TEACHERS WITHOUT BORDERS PROGRAMME

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GRADE 11
June 2019

PHYSICAL SCIENCES

TIME: 2 hours + 10 mins reading time **130 marks**

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of 10 pages, and a Data Sheet. Please make sure that your question paper is complete.
2. Answer ALL the questions.
3. Read the questions carefully.
4. Question 1 consists of 5 multiple-choice questions. There is only one correct answer to each question. The letter that corresponds with your choice of the correct answer must be marked with a cross as shown in the example below:

A	B	C	D

Here, C is the answer

5. Use the data and formulae whenever necessary.
6. **Start each question on a new page**.
7. You may use an approved, non-programmable and non-graphical calculator, unless otherwise stated.
8. Units need not be included in the working of calculations, but appropriate units should be shown in the answer.
9. Where appropriate, express answers to TWO decimal places.
10. It is in your own interests to write legibly and set your work out neatly.

QUESTION 1

Answer these questions on the Answer Sheet provided. Make a cross (X) in the box corresponding to the letter that you consider to be correct.

1.1 Newton's Second Law can be expressed mathematically as $F_{net} = ma$. This equation consists of:

A. one vector quantity and two scalar quantities
B. two vector quantities and one scalar quantity
C. three vector quantities
D. three scalar quantities (2)

1.2 A 20,4 kg box remains ***at rest*** on a horizontal surface while the box is pushed horizontally with a force of 60 N. The coefficient of static friction between the box and the surface is 0,60. What is the force of friction acting on the box during the push? (Rounded off to the closest whole number)

A. 200 N
B. 140 N
C. 120 N
D. 60 N (2)

1.3 The chemical formula for potassium chlorate is:

A. $K_2C\ell O_3$
B. $K_3C\ell O_2$
C. $KC\ell$
D. $KC\ell O_3$ (2)

1.4 The carbon tetrachloride molecule (CCl_4) is non-polar because:

A. The atoms in the molecule have a linear arrangement.
B. The molecule is not symmetric.
C. The difference in the electronegativity of the atoms is too small.
D. The molecule is tetrahedral. (2)

1.5 8 mole of zinc is mixed with 7 mole of hydrochloric acid and allowed to react to form zinc chloride and hydrogen gas, according to the following balanced equation:

$Zn(s) + 2\ HC\ell(aq) \rightarrow ZnC\ell_2(aq) + H_2(g)$

If 2 mole of $H_2(g)$ is formed during the reaction, the number of moles of Zn(s) and $HC\ell(aq)$ that **remain** in the container respectively are:

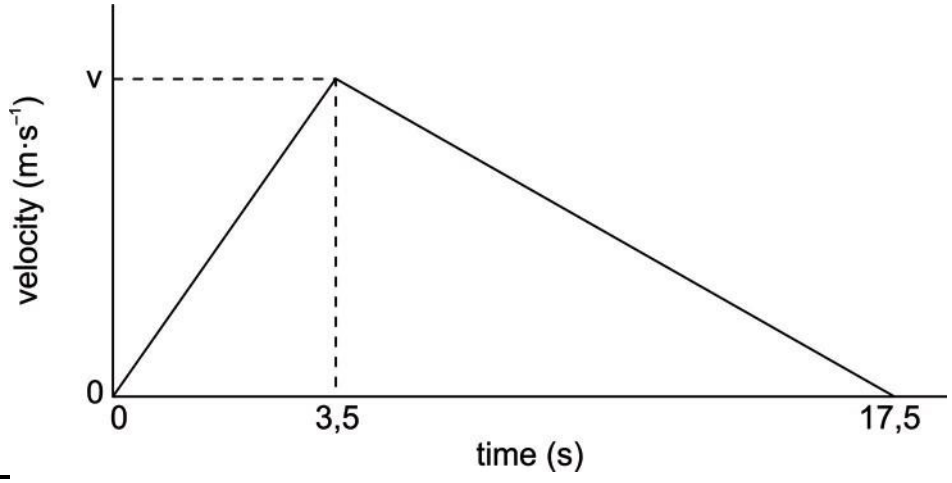
	Mol of Zn	**Mol of HCl**
A	6	5
B	0	5
C	0	1
D	6	3

(2)

[10]

QUESTION 2

2.1 A toy car is pushed in a **northerly** direction along the ground for several seconds and then released. The car continues to move until friction brings it to rest. The velocity-time graph shown below represents the motion of the toy car.



