education

Department of Education
FREE STATE PROVINCE

# JUNE EXAMINATION

## GRADE 11

# PHYSICAL SCIENCES

## JUNE 2023

## MARKS: 150

Stanmorephysics

## TIME: 3 HOURS

**This paper consists of 15 pages and three information sheets.**

**INSTRUCTIONS AND INFORMATION**

1. Write your name and other information in the appropriate spaces on the ANSWER BOOK.

2. This question paper consists of 10 questions. Answer ALL 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 two sub-questions, for example between QUESTION 2.1 and QUESTION 2.2.

6. You may use a non-programmable pocket calculator.

7. You may use appropriate mathematical instruments.

8. You are advised to use the attached DATA SHEETS.

9. Show ALL formulae and substitutions in ALL calculations.

10. Round off your FINAL numerical answers to a minimum of TWO decimal places where applicable.

11. Give brief motivations, discussions, et cetera where required.

12. 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. Choose the answer and write down only the letter A, B, C or D next to the question number (1.1–1.10) in your ANSWER BOOK.

1.1 Two forces of 3 N and 5 N respectively, act simultaneously at the same point. The magnitude of their resultant force is 2 N. What will the angle between the two forces be?

A 0°

B 90°

C 180°

D 360° (2)

1.2 An object is moving at a CONSTANT VELOCITY, this means that …

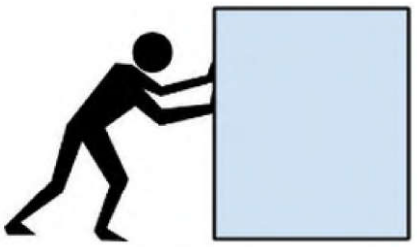
A no forces are acting on an object.

B a constant force is acting on the object.

C the only force acting on the object is gravitational force.

D all the forces acting on the object, together form a closed vector diagram. (2)

1.3 A man tries to move a block, but the block is NOT moving. Which one of the following statements best explains why the block will not move?



A The force the man exerts on the block is greater than the force the block exerts on the man.

B The force the man exerts on the block is smaller than the force the block exerts on the man.

C The force friction exerts on the block is greater than the force the man exerts on the block.

D The resultant force acting on the block is zero. (2)

1.4 Object **X** with an unknown mass is a distance **r** away from object **Y** with mass **M**. Object **X** exert a force **F** on object **Y**. What will the force **F** be if **X** is placed at a distance 2**r** from object **Y**?

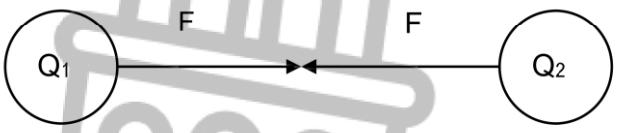
A ¼ **F**

B ½ **F**

C 2 **F**

D 4 **F** (2)

1.5 Two identical charged particles carry equal charges $Q_1$ and $Q_2$. Each charged particle experiences an electrostatic force of magnitude *F* as shown in the diagram below.

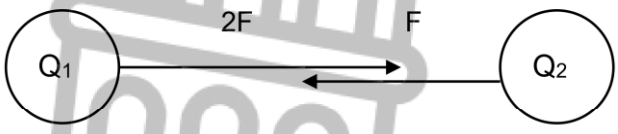



$Q_1$ is doubled, the distance between the particles remains the same. Which one of the following representations is CORRECT?

A



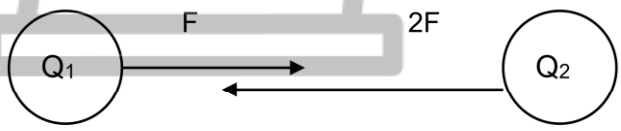

B




C



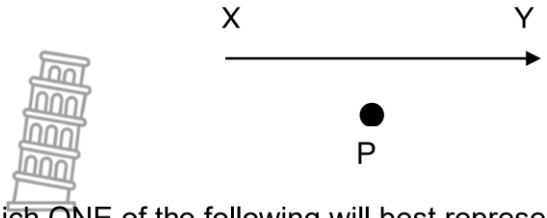

D




(2)

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1.6 An electric current flow through a conducting wire **X** and **Y** as shown in the diagram below.




Which ONE of the following will best represent the direction of the magnetic field at point **P**?

