GRADE 11 EXEMPLAR PAPERS

PHYSICAL SCIENCE: PAPER I

Time: 3 hours | 150 marks

QUESTION 1

1.1 Give one word/term for the following descriptions.

1.1.1 The disturbance of the medium is in the direction of propagation of the wave. (1)

1.1.2 A generic name for the material that is used in capacitors to increase its capacitance. (1)

1.2 Consider the following statements and decide which are true or which are false. Correct any false statement.

1.2.1 Particles of the medium are in phase when they are one wavelength apart.

1.2.2 Increasing the distance between the plates of a capacitor increases its capacitance. (3)

1.3 The following are Multiple Choice questions …

1.3.1 In the formula generated from Coulomb's Law, the unit for F is:

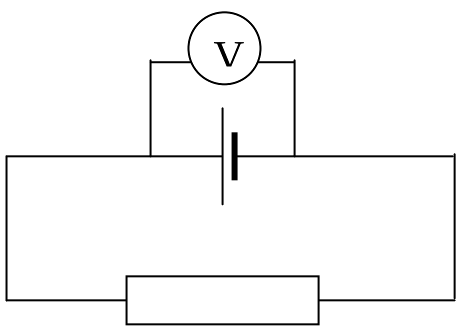
A N
B $N.C^2.m^{-2}$
C $N.m^2.C^{-2}$
D $V.m^{-1}$ (2)

1.3.2 The pitch and loudness of sound depends on:

	Pitch	**Loudness**
A	Frequency	Amplitude of vibration
B	Frequency	Speed of vibration
C	Amplitude of vibration	Frequency
D	Speed of vibration	Frequency

(2)

1.3.3 A closed circuit is made up of a cell, with internal resistance, connected in series to a resistor, and a voltmeter connected across the cell.



When a second resistor is connected in parallel to the first resistor, the reading on the voltmeter …

A increases
B stays the same
C decreases
D increases at first, then decreases to the original value. (2)

11 marks

QUESTION 2

In the past 60 years we have seen major developments in cars. Thanks to the influence of science and technology the average car has changed from cramped, slow, fuel inefficient, rigid and unsafe to become spacious, fast, streamlined, fuel efficient, soft and much safer.

2.1 Safety has improved because of innovations like better braking, seat belts, changing the front end of the car to a crumple front and improving the grip of the tyres they use, to name a few.
Designers have made use of scientific concepts such as pressure, Newton's Laws of motion, impulse, change in momentum, kinetic energy and others to direct their improvement.

1936 DKW F-5 Roadster

1999 BMW 320i

Vertical front window	Slanted front window
Steel bumpers	Plastic bumper
2 doors	2 doors
No seat belts	Seat belts and air bag
Steel body	Soft metal body
Solid steering column	Collapsible steering column

2.1.1 Draw up a table in which you list 4 safety features common to modern cars and match these safety features to the scientific concept that explains why they work. (4)

2.1.2 Choose one of the safety features from your table and explain how the scientific concept explains the function of the safety feature. (2)

2.2 Consider the following info/specifications for a VW Polo 1.9 Tdi and an Audi Q7 3,0 Tdi SUV.

VW Polo

VW SUV

	VW Polo 1.9 Tdi	Audi Q7 3,0 Tdi SUV
Fuel Consumption	6,03 l/100 km	11,25 l/100 km
Braking time from 100 km/h to zero	3,1 s	2,9 s
Max Power	74 kW	283 kW
Top speed	188 km/h	169 km/h
Time to get to 100 km/h	8,24 s	9,83 s

2.2.1 How many litres of petrol are used to cover 1 km in the SUV? (1)

2.2.2 When the Polo is operating at its maximum power, how many joules of energy are needed to get to 100 km/h? (2)

2.2.3 Compare driving a Polo with a SUV.

2.2.3.1 Which would you expect to have the most negative impact on the environment if you were to drive each at the same speed, for the same distance along the same route? Give a one sentence reason for your choice. (1)

2.2.3.2 List three negative effects that driving motor vehicles has on the environment. (3)

2.2.3.3 Give a difference between the Polo and the SUV, not listed on the table that you could have used to predict which of the two vehicles has the greater fuel consumption. Explain briefly. (2)

2.2.3.4 Why was "…at the same speed, for the same distance along the same route" included in question 2.2.3.1? Explain briefly. (2)

2.3 The following table gives the position of the Polo against time as it accelerates from rest (assume constant acceleration).

