LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

VHEMBE EAST DISTRICT

NATIONAL

SENIOR CERTIFICATE

GRADE 11

PHYSICAL SCIENCES

CONTROLLED TEST 1

07 MARCH 2022

MARKS	**:**	**100**
DURATION	**:**	**2 HOURS**

This Question paper consists of 13 pages including the cover page.

INSTRUCTIONS AND INFORMATION

1. This question paper consists of 11 questions. Answer ALL the questions in the ANSWER BOOK.
2. Number the answers correctly according to the numbering system used in this question paper.
3. You may use a non-programmable calculator.
4. You may use appropriate mathematical instruments.
5. You are advised to use the attached DATA SHEETS.
6. Show ALL formulae and substitutions in ALL calculations.
7. Round off your final numerical answers to a minimum of TWO decimal places.
8. Give brief motivations, discussions et cetera where required.
9. Write neatly and legibly.

QUESTION 1 : MULTIPLE CHOICE QUESTIONS

Four options are provided as possible answers to the following questions.
Each question As only ONE correct answer. Write only the letter (A-D) next to the question number (1.1 – 1.8 in the ANSWER BOOK. For example 1.5 D

1.1 The statements below refers to vector and scalar quantities

(i) A vector has magnitude and direction while a scalar has magnitude only.
(ii) A scalar quantity can always be added to a vector quantity.
(iii) Force is an example of a vector quantity, while distance is an example of a scalar quantity.

Which of the above statements is is/are TRUE?

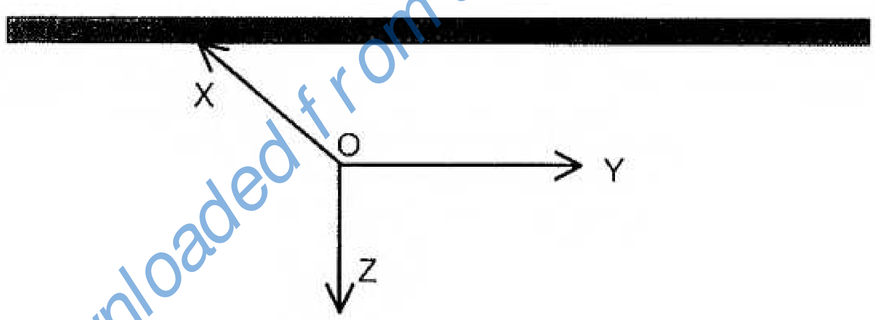
A. (i) and (ii) only

B. (i) and (iii) only

C. (ii) and (iii) only

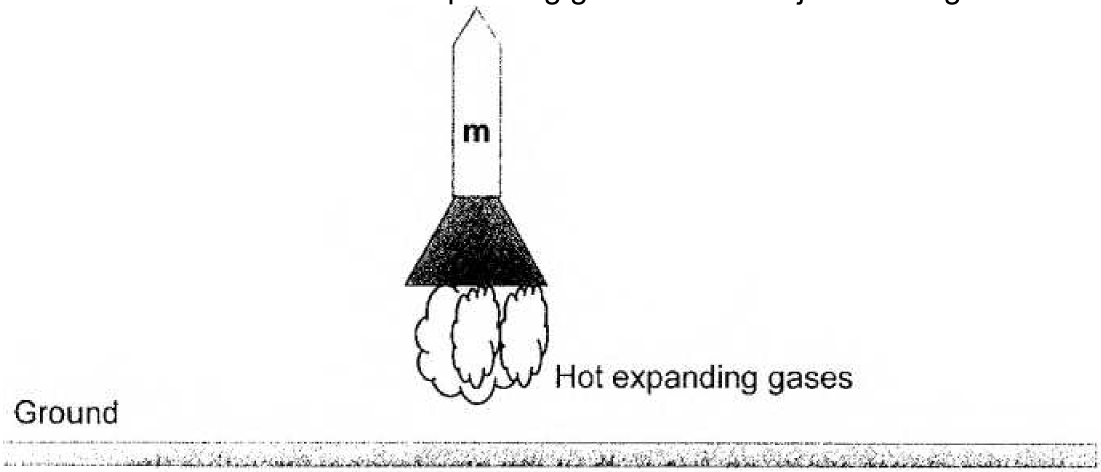
D. (i) only (2)

