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NATIONAL SENIOR CERTIFICATE

GRADE 11

PHYSICAL SCIENCES MEMORANDUM

JUNE 2017

MARKS: 150

This memorandum consists of 10 pages.

QUESTION 1

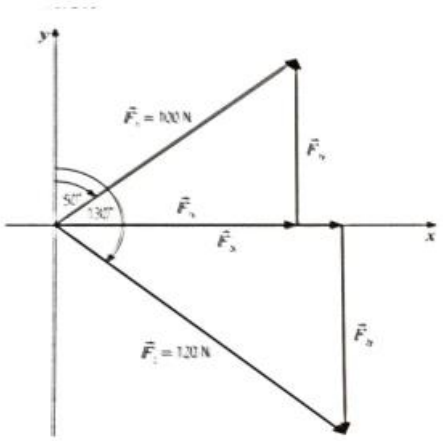
1.1	C✓✓	(2)
1.2	B✓✓	(2)
1.3	C✓✓	(2)
1.4	C✓✓	(2)
1.5	B✓✓	(2)
1.6	D✓✓	(2)
1.7	B✓✓	(2)
1.8	A✓✓	(2)
1.9	A✓✓	(2)
1.10	B✓✓	(2)

[20]

QUESTION 2

2.1 Resultant of two or more vectors is a single vector that has the same effect as the original vectors combined. ✓✓ (2)

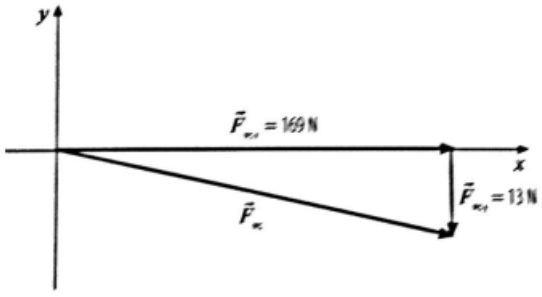
2.2



Vertical component = F sin θ
Vertical component of force applied by Daniel
F_1y = 100 sin 40º
=64,28 N✓
Vertical component of force applied by Thato
F_2y = 120 sin 40º
=77,13 N✓
Sum of vertical components of the force = 64,28-77,13
= -12,85 N✓
NOTE: no mark for the equation

Horizontal component = F cos θ
Horizontal component of force applied by Daniel
F_1x = 100 cos 40º
=76,60 N✓
Horizontal component of force applied by Thato
F_2x = 120 cos 40º
=91,93 N✓
Sum of horizontal components of the force =76,60 + 91,93
= 168,52 N✓
NOTE: no mark for the equation (6)

2.3 Magnitude of the resultant force



$(F_{res})^2 = 168,52^2 + (-12,85)^2$ ✓
$= 168,01$ N✓
Direction of the resultant
$\tan \theta = F_y/F_x$
$\tan \theta = 12,85/168,0$✓
$\theta = 4,37^o$✓
F_{res} = 168,01 N 4,37º south of east or on a bearing of 94,37º

(4)
[12]

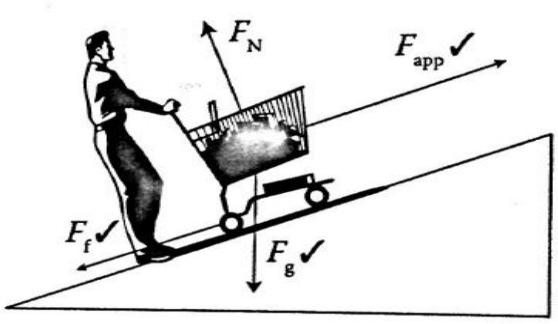
QUESTION 3

3.1 Weight of the truck = mg
$F_g = 1500 \times 9,8$✓
$= 14700$ N✓ (2)

3.2 Static frictional force is the force that opposes the tendency of motion of a stationary object✓ relative to a surface. ✓
Kinetic frictional force is the force that opposes the motion of a moving object✓ relative to a surface. ✓ (4)
[6]

QUESTION 4

4.1

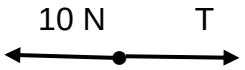


(3)

4.2 F_g = Normal force = mg cos θ
$= 20 \times 9,8 \times \cos 20^o$✓
$=184,18$ N✓
$f_k = \mu_k N$
$f_k = 0,7 \times 184,18$✓
$= 128,93$ N✓
$F_{g\parallel} = mg \sin \theta$
$= 20 \times 9,8 \times \sin 20^o$✓
$= 67,04$ N✓
Take up the slope as positive
$F_{net} = F_{app} - F_f - F_{g\parallel}$
In order to move the trolley
$F_{net} \geq 0$✓
$0 \leq F_{app} – 128,93 – 67,04$✓
$F_{app} \geq 195,97$ N✓
The minimum force that can be applied to the trolley ≥ 195,97 N (9)
[12]

QUESTION 5

5.1 Free body diagram for the engine free body diagram for the cart



$F_{net} = ma$✓
$10-T = 1 \times a$✓ ……(1)
Equation (1)+(2)
$10 = 1,5\ a$
$a = 6,67\ m{\cdot}s^{-2}$ forward✓