A out of the page

B into the page

C to the right

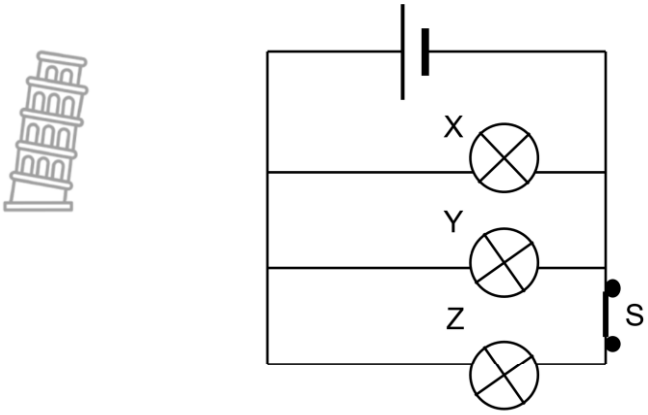
D to the left (2)

1.7 For which one of the quantities below is the CORRECT unit of measurement given?

| | **QUANTITY** | **UNIT** |
|---|---|---|
| A | Current | $A \cdot s^{-1}$ |
| B | Energy | kW |
| C | Potential difference | V |
| D | Resistance | V·s |

(2)

1.8 Three identical bulbs **X**, **Y** and **Z** are connected in parallel in the circuit. Switch **S,** is initially closed. The internal resistance of the battery can be ignored.




Switch **S** is now open, how will this affect the brightness of the bulbs.

| | Bulb **X** | Bulb **Y** | Bulb **Z** |
|---|---|---|---|
| A | increases | increases | no light |
| B | decreases | decreases | no light |
| C | no light | no light | no light |
| D | remain the same | remain the same | no light |

1.9 Which one of the following has a dative covalent bond?

A $NH_3$

B $N_2$

C $NH_4^+$

D $NO_2$ (2)

1.10 Which one of the following substances will have the highest boiling point?

A $H_2$

B $H_2O$

C $H_2S$

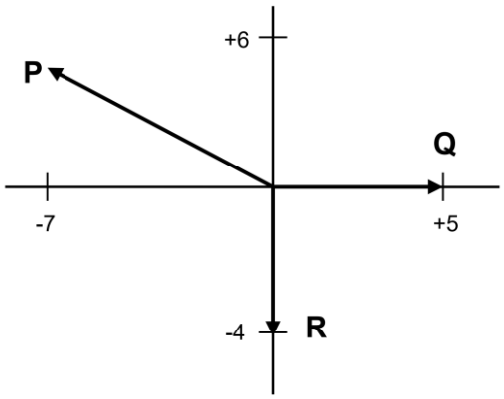
D $H_2Se$ (2)

**[20]**

**QUESTION 2**

2.1 Fana applies a force of 20 N due North on Mpho. At the same time Thabang applies a force of 30 N on Mpho in the OPPOSITE direction to the one by Fana. Calculate the resultant force exerted by Fana and Thabang on Mpho. (3)

2.2 Three vectors **P**, **Q** and **R** on a cartesian plane (NOT DRAWN TO SCALE) are shown below.




2.2.1 Define the term *resultant vector*. (2)

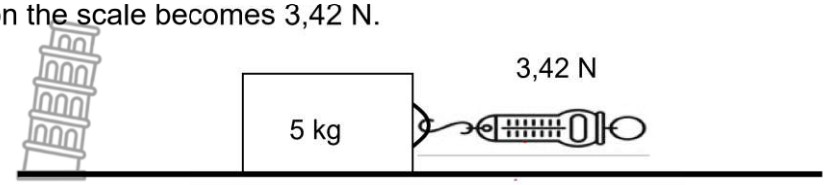
2.2.2 Determine the resultant of **Q** and **R** in Newtons by using head-to-tail method. Indicate the scale used. (6)

2.2.3 Calculate the magnitude of the resultant of all three vectors, **P**, **Q** and **R**, in Newtons. (4)

**[15]**

## QUESTION 3

A 0,1 kg Newton scale is connected to a 5 kg wooden block as shown in the diagram below. When the block moves at a constant velocity across a horizontal surface, the reading on the scale becomes 3,42 N.