1.2 Three forces X, Y and Z act at appoint O and are in equilibrium.
Which of the following statements is incorrect.



A The vector sum of all the forces is zero.
B. X is equal to the resultant of Y and Z.
C Z is the equilibrant of X and Y.
D The resultant of X, Y and Z is zero (2)

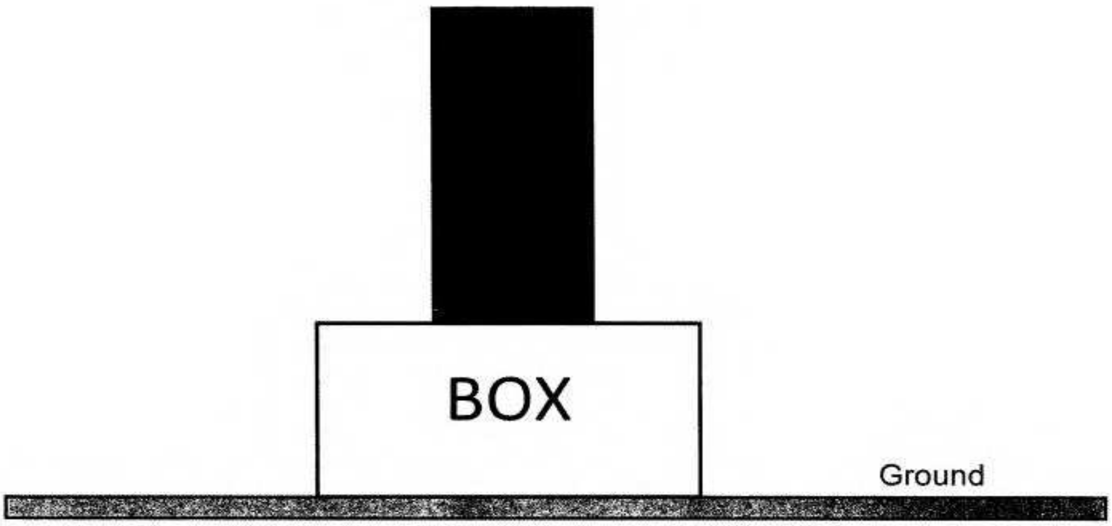
1.3 A rocket of mass m is launched vertically upwards from the ground. The engine of the rocket converts the fuel to hot expanding gases which it ejects during its motion.



Which one of the following statements best describes the cause of the rocket'"s acceleration?

A. The hot expanding gases exert a downwards force on the ground.
B The hot expanding gases exert an upwards force on the rocket.
C. The rocket exerts a downwards force on the ground.
D. The rocket exerts a downwards force on the hot expanding gases. (2)

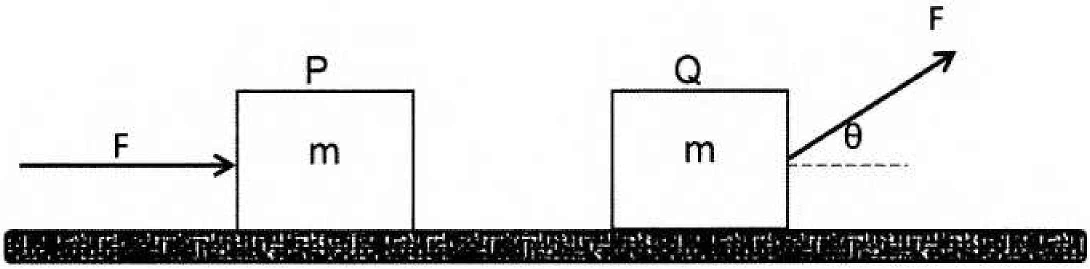
1.4 A man of mass m stands upright on a stationary wooden box placed on the ground.



The weight of the box is W
The NORMAL force acting on the box is equal to….