$T = 0,5 \times a$✓ ……(2)

(4)

5.2 Substitute 'a' in to equation (1) or (2)
$10 - T = 1 \times 6,67$✓
$T = 3,33$ N✓
Accept range 3,33 N to 3,34 N

Or $T = 0,5 \times 6,67$✓
$T = 3,34$ N✓

(2)
[6]

QUESTION 6

6.1 S. ✓ The gravitational force is strongest when the objects are closer together. Or when the distance is smaller✓.

(2)

6.2 Q✓ (1)

6.3 T. ✓ The radius 'r' has increase by a factor of '2' ✓or ¼ th of gravitational force at the surface of the Earth. ✓ (2)

6.4 $F_g = mg$
$784 = m \times 9,8$✓
$m = 80$ kg✓ (2)
[7]

QUESTION 7

7.1 $-432\ kJ\cdot mol^{-1}$✓ (1)

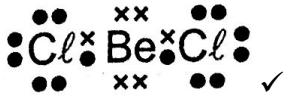
7.2 74 pm✓ (1)

7.3 Greater the bond length, smaller the bond energy✓ (1)

7.4 Section 1-The atoms are far apart and their potential energy is close to 0 $kJ\cdot mol^{-1}$. There is very little electrostatic attraction between the protons of one atom and electrons of the other atom. ✓
Section 2- As the atoms move closer to each other, the potential energy starts to decrease as the positive protons of one atom starts to exert an electrostatic force of attractions on the negative electrons of the other atom. ✓
Section 3 - Bonding takes place and the potential energy is the lowest for two atoms and the molecule is more stable. The forces of attraction and repulsion are equal to each other. ✓
Section 4- As the atoms are forced closer than bonding distance the forces of repulsion become much greater, the molecule become less stable and the potential energy increases rapidly. ✓ (4)

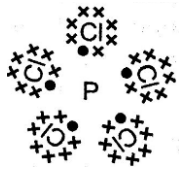
7.5 Carbon dioxide is linear✓made up of two polar bonds arranged symmetrically, making the molecule non polar.✓
Water molecule is angular✓ made up of two polar bonds arranged asymmetrically, making the molecule polar.✓ (4)

7.6.1 Linear✓ (2)



✓

7.6.2 Trigonal bipyramidal✓ (2)



✓

[15]

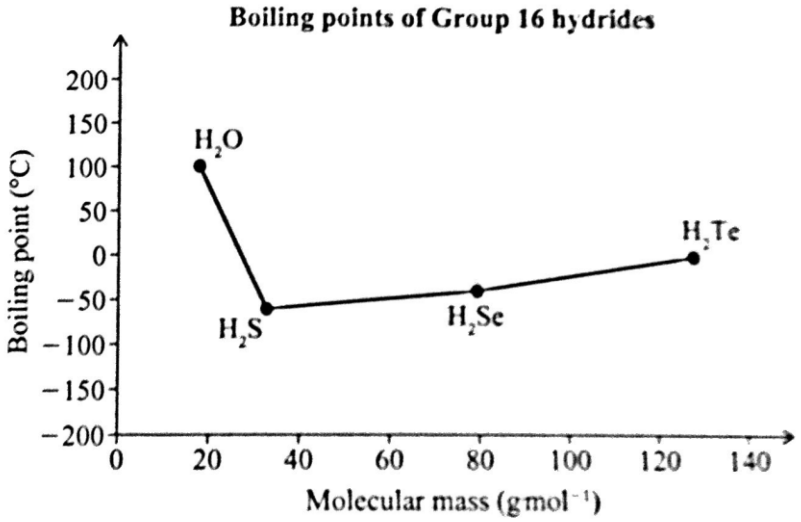
QUESTION 8

8.1

Substance	Type of particles	Type of intramolecular force	Type of intermolecular force	Polar or non polar or none
NH_4Cl	ions✓	ionic✓	Coulomb forces✓	none✓
CCl_4	molecules✓	covalent✓	van der Waals forces✓	non polar✓
NH_3	molecules✓	covalent✓	hydrogen bonding✓	polar✓

(12)

8.2.1



Criteria	Marks
Axes correctly labelled with units	1
Correct scale on both axes	1
Points correctly plotted.	1

(3)

8.2.2 Boiling point increases from H_2S to H_2Te. ✓ London forces exist✓ between all of these molecules. The strength of London forces increases as molecular size increases. ✓ Therefore as the hydride molecules become bigger, more energy is needed to overcome the London forces. ✓ (4)

8.2.3 Hydrogen bonding✓ that exists between water molecules is significantly stronger than London forces exist between other hydrides. ✓ (2)

[21]