3.1 State Newton's first law of motion. (2)

3.2 Is frictional force acting on the block? Write only YES or NO. (1)

3.3 Explain your answer to 3.2 by referring to the Newton's first law of motion. (2)

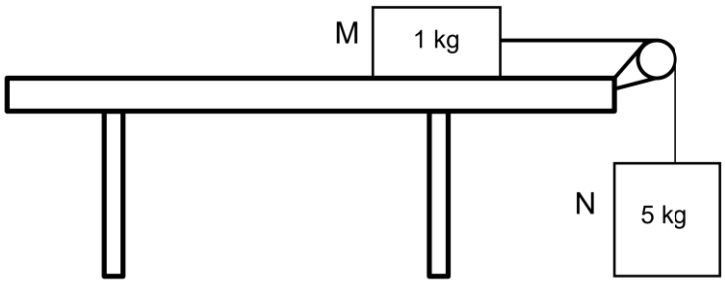
3.4 Draw a free body diagram and identify ALL the forces acting on the block. (4)

3.5 Calculate the magnitude of the coefficient of the frictional force for the block. (4)

**[13]**

## QUESTION 4

4.1 Blocks **M** and **N** of masses 1 kg and 5 kg respectively, are connected with a light inextensible string. The string runs over a frictionless pulley as shown in the diagram. The 1 kg block experiences a frictional force of 3 N.




4.1.1 Define the *frictional force* in words. (2)

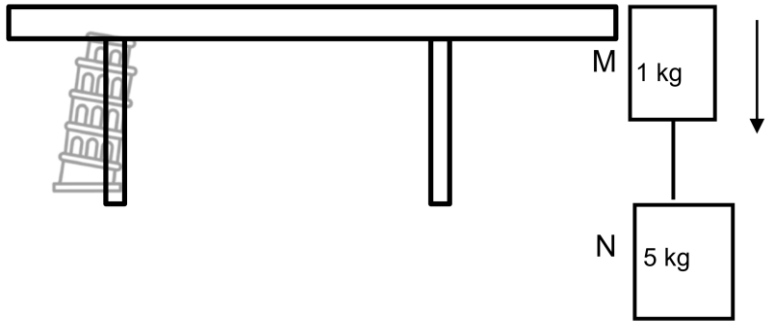
4.1.2 Calculate the magnitude of the tension on the blocks. (6)

4.1.3 A learner presents the following argument:

*The force by **M** on string is equal in magnitude but opposite in direction to the force by **N** on string. Since these two forces are equal in magnitude and opposite in direction, they will cancel each other.*

Is the learner's argument correct? Explain your answer using a relevant Physics law. (4)

4.2 The 1 kg block then sides over the pulley and both blocks fall to the ground as shown in the diagram below.




How does the acceleration of block **M** compare to that of block **N**? Write down only GREATER THAN, SMALLER THAN or EQUAL TO. Explain the answer. (2)

**[14]**

**QUESTION 5**

A 500 kg satellite is moving in an orbit of $3,6 \times 10^7$ m above the earth's surface.

5.1 State Newton's law of universal gravitation. (2)

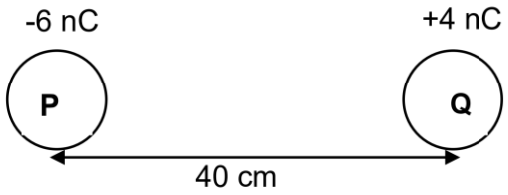
5.2 Calculate the gravitational force exerted by the earth on the satellite. (5)

5.3 Calculate the gravitational acceleration experienced by the satellite due to the force of gravity exerted by the earth on the satellite. (3)

**[10]**

**QUESTION 6**

6.1 Two metal spheres **P** and **Q,** carrying charges -6 nC and +4 nC respectively, are placed 40 cm apart along a straight line, as shown in the diagram below.



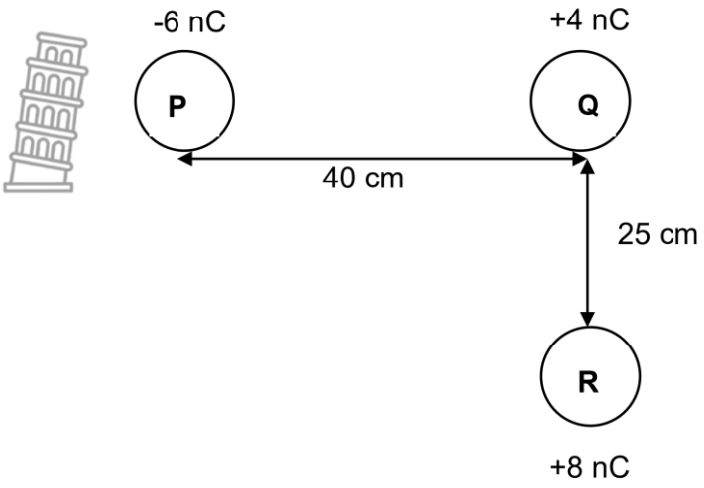

6.1.1 Sphere **Q** experiences an electrostatic force. In which direction will sphere **Q** move? Write down only TO THE LEFT or TO THE RIGHT. (1)

The spheres are now in contact with each other and then separated.