A W + m
B W - m
C W + mg
D W - mg (2)

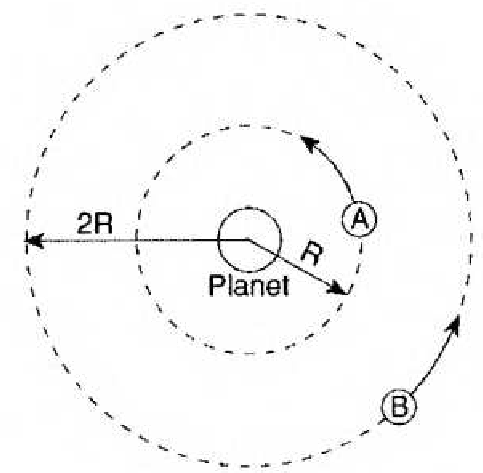
1.5 The same force, with magnitude F, is applied to two IDENTICAL blocks on the same surface as shown. Both blocks move to the right



Which of the following is the same for both blocks?

A The acceleration.
B The kinetic frictional force.
C The ratio of the kinetic frictional force to the normal force.
D The normal force. (2)

1.6 The diagram below represents two satellites A and B of equal mass in circular orbits.



The distances of satellites A and B from the centre of the planet are R and 2R respectively. If the gravitational force that the planet exerts on A is F, then the gravitational force that the planet exerts on B will be

A 2F

B $\frac{1}{2}F$

C 4F

D $\frac{1}{4}F$ (2)

1.7 For which one of the following bonds is the difference in electronegativity the GREATEST?

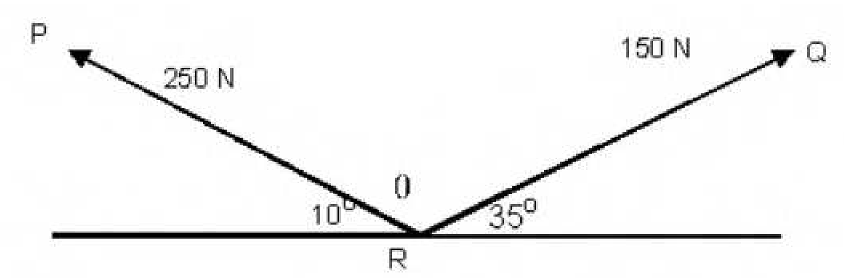
A C - O
B C - H
C C - Br
D H - Br (2)

1.8 The shape of the CO_2 molecules is….

A Angular
B Trigonal planar
C Linear
D Trigonal bipyramidal (2)
[16]

QUESTION 2 (Start on a new page)

The diagram below shows two forces P and Q of magnitude 250 N and 150 N respectively acting at a point R



2.1 Define the term *resultant* of a vector. (2)

2.2 Calculate the horizontal and vertical components of vector P (4)

2.3 Calculate the vector sum of horizontal components of P and Q (3)

2.4 The vector sum of the vertical components of these forces is 129,45 N.

Using the vector sums of the horizontal and vertical components of P and Q, draw a labelled force vector diagram to show the resultant force acting on point R (3)

2.5 Calculate the magnitude of the resultant of forces P and Q (3)

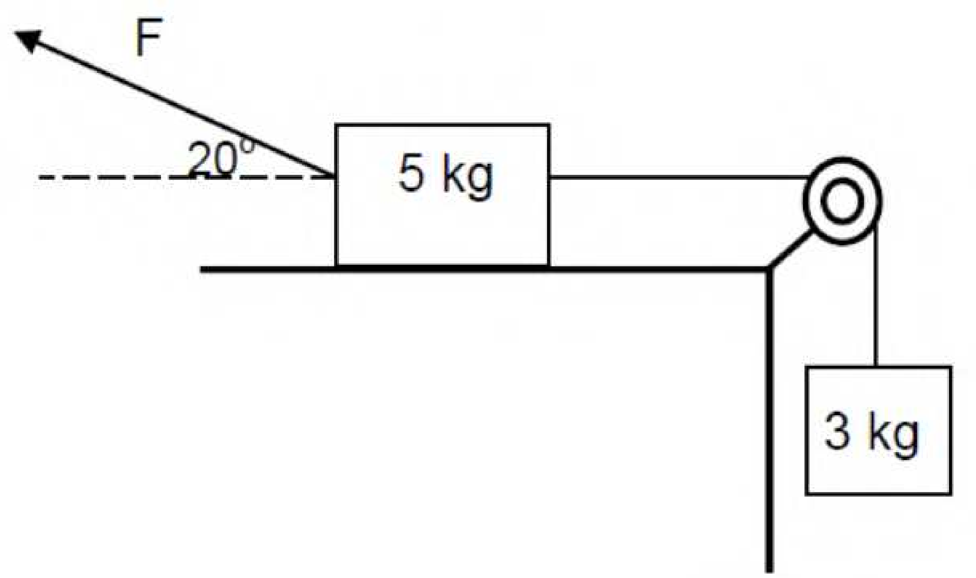
2.6 Calculate the direction (measured clockwise from the positive Y –axis) of the resultant of vectors P and Q. (3)

