ALEXANDER ROAD HIGH SCHOOL

JUNE 2021	**PHYSICAL SCIENCES ASSESSMENT**	3 HOURS
CO, JA, MH	**GRADE 12**	TOTAL = 150

PHYSICS

1.1 C ✓✓

1.2 B ✓✓

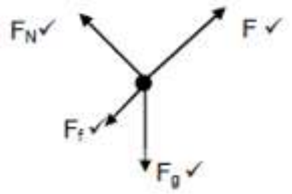
1.3 B ✓✓

1.4 C ✓✓

TOTAL SECTION A = [8]

2.1 When a resultant force acts on an object, the object will accelerate in the direction on net force. The acceleration is directly proportional to the net force and inversely proportional toe the mass of the object.

2.2



2.3.1 **Up the incline as positive**

$F_{net} = ma$
$F + (f_{kA} + f_{kB} + F_{g\parallel}) = ma$ } ✓ Any ONE
$F + (f_{kA} + f_{kB} + mg\sin 30^0) = (m_A + m_B)a$

$F - \underline{6{,}8 - 3{,}4}$ ✓ $- \underline{(12)(9{,}8)\sin 30^0}$ ✓ $= 0$ ✓

$F = 69$ N ✓

2.3.2 $f_k = \mu_k F_N$ ✓

$3{,}40 = \mu_k (4)(9{,}8)\cos 30^0$ ✓

$\mu_k = 0{,}10$ ✓

2.4.1 Remain the same ✓

2.4.2 Decreases ✓

Since Θ increases, $F_{g\perp}$ decreases ✓, therefore F_N decreases ✓ / f_k α F_N ✓

QUESTION 3:

3.1 the change in frequency (or pitch) of the sound detected by a listener, because✓ the sound source and the listener have different velocities relative✓ to the medium of sound propagation. (2)

3.2 $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓

$\therefore f_L = \frac{340 \pm 0}{340 - 20}$ ✓ (458) ✓ (4)

$\therefore f_L = 486{,}63$ Hz ✓

3.3 Decreases✓ (1)

3.4 Equal to, ✓

Velocity of train driver relative✓ to the whistle is zero. ✓

OR

Train driver has same✓ velocity as whistle. ✓

OR

There is no relative motion✓ between source and observer. ✓ (3)

3.5 Decreases ✓ (1)

3.6 Doppler flow meter ✓ (or ultrasound) (1)

3.7 The change in the observed frequency of light given off by far-away stars. ✓ The light looks more red✓, because the star is moving away from the observer and thus the colour shift to the red side of the spectrum. ✓ (3)

[15]

4.1 A conservative force is a force for which the work done in moving an object between two points is independent of the path taken. ✓✓ (2 or 0) (2)

4.2 The <u>net work done</u> on an object <u>is equal to the change in kinetic energy</u> of the object. ✓✓ (2 or 0)

[OR: The <u>work done</u> on an object <u>by a net force is equal to the change in the kinetic energy</u> of the object.] (2)

4.3 Kinetic energy is converted into gravitational potential energy. ✓
Chemical (potential) energy is converted into kinetic energy. ✓ (2)

4.4.1 $W_{nc} = \Delta E_k + \Delta E_p$ ✓

$W_{engine} = 0 + (410)(9{,}8)(3)$ ✓ $= 12\ 054\ J$

$P_{engine} = \frac{W_{engine}}{\Delta t}$ ✓

$P_{engine} = \frac{12\ 0\ 54}{2}$

$P_{engine} = 6\ 027\ W$ ✓ (5)

4.4.2 $W_{net} = \Delta E_k$ $[W_{nc} = \Delta E_k + \Delta E_p]$

$W_{engine} + W_{friction} = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ ✓ $[W_{engine} + W_{friction} = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 + \Delta E_p]$

