ALEXANDER ROAD HIGH SCHOOL

November 2021	**PHYSICAL SCIENCES ASSESSMENT PAPER 1**	180 MINUTES
CO, JA, MH	**GRADE 11 MEMO**	TOTAL = 150

1.1 B✓✓

1.2 B✓✓

1.3 D✓✓

1.4 D✓✓

1.5 B✓✓

1.6 C ✓✓

1.7 D ✓✓

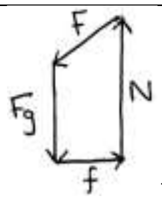
1.8 A ✓✓

1.9 C✓✓

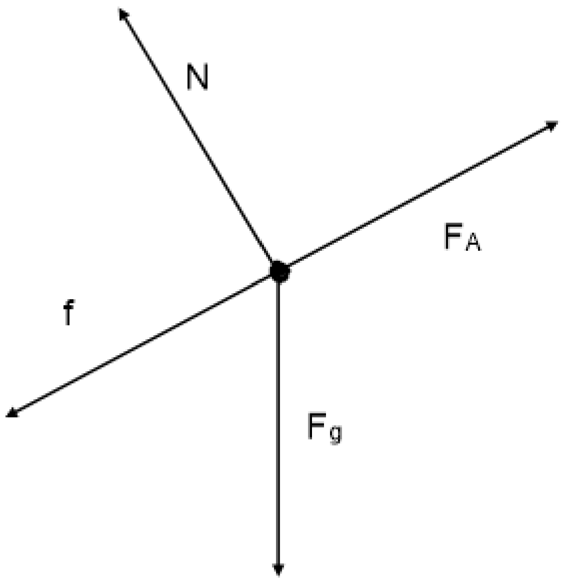
1.10 A✓✓

[20]

QUESTION 2:

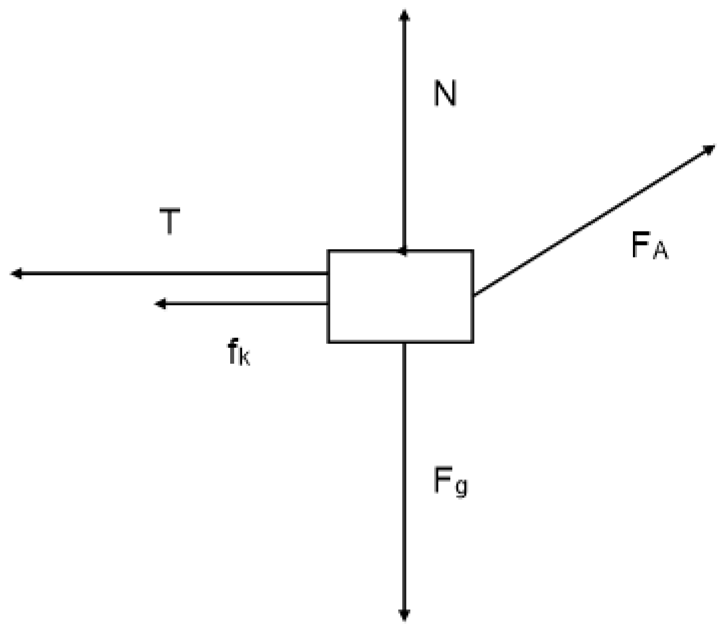
Vectors		
2.1	X = 180 cos 55° = 103,24 N Y = 180 sin 55 ° = 147,45 N	(4)
2.2	N = Fg + Y = (30)(9,8) + 147,45 = 441,45 N	(3)
2.3	The single vector having the same effect as the original vectors combined	(2)
2.4	 ✓✓✓✓	(4)
2.5	No resultant ✓✓OR Equilibrium ✓✓ OR There is friction✓✓ present	(2)
		[14]

QUESTION 3:

Newton's Laws of Motion		
3.1	A body will remain in its state of rest or motion at constant velocity unless a nonzero resultant force acts on it.	(2)
3.2		(4)
3.3	$N=F_{g\perp}$ $N=F_g.\cos 30°$ ✓ N=15 (9,8) cos 30° ✓ N=127,31 N ✓	(3)
3.4	$F_{net}= 0$	

