ALEXANDER ROAD HIGH SCHOOL

JUNE 2021	**PHYSICAL SCIENCES JUNE ASSESSMENT**	180 MINUTES
JA	**GRADE 11**	TOTAL = 150

1.1	D ✓✓		7.1	B ✓✓	
1.2	C ✓✓		7.2	A ✓✓	
1.3	B ✓✓		7.3	D ✓✓	
1.4	A ✓✓		7.4	D ✓✓	
1.5	A ✓✓	**[10]**	7.5	B ✓✓	**[10]**

2.1 The resultant force is zero. ✓

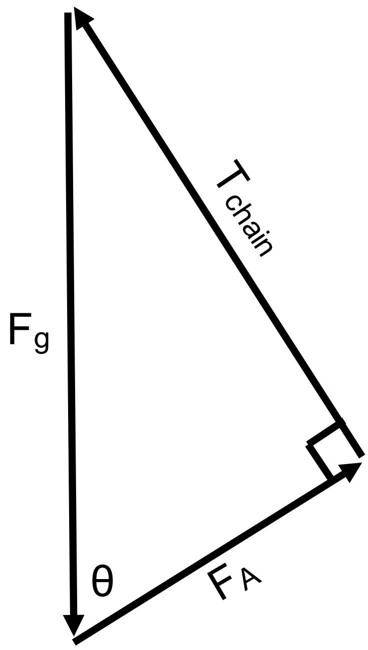
[OR: The forces form a closed vector diagram]. (1)

2.2 A resultant vector is a single vector having the same effect as two or more vectors together. ✓✓ (2 or 0)

[OR: A resultant vector is the vector sum of two or more vectors.] (2)

2.3 ✓ F_g ✓ F_A (or T_{rope}) ✓ T_{chain} (with labels)

✓ at least one angle indicated (4)



2.4 $F_g = mg = (5\ 400)(9{,}8) = 52\ 920\ N$ ✓

$(F_g)^2 = (T_{chain})^2 + (F_A)^2$

$(52\ 920)^2 = (T_{chain})^2 + (35\ 000)^2$ ✓

$\therefore T_{chain} = 39\ 692{,}90\ N$ ✓ (3)

2.5 Using the symmetry of the diagram:

$\cos\theta = \frac{35000}{52920}$ ✓

$\therefore \theta = 48{,}60°$ ✓ (2)

[12]

3.1 A body will remain in its state of rest or motion at constant velocity unless a non-zero resultant/net force acts on it. ✓✓ (2 or 0) (2)

3.2 F_g (box & car) $= F_N = 13\ 230\ N$ ✓ recognising Fg=13230N

$13\ 230 = (m_{box\&car})(9,8)$ ✓ subbing to find the combined mass

$\therefore m_{box\&car} = 1\ 350\ kg$

$m_{box} = 1\ 350 - 1\ 200$ ✓ subtracting masses

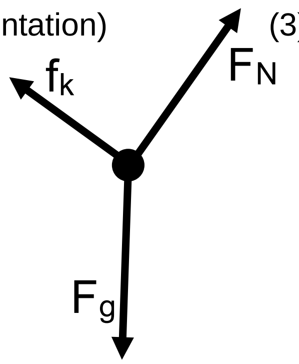
$\therefore m_{box} = 150\ kg$ ✓ (4)

3.3 TO THE LEFT. ✓

The inertia of the box resists a change to its state of motion. ✓ (2)

[8]

4.1 ✓ F_g (OR components) ✓ F_N ✓ f_k (with labels and correct orientation) (3)



4.2 $F_{g\parallel} = mg\sin\theta = (8)(9,8)(\sin 30°) = 12,9\ N$ ✓ calculating Fg parallel

$F_{net} = ma$

$F_{g\parallel} - f_k = ma$ ✓ either formula

$12,9 - 4,4 = 8a$ ✓ substitution with correct values

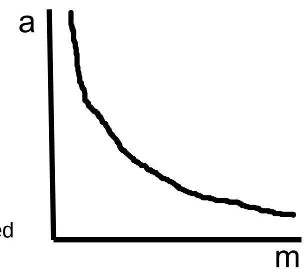
$\therefore a = 1,06\ m.s^{-2}$ ✓ down the incline ✓ direction (5)