2.7 If vector P was fixed but the direction of vector Q could be changed, for which value of ɵ will the resultant force have a maximum value? (1)

[19]

QUESTION 3 (Start on a new page)

A 5 kg block, resting on a rough horizontal surface, is connected by a light inextensible string passing over frictionless pully to a second block of mass 3 kg hanging vertically
An applied force F is cating on the 5 kg block as shown in the diagram below and the coefficient of kinetic friction between the 5 kg block and the surface is 0.2
The 5 kg block accelerates to the left



3.1 Define the term frictional force (2)

3.2 Draw a labelled free-body diagram to indicate all the forces acting on the 5 kg block. (5)

3.3 Calculate the magnitude of the:

3.3.1 Vertical component of F if the magnitude of the horizontal component of F is equal to 38 N (2)

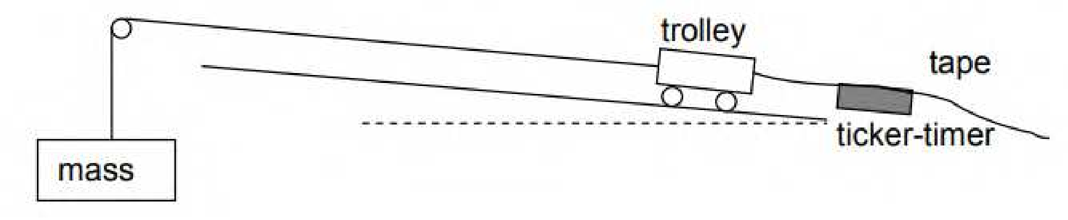
3.3.2 Normal force acting on the 5 kg block (3)

3.4 State Newton's Second Law of motion (2)

3.5 Calculate the tension in the string connecting the blocks (5)
[19]

QUESTION 4 (Start on a new page)

Learners investigate the relationship between net force and acceleration by pulling a trolley across a surface which is slightly inclined to compensate for friction.
The trolley is connected to different masses by a string of negligible mass. The string passes over a frictioless pulley. Refer to the diagram below



Ticker tape attached to a trolley passes through the ticker-timer. The acceleration of the trolley is determined by analysing the ticker-tape. The results of the net force of the trolley were recorded in the table below.

NET FORCE (N)	a ($m \cdot s^{-2}$)
0,3	0,36
0,6	0,73
0,9	1,09
1,2	1,45

4.1 Write down the hypothesis for this experiment (2)

4.2 4.2.1 Identify the independent variable (1)

4.2.2 Identify the controlled variable (1)

4.3 Use the graph paper and draw a graph of the acceleration versus net force (4)

4.4 Calculate the gradient of the graph (3)

4.4 Use the gradient of the graph calculated in QUESTION 4.4 to determine the mass of the trolley (2)
[13]

QUESTION 5 (Start on a new page)

Two satelites orbiting the earth are situated on opposite sides 0f the earth. Satellite A hasa a mass of 3800 kg and satellite B has a mass of 4500 kg. Satellite A is at a height of 25 000 km above the earth surface

5.1 State Newton's universal gravitational law in words. (2)

5.2 Explain the term weightlessness. (2)

5.3 Calculate the force between the earth and satellite A. (4)

5.4 What distance above the surface of the earth should satellite B be to experience the same force towards the earth as satellite A?
Choose GREATER THAN, LESS THAN OR EQUAL TO the distance above the earth. (1)

5.5 Give reason for the answer in QUESTION 4.4 above. (3)
[12]

QUESTION 6 (Start on a new page)

.6.1 Ammonia NH_3(g) and hypochlorous acid HOCl(l) are both examples of covalent compounds.