6.1.2 Were electrons REMOVED FROM or TRANSFERRED TO **P**? (1)

6.1.3 Calculate the magnitude of the net charge after the spheres are separated. (3)

6.2 A third sphere **R**, carrying a charge of +8 nC is now placed at a distance of 25 cm from sphere **Q**.




6.2.1 State Coulomb's law in words. (2)

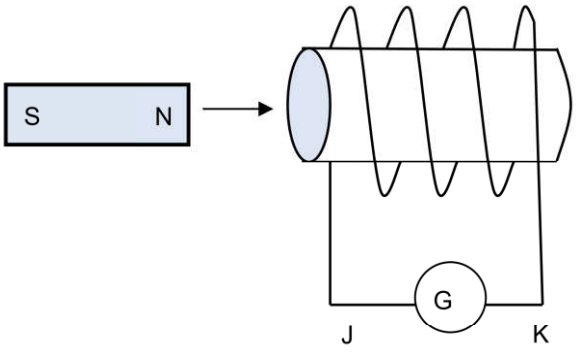
6.2.2 Draw a vector diagram and show the electrostatic forces and the net force experienced by sphere **Q** due to **P** and **R**. (3)

6.2.3 Calculate the net electrostatic force experienced by sphere **Q** due to **P** and **R**. (7)

**[17]**

**QUESTION 7**

7.1 A conducting coil, with a diameter of 0,0015 m is connected to a galvanometer as shown in the diagram below. A bar magnet is pushed into the coil, kept stationary for a brief while and is then pulled out of the coil.

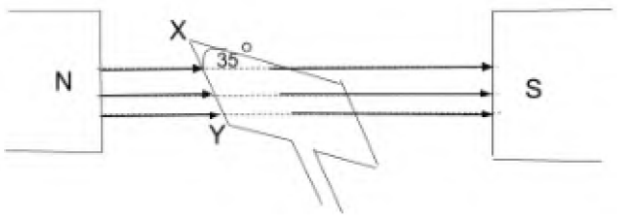



7.1.1 State Faraday's law in words. (2)

7.1.2 Explain how the reading on the galvanometer will change from the moment the magnet enters the coil to the moment it leaves the coil again. (3)

7.1.3 In which direction will the current in the conductor flow when the magnet enters the coil? Write only **J to K** or **K to J.** (1)

7.2 A coil makes an angle of 35° with the horizontal plane. The coil has an area of 0,04 $m^2$ and magnetic field of 0,3 T is directed which passes through the coil as shown in the diagram below.



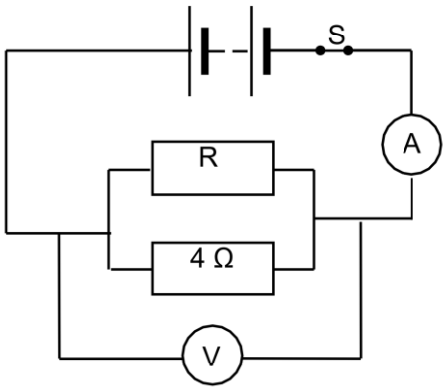

7.2.1 If the coil is rotated clockwise, in which direction does the induced current flow? Write down only X TO Y OR Y TO X. (1)

7.2.2 Which Physics law or principle is used to arrive to the answer in QUESTION 7.2.1? (1)

**[8]**

**QUESTION 8**

8.1 Two resistors, one with a resistance of 4 Ω and the other one of unknown resistance *R*, are connected in parallel. This combination is connected to a voltmeter, an ammeter, a battery and aswitch as indicated below. The current passing through the combination of parallel resistors is measured for VARIOUS potential differences across the combination.




