ALEXANDER ROAD HIGH SCHOOL

APRIL 2021	**PHYSICAL SCIENCES CONTROL TEST 2**	75 MINUTES
CO, JA, MH	**GRADE 12**	TOTAL = 60

Instructions:

- The question paper consists of 7 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.
- Half reaction Table 4B is provided on the back of the A5 answer sheet.

SECTION A

(answer on the answer sheet)

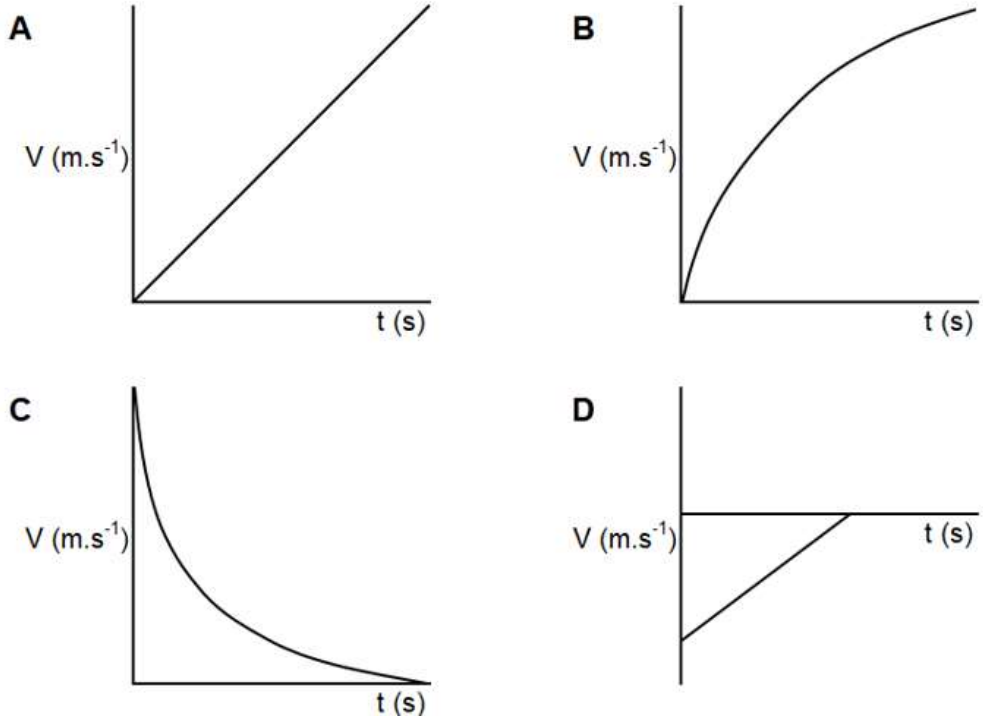
QUESTION 1:

Four possible options are provided as answers to the following questions. Each question has only one correct answer. Choose the correct answer and write the letter (A – D) next to the relevant question number (1.1 – 1.3) on the answer sheet.

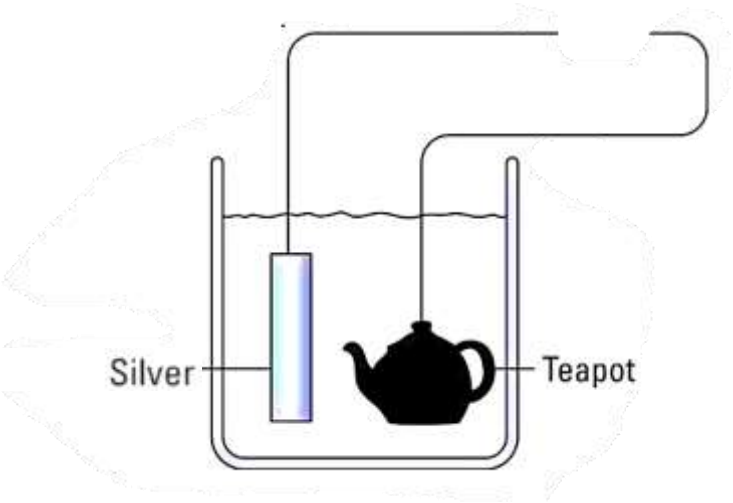
1.1 When an airbag inflates in a car during a collision, the chances of serious injury to a passenger is reduced because the …

A. passenger is brought to rest in a shorter period of time.
B. net force acting on the passenger is reduced.
C. passenger's change in momentum is reduced.
D. passenger's change in momentum is increased.