4.3.1 What is the relationship between the acceleration and mass of an object?

✓ mentions independent and dependent variable ✓ does not have a yes/no answer (2)

4.3.2
- The type of material the crate is made from
- The surface of the truck
- The angle of inclination ✓ (ANY ONE) (1)

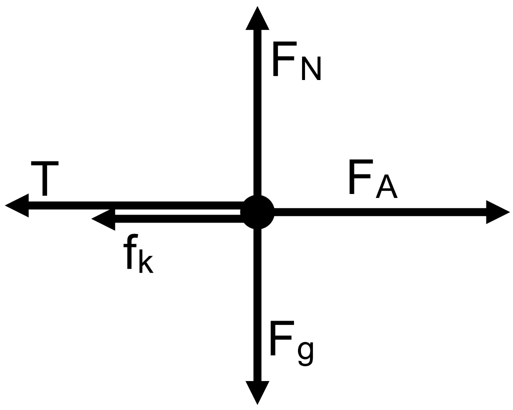
4.3.3 ✓ hyperbolic shape ✓ axes labelled (2)



4.3.4 <u>When a resultant/net force acts on an object, the object will accelerate in the direction of the force</u> ✓ at <u>an acceleration directly proportional to the force and inversely proportional to the mass of the object</u>. ✓ (2)

[15]

5.1 ✓ F_A (OR components) ✓ F_g ✓ F_N ✓ f_k ✓ T (with labels and correct orientation) (5)



5.2.1 $F_g = mg$

$F_g = (5)(9,8)$ ✓ calculating Fg

$N = F_g = 49\ N$ ✓ realising N=Fg

$\mu_k = \frac{f_k}{N}$ ✓ formula

$0,35 = \frac{f_k}{49}$

$\therefore f_k = 17,15\ N$ ✓

(4)

5.2.2 <u>3kg block:</u>

$F_{net} = ma$

$T - F_g = ma$ ✓ either formula

$T - (3)(9,8) = 3a$ ✓ substitution

$\therefore T = 3a + 29,4 \quad \ldots (\text{eqn. } 1)$

<u>15kg block:</u>

$F_A - f_k - T = ma$ ✓ correct Fres – direction MUST be consistent with previous equation

$90 - 17,15 - \mathrm{T} = 15\mathrm{a} \quad \ldots (\text{eqn. } 2)$ ✓ substitution

Sub eqn.1 into eqn.2: $90 - 17,15 - (3a + 29,4) = 15a$ ✓ subbing

$\therefore a = 2,41\ m.s^{-2}$ ✓ (6)

5.2.3 $T = 3(2,41) + 29,4$ ✓ subbing $= 36,63\ N$ ✓ (ACCEPT: $36,64\ N$) (2)

5.3 INCREASES. ✓

In the absence of friction, <u>the resultant force will increase</u> ✓

resulting in an increase in acceleration. (2)

[19]

6.1 The gravitational force of attraction between two objects is directly proportional to the product of their masses ✓ and inversely proportional to the square of the distance between their centres. ✓ (2)

6.2 $F = \frac{Gm_1m_2}{r^2}$ ✓

$$F = \frac{(6{,}67 \times 10^{-11})\left(\frac{1}{10}\right)(5{,}98 \times 10^{24})(5{,}98 \times 10^{24}) \checkmark}{(3{,}58 \times 10^{9} \times 1000)^2 \checkmark}$$

$F = 1{,}86 \times 10^{13}\ N$ ✓ (4)

6.3 $1{,}86 \times 10^{13}\ N$ ✓ (1)

6.4 Newton's Third Law. ✓

When object A exerts a force on object B, object B SIMULTANEOUSLY exerts an oppositely directed force of equal magnitude on object A. ✓ (2)

6.5

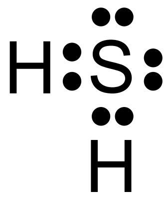
$$\frac{W_{Mars}}{W} = \frac{Gm\left(\frac{1}{10}\right)M_E}{\left(\frac{1}{2}R_E\right)^2} \div \frac{GmM_E}{R_E^2}$$

$W_{Mars} = 0{,}4W$ ✓✓ (2)

[11]

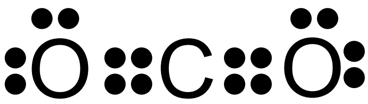
8.1 The mutual attraction between two atoms resulting from the simultaneous attraction between their nuclei and the outer electrons.
✓✓ (2 or 0) (2)