QUESTION 9

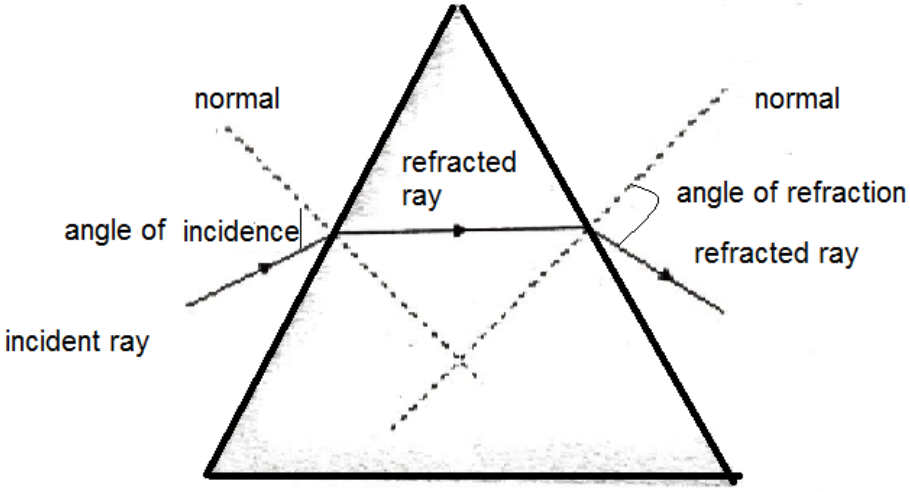
9.1 The bending of light when it passes from one optical medium to another that has a different optical density. ✓✓ (2)

9.2.1 $v = 3 \times 10^8 \text{ m·s}^{-1}$ ✓ (1)

9..2.2 $n = \frac{c}{v}$ ✓

$n = \frac{3 \times 10^8}{1{,}97 \times 10^8}$ ✓ = 1,52 ✓ (3)

9.3



(4)

Note: Award full marks for labelling correct angle of incidence, angle of refraction and refracted ray inside the prism.

9.4 $n_1 \sin \theta_1 = n_2 \sin \theta_2$ ✓

$1{,}33 \sin 59^o = n_2 \sin 27^o$ ✓

$n_2 = 2{,}51$ ✓

The unknown material is diamond ✓ (2,5 is more closer to 2,4) (4)

[14]

QUESTION 10

10.1 Light of a single frequency✓ (1)

10.2 A broad band of bright green light with alternating dark and green bands that become less intense as the light spreads away from the centre. ✓✓ (2)

10.3 Diffraction. ✓It is the ability of a wave to spread out in wavefronts as it passes through a narrow aperture or around a sharp edge. ✓✓ (3)

10.4 Huygens' Principle. ✓ Every point on a wavefront acts as the source of secondary wavelets that spread out in the forward direction with the same speed as the wave. ✓✓ (3)

[9]

QUESTION 11

11.1.1 Pressure✓ (1)

11.1.2 Volume✓ (1)

11.1.3 Temperature and number of moles of the gas✓ (both) (1)

11.2 How does the volume of a gas vary as pressure changes✓when the amount of gas and temperature remain constant? ✓
Note: Indicating correct variables – one mark
Relation in the form of question – one mark (2)

11.3 Boyle's Law.✓For a fixed amount of a gas at constant temperature, the pressure of a gas is inversely proportional to its volume. ✓✓ (3)

11.4 If the gas is obeying Boyle's Law $P_1V_1 = P_2V_2$ ✓ (3)
P_1V_1 = 198 x 25,4 = 5029,2 ✓
P_2V_2 = 158,6 x 31,71 = 5029,2 ✓
$P_1V_1 = P_2V_2$, therefore Boyle's Law is obeyed.
Note: Credit full marks even though the conversions were not done since it is a ratio.

11.5 $P_1V_1 = P_3V_3$
5029,2 = 120 x V_3 ✓
V_3 = 41,91 cm^3 ✓
Note: Credit full marks even though the conversions were not done since it is a ratio. (2)

[13]

QUESTION 12

12.1 If the gas is an ideal, $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ at constant pressure

$\frac{V_1}{T_1} = \frac{0,0546}{273}$ ✓

$= 0,0002$

$\frac{V_2}{T_2} = \frac{0,0746}{373}$ ✓

$= 0,0002$

Since $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ ✓ , so the gas is behaving like an ideal gas. (3)

12.2 Intermolecular forces are zero✓ and the particles in the gas have no volume✓ (2)

12.3 $\frac{V_1}{T_1} = \frac{V_3}{T_3}$

$0,0002 = \frac{V_3}{473}$ ✓

$V_3 = 0,0946\ cm^3$✓ or $9,46 \times 10^{-8}\ m^3$

Note: Credit full marks even though the conversions were not done since it is a ratio. (2)

12.4.1

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

$n\ (NH_4NO_3) = \frac{2,8}{80}$ ✓

$n = 0,035$ mol ✓

1 mol of NH_4NO_3 gives 1 mole of N_2O and 2 moles of H_2O

Number of moles of $N_2O = 0,035$ mol✓

Number of moles of $H_2O = 0,07$ mol✓

Total number of mols of gaseous products $= 0,035 + 0,07$

$0,105$ mol✓ (5)

12.4.2 $PV = nRT$✓ (3)

$P = \frac{0,105 \times 8,31 \times 344}{(1 \times 10^{-3})}$ ✓

$= 300157,2$

$= 300,16$ kPa✓

[15]

TOTAL: 150