8.1.1 Formulate an investigative question for this investigation. (2)

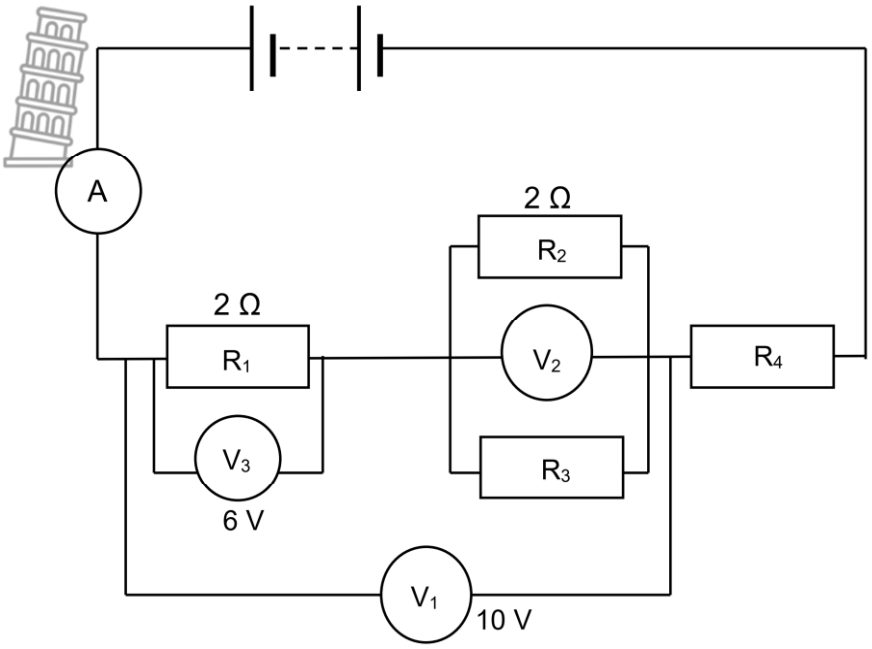
The results of the investigation are as follows:

| **POTENTIAL DIFFERENCE (V)** | 1,5 | 3,0 | 4,5 | 6,0 | 7,5 |
|---|---|---|---|---|---|
| **CURRENT (A)** | 0,75 | 1,50 | 2,25 | 3,00 | 3,75 |

8.1.2 Use the attached graph paper and draw a graph of potential difference versus current using the data in the table. (5)

8.1.3 Calculate the gradient by referring to the graph drawn in QUESTION 8.1.2 (4)

8.2 In the circuit represented below, the battery has negligible internal resistance. Each of resistors $R_1$ and $R_2$ has a resistance of 2 Ω, while the resistances of $R_3$ and $R_4$ are unknown. Voltmeters $V_1$ and $V_3$ have readings of 10 V and 6 V respectively.




8.2.1 Write down *Ohm's law* in words. (2)

Calculate:

8.2.2 The power dissipated by resistor $R_1$. (3)

8.2.3 The reading on the ammeter. (3)

8.2.4 The current in resistor $R_2$. (3)

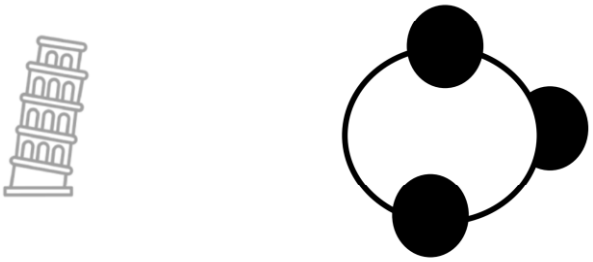
8.2.5 The resistance of resistor $R_3$. (2)

8.2.6 The potential difference across resistor $R_4$ if its power is equal to 6 W. (2)

**[26]**

**QUESTION 9**

Ammonia ($NH_3$) is represented in the diagram below.



9.1 Write down the number of valence electrons for nitrogen. (1)

9.2 Draw the Lewis structure for ammonia. (3)

9.3 Write down the molecular shape of the ammonia molecule (1)

9.4 Explain why ammonia does not have a trigonal planar shape. (2)

9.5 Is ammonia a polar or non-polar molecule? (1)

9.6 Refer to the structure and difference in electronegativity to explain the answer to QUESTION 9.5. (2)

When a hydrogen ion reacts with an ammonia molecule, it forms the ammonium ion.

