ALEXANDER ROAD HIGH SCHOOL

MARCH 2020 TIME = 60 min

PHYSICAL SCIENCES CONTROLLED TEST

CO, JA, MH TOTAL = 55

GRADE 12

Instructions

- The question paper consists of 6 questions.
- Answer all the questions.
- Answer section A on the answer sheet provided AND section B on folio sheets.
- A non-programmable calculator may be used.
- Number the answers correctly according to the numbering system.
- Round off to two (2) decimal places where necessary.
- A formula sheet has been provided at the end of the question paper.
- A half-reaction table has been provided on the back of the answer sheet.

SECTION A

- Answer on the answer sheet -

QUESTION 1: Multiple choice

Four possible options are provided as answers to the following questions. Each question has only 1 correct answer. Choose the correct answer and write the letter (A – D) next to the relevant question number (1.1 – 1.5) on the answer sheet.

1.1 A 50 kg steel sphere and a 25 kg aluminium sphere with the same diameter fall freely from the roof of a tall building. Ignore the effects of air resistance.

When the spheres are 1 m above the ground, they have the same …

A. momentum.
B. acceleration.
C. kinetic energy.
D. potential energy.

1.2 If the total momentum of a system is changing:

A. particles of the system must be exerting forces on each other
B. the system must be under the influence of gravity
C. the system must be moving at a constant velocity
D. a net external force must be acting on the system

1.3 When a line in a hydrogen spectrum is measured in a laboratory, it has a wavelength of 1,32 x 10^{-15} m. The **same line** in the light of a star has a wavelength of 1,38 x 10^{-15} m. What is the correct conclusion?

A. The star is slowly moving towards the earth and blue shifting is observed.

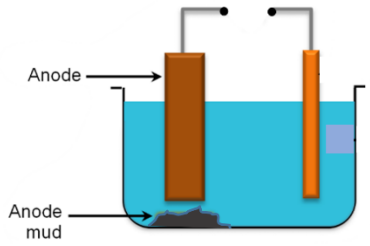
B. The star is slowly moving away from the earth and blue shifting is observed.

C. The star is slowly moving away from the earth and red shifting is observed.

D. The star is slowly moving towards the earth and red shifting is observed.

1.4 Which combination regarding the **Copper refining** industry is correct?

See the diagram.



	Spontaneous or not?	**What is in the anode mud?**	**Anode connected to…?**	**Ion concentration in solution**
A.	Yes	Useless soil particles	Negative pole	It changes
B.	Yes	Invaluable non-metals	Negative pole	No change
C.	No	Invaluable metals	Positive pole	It changes
D.	No	Valuable metals	Positive pole	No change

1.5 An electrochemical cell in which electrical energy is given off, becomes 'flat' after a while. The reason for this is:

A. The chemicals in the cell become depleted (used up) and energy needs to be added.

B. The redox reactions reach equilibrium

C. The concentration of one of the half cells become too low and the forward reaction stops

D. Only reduction takes place, but the oxidation is still going on.

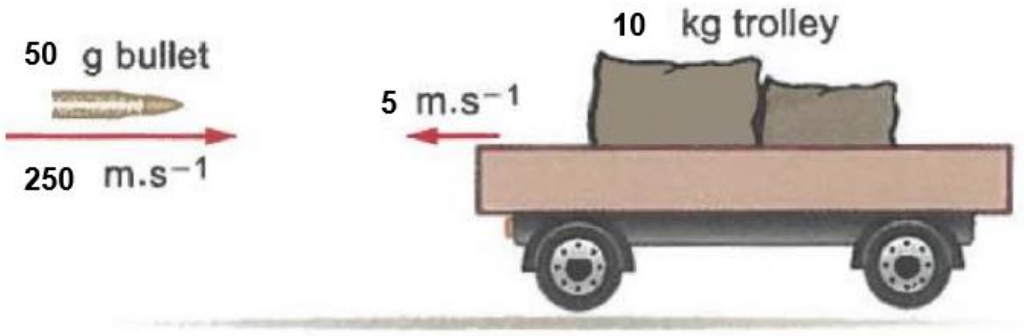
TOTAL SECTION A [10]

SECTION B

-Answer on folio paper-

QUESTION 2:

A 50g bullet is fired into sandbags resting on a trolley. The combined mass of the trolley and the sandbags are 10kg. Initially the trolley is moving at 5 $m.s^{-1}$ in a westerly direction. Just before impact, the bullet is moving at 250 $m.s^{-1}$ in an easterly direction. After the collision the bullet is embedded in the sandbags.