	$F_A - f - F_{g\parallel} = 0$ ✓ 120 ✓– f – 15(9,8) sin 30°✓ f = 46,5 N ✓	(4)
3.5	f = μN ✓ 46,5 = μ 127,31 ✓ μ = 0,37 ✓	(3)
3.6	decrease	(1)
3.7	N directly proportional to f ✓ When N decrease, f decrease ✓	(2)
3.8	Stay the same	(1)
		[20]

QUESTION 4:

Newton's Laws of Motion		
4.1	When a resultant force acts on an object, the object will accelerate in the direction of the force at an acceleration directly proportional to the force and inversely proportional to the mass of the object.	(2)
4.2		(5)
4.3	$N - F_g + F_{A\perp} = 0$ ✓	

	N – 15(9,8) + 100.sin 30° = 0 ✓ N = 97 N $f_k = \mu_k N$ ✓ f_k = 0,4 (97) ✓ f_k = 38,8 N ✓	(5)
4.4	$F_{A \parallel}$ - T – f = 15.a ✓ 100. cos 30° - T – 38,8 = 15.a ✓ T = 47,8025… - 15a F = ma T – F_g = 3.a ✓ T – 29,4 = 3.a ✓ T = 29,4 + 3a 47,8025… - 15a = 3a + 29,4 ✓ a = 1,02 $m.s^{-2}$ right ✓	(6)
4.5	T = 29,4 + 3(1,02) T = 32,47 N ✓✓	(2)
		[20]

QUESTION 5:

Newton's Law of Universal Gravitation **MH**		
5.1	The <u>gravitational force of attraction</u> between two objects is **<u>directly</u>** <u>proportional to the</u> **product** <u>of the masses</u> and **<u>inversely</u>** <u>proportional to the</u> **square** <u>of the distance</u> **<u>between their centres</u>**.	(2)
5.2	$mg = \frac{GmM}{r^2}$ ✓ $mg = \frac{6{,}67 \times 10^{-11} \times m \times 5{,}98 \times 10^{24}}{(6{,}38 \times 10^6)^2}$ ✓ $g = 9{,}8\ m.s^{-2}$ ✓	(3)

5.3	$F_g = \frac{GmM}{r^2}$ ✓ $1850 = \frac{6{,}67 \times 10^{-11} \times 1000 \times 5{,}98 \times 10^{24}}{r^2}$ ✓ $r = 1.4683 \ldots \times 10^{7}\text{m}$ ✓ $1{,}4683 \ldots \times 10^{7} - 6.38 \times 10^{6}$ ✓ $= 8\ 303400\ m = 8{,}30 \times 10^{6} m$ ✓	(5)
5.4	1 850 N	(1)
5.5	Newton’s Third Law (of Motion)	(1)
5.6	hyperbola	(1)
5.5	G/r^2 ($1/r^2$ ½)	(2)
		[15]

6.1 ✓ opposing pattern ✓ lines perpendicular & not crossing ✓ direction

6.2 $n = \frac{Q}{e}$ ü $= \frac{(-)\ 8 \times 10^{-6}}{(-)\ 1{,}6 \times 10^{-19}}$ ü $= 5 \times 10^{13}$ electrons ü

6.3 The (electrostatic) <u>force</u> (between two charges<u>) is directly proportional to the product of the charges</u> ✓ <u>and inversely proportional to the square of the distance</u> (between their centres). ✓

6.4.1 $F = \frac{k.q_1.q_2}{r^2}$ ü $= \frac{9 \times 10^9 \times 8 \times 10^{-6} \times 5 \times 10^{-6}}{(0{,}12)^2}$ ü $= 25\ N$ ü

6.4.2 $\cos 60° = \frac{25}{T}$ üü +marking from 6.4.1

$\therefore T = 50\ N$ ü

6.5 <u>Force experienced per unit charge</u> placed at the point. ✓✓

6.6.1 $E_{net} = E_A + E_B$ ü

$E_{net} = \frac{k.q_A}{r_A^2} + \frac{k.q_B}{r_B^2}$ ü formula

$E_{net} = \frac{9 \times 10^9 \times 8 \times 10^{-6}}{(0{,}15)^2}$ ü $+ \frac{9 \times 10^9 \times 5 \times 10^{-6}}{(0{,}03)^2}$ ü

$\therefore E_{net} = 5{,}32 \times 10^7\ N.C^{-1}$ to the right ü (or 53 200 000)