1.2 Which ONE of the following can be the velocity vs time graph of a projectile being thrown upwards?



1.3 A metal teapot needs to be electroplated with silver. Select the correct statement:



A. The teapot is connected to the positive pole of the battery and reduction will take place on it, while the silver rod acts as the anode.

B. The silver rod is reduced and the pot is connected to the negative pole and thus oxidised.

C. The teapot is connected to the negative pole of the battery and reduction will take place on it, while the silver rod acts as the anode.

D. The silver rod is oxidised and the pot is connected to the positive pole and thus reduced.

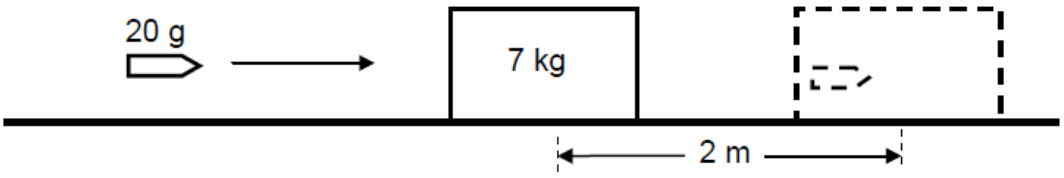
TOTAL SECTION A = [6]

SECTION B

(answer on folio paper)

QUESTION 2:

The diagram below shows a bullet of mass 20 g that is travelling horizontally. The bullet strikes a stationary 7 kg block with a velocity of 300 $m.s^{-1}$ and becomes embedded in the block. The bullet and block together travel a horizontal distance of 2m before coming to a stop. Ignore air resistance.



2.1 State the *principle of conservation of linear momentum* in words. (2)

2.2 Calculate the velocity of the block after it was struck by the bullet. (4)

2.3 Use a calculation to show whether the collision was elastic or not. (4)

[10]

QUESTION 3:

A man drops ball A from the edge of a window 45 m above the ground. One second later he throws a second ball, ball B, downwards with a velocity of 40 $m.s^{-1}$. Ignore air friction.

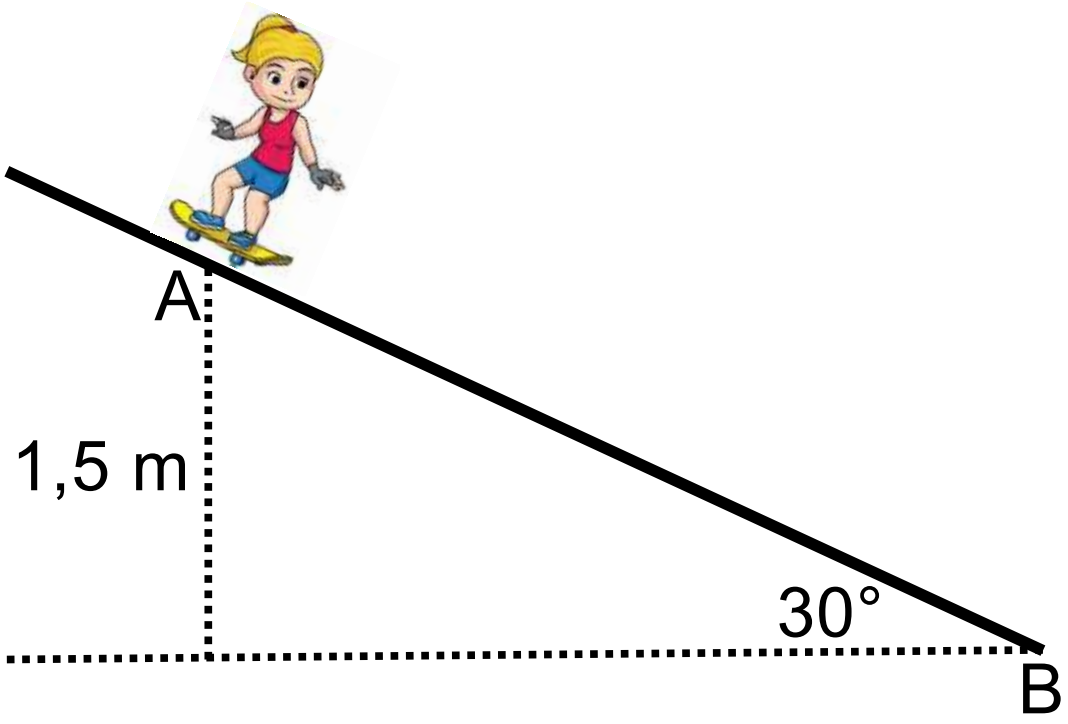
3.1 Define the term *free fall.* (2)

3.2 Calculate how long after ball B was thrown, the two balls will cross. (5)

[7]

QUESTION 4:

An 80 kg skateboarder passes point A moving at 3 $m.s^{-1}$ down the ramp inclined at 30° to the horizontal. Point A is 1,5 m above the ground and the force of friction between the ramp and the skateboard's wheels is 25 N.