Time, t, in s	Δt^2	VW Polo 1.9 Tdi Position x (in m)
0		0
1		1,70
1,5		3,80
2		6,80
2,5		10,50
3		15,30

2.3.1 Plot a graph for the change in position, Δx, versus Δt for the VW Polo on the graph paper provided. (3)

2.3.2 For constantly accelerated straight line motion, the change in position is given by:

$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ where Δx = change in position, v_i = initial velocity, a = acceleration and Δt = the time elapsed.

(a) Simplify this equation for an object starting from rest. (1)

(b) Complete the second column in the table. Write down only the values. (1)

(c) Plot a graph of change in position, Δx, versus Δt^2. (3)

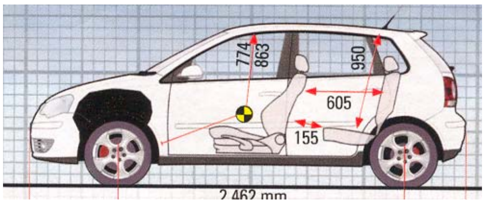
(d) Using the equation you gave in (a) deduce the significance of the slope of the graph you plotted in (c). (1)

(e) Hence, give the quantity and deduce its value from your graph plotted in answer to question (c). (2)

28 marks

QUESTION 3 Forces

3.1 The diagram shows a VW Polo car that has a mass of 1 264 kg. The force of friction on each wheel is 700 N and the normal reaction force on each wheel is 3 160 N.

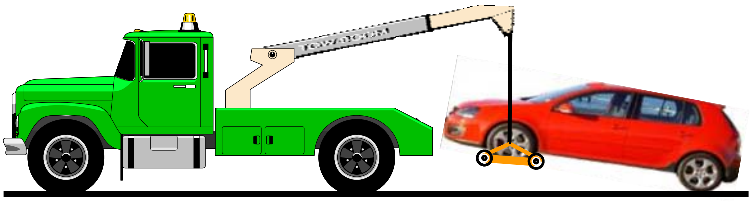


Imagine that the car is moving to the left at a constant velocity.

3.1.1 Draw a force diagram (not to scale) of all the forces acting on the left front wheel. (3)

3.1.2 Calculate the co-efficient of kinetic friction. (3)

3.2 The VW Polo's engine stops working and a crane is required to lift the front wheels of the car. The mass of the car is 1 264 kg. Assume the crane lifts half the mass.



Calculate the tension in the cable at the moment the car accelerates upwards at 0,35 $m.s^{-2}$. (4)

10 marks

QUESTION 4 Newton's laws, impulse and momentum

A driver in a bakkie (mass of man 75 kg and the bakkie is 1400 kg) is travelling along a straight road at 36 $m.s^{-1}$ when he misjudges an exit point and crashes into a tree. It takes the bakkie 0,09 s to come to a complete halt.

4.1 Calculate the magnitude of the average force exerted on the bakkie. (3)

4.2 Study the picture of the crashed bakkie. From the evidence in the picture decide whether the driver was wearing his seat belt or not. Justify your answer. (3)

6 marks

QUESTION 5 Newton's Law of Universal Gravitation

The mass of the Audi Q7 3,0 Tdi SUV is 2 600 kg. The mass of the earth is 6×10^{24} kg and the radius of the earth is $6,4 \times 10^{3}$ km.

5.1 Use Newton's Law of Universal Gravitation to calculate the force of attraction between the earth and the Audi. (3)

5.2 Why do we not observe the force that exists between two cars that are parked next to each other on a horizontal surface on earth? (3)

6 marks

QUESTION 6 Waves and sound

6. A car and a truck are involved in a head on collision. Much noise is generated by the crash. Tracy is standing 62 m away from the crash when she hears the first sounds.