6.1.1 Define the term bonding pair. (2)

6.1.2 Draw Lewis structures for the following molecules

(a) NH_3 (2)

(b) HOCl (2)

(c) CO_2 (2)

6.1.3 Write down the:

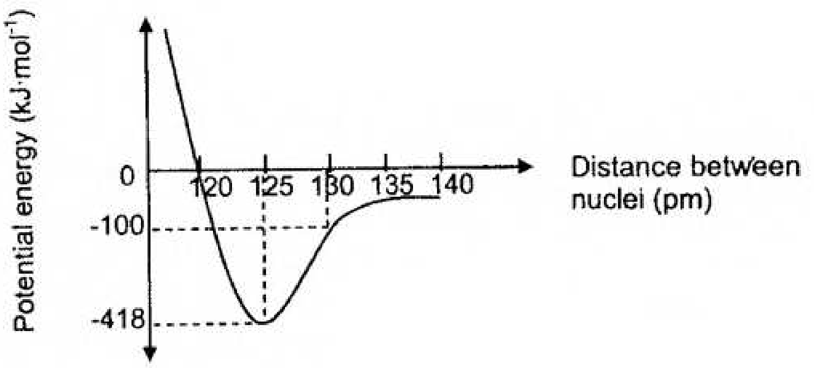
(a) Number of bonding pairs in NH_3 (1)

(b) Number of lone pairs on the oxygen atom of HOCl (1)

(c) Shape of ammonia molecule (1)

6.1.4 Which bond, N-H or O-H, is more polar? Give a reason for the answer. (2)

6.2 The graph below shows how the potential energy varies with distance between the nuclei of 2 nitrogen atoms when a double bond between the nitrogen atoms **(N=N)** is formed.



6.2.1 Define bond length. (2)

6.2.2 What is the bond length (in pm) of the N=N bond? (1)

6.2.3 Define bond energy. (2)

6.2.4 The bond energy of the N≡N bond is 496 $Kj.mol^{-1}$. Will the bond length of the N≡N bond be GREATER THAN, LESS THAN OR EQUAL TO your answer in 6.2.2? (1)

