**PHYSICAL SCIENCES**

**MEMORANDUM**

**JUNE 2017**

# NATIONAL

# SENIOR CERTIFICATE

# GRADE 11



**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**

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

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| 2.2 |  |  |  |
|  | Vertical component = F sin θ  Vertical component of force applied by Daniel  F1y = 100 sin 40º  =64,28 N✓  Vertical component of force applied by Thato  F2y = 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  F1x = 100 cos 40º  =76,60 N✓  Horizontal component of force applied by Thato  F2x = 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 |  |  |
|  | (Fres)2 = 168,522 + (-12,85)2 ✓  = 168,01 N✓  Direction of the resultant  tan θ = Fy/Fx  tan θ =12,85/168,0✓  θ = 4,37º✓  Fres  = 168,01 N 4,37º south of east or on a bearing of 94,37º | (4) |  |
|  |  | **[12]** |  |

**QUESTION 3**

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| 3.1 | Weight of the truck = mg  Fg = 1500 x 9,8✓  = 14700 N✓ | (2) |  |

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| 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**

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| 4.1 |  | (3) |  |

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| 4.2 | Fg = Normal force = mg cos θ  = 20 x 9,8 x cos 20º✓  =184,18 N✓  fk = 0,7 x 184,18✓  = 128,93 N✓  Fgǁ = mg sin θ  = 20 x 9,8 x sin 20º✓  = 67,04 N✓  Take up the slope as positive  Fnet = Fapp - Ff - Fgǁ  In order to move the trolley  Fnet ≥ 0✓  0 ≤ Fapp – 128,93 – 67,04✓  Fapp ≥ 195,97 N✓  The minimum force that can be applied to the trolley ≥ 195,97 N | (9) |  |
|  |  | **[12]** |  |

**QUESTION 5**

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| 5.1 | Free body diagram for the engine free body diagram for the cart    10 N T T  ● ●  Fnet = ma✓  10-T =1 x a✓ ……………(1) T = 0,5 x a✓ …………(2)  Equation (1)+(2)  10 = 1,5 a  a = 6,67 m∙s-2 forward✓ | (4) |  |

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| 5.2 | Substitute ‘a’ in to equation (1) or (2) Or T = 0,5 x 6,67✓  10 -T =1 x 6,67✓ T = 3,34 N✓  T = 3,33 N✓  Accept range 3,33 N to 3,34 N | (2) |  |
|  |  | **[6]** |  |

**QUESTION 6**

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| 6.1 | S. ✓ The gravitational force is strongest when the objects are closer together.  Or when the distance is smaller✓. | (2) |  |

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| 6.2 | Q✓ | (1) |  |

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| 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) |  |

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| 6.4 | Fg = mg  784 = m x 9,8✓  m = 80 kg✓ | (2) |  |
|  |  | **[7]** |  |

**QUESTION 7**

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| 7.1 | -432 kJ∙mol-1✓ | (1) |  |

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| 7.2 | 74 pm✓ | (1) |  |

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

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| 7.4 | Section 1-The atoms are far apart and their potential energy is close to  0 kJ∙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) |  |

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| 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) |  |

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| 7.6.1 | Linear✓  ✓ | (2) |  |
| 7.6.2 | Trigonal bipyramidal✓  ✓ | (2) |  |
|  |  | **[15]** |  |

**QUESTION 8**

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| 8.1 | |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Substance** | **Type of particles** | **Type of intramolecular force** | **Type of intermolecular force** | **Polar or non polar or none** | | NH4Cl | ions✓ | ionic✓ | Coulomb forces✓ | none✓ | | CCl4 | molecules✓ | covalent✓ | van der Waals forces✓ | non polar✓ | | NH3 | molecules✓ | covalent✓ | hydrogen bonding✓ | polar✓ | |  |  |
|  | (12) |  |  |

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| 8.2.1 | |  |  | | --- | --- | | Criteria | Marks | | Axes correctly labelled with units | 1 | | Correct scale on both axes | 1 | | Points correctly plotted. | 1 |   (3) |  |  |

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| 8.2.2 | Boiling point increases from H2S to H2Te. ✓ 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) |  |

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| 8.2.3 | Hydrogen bonding✓ that exists between water molecules is significantly stronger than London forces exist between other hydrides. ✓ | (2) |  |
|  |  | **[21]** |  |

**QUESTION 9**

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

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| 9.2.1 | v = 3 x 108 m∙s-1 ✓ | (1) |  |

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| 9..2.2 | n = c ✓  v  n = 3 x 108 ✓ = 1,52 ✓  1,97 x 108 | (3) |  |

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| 9.3 | **Note:** Award full marks for labelling correct angle of incidence, angle of refraction and refracted ray inside the prism. | (4) |  |

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| 9.4 | n1 sin θ 1 = n2 sin θ 2 ✓  1,33 sin 59º = n2 sin 27º✓  n2 = 2,51✓  The unknown material is diamond ✓ (2,5 is more closer to 2,4) | (4) |  |
|  |  | **[14]** |  |

**QUESTION 10**

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| 10.1 | Light of a single frequency✓ | (1) |  |

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| 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) |  |

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| 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) |  |

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| 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) |  |

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**QUESTION 11**

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| 11.1.1 | Pressure✓ | (1) |  |

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| 11.1.2 | Volume✓ | (1) |  |

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

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| 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) |  |

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| 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) |  |

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| 11.4 | If the gas is obeying Boyle’s Law P1V1 = P2V2 ✓  P1V1 = 198 x 25,4 = 5029,2 ✓  P2V2 = 158,6 x 31,71 = 5029,2 ✓  P1V1 = P2V2, therefore Boyle’s Law is obeyed.  **Note:** Credit full marks even though the conversions were not done since it is a ratio. | (3) |  |

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| 11.5 | P1V1 = P3V3  5029,2 = 120 x V3 ✓  V3 = 41,91 cm3 ✓  **Note:** Credit full marks even though the conversions were not done since it is a ratio. | (2) |  |

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|  |  | **[13]** |  |

**QUESTION 12**

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| 12.1 | If the gas is an ideal, V1 = V2 at constant pressure  T1 T2  V1 = 0,0546✓  T1 273  = 0,0002  V2 = 0,0746✓  T2 373  = 0,0002  Since V1 = V2 ✓ , so the gas is behaving like an ideal gas.  T1 T2 | (3) |  |

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

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| 12.3 | V1 = V3  T1 T3  0,0002 = V3 ✓  473  V3 = 0,0946 cm3✓ or 9,46 x 10-8 m3  **Note:** Credit full marks even though the conversions were not done since it is a ratio. | (2) |  |

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| 12.4.1 | n = m  M  n (NH4NO3)= 2,8✓  80  n = 0,035 mol ✓  1 mol of NH4NO3 gives 1 mole of N2O and 2 moles of H2O  Number of moles of N2O = 0,035 mol✓  Number of moles of H2O = 0,07 mol✓  Total number of mols of gaseous products =0,035 + 0,07  0,105 mol✓ | (5) |  |
| 12.4.2 | PV = nRT✓  P = 0,105 x 8,31 x 344 ✓  (1x 10-3)  =300157,2  = 300,16 kPa✓ | (3) |  |

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|  |  | **[15]** |  |

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| **TOTAL:** |  | **150** |