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

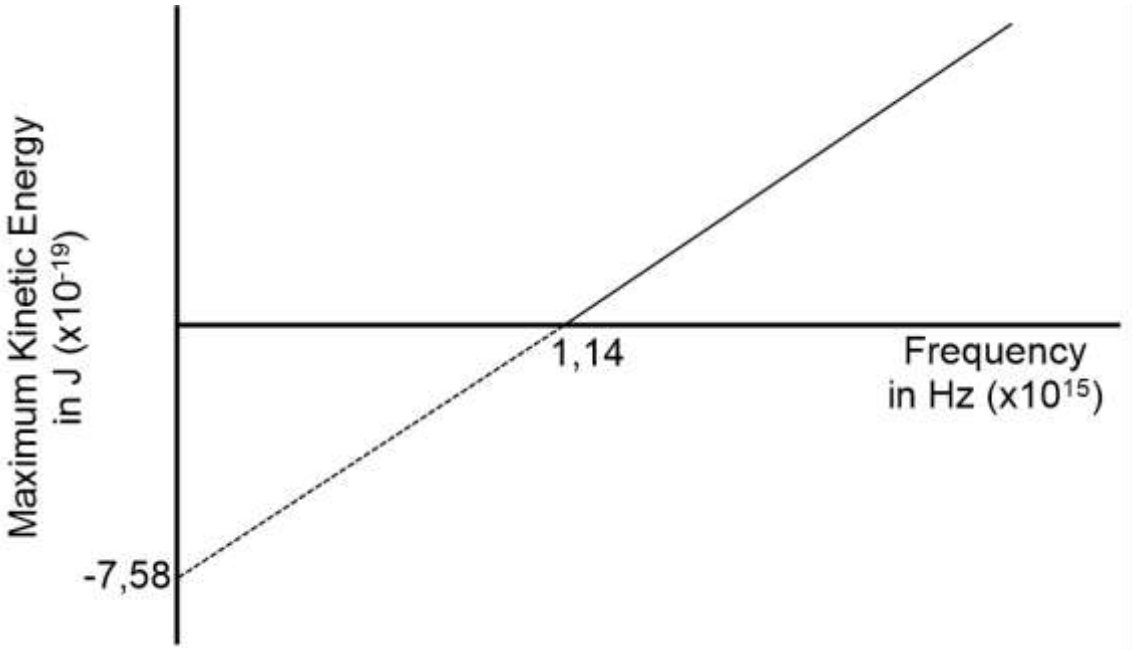
4.2 Use **energy principles** to calculate the speed of the skateboarder when she reaches the bottom of the ramp at point B. (5)

4.3 How will the speed of the skateboarder at point B change if the ramp is inclined at a larger angle? Write only INCREASES, DECREASES or REMAINS THE SAME. (1)

[8]

QUESTION 5:

The relationship between the frequency of light incident on a piece of copper metal and the maximum kinetic energy of ejected photoelectrons is investigated. The following graph, which is NOT drawn to scale, is obtained:



5.1 Define *work function*. (2)

5.2 Using the graph, write down the work function of copper. (1)

5.3 Calculate the maximum speed of a photoelectron when light of frequency $1,5 \times 10^{15}$ Hz is incident on the piece of copper metal. (3)

5.4 Would the maximum kinetic energy of the photoelectrons INCREASE, DECREASE or REMAIN THE SAME if the intensity of light mentioned in question 5.3 was increased? **Give a reason for your answer.** (2)

[8]

QUESTION 6:

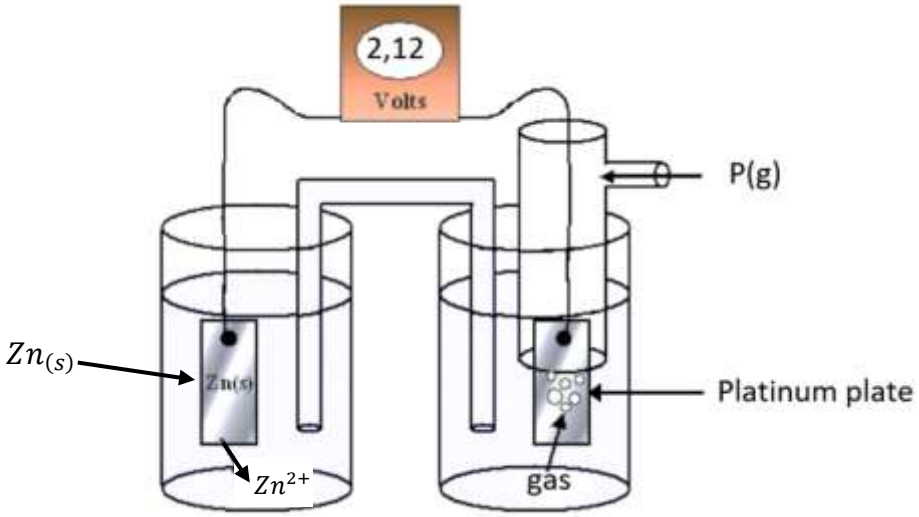
6.1 A man standing on the side of the road hears the sound of a moving car's hooter at 96 Hz **higher** than what the driver of the car hears it. If the speed of the car is 30 m.s^{-1}, and the observed frequency is 1076 Hz, calculate the speed of sound on the day. (4)

6.2 Name one medical application/instrument that uses the effect observed in 6.1. (1)

[5]

QUESTION 7:

7.1 The following diagram represents an electrochemical cell.



Zinc Electrode

7.1.1 At which electrode will oxidation take place? (1)

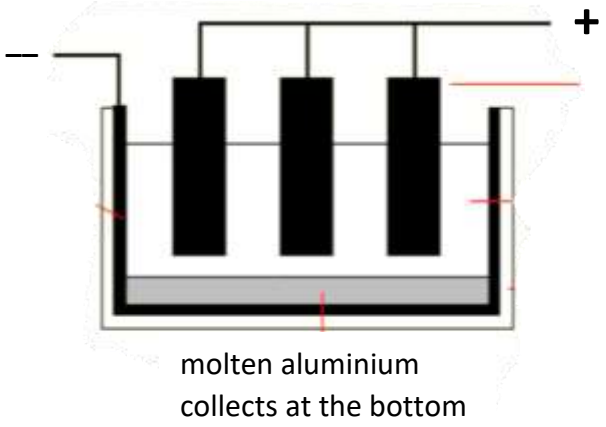
7.1.2 Identify the substance P through calculation, if the initial voltage of the cell is 2,12 V. (4)

7.1.3 Explain, by using relative **reducing agent strength**, why this cell can produce energy. (2)

7.1.4 State one function of the salt bridge. (1)

7.1.5 Give the cell notation for this cell by using the answer of 7.1.3. (3)

7.2 The following cell is used to extract **aluminium** from its ore.



7.2.1 Define *electrolysis*. (2)

7.2.2 This cell is not spontaneous: what does this mean in terms of this cell? (1)

7.2.3 Give the reduction half reaction. (1)

7.2.4 Give one environmental disadvantage of this cell. (1)

[16]

TOTAL SECTION B = [54]

Formula Sheet

Physical Constants:

Name	Symbol	Value
Acceleration due to gravity	g	9,8 $m.s^{-2}$
Speed of light in a vacuum	c	$3,0 \times 10^{8}$ $m.s^{-1}$
Planck's constant	h	$6,63 \times 10^{-34}$ J.s
Charge on electron	e	$-1,6 \times 10^{-19}$ C
Electron mass	m_e	$9,11 \times 10^{-31}$ kg

Formulae:

MOTION

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

FORCE

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

WORK, ENERGY AND POWER

$W = F\Delta x\cos\theta$	$E_p = mgh$
$E_k = \frac{1}{2}mv^2$	$W_{net} = \Delta E_k$ $\Delta E_k = E_{kf} - E_{ki}$
$W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{ave} = Fv_{ave}$	

WAVES, SOUND AND LIGHT

$v = f\lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_S} f_S$	$E = hf \quad \text{or} \quad E = \frac{hc}{\lambda}$
$E = W_0 + E_{k(max)}$ where $E = hf, W_0 = hf_0$ and $E_{k(max)} = \frac{1}{2}mv_{max}^2$	