6.2.5 What is the relationship between bond energy and bond length? (2)

13

TOTAL = 100 marks

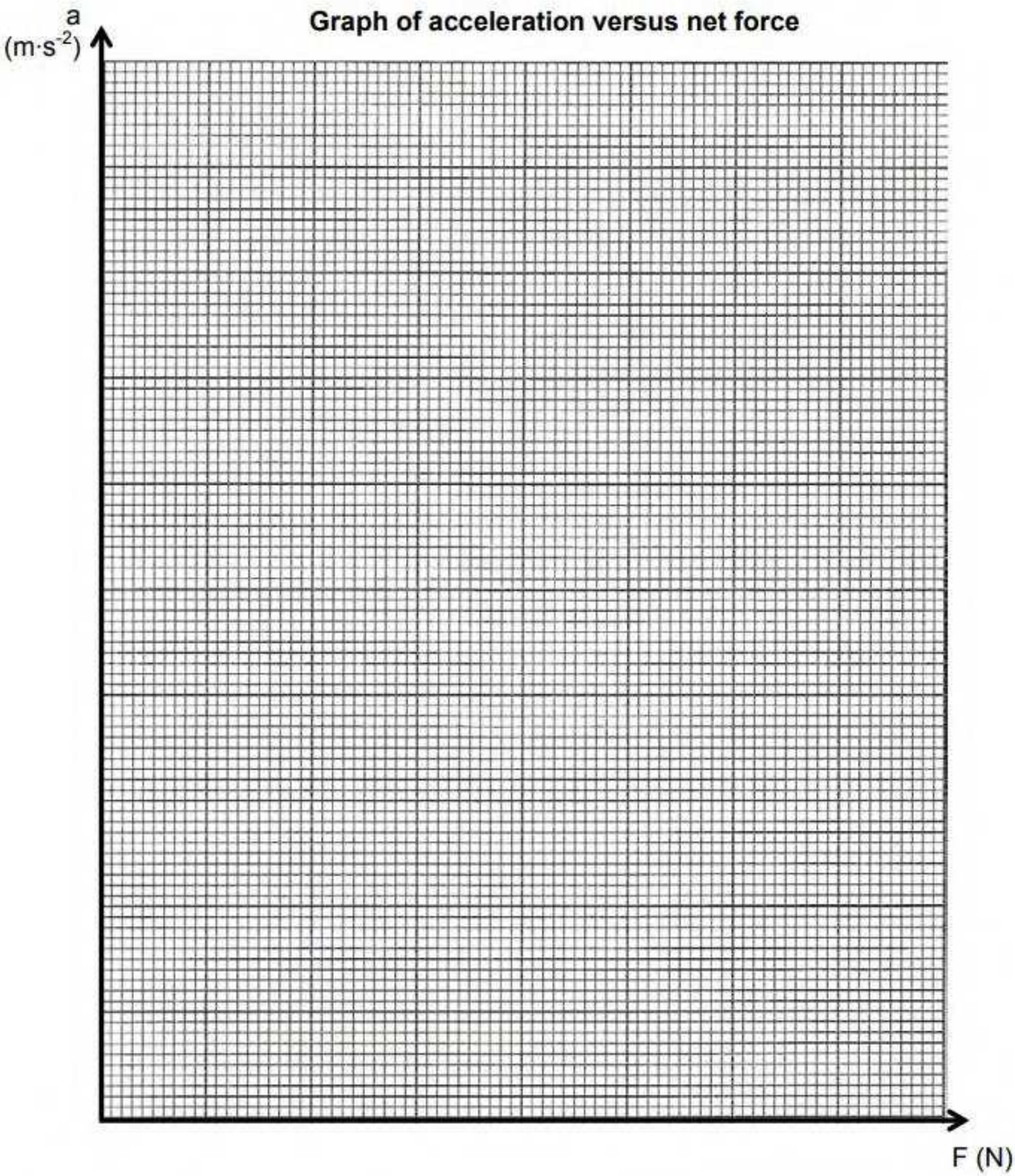


TABLE 3: THE PERIODIC TABLE OF ELEMENTS

KEY/*SLEUTEL*

Electronegativity / *Elektronegatiwiteit*	Atomic number / *Atoomgetal*	Symbol / *Simbool*	Approximate relative atomic mass / *Benaderde relatiewe atoommassa*
1,9	29	Cu	63,5

1 (I)	2 (II)	3	4	5	6	7	8	9	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	18 (VIII)
2,1 1 H 1																	2 He 4
1,0 3 Li 7	1,5 4 Be 9											2,0 5 B 11	2,5 6 C 12	3,0 7 N 14	3,5 8 O 16	4,0 9 F 19	10 Ne 20
0,9 11 Na 23	1,2 12 Mg 24											1,5 13 Aℓ 27	1,8 14 Si 28	2,1 15 P 31	2,5 16 S 32	3,0 17 Cℓ 35,5	18 Ar 40
0,8 19 K 39	1,0 20 Ca 40	1,3 21 Sc 45	1,5 22 Ti 48	1,6 23 V 51	1,6 24 Cr 52	1,5 25 Mn 55	1,8 26 Fe 56	1,8 27 Co 59	1,8 28 Ni 59	1,9 29 Cu 63,5	1,6 30 Zn 65	1,6 31 Ga 70	1,8 32 Ge 73	2,0 33 As 75	2,4 34 Se 79	2,8 35 Br 80	36 Kr 84
0,8 37 Rb 86	1,0 38 Sr 88	1,2 39 Y 89	1,4 40 Zr 91	41 Nb 92	1,8 42 Mo 96	1,9 43 Tc	2,2 44 Ru 101	2,2 45 Rh 103	2,2 46 Pd 106	1,9 47 Ag 108	1,7 48 Cd 112	1,7 49 In 115	1,8 50 Sn 119	1,9 51 Sb 122	2,1 52 Te 128	2,5 53 I 127	54 Xe 131
0,7 55 Cs 133	0,9 56 Ba 137	57 La 139	1,6 72 Hf 179	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	1,8 81 Tℓ 204	1,8 82 Pb 207	1,9 83 Bi 209	2,0 84 Po	2,5 85 At	86 Rn
0,7 87 Fr	0,9 88 Ra 226	89 Ac															