6.1 Explain how the sound is generated and how it is propagated so that she can hear the sound. (3)

6.2 How long does it take for the sound to reach her? (2)

6.3 Design and describe an experiment you could use to determine the speed of sound in air.

You must include the following in your write up: aim, hypothesis, apparatus, method, control variable(s) and conclusion. (7)

6.4 At the crash site Tracy hears an accident victim request to be taken to a hospital to have an ultrasound to check on her unborn baby.

6.4.1 What is an ultrasound? (1)

6.4.2 Give a one or two sentence explanation of the principle on which ultrasound works. (3)

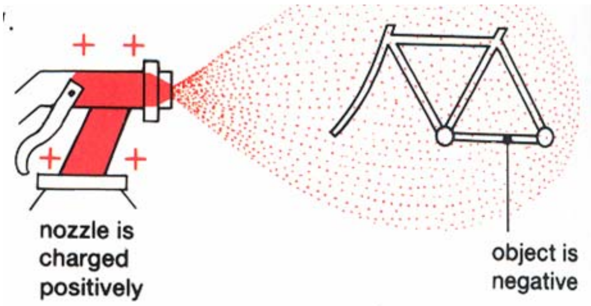
6.4.3 Give another use of ultrasound. (1)

17 marks

QUESTION 7

Science has also helped the motor industry by providing the theoretical knowledge that lead to developing the technique that allows objects to be painted (sprayed) without too much hassle. Bicycles and cars are painted using an electrostatic spray. The nozzle is given a positive charge which in turn charges the expelled droplets of paint also positively to form a large even cloud. They are then attracted towards the object that is negatively charged.

[Ref *Physics for you*, Keith Johnson]



The droplets of paint repel each other but are attracted to the object

7.1 Consider two of these droplets of paint. They are 3 mm apart and each carry a charge of 5nC.

7.1.1 Draw the electric field pattern around these two charges. (3)

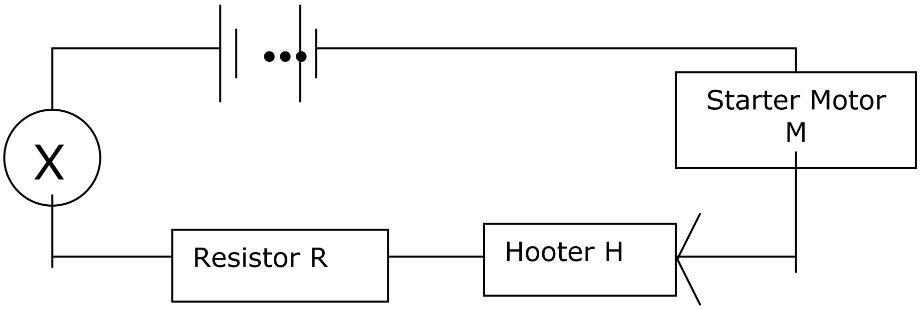
7.1.2 Calculate the magnitude of the force that exists between these two charges. (4)

7.2 Although this is a very useful technique, what concerns would someone have when working in a closed environment while spraying a car and why? (4)

11 marks

Question 8 Circuits and Electromagnetism

Consider the following basic circuit found in a motor car. A battery with internal resistance r and emf of 12 V is connected in series to a bulb, resistor R, Hooter H and a starter motor M, each with a respective resistance of 1Ω, 16 Ω, 8 Ω and 35 Ω . When the current is flowing in the circuit the potential difference across the battery drops to 10,8 V.