6.6.2 $E = \frac{F}{q}$ ü

$5{,}32 \times 10^7 = \frac{F}{2(1{,}6 \times 10^{-19})\text{ ü}}$ ü + marking from 6.6.1

$\therefore F = 1{,}7024 \times 10^{-11}\ N$ to the right ü

[25]

7.1 The induced emf in a coil is directly proportional to the rate of change of magnetic flux linkage. ✓✓ (2 or 0)

7.2.1 DECREASES. ✓

7.2.2 INCREASES. ✓

7.2.3 REMAINS THE SAME. ✓

7.2.4 DECREASES. ✓

7.3 A to B. ✓✓

7.4 ✓ concentric circles ✓ clockwise

[10]

QUESTION 8:

Electric Circuits & Power		
8.1.1	Voltage (potential difference) between two points in a circuit is directly proportional to current strength at constant temperature. ✓✓	(2)
8.1.2	The battery has an emf of 3V ✓; it can deliver 3J per 1 C ✓ of charge flowing through it.	(2)
8.1.3	3V ✓	(1)
8.1.4	V = IR ✓ 3 = I (2+3) ✓ I = 0,6 A ✓	(3)
8.1.5	V_p = I R ✓ 3 = I (3+4) ✓ I = 0,428...A V_2 = I R = 0,428... x 4 ✓ = 1,71 V ✓ OR (use voltage divider ratio): $V_2 = 3 \times {}^4/_7$ ✓✓ = 1,71 V ✓✓	(4)
8.1.6	Increase ✓	(1)
8.1.7	The total R will decrease ✓, thus I will increase (inverse proportionality) ✓	(2)
8.1.8	Ammeter has no resistance ✓, total current flows through ammeter, no resistance in circuit, I too high. ✓	(2)
8.2.1	P = V^2/R ✓ 2600 ✓ = 220^2 / R ✓ R = 18,62 Ω ✓	(4)
8.2.2	Cost = kW x h x unit price = 2,6 x (3,5 x 2 x 30✓✓) x 2,90✓ = R 1583,40✓	(4)

TOTAL SECTION B = [130]

Formula Sheet

Physical Constants:

Name	Symbol	Value
Acceleration due to gravity	g	$9{,}8\ m.s^{-2}$
Gravitational constant	G	$6{,}67 \times 10^{-11}\ N.m^2.kg^{-2}$
Radius of Earth	R_E	$6{,}38 \times 10^6\ m$
Mass of Earth	M_E	$5{,}98 \times 10^{24}\ kg$
Speed of light in a vacuum	c	$3{,}0 \times 10^8\ m.s^{-1}$
Planck's constant	h	$6{,}63 \times 10^{-34}\ J.s$
Coulomb's constant	k	$9{,}0 \times 10^9\ N.m^2.C^{-2}$
Charge on electron	e	$-1{,}6 \times 10^{-19}\ C$
Electron mass	m_e	$9{,}11 \times 10^{-31}\ kg$
Avogadro's constant	N_A	$6{,}02 \times 10^{23}\ mol^{-1}$
Molar gas constant	R	$8{,}31\ J.K^{-1}.mol^{-1}$
Standard pressure	p^θ	$1{,}013 \times 10^5\ Pa$
Molar gas volume at STP	V_m	$22{,}4\ dm^3.mol^{-1}$
Standard temperature	T^θ	$273\ K$

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

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

WAVES, SOUND AND LIGHT

$v = f\lambda$	$T = \frac{1}{f}$
$n_i \sin\theta_i = n_r \sin\theta_r$	$n = \frac{c}{v}$

ELECTROSTATICS

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{F}{q}$
$E = \frac{kQ}{r^2}$	$n = \frac{Q}{e}$

ELECTROMAGNETISM

$\varepsilon = -N\frac{\Delta\Phi}{\Delta t}$	$\Phi = BA\cos\theta$

ELECTRIC CIRCUITS

$I = \frac{Q}{\Delta t}$	$R = \frac{V}{I}$
$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} + \cdots$	$R = r_1 + r_2 + r_3 + \cdots$
$W = Vq$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$

CHEMISTRY

$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$	$pV = nRT$
$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$n = \frac{V}{V_m}$	$c = \frac{n}{V}$ or $c = \frac{m}{MV}$