58 Ce 140	59 Pr 141	60 Nd 144	61 Pm	62 Sm 150	63 Eu 152	64 Gd 157	65 Tb 159	66 Dy 163	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175
90 Th 232	91 Pa	92 U 238	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

DATA FOR PHYSICAL SCIENCES
PAPER I (PHYSICS)

TABLE 1: PHYSICAL CONSTANT

NAME	SYMBOL	VALUE
Acceleration due to gravity	g	$9,8 \text{ m.s}^{-2}$
Gravitational constant	G	$6,67 \times 10^{-11} \text{ N.m}^2.\text{kg}^{-2}$
Charge on electron	e^-	$-1,6 \times 10^{-19}$ C
Speed of light in a vacuum	c	$3,0 \times 10^8 \text{ m.s}^{-1}$
Coulomb's constant	k	$9,0 \times 10^9 \text{ N.m}^2\text{C}^{-2}$
Electron mass	m_e	$9,11 \times 10^{-31}$ kg
Permittivity of free space	ε_0	$8,85 \times 10^{-12} \text{ F.m}^{-1}$

TABLE 2: FORMULAS

MOTION

$v_f = v_i + a\Delta t$	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$v_f^2 = v_i^2 + 2a\Delta x$	$\Delta x = \left(\frac{v_f + v_i}{2}\right)\Delta t$

FORCE

$F_{net} = ma$	$P = mv$
$F = \frac{Gm_1m_2}{r^2}\ (G = 6,67 \times 10^{-11} \text{ N.m}^2.\text{kg}^{-2})$	$F\Delta t = \Delta p = mv_f - mv_i$
$\mu_s = \frac{f_s(max)}{F_N}$	$\mu_k = \frac{f_k}{F_N}$
$\tau = Fr$	

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PHYSICAL SCIENCES

CONTROLLED TEST 1 MEMORANDUM

07 MARCH 2022

MARKS: 35

This Memorandum consists of 8 pages including the cover page.

QUESTION 1

1.1	B ✓✓	**(2)**
1.2	B ✓✓	**(2)**
1.3	B ✓✓	**(2)**
1.4	C ✓✓	**(2)**
1.5	C ✓✓	**(2)**
1.6	D ✓✓	**(2)**
1.7	A✓✓	**(2)**
1.8	C✓✓	**(2)**
		[12]

QUESTION 2

2.1 The vector with the same effect✓ as all the vectors together ✓ (2)

2.2 F_{PX} $= F_P \cdot \cos\theta$

$= 250 \times \cos 10^0$ ✓

$= 246,20$ N ✓

F_{PY} $= F_P \cdot \sin\theta$

$= 250. \text{ Sin } 10^o$ ✓

$= 43.41$ N ✓ (4)

2.3 F_{QX} $= F \cos\theta$

$= 150 \cos 35^o$

$= 122,87$ N to the right ✓

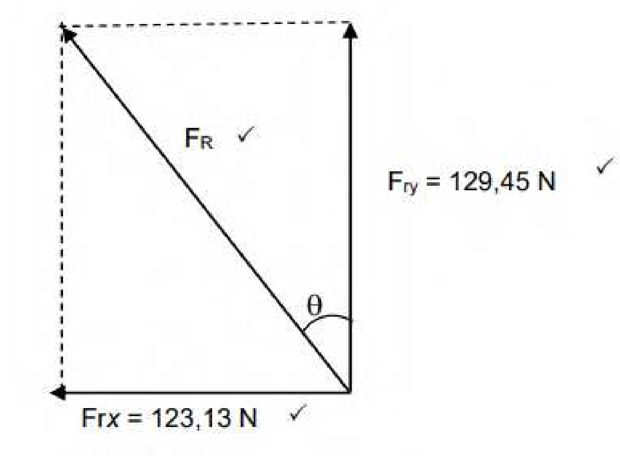
F_{RX} $= F_{PX} + F_{QX}$

$= -246 + 122.87$ ✓

$= 123.13$ N

$= 123,13$ N to the left

2.4



(3)

