3 Calculate the force applied on piston A_1. (3)

6.2.4 Calculate the pressure of the hydraulic system. (3)

6.2.5 If the distance between piston A_1 and piston A_2 is increased, how would it affect the answer to QUESTION 6.2.3? Write down only INCREASE, DECREASE or STAYS THE SAME. (1)

6.2.6 Give TWO examples of hydraulic systems. (2)
[15]

QUESTION 7 (Start on a new page.)

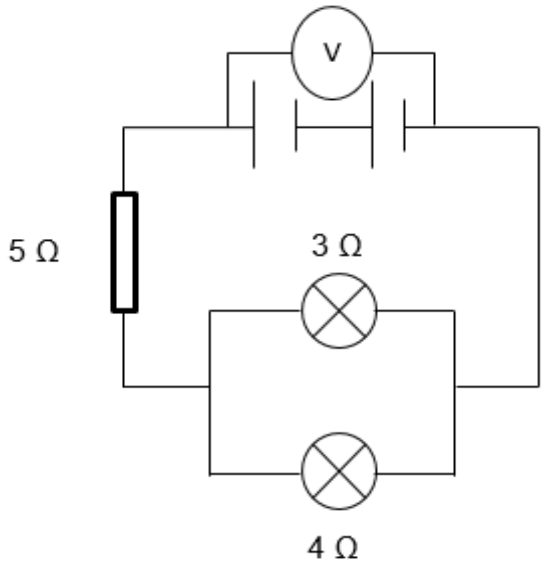
7.1 Define *capacitance*. (2)

7.2 Name TWO factors that influence the capacitance of a capacitor. (2)

7.3 A capacitor has a capacitance of 6.5 µF and potential difference of 10 V. Calculate the amount of charge stored by the capacitor. (3)
[7]

QUESTION 8 (Start on a new page.)

A group of learners is instructed to construct the circuit as depicted in the diagram below. The circuit has an EMF of 6 V.



Ignore the internal resistance of the battery and calculate:

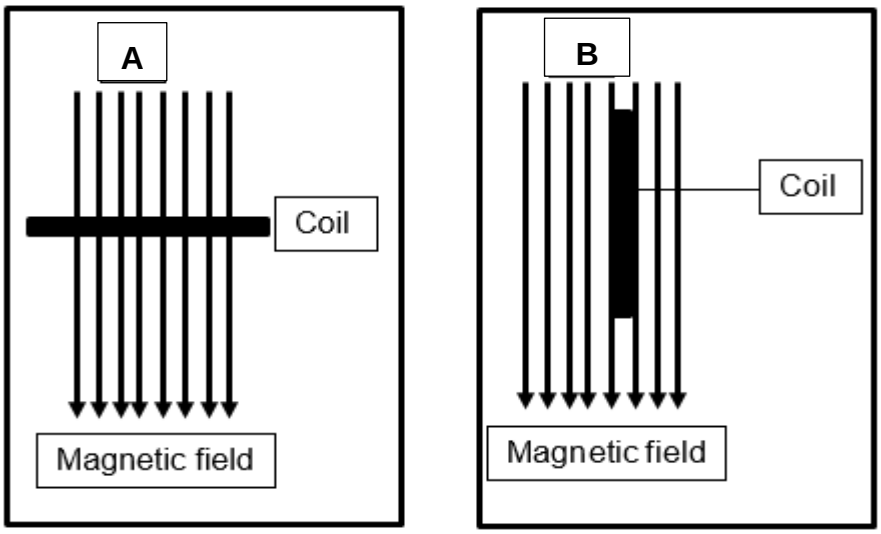
8.1 The total resistance of the parallel network in the circuit (3)

8.2 The total current of the circuit (4)

8.3 The power of the circuit (3)
[10]

QUESTION 9 (Start on a new page.)

The following diagram depicts the experimental setup of the experiment performed in class using a coil and the uniform magnetic field produced by bar magnets.