8.1 Calculate the current flowing in the circuit. (3)

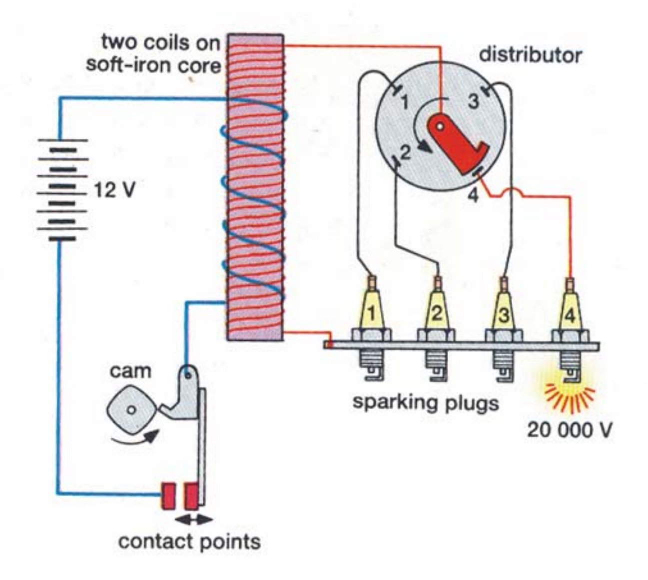
8.2 Calculate resistance r. (3)

8.3 How much heat is generated in the resistor R in 25 minutes? (3)

8.4 Consider the diagram of a circuit including an induction coil

To make the car run effectively, the 12 V battery is connected to **an induction coil** which works like a step-up transformer, but with direct current. This current is switched on and off using the rotating cam (a rotating surface with rises and falls that opens and closes the switches in a timer). There are 50 turns on the primary coil and 80 000 turns on the secondary coil.

An induction coil ('a step-up transformer') in a circuit to generate high voltages that causes the spark plugs to ‘fire’



Using the diagram to help, give a brief explanation on how a scientist's understanding of electromagnetic induction is used in an induction coil to produce a high voltage using direct current. (3)

8.5 Calculate the stepped up voltage. (3)

8.6 This voltage is sufficient to cause a spark or electrical discharge across parallel plates at the tip of the spark plug.

8.6.1 If the distance between the plates is 2 mm, calculate the magnitude of the electric field strength at the tip. (2)

8.6.2 How much energy is needed to move an electron between the plates? (3)

8.7 An electronic device that makes use of parallel plates is a capacitor.

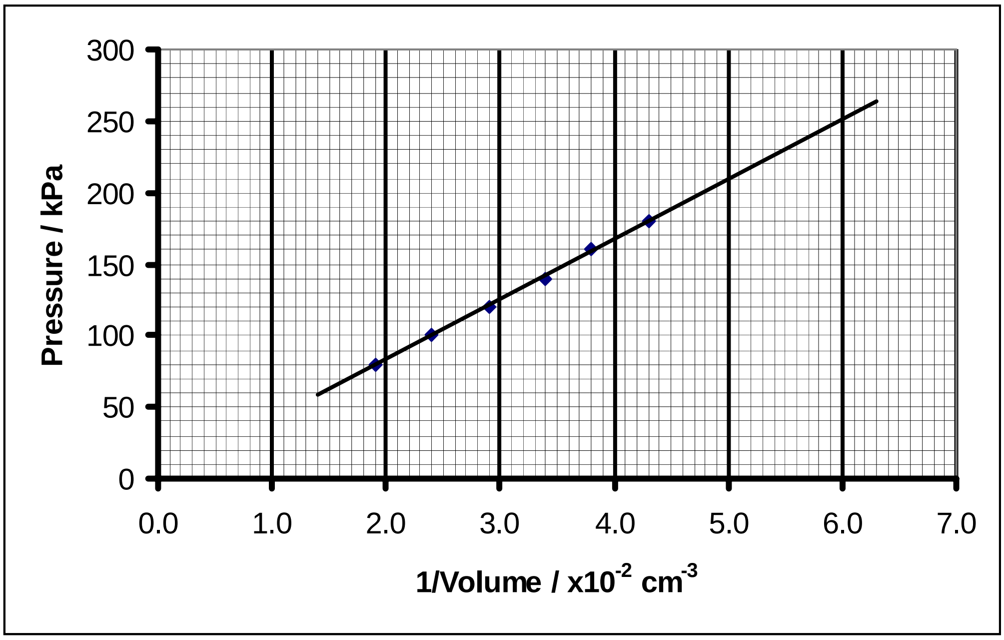
8.7.1 What is the use of a capacitor in an electrical circuit? (1)