9.7 By referring to the ammonium ion, explain what is a dative covalent bond. (2)

**[12]**

**QUESTION 10**

Refer to the table below and answer questions that follow.

| Substance | Melting Point (°C) | Boiling Point (°C) | Relative molecular/ atomic mass |
|---|---|---|---|
| Sodium (Na) | 97,79 | 882,8 | 23 |
| Bromine ($Br_2$) | -7,2 | 58,8 | 160 |
| Hydrogen chloride ($HC\ell$) | -114,2 | -85,1 | 36,5 |
| Water ($H_2O$) | 0 | 100 | 18 |

10.1 Define the term *boiling point*. (2)

10.2 By referring to the forces present in hydrogen chloride, explain the difference between intermolecular forces and interatomic forces. (2)

10.3 Which of these substances will be a liquid at +50 °C? (1)

10.4 Refer to intermolecular forces and energy and explain why the boiling point of $HC\ell$ is lower than the boiling point of $H_2O$. (4)

10.5 $NaC\ell$ is dissolved in $H_2O$.

10.5.1 Write down the name the intermolecular forces between $NaC\ell$ and $H_2O$. (1)

10.5.2 Are the intermolecular forces stated in QUESTION 10.5.1 weaker or stronger than those of $H_2O$ molecules. (1)

10.6 Refer to TYPE of INTERMOLECULAR FORCES, MOLECULAR MASS, STRENGTH of INTERMOLECULAR FORCES and ENERGY to explain the big difference in boiling points of $Br_2$ and $HC\ell$. (4)

**[15]**

**GRAND TOTAL: 150**

**DATA FOR PHYSICAL SCIENCES GRADE 11**
**(Physics)**
***GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11***
***(Fisika)***

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

| NAME/NAAM | SYMBOL/SIMBOOL | VALUE/*WAARDE* |
|---|---|---|
| Acceleration due to gravity<br>*Swaartekragversnelling* | g | 9,8 $m \cdot s^{-2}$ |
| Gravitational constant<br>*Swaartekragkonstante* | G | 6,67 x $10^{-11}$ $N \cdot m^2 \cdot kg^{-2}$ |
| Coulomb's constant<br>*Coulomb se konstante* | k | 9,0 x $10^9$ $N \cdot m^2 \cdot C^{-2}$ |
| Speed of light in a vacuum<br>*Spoed van lig in 'n vakuum* | c | 3,0 x $10^8$ $m \cdot s^{-1}$ |
| Charge on electron<br>*Lading op elektron* | e | -1,6 x $10^{-19}$ C |
| Electron mass<br>*Elektronmassa* | $m_e$ | 9,11 x $10^{-31}$ kg |
| Mass of Earth<br>*Massa van Aarde* | M | 5,98 x $10^{24}$ kg |
| Radius of Earth<br>*Radius van Aarde* | $r_E$ | 6,38 x $10^6$ m |

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

### MOTION/BEWEGING

| | |
|---|---|
| $v_f = v_i + a\Delta t$ | $\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$ |
| $v_f^{\,2} = v_i^{\,2} + 2a\Delta x$ | $\Delta x = \left( \frac{v_f + v_i}{2} \right) \Delta t$ |

### FORCE / *KRAG*

| | |
|---|---|
| $F_{net} = ma$ | $w = mg$ |
| $F = \frac{Gm_1m_2}{r^2}$ | $g = \frac{GM}{r^2}$ |
| $f_k = \mu_k N$ | $f_s^{(max)} = \mu_s N$ |

### WEIGHT AND MECHANICAL ENERGY / GEWIG EN MEGANIESE ENERGIE

| | |
|---|---|
| $w = mg$ or/*of* $F_g = mg$ | $U = mgh$ or/*of* $E_p = mgh$ |
| $K = \frac{1}{2}mv^2$ or/*of* $E_k = \frac{1}{2}mv^2$ | |

## ELECTROSTATICS / *ELEKTROSTATIKA*

| | |
|---|---|
| $F = \frac{kQ_1Q_2}{r^2}$ | $E = \frac{kQ}{r^2}$ |
| $E = \frac{V}{d}$ | $E = \frac{F}{q}$ |
| $U = \frac{kQ_1Q_2}{r}$ | $V = \frac{W}{q}$ |
| $C = \frac{Q}{V}$ | $C = \frac{\varepsilon_0 A}{d}$ |