2.1 State the *Law of Conservation of Momentum* in words. (2)

2.2 Calculate the velocity of the trolley after the collision. (3)

2.3 Was the collision elastic or inelastic? Show all calculations to support your answer. (5)

[10]

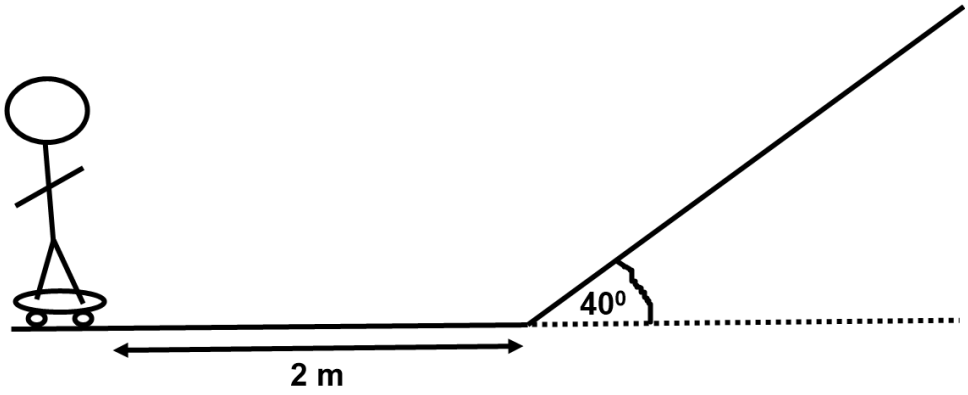
QUESTION 3:

Romeo and Juliet do a vertical motion investigation. Juliet is standing on a balcony 10 m above Romeo who is standing on the ground. Romeo throws a small gift vertically upwards at 9,5 $m.s^{-1}$ and at the **same time** Juliet drops a bunch of keys. Ignore air resistance.

How high above the ground will the gift and the keys cross path (i.e. pass each other)? **[6]**

QUESTION 4:

A 75 kg skateboarder has a velocity of 7 $m.s^{-1}$ to the right when exactly 2 m away from a slope inclined at 40° to the horizontal as shown in the diagram below. The skateboarder experiences a constant frictional force of 147 N for the entire duration of her motion.



4.1 State the *work-energy theorem* in words. (2)

4.2 Use energy principles to calculate:

4.2.1 The speed of the skateboarder at the bottom of the slope. (4)

4.2.2 The maximum distance the skateboarder will travel up the slope. (5)

[11]

QUESTION 5:

A siren of a stationary ambulance emits sound waves of frequency 280 Hz. A car is moving towards a stationary ambulance at a constant speed that is 310 $m.s^{-1}$ **lower** than the speed of sound in air.

5.1 Define the *Doppler Effect*. (2)

5.2 Calculate the frequency of sound detected by the driver of the car. Use the speed of sound in air as 340 $m.s^{-1}$. (4)

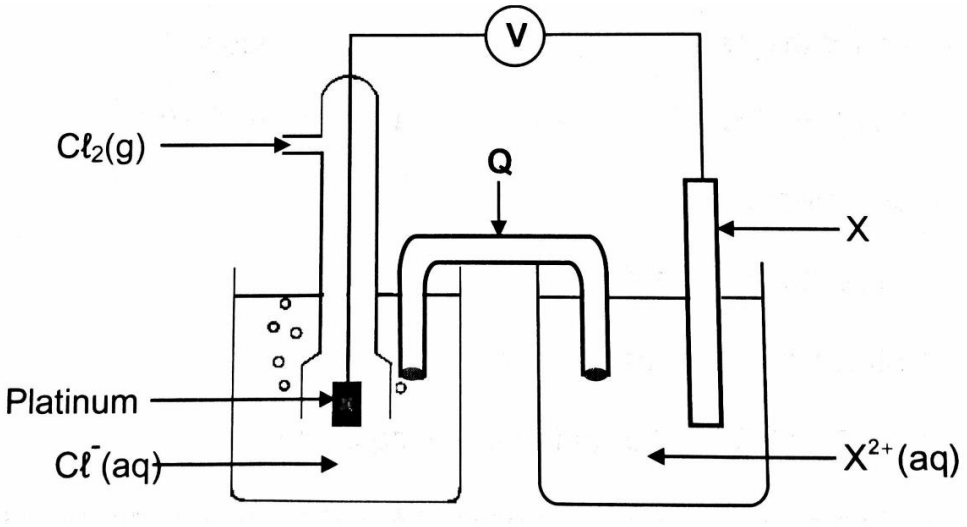
[6]