$F_{engine}\,\Delta x \cos\theta + W_{friction} = \left(\frac{1}{2}\right)(410)(35)^2 - \left(\frac{1}{2}\right)(410)(20)^2$ ✓

$(3\ 527)(125)(\cos 0°)$ ✓ $+ W_{friction} = 169\ 125$

$440875 + W_{friction} = 169\ 125$

$\therefore$ Heat $= W_{friction} = -271\ 750\ J$ ✓ (4)

4.4.3 $W_{friction} = f_k\,\Delta x \cos\theta$

$-271\ 750 = f_k(125)(\cos 180°)$ ✓

$f_k = 2\ 174\ N$

$W_{net} = \Delta E_k$ $[W_{nc} = \Delta E_k + \Delta E_p]$

$F_{net}\ \Delta x \cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ ✓ $[W_{wall} + W_{friction} = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 + \Delta E_p]$

$F_{net}(13)(\cos 180°)$ ✓ $= 0 - \frac{1}{2}(410)(35)^2$ ✓

$F_{net} = 19\ 317{,}31\ N$

$[F_{wall}\ (13)(\cos 180°)$ ✓

$+ (2\ 174)(13)(\cos 180°)$ ✓

$= 0 - \frac{1}{2}(410)(35)^2 + 0$ ✓ $]$

$F_{wall} + f_k$ ✓ $= 19\ 317{,}31$

$F_{wall} + 2\ 174 = 19\ 317{,}31$

$\therefore F_{wall} = 17\ 143{,}31\ N$ to the left ✓ (6)

4.5 Non-conservative force. ✓ (1)

[22]

CHEMISTRY

5.1 D ✓✓

5.2 A ✓✓

5.3 C ✓✓

5.4 B ✓✓

5.5 B ✓✓

5.6 D ✓✓

TOTAL SECTION C = [12]

6.1 Reaction rate is the <u>change in concentration</u> (or moles/mass/volume) of reactants/products <u>per unit time</u>. ✓✓ (2 or 0) (2)

6.2 How does the temperature affect reaction rate?

✓ BOTH the independent and dependent variable mentioned
✓ NO yes/no answer possible (2)

6.3
- Surface area/state of division of Zn
- Concentration of HCl
- Volume of the solution ✓ (any ONE) (1)

6.4 Experiment 1. ✓

The reaction rate was faster. ✓ (2)

6.5 $\text{Average Rate} = \frac{\Delta V}{\Delta t} = \frac{480 - 0 ✓}{540 - 0 ✓} = 0,89\ dm^3.s^{-1}$ ✓ (3)

6.6 INCREASES. ✓
In the absence of impure particles there are more effective collisions per unit time. ✓ (2)

6.7 $n_{H_2} = \frac{V}{V_m}$ ✓ $= \frac{0,48}{24}$ ✓ $= 0,02\ mol$

$n_{Zn} = n_{H_2}$ ✓ $= 0,02\ mol$

$m_{Zn} = nM = (0,02)(65)$ ✓ $= 1,3\ g$

$\therefore \%Purity = \frac{pure\ mass}{total\ mass} \times 100 = \frac{1,3}{2} \times 100 = 65\%$ ✓ (5)

6.8 ✓ Reactant energy > product energy
✓ Activation energy (drawn & labelled)
✓ Heat of reaction (labelled) (3)

[20]

7.1 When the equilibrium in a closed system is disturbed, the system will re-instate a new equilibrium by favouring the reaction that will oppose the disturbance. ✓✓ (2 or 0) (2)

7.2.1 By Le Chatelier's principle, a decrease in the amount of CO_2 will <u>favour the reverse reaction</u> ✓ since the reverse reaction <u>produces CO_2</u> ✓. (2)

7.2.2 Forward reaction. ✓ (1)

7.2.3 $K_C = \frac{[H_2CO_3]\ ✓}{[CO]_2\ ✓}$ (2)