## ELECTROMAGNETISM / *ELEKTROMAGNETISME*

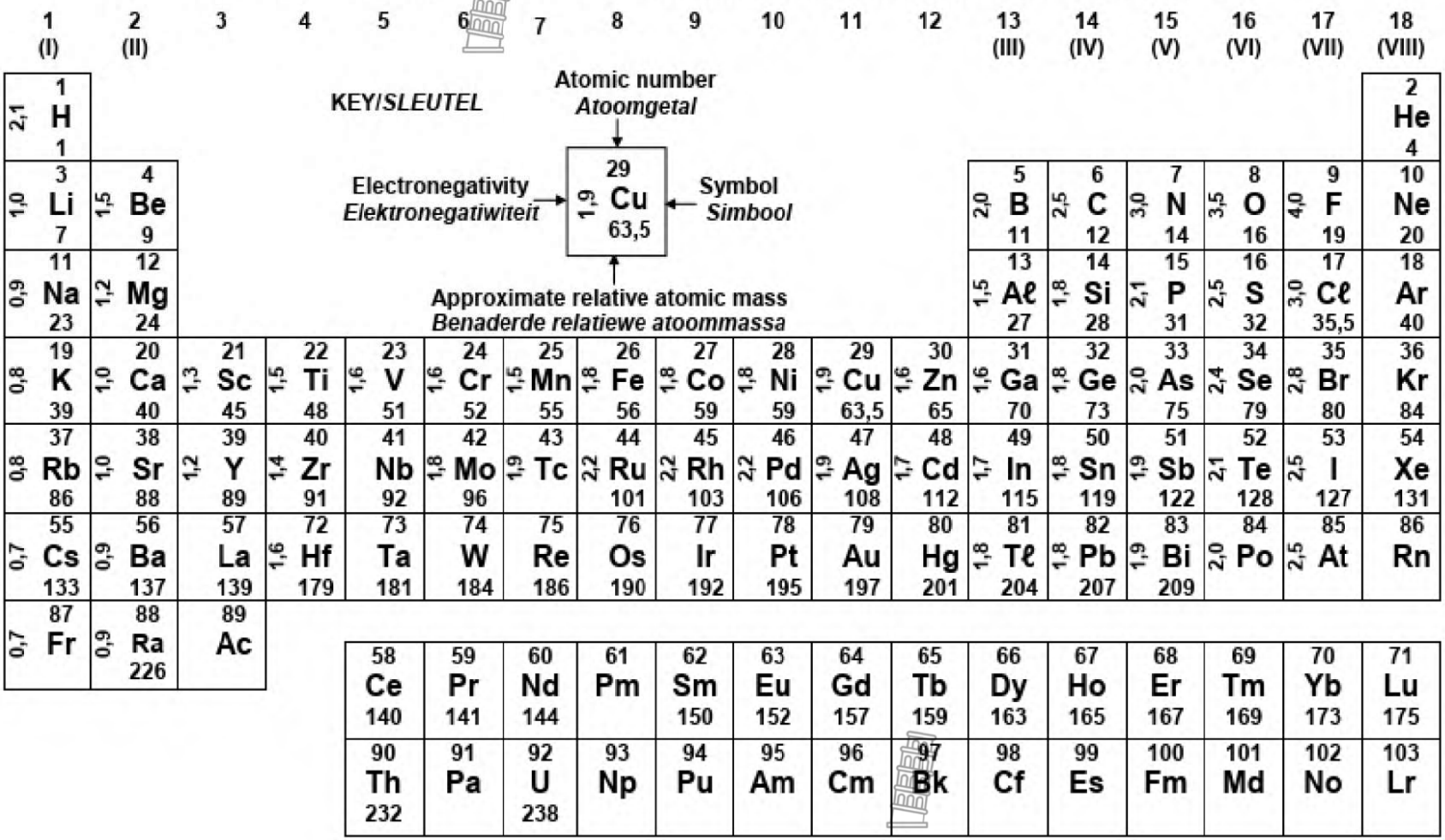
| | |
|---|---|
| $\varepsilon = -N\frac{\Delta\Phi}{\Delta t}$ | $\Phi = BA$ |
| $\frac{V_s}{V_p} = \frac{N_s}{N_p}$ | |

## ELECTRIC CIRCUITS / *ELEKTRIESE STROOMBANE*

| | |
|---|---|
| $I = \frac{Q}{\Delta t}$ | $R = \frac{V}{I}$ |
| $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$ | $R_s = R_1 + R_2 + \ldots$ |
| $W = Vq$<br>$W = VI\Delta t$<br>$W = I^2R\Delta t$<br>$W = \frac{V^2}{R}\Delta t$ | $P = \frac{W}{\Delta t}$<br>$P = VI$<br>$P = I^2R$<br>$P = \frac{V^2}{R}$ |