8.2.1



✓✓

8.2.2



✓✓

(one mark for bonding partners & correct shape; one mark for electrons) (4)

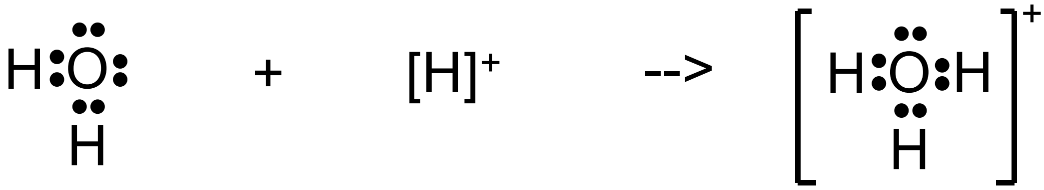
8.3 $N \equiv N$ ✓ (1)

8.4.1 $HC\ell$, H_2S, CO_2, BF_3 ✓✓✓ (3)

8.4.2 $HC\ell$, PH_3, H_2S, BF_3 ✓✓✓ (3)

(one mark for every TWO correct compounds;
third mark is if no ADDITIONAL compounds are listed).

8.5.1



✓ ✓ ✓ (3)

8.5.2 Dative covalent bond. ✓ (1)

[17]

9.1 The temperature at which the vapour pressure of a substance equals atmospheric pressure. ✓✓ (2 or 0) (2)

9.2

- HF has hydrogen bonds between its molecules. ✓
- $HC\ell$ has dipole-dipole forces between its molecules. ✓
- Hydrogen bonds are stronger than dipole-dipole forces. ✓
- More energy is required to break hydrogen bonds. ✓
- ∴ The boiling point of HF is higher than the boiling point of $HC\ell$. (4)

9.3
- All the hydrogen halides are polar molecules. ✓
- All the molecular halogens are non-polar molecules. ✓
- Like dissolves like. ✓
- ∴ The polar hydrogen halides dissolve in polar water and non-polar molecular halogens will not dissolve in polar water.

OR

- All the hydrogen halides have hydrogen bonds or dipole-dipole forces between their molecules. ✓
- All the molecular halogens have London forces between their molecules. ✓
- Like dissolves like. ✓
- ∴ The hydrogen halides dissolve in water (which has hydrogen bonds) and the molecular halogens will not dissolve in water. (3)

9.4.1 **B.** ✓ (1)

9.4.2
- $HC\ell$ has a lower boiling point than HF. ✓
- $HC\ell$ is more volatile (i.e. evaporates more easily). ✓
- ∴ More $HC\ell$ will evaporate resulting in a greater decrease in volume. (2)

[12]

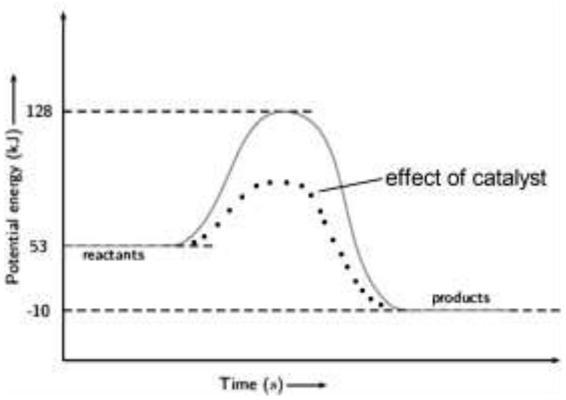
10.1 The energy absorbed or released per mole in a chemical reaction. ✓✓ (2)

10.2 EXOTHERMIC. ✓
The energy of the products is less than the energy of the reactants ✓ (meaning energy was released). (2)

10.3.1 $\Delta H = -10 - 53$ ✓ $= -63\ \text{kJ}$ ✓ (2)

10.3.2 $E_A = 128 - 53$ ✓ $= 75\ \text{kJ}$ ✓ (2)

10.4



✓ (1)

[9]

11.1 Energy Absorbed $= 3(436)$ ✓ $^{\text{3x H−H energy}}$ $+ 946 = 2\ 254$ kJ ✓ $^{\text{adding reactants}}$

Energy Released $= 2[3(390)]$ ✓ $^{\text{3x N−H energy}}$ $= 2\ 340$ kJ ✓ $^{\text{2x }NH_3\text{ energy}}$