The total distance travelled by the toy car in 17,5 s is 29,8 m.

2.1.1 Define *velocity*. (2)

2.1.2 Calculate the magnitude of the maximum velocity of the car. (3)

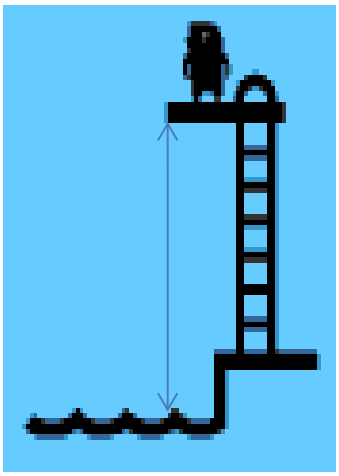
2.1.3 Calculate the acceleration of the car during the last 14 s (3)

The car has a mass of 20 kg. The only forces acting on the car during the last 14 s are weight and friction.

2.1.4 State Newton's Second Law (2)

2.1.5 Calculate the frictional force on the car during the last 14 s. (4)

2.2 A 75 kg diver jumps from a diving board with an initial upward velocity of 4 $m.s^{-1}$. He is in the air for 1,3 s before reaching the water below. (***Take up as positive***)



2.2.1 Calculate the maximum height, above the board, reached by the diver. (3)

2.2.2 Determine the height of the diving board above the water surface. (3)

The diver enters the water with a speed of 8,65 $m.s^{-1}$ and is brought to a stop in a time of 0,9 s while he travels vertically downwards through the water. He then turns around and returns to the surface.

2.2.3 Calculate the magnitude of the deceleration of the diver while in the water. (3)

2.2.4 Calculate the net force which brings the diver to a stop. (4)

2.2.5 Sketch the velocity-time graph to represent the motion of the diver from the time that he leaves the diving board to when he is brought to a stop under water.

On your graph show the following:

* **labe**l the point of maximum height as **H**

* the point at which the diver enters the water as **W**

*** his initial velocity**

*** his velocity as he hits the water**

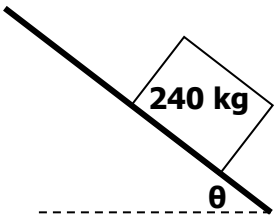
*** the time he hits the water**

*** the time he is brought to a stop under the water** (6)

[33]

QUESTION 3

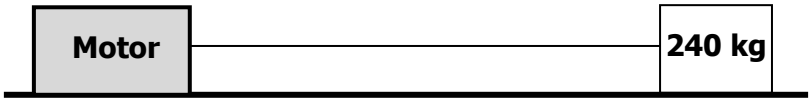
A crate, of mass 240 kg, at rest on an inclined plane is **just *on the point of sliding***. The maximum static frictional force acting on the crate is 1 382 N.



3.1 Draw a ***fully-labelled***, free-body diagram of all the forces acting on the crate. (3)

3.2 If the angle of the slope is 36°, calculate the co-efficient of static friction between the crate and the surface of the plane. (4)

3.3 The angle of the inclined plane is adjusted to 0^{o} (i.e. it is now horizontal). A light inextensible cable is attached to the crate and gradually pulled by a motor until the crate is ***just on the point of sliding***.



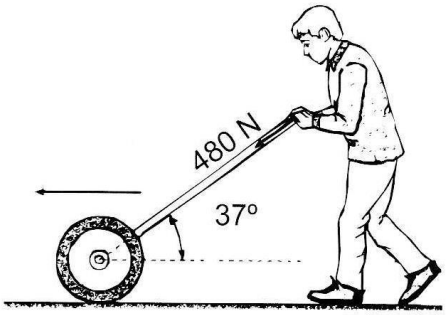
3.3.1 Will the maximum static frictional force now be GREATER THAN, EQUAL TO or LESS THAN it was on the inclined plane? (1)

3.3.2 Explain your answer, by making reference to one or more relevant formulae. ***No further calculations are required***. (4)