## TABLE 3: THE PERIODIC TABLE OF ELEMENTS/*TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE*




| 1 (I) | 2 (II) | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 (III) | 14 (IV) | 15 (V) | 16 (VI) | 17 (VII) | 18 (VIII) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1<br>2,1<br>H<br>1 | | | | | | | | | | | | | | | | | 2<br>He<br>4 |
| 3<br>1,0<br>Li<br>7 | 4<br>1,5<br>Be<br>9 | | | | | | | | | | | 5<br>2,0<br>B<br>11 | 6<br>2,5<br>C<br>12 | 7<br>3,0<br>N<br>14 | 8<br>3,5<br>O<br>16 | 9<br>4,0<br>F<br>19 | 10<br>Ne<br>20 |
| 11<br>0,9<br>Na<br>23 | 12<br>1,2<br>Mg<br>24 | | | | | | | | | | | 13<br>1,5<br>Aℓ<br>27 | 14<br>1,8<br>Si<br>28 | 15<br>2,1<br>P<br>31 | 16<br>2,5<br>S<br>32 | 17<br>3,0<br>Cℓ<br>35,5 | 18<br>Ar<br>40 |
| 19<br>0,8<br>K<br>39 | 20<br>1,0<br>Ca<br>40 | 21<br>1,3<br>Sc<br>45 | 22<br>1,5<br>Ti<br>48 | 23<br>1,6<br>V<br>51 | 24<br>1,6<br>Cr<br>52 | 25<br>1,5<br>Mn<br>55 | 26<br>1,8<br>Fe<br>56 | 27<br>1,8<br>Co<br>59 | 28<br>1,8<br>Ni<br>59 | 29<br>1,9<br>Cu<br>63,5 | 30<br>1,6<br>Zn<br>65 | 31<br>1,6<br>Ga<br>70 | 32<br>1,8<br>Ge<br>73 | 33<br>2,0<br>As<br>75 | 34<br>2,4<br>Se<br>79 | 35<br>2,8<br>Br<br>80 | 36<br>Kr<br>84 |
| 37<br>0,8<br>Rb<br>86 | 38<br>1,0<br>Sr<br>88 | 39<br>1,2<br>Y<br>89 | 40<br>1,4<br>Zr<br>91 | 41<br>Nb<br>92 | 42<br>1,8<br>Mo<br>96 | 43<br>1,9<br>Tc | 44<br>2,2<br>Ru<br>101 | 45<br>2,2<br>Rh<br>103 | 46<br>2,2<br>Pd<br>106 | 47<br>1,9<br>Ag<br>108 | 48<br>1,7<br>Cd<br>112 | 49<br>1,7<br>In<br>115 | 50<br>1,8<br>Sn<br>119 | 51<br>1,9<br>Sb<br>122 | 52<br>2,1<br>Te<br>128 | 53<br>2,5<br>I<br>127 | 54<br>Xe<br>131 |
| 55<br>0,7<br>Cs<br>133 | 56<br>0,9<br>Ba<br>137 | 57<br>La<br>139 | 72<br>1,6<br>Hf<br>179 | 73<br>Ta<br>181 | 74<br>W<br>184 | 75<br>Re<br>186 | 76<br>Os<br>190 | 77<br>Ir<br>192 | 78<br>Pt<br>195 | 79<br>Au<br>197 | 80<br>Hg<br>201 | 81<br>1,8<br>Tℓ<br>204 | 82<br>1,8<br>Pb<br>207 | 83<br>1,9<br>Bi<br>209 | 84<br>2,0<br>Po | 85<br>2,5<br>At | 86<br>Rn |
| 87<br>0,7<br>Fr | 88<br>0,9<br>Ra<br>226 | 89<br>Ac | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 58<br>Ce<br>140 | 59<br>Pr<br>141 | 60<br>Nd<br>144 | 61<br>Pm | 62<br>Sm<br>150 | 63<br>Eu<br>152 | 64<br>Gd<br>157 | 65<br>Tb<br>159 | 66<br>Dy<br>163 | 67<br>Ho<br>165 | 68<br>Er<br>167 | 69<br>Tm<br>169 | 70<br>Yb<br>173 | 71<br>Lu<br>175 |
| 90<br>Th<br>232 | 91<br>Pa | 92<br>U<br>238 | 93<br>Np | 94<br>Pu | 95<br>Am | 96<br>Cm | 97<br>Bk | 98<br>Cf | 99<br>Es | 100<br>Fm | 101<br>Md | 102<br>No | 103<br>Lr |

**NAME**: _____

**CLASS**: _____

**8.1.2**



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