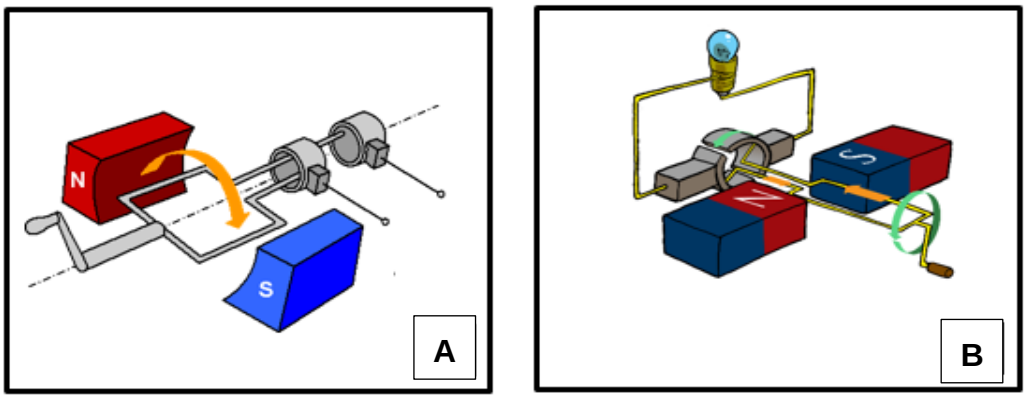


9.1 Define the term *magnetic flux*. (2)

9.2 Which experiment between **A** and **B** will produce a non-zero magnetic flux? Give a reason for your answer. (2)

9.3 How can the magnetic flux be increased? (2)

9.4 Two types of generators are shown below. Study the diagram carefully and answer the questions that follow:

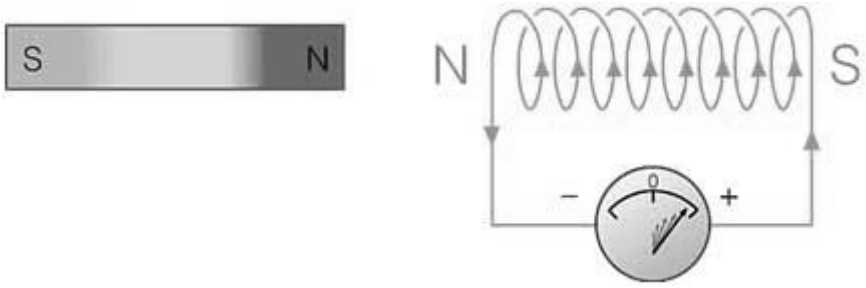


9.4.1 Which one of the diagrams represents an AC generator? Write down only **A** or **B**. (1)

9.4.2 Give a reason for your answer in 9.4.1 above. (2)
[9]

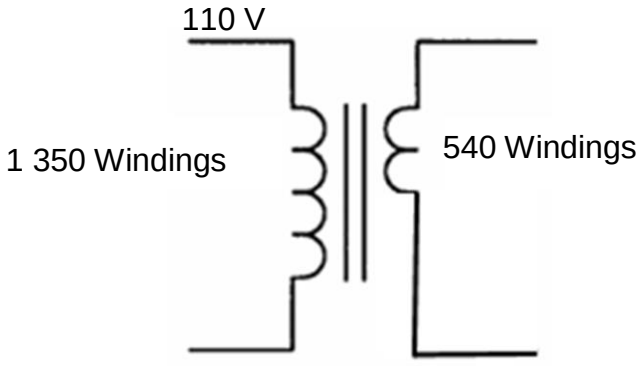
QUESTION 10 (Start on a new page.)

The coil below is connected to a galvanometer. The magnet was moved in and out of the coil as shown in the picture.



10.1 Explain how the reading on the galvanometer above can be generated when the magnet was moved in and out of the coil. (1)

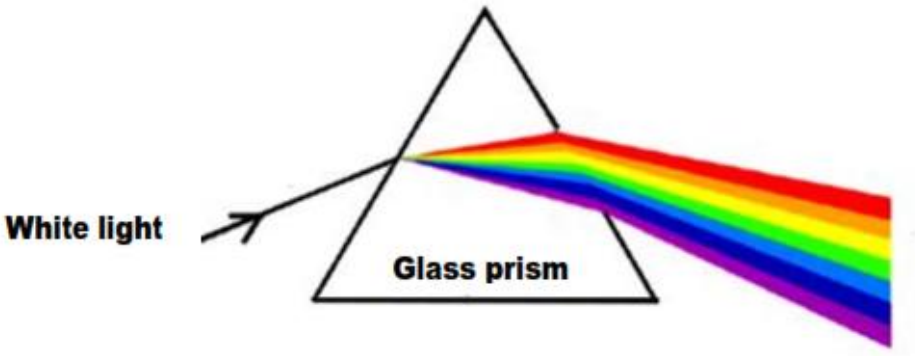
The transformer shown below has a potential difference of 110 V on the primary coil with 1 350 windings. The secondary coil has 540 windings.



10.2 Calculate the potential difference that is generated at the secondary coil. (4)
[5]

QUESTION 11 (Start on a new page.)

11.1 When white light falls into a triangular prism, the following phenomenon is observed as shown in the diagram below.



11.1.1 Define the phenomenon demonstrated in the diagram above. (2)

11.1.2 Which colour of light is refracted the most? Give a reason for your answer. (3)

11.2 Light can undergo total internal reflection in different media, like water and glass.

11.2.1 Give ONE condition for light to undergo total internal reflection. (2)

11.2.2 State the *law of reflection* in words. (2)

11.3 Give ONE word for the following definitions:

11.3.1 An imaginary line that is perpendicular to the surface of an object. (1)

11.3.2 When a ray of light is incident on an irregular surface and is reflected in all directions. (1)

11.4 Write TWO properties of an image in a flat mirror. (2)

[13]

QUESTION 12 (Start on a new page.)

A radio station **X**, broadcasts an FM radio signal at 89,7 MHz.

12.1 Calculate the wavelength of this radio station. (4)

12.2 The frequency of another radio station **Y**, is 100,6 MHz.
How does the wavelength of the radio station **X** compare with that of radio station **Y**? Write down only EQUAL TO; SHORTER THAN or LONGER THAN. (1)

12.3 Explain your answer to QUESTION 12.2 above. (2)
[7]

TOTAL: 150

END

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

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity/ *Swaartekragversnelling*	g	9,8 $m \cdot s^{-2}$
Permittivity of free space/ *Permittiwiteit van vrye ruimte*	ε_0	8,85 x 10^{-12} $F \cdot m^{-1}$
Speed of light in a vacuum/ *Spoed van lig in 'n vakuum*	c	3,0 x 10^{8} $m \cdot s^{-1}$
Planck's constant/ *Planck se konstante*	h	6,63 x 10^{-34} $J \cdot s$

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

FORCE/*KRAG*

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

WORK, ENERGY AND POWER/*WERK, ENERGIE EN KRAG*

$W = F\Delta x\cos\theta$	$U = mgh$ 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/*STROOMELEKTRISITEIT*

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

ELECTROMAGNETISM/*ELEKTROMAGNETISME*

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

WAVES, SOUND AND LIGHT/*GOLWE, KLANK EN LIG*

$v = f\lambda$ or/*of* $v = v\lambda$	$T = \frac{1}{f}$ or/*of* $T = \frac{1}{v}$
$E = hf$ or/*of* $E = hv$ or/*of* $E = h\frac{c}{\lambda}$	