CHEMISTRY

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

or

$$E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$$

or

$$E^{\theta}_{cell} = E^{\theta}_{oxidisingagent} - E^{\theta}_{reducingagent}$$

TABLE 4B: STANDARD REDUCTION POTENTIALS
TABEL 4B: STANDAARD-REDUKSIEPOTENSIALE

Increasing oxidising ability/*Toenemende oksiderende vermoë* ↓

Half-reactions/*Halfreaksies*	E^{θ} (V)
$Li^+ + e^- \rightleftharpoons Li$	− 3,05
$K^+ + e^- \rightleftharpoons K$	− 2,93
$Cs^+ + e^- \rightleftharpoons Cs$	− 2,92
$Ba^{2+} + 2e^- \rightleftharpoons Ba$	− 2,90
$Sr^{2+} + 2e^- \rightleftharpoons Sr$	− 2,89
$Ca^{2+} + 2e^- \rightleftharpoons Ca$	− 2,87
$Na^+ + e^- \rightleftharpoons Na$	− 2,71
$Mg^{2+} + 2e^- \rightleftharpoons Mg$	− 2,36
$A\ell^{3+} + 3e^- \rightleftharpoons A\ell$	− 1,66
$Mn^{2+} + 2e^- \rightleftharpoons Mn$	− 1,18
$Cr^{2+} + 2e^- \rightleftharpoons Cr$	− 0,91
$2H_2O + 2e^- \rightleftharpoons H_2(g) + 2OH^-$	− 0,83
$Zn^{2+} + 2e^- \rightleftharpoons Zn$	− 0,76
$Cr^{3+} + 3e^- \rightleftharpoons Cr$	− 0,74
$Fe^{2+} + 2e^- \rightleftharpoons Fe$	− 0,44
$Cr^{3+} + e^- \rightleftharpoons Cr^{2+}$	− 0,41
$Cd^{2+} + 2e^- \rightleftharpoons Cd$	− 0,40
$Co^{2+} + 2e^- \rightleftharpoons Co$	− 0,28
$Ni^{2+} + 2e^- \rightleftharpoons Ni$	− 0,27
$Sn^{2+} + 2e^- \rightleftharpoons Sn$	− 0,14
$Pb^{2+} + 2e^- \rightleftharpoons Pb$	− 0,13
$Fe^{3+} + 3e^- \rightleftharpoons Fe$	− 0,06
$2H^+ + 2e^- \rightleftharpoons H_2(g)$	**0,00**
$S + 2H^+ + 2e^- \rightleftharpoons H_2S(g)$	+ 0,14
$Sn^{4+} + 2e^- \rightleftharpoons Sn^{2+}$	+ 0,15
$Cu^{2+} + e^- \rightleftharpoons Cu^+$	+ 0,16
$SO_4^{2-} + 4H^+ + 2e^- \rightleftharpoons SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + 2e^- \rightleftharpoons Cu$	+ 0,34
$2H_2O + O_2 + 4e^- \rightleftharpoons 4OH^-$	+ 0,40
$SO_2 + 4H^+ + 4e^- \rightleftharpoons S + 2H_2O$	+ 0,45
$Cu^+ + e^- \rightleftharpoons Cu$	+ 0,52
$I_2 + 2e^- \rightleftharpoons 2I^-$	+ 0,54
$O_2(g) + 2H^+ + 2e^- \rightleftharpoons H_2O_2$	+ 0,68
$Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$	+ 0,77
$NO_3^- + 2H^+ + e^- \rightleftharpoons NO_2(g) + H_2O$	+ 0,80
$Ag^+ + e^- \rightleftharpoons Ag$	+ 0,80
$Hg^{2+} + 2e^- \rightleftharpoons Hg(\ell)$	+ 0,85
$NO_3^- + 4H^+ + 3e^- \rightleftharpoons NO(g) + 2H_2O$	+ 0,96
$Br_2(\ell) + 2e^- \rightleftharpoons 2Br^-$	+ 1,07
$Pt^{2+} + 2e^- \rightleftharpoons Pt$	+ 1,20
$MnO_2 + 4H^+ + 2e^- \rightleftharpoons Mn^{2+} + 2H_2O$	+ 1,23
$O_2(g) + 4H^+ + 4e^- \rightleftharpoons 2H_2O$	+ 1,23
$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightleftharpoons 2Cr^{3+} + 7H_2O$	+ 1,33
$C\ell_2(g) + 2e^- \rightleftharpoons 2C\ell^-$	+ 1,36
$MnO_4^- + 8H^+ + 5e^- \rightleftharpoons Mn^{2+} + 4H_2O$	+ 1,51
$H_2O_2 + 2H^+ + 2e^- \rightleftharpoons 2H_2O$	+1,77
$Co^{3+} + e^- \rightleftharpoons Co^{2+}$	+ 1,81
$F_2(g) + 2e^- \rightleftharpoons 2F^-$	+ 2,87

Increasing reducing ability/*Toenemende reduserende vermoë* ↑