8.7.2 If an electron moves between the parallel plates which have a potential difference of 6 V, calculate the capacitance of the capacitor. (2)

23 marks

QUESTION 9 Phases of matter

9.1 An experiment was carried out to investigate the relationship between the pressure exerted by a sample of air and the volume of the air. The following graph of P(kPa) versus 1/V(cm^{-3}) for the air taken at 25°C was generated.



9.1.1 Draw up a table of results from which this graph can be plotted. (2)

9.1.2 Calculate the gradient of the graph. (2)

9.1.3 What does the gradient of the graph represent? (1)

9.1.4 What is the relationship between pressure and volume for this sample of gas? (1)

9.1.5 Using data from your table, calculate the number of moles of gas that were used in this experiment. (4)

9.1.6 If this experiment was carried out at a higher temperature, what do you think would happen to:

(a) the gradient of the graph? (1)
(b) the value of pV? (1)

9.2

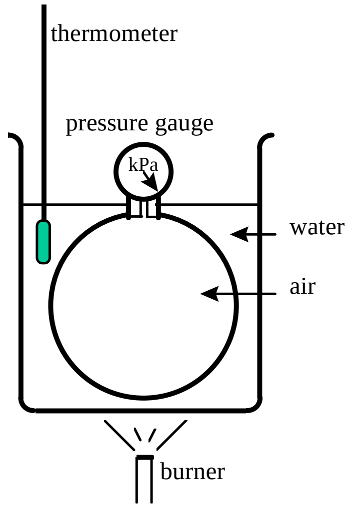
9.2.1 Remembering air is not an ideal gas; draw a sketch to show the shape of the graph for values of 1/V from 0 to 0,04 cm^{-3}. (2)

9.2.2 Using the Kinetic Theory of matter, explain the shape of the graph. (3)

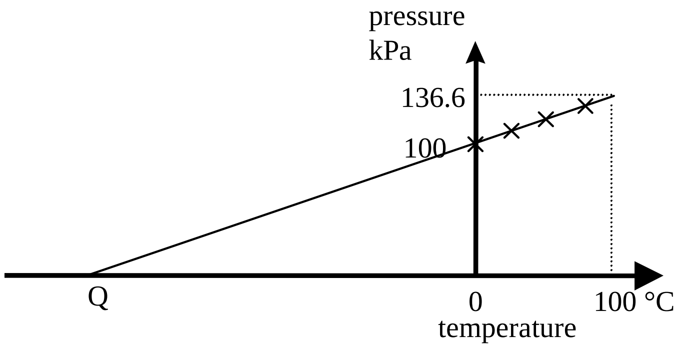
17 marks

QUESTION 10 Phases of matter

A teacher uses a thick walled round bottom flask filled with air, to which she has attached a pressure gauge, to investigate one of the gas laws. See the sketch.



She plots the data she collects on a graph as follows:



10.1 Which of the possible variables in such an investigation, amount of gas, pressure of gas, volume of gas and temperature of gas, is the teacher keeping constant? (2)

10.2 Which one of the variables does the teacher change? (1)

10.3. How does the teacher change this variable? (1)

10.4 According to the graph, what pressure can we expect the air in the flask to exert at temperature Q? (1)

10.5 We give the relationship between the pressure (p) and the temperature (T in Kelvin) using the equation p = kT.

Explain how the teacher can use the graph to arrive at this equation. (3)

8 marks

QUESTION 11

Modern motor cars are an example of the use of science to develop technology that has impacted on humans.

11.1 Make separate lists of the positive impact and negative impact of cars on humans and the environment. (6)

11.2 Write a paragraph in which you describe what should be done and why, to capitalise on the positives and negate the negatives on your lists. (6)

12 marks

Total: 150 marks