Heat of Reaction $= 2\ 254 - 2\ 340 = -86\ \text{kJ.mol}^{-1}$ ✓ (5)

11.2 EXOTHERMIC. ✓ positive marking from 11.1 (1)

[6]

12.1.1 $c = \frac{n}{V}$ ✓ formula

$0{,}02 = \frac{n_{AgNO_3}}{0{,}5}$ ✓ substitution

$n_{AgNO_3} = 0{,}01\ mol$

$n_{AgC\ell} = n_{AgNO_3} = 0{,}01\ mol$ ✓use of ratio

$n = \frac{m}{M}$ ✓ formula

$0{,}01 = \frac{m}{108 + 35{,}5}$

$n_{AgC\ell} = 1{,}435 = 1{,}44\ g$ ✓

(5)

12.1.2 $\text{n} = \frac{\text{N}}{\text{N}_\text{A}}$ ✓ formula

$0{,}01 = \frac{\text{N}}{6{,}02 \times 10^{23}}$ ✓ substitution

$\text{N} = 6{,}02 \times 10^{21}\ \text{AgC}\ell$ molecules ✓ (3)

12.2 The reactant which is completely consumed in a reaction. ✓✓ (2 or 0)

[OR: The reactant which determines the amount of product which forms]. (2)

12.3 n_{H_2} reacted $= 3 \times \text{n}_{N_2} = 3(0{,}14) = 0{,}42$ mol

$\therefore H_2$ is the limiting reactant. ✓

$\text{n}_{NH_3} = \frac{2}{3} \times \text{n}_{H_2}$ ✓ use of mole ratio **with H_2**

$\therefore n_{NH_3} = \frac{2}{3}(0{,}40) = \frac{4}{15} = 0{,}2\dot{6}$ mol

$\text{n} = \frac{\text{V}}{\text{V}_\text{m}}$ ✓ formula

$0{,}2\dot{6} = \frac{\text{V}}{22{,}4}$ ✓ substitution

$\text{V} = 5{,}97\ \text{dm}^3$ ✓

(5)

[15]

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

$$80 = \frac{16}{\text{theoretical yield}} \times 100 \checkmark$$

$$\text{Theoretical Yield} = 20 \text{ dm}^3 \checkmark$$

$$n_{N_2} = \frac{V}{V_m} \checkmark^{\text{formula}}$$

$$n_{N_2} = \frac{20}{24} \checkmark^{\text{substitution}}$$

$$\therefore n_{N_2} = \frac{5}{6} = 0{,}8\dot{3} \text{ mol}$$

$$n_{NaN_3} = \frac{2}{3} \times n_{N_2} \checkmark^{\text{use of ratio}}$$

$$\therefore n_{NaN_3} = \frac{2}{3}(0{,}8\dot{3}) = \frac{5}{9} = 0{,}\dot{5} \text{ mol}$$

$$n = \frac{m}{M}$$

$$0{,}\dot{5} = \frac{m_{NaN_3}}{23 + 3(14)}$$

$$\therefore m_{NaN_3} = 36{,}11 \text{ g} \checkmark$$

$$n_{N_2} = \frac{V}{V_m} \checkmark^{\text{formula}}$$

$$n_{N_2} = \frac{16}{24} \checkmark^{\text{substitution}}$$

$$\therefore n_{N_2} = \frac{2}{3} = 0{,}\dot{6} \text{ mol}$$

$$n_{NaN_3} = \frac{2}{3} \times n_{N_2} \checkmark^{\text{use of ratio}}$$

$$\therefore n_{NaN_3} = \frac{2}{3}(0{,}\dot{6}) = \frac{4}{9} = 0{,}\dot{4} \text{ mol}$$

$$n = \frac{m}{M}$$

$$0{,}\dot{4} = \frac{m_{NaN_3}}{23 + 3(14)}$$

$$\therefore m_{NaN_3} = 28{,}\dot{8} \text{ g} \checkmark$$

$$\% \text{ Yield} = \frac{\text{actual}}{\text{theoretical}} \times 100$$

$$80 = \frac{28{,}\dot{8}}{m_{NaN_3}} \times 100 \checkmark$$

$$m_{NaN_3} = 36{,}11 \text{ g} \checkmark$$

[6]