[12]

QUESTION 4

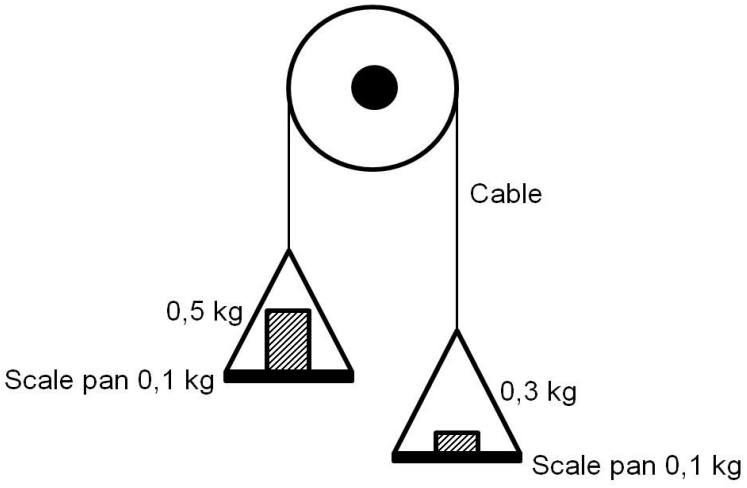
4.1 Riaan pushes a roller of mass 200 kg with a force of 480 N over a rough horizontal path. The force makes an angle of 37^{o} with the horizontal. Riaan pushes the roller with a ***constant acceleration*** of 0,9 m s^{-2}.



4.1.1 Draw a ***fully-labelled***, free-body diagram of all the forces acting on the roller. Remember to consider the relative magnitudes of the forces in your diagram. (4)

4.1.2 Calculate the magnitude of the kinetic frictional force (F_{fk}) between the roller and the surface. (5)

4.2 Two scale pans each of mass 0,1 kg are attached to a light inextensible cable which passes over a smooth pulley. A mass of 0,5 kg is placed on one pan and a mass of 0,3 kg is placed on the other pan as shown in the diagram. The system is released from rest.



4.2.1 Consider each side separately and use Newton's second law to write an equation for each side. Use your equations to calculate the magnitude of the acceleration of the system. (5)

4.2.2 State Newton's third law of motion. (2)

4.2.3 Describe the force that is the Newton third law pair to the force that the scale pan exerts on the 0,5 kg mass. (2)

[18]

QUESTION 5

An astronaut on a planet wants to determine the acceleration due to gravity. The astronaut has a number of different masses available and determines the weight of each mass.

The following measurements were recorded by the astronaut:

Mass (kg)	Weight (N)
0,1	0,30
0,2	0,79
0,3	1,05
0,5	1,90
0,6	2,18
0,7	2,70

5.1 Distinguish between mass and weight. (2)

5.2 Plot a graph of weight (on the *y*-axis) vs mass (on the *x*-axis) on the graph paper provided **in the answer sheet**. (6)

5.3 Calculate the gradient of the graph. Show the values you used on your graph and include the appropriate unit in your answer. (3)

5.4 Hence, determine the acceleration due to gravity on the planet. (2)
Use the table of "g values" below to answer the questions that follow.

Planet	g ($m \cdot s^{-2}$)
Venus	8,87
Mars	3,71
Jupiter	23,12
Pluto	0,58

5.5 Which planet is the astronaut on? (1)

5.6 The radius of Pluto is $1{,}19 \times 10^{6}$ m. Determine the mass of Pluto. (4)

[18]

QUESTION 6

6.1 160 cm^3 of a 1,5 $mol.dm^{-3}$ nitric acid (HNO_3) standard solution reacts with 15 g of calcium carbonate, according to the following balanced reaction:

$$\mathbf{2HNO_3 + CaCO_3 \rightarrow Ca(NO_3)_2 + H_2O + CO_2}$$

6.1.1 Calculate the number of moles of nitric acid used. (3)

6.1.2 Using suitable calculations, determine the **limiting** reagent in the above reaction. (4)

6.2 The purity of a sample of NaCℓ was tested by means of a reaction represented by the following balanced chemical equation:

$$\mathbf{10NaC\ell(s) + 8H_2SO_4 + 2KMnO_4 \rightarrow 5C\ell_2(g) + 2MnSO_4 + 5Na_2SO4 + K_2SO_4 + 8H_2O}$$

When 20 g of impure NaCℓ was treated with excess H_2SO_4 and $KMnO_4$, 3,36 dm^3 of chlorine gas ($C\ell_2$) was formed at STP.