QUESTION 6:

6.1 A photo is shown of the product in the silver tree experiment. The 'tree' forms when a **copper** wire is suspended (hung) in a **silver nitrate** solution. Refer to the relative strengths of oxidising and reducing agents and explain why this 'tree' forms without any energy added.

(2)

6.2 A standard electrochemical cell is set up using two standard half-cells, as shown in the diagram below.



6.2.1 State the energy conversion that takes place in this cell. (1)

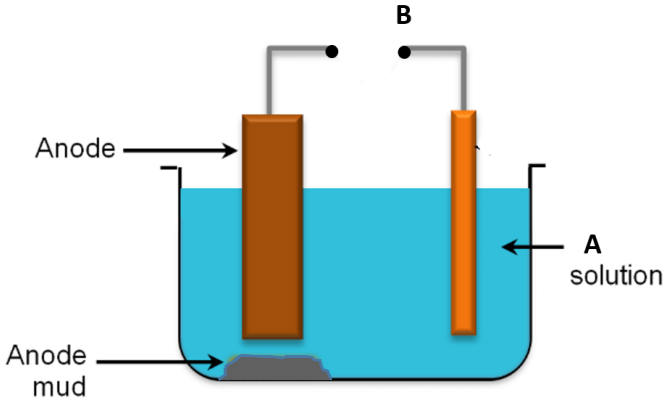
6.2.2 What is the function of component Q? (1)

6.2.3 X is a metal. A voltmeter connected across the cell initially registers 1,8 V.

Use a calculation to identify metal X. (4)

6.2.4 Write down the NAME or FORMULA of the reducing agent. (1)

6.3 The **Copper** refining industry is shown in the incomplete diagram:



6.3.1 Give the name or formula of the **solution** at **A**. (1)

6.3.2 Give the half reaction taking place at the anode. (2)

[12]

TOTAL SECTION B [45]

Formulas:

ELECTROCHEMISTRY/*ELEKTROCHEMIE*

$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ /$E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$

or/*of*

$E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$/$E^{\theta}_{sel} = E^{\theta}_{reduksie} - E^{\theta}_{oksidasie}$

or/*of*

$E^{\theta}_{cell} = E^{\theta}_{oxidisingagent} - E^{\theta}_{reducingagent}$ /$E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$

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

$v = f\lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ or/*of* $f_L = \frac{v \pm v_L}{v \pm v_b} f_b$	$E = hf$ or/*of* $E = \frac{hc}{\lambda}$

MOTION/*BEWEGING*

$v_f = v_i + a\Delta t$	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ or/*of* $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$v_f^{\,2} = v_i^{\,2} + 2a\Delta x$ or/*of* $v_f^{\,2} = v_i^{\,2} + 2a\Delta y$	$\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ or/*of* $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$

FORCE/*KRAG*

$F_{net} = ma$	$p = mv$
$f_s^{\,max} = \mu_s N$	$f_k = \mu_k N$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = G\frac{m_1 m_2}{d^2}$ or/*of* $F = G\frac{m_1 m_2}{r^2}$	$g = G\frac{M}{d^2}$ or/*of* $g = G\frac{M}{r^2}$

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* $E_k = \frac{1}{2}mv^2$	$W_{net} = \Delta K$ or/*of* $W_{net} = \Delta E_k$ $\Delta K = K_f - K_i$ or/*of* $\Delta E_k = E_{kf} - E_{ki}$
$W_{nc} = \Delta K + \Delta U$ or/*of* $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{ave} = Fv_{ave}$ / $P_{gemid} = Fv_{gemid}$	