7.3 The Haber-Bosch process is used to produce over 175 million tonnes of ammonia (NH_3) each year in an industry estimated to be worth over $100 billion. The balanced equation for the Haber-Bosch process is

$$N_{2(g)} + 3\,H_{2(g)} \rightleftharpoons 2\,NH_{3(g)} \qquad \Delta H < 0$$

7.3.1 EXOTHERMIC. ✓ (1)

7.3.2 INCREASE. ✓

- Since the equilibrium constant decreased, there are <u>more reactants than products</u>. ✓
- ∴ The <u>reverse reaction was favoured</u>. ✓
- Since reverse reaction is the endothermic reaction, the <u>endothermic reaction was favoured</u>. ✓
- Since an increase in temperature always favours the endothermic reaction, the temperature was increased. (4)

7.3.3 $n = \frac{V}{V_m}$ ✓ $= \frac{0,896}{22,4}$ ✓ $= 0,04\ mol$

	N_2	$+ 3\ H_2$	$\rightleftharpoons\ 2\ NH_3$	
$n_i\ (mol)$	0,07	0,15	0	✓
$\Delta n\ (mol)$	−0,02	−0,06	+0,04	✓
$n_{eq}\ (mol)$	0,05	0,09	0,04	✓
$c = \frac{n}{V}$ $(mol.dm^{-3})$	$\frac{0,05}{0,5} = 0,1$	$\frac{0,09}{0,5} = 0,18$	$\frac{0,04}{0,5} = 0,08$	✓

$K_C = \frac{[NH_3]^2}{[N_2][H_2]^3}$ ✓ $= \frac{(0,08)^2}{(0,1)(0,18)^3} = 10,97$ ✓ (8)

[20]

8.1 The substance that is used up.

The substance that determines the amount of product formed. (2)

8.2

$AgNO_3$	+ KCl	⟶	$AgCl$	+ KNO_3
1	1		1	1
n = cV ✓	n = cV			n = 0,0125 mol✓
n = 0,2 (0,065) ✓	n = 0,25 (0,5) ✓			m = nM ✓
n = 0,013	n = 0,0125			m=0,0125(101)✓
				m = 1,26 g ✓

(7)

8.3 %yield = $\frac{actual\ yield}{theoretical\ yield} \times 100$

$= \frac{0,9}{1,26} \times 100$ ✓ (2)

= 71,43% ✓

[11]

QUESTION 9:

9.1 A proton acceptor. ✓ (1)

9.2 NH_3 and NH_4^+ or H_2O and OH^- ✓ (1)

9.3 A substance that can act as an acid or a base. ✓✓ (2)

9.4 H_2O ✓ (1)

9.5 H_2O acts as a base in reaction 1 ✓ and an acid in reaction 2.✓ (2)

9.6.1 pOH = -log $[OH^-]$ (3)

pOH = -log [0,15] ✓

pOH = 0,8239…

pH = 14 – pOH ✓

pH = 14 – 0,8239…

pH = 13,18 ✓

9.6.2 (5)

X	:	NaOH
1	:	1
		n = cV ✓
		n = 0,15 (0,027) ✓
		n = $4,05 \times 10^{-3}$

n = $4,05 \times 10^{-3}$ ✓

$c = \frac{n}{V}$

$c = \frac{4,05 \times 10^{-3}}{0,025}$ ✓

c = 0,165 $mol.dm^{-3}$ ✓

9.7 Weak base ✓

$[H_3O^+] < [acid]$ ($K_a<1$)

Does not fully ionise. ✓ **L2** (2)

9.8 Phenolphthalein ✓ **L2** (1)

9.9 Reaction of a salt with water. ✓✓ **L1** (2)

9.10 $NH_4Cl + H_2O \rightarrow NH_3 + Cl^- + H_3O^+$ ✓ ✓ Balancing ✓ **L2** (3)

9.11 ACIDIC ✓ **L2** (1)

[24]

TOTAL SECTION D = [75]