Calculate the % purity of the NaCℓ sample. (8)

[15]

QUESTION 7

Consider the following substances at room temperature represented by their chemical formulae.

Ne (g) **CF_4(g)** **NH_3(g)** **HCℓ (g)** **KBr (s)** **Zn(s)** **SiO_2(s)**

Use the substances in the list **once**, **more than once** or **not at all** in response to the descriptions.

Give the formula of **ONE** substance from the above list which ….

7.1 experiences hydrogen bond forces when in the liquid phase.

7.2 conducts electricity when molten but not as a solid.

7.3 has delocalised valence electrons.

7.4 does not dissolve in water but dissolves in CCl_4

7.5 has induced dipole (London) forces between its atoms

7.6 has a giant covalent network structure

[6]

QUESTION 8

Consider the list of six substances with their formulae and boiling points in the table below:

NAME OF SUBSTANCE	FORMULA	BOILING POINT (^{O}C)	MELTING POINT (^{O}C)
Water	H_2O	100	0
Bromine	Br_2	58,8	-7
Iodine	I_2	184,3	114
Ammonia	NH_3	-33,3	-78
Phosphine	PH_3	-87,7	-133
Sodium chloride	NaCl		1074

8.1 Define the following terms:

8.1.1 *Intramolecular bond* (2)

8.1.2 *Intermolecular force* (2)

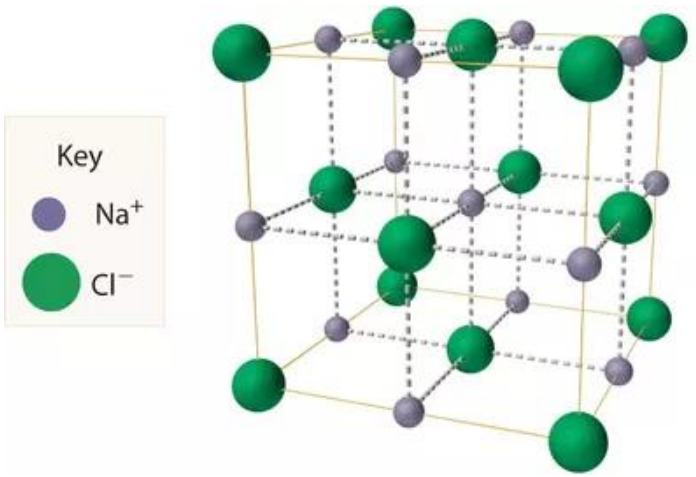
8.2 Consider bromine.

8.2.1 Name the intermolecular force found between bromine molecules. (1)

8.2.2 Provide the specific name for the intramolecular bond found in Br_2. (2)

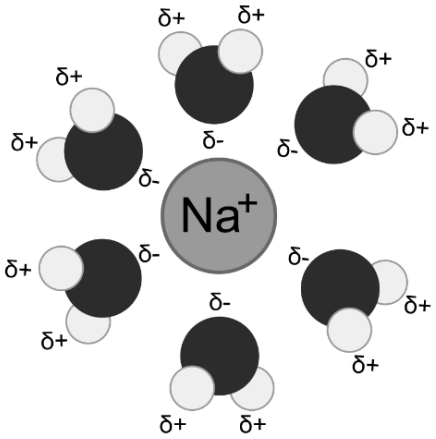
8.3 Explain, why the melting point of iodine is higher than the melting point of bromine . (4)

8.4 Explain why the heat energy required to melt sodium chloride is large by referring to the image below. (3)



Source: http://physicsopenlab.org accessed on 11 August 2018

8.5 The diagram below shows the arrangement of water particles around a dissolved sodium ion.



8.5.1 What is the name of the intermolecular force responsible for this dissolving process? (1)

8.5.2 Which molecular substance in the table is extremely soluble in water? Explain your choice (3)

[18]

[Total marks = 130]