2.5 $F_R^2 = F_{RX}^2 * F_{RY}^2$ ✓

$= (122.13)^2 + (129{,}49)^2$ ✓

$= 31918{,}30$

$F_R = 178{,}66$ N ✓ (3)

2.6 $\tan \theta = \frac{F_{RX}}{F_{RY}}$

$= \frac{123{,}13}{129{,}45}$ ✓

$= 0.$

$\theta = 43.57°$ ✓

Direction = 360° - 43,57° = 316,43° ✓ (3)

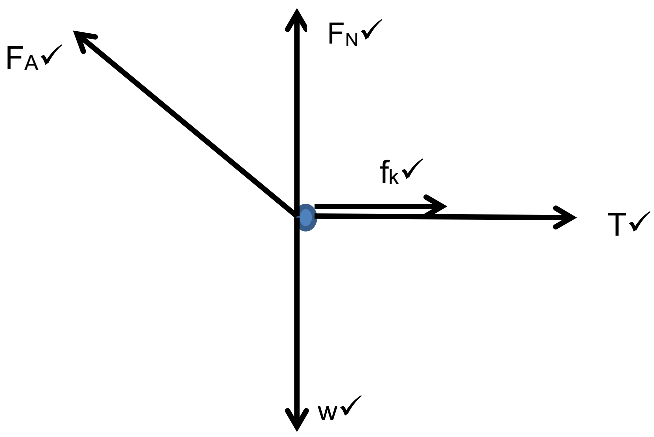
2.7 0° ✓ (1)

[19]

QUESTION 3

3.1 It is the force that opposes the motion of an object✓ and which acts parallel to the surface. ✓ (2)

3.2



(5)

3,3 3.3.1 $\tan 20^0 = \frac{F_V}{F_H}$

$F_V = 38 \tan 20^0$✓

= 13,83 N✓ (2)

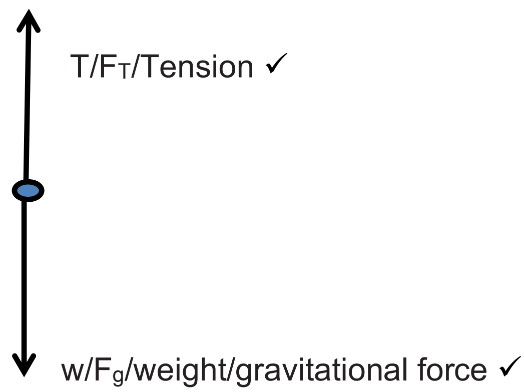
3.3.2 $F_N = F_g - F_V$ (3)

= (5)(9.8) ✓ - 13.83✓

= 35.17 N✓

3.4 When a resultant force act s 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)

3.5



OPTION 1

Left/Upwards as positive

5 kg block: F_{net} = ma ✓

-T + FH – f = ma

-T + 38 – (0.2)(35.17) ✓ = 5a ✓-----------(1)

3 kg block : -Fg + T = ma

-(3)(9.8) + T = 3a ✓ ------------------(2)

Substitute 2 into 1

A = 0.196m.s^{-2}

Substitute a into 2:

-29.4 + T = (3)(0.196) ✓

T = 29.99N ✓ (5)

OPTION 2

Right/ Downwards as positive

5 kg block: F_{net} = ma✓

T - FH + f = ma

T - 38 + (0.2)(35.17) ✓ = -5a✓ -----------(1)

3 kg block : Fg - T = ma

(3)(9.8) - T = -3a✓ ------------------(2)

Substitute 2 into 1

a = 0.196m.s^{-2}

Substitute a into 2:

29.4 - T = -(3)(0.196) ✓

T = 29.99N✓ (5)

QUESTION 4

4.1

Criteria for hypothesis	
The dependent and independent variables are stated correctly	✓
State the relationship between the dependent and independent variables	✓
Dependent variable : acceleration Independent variable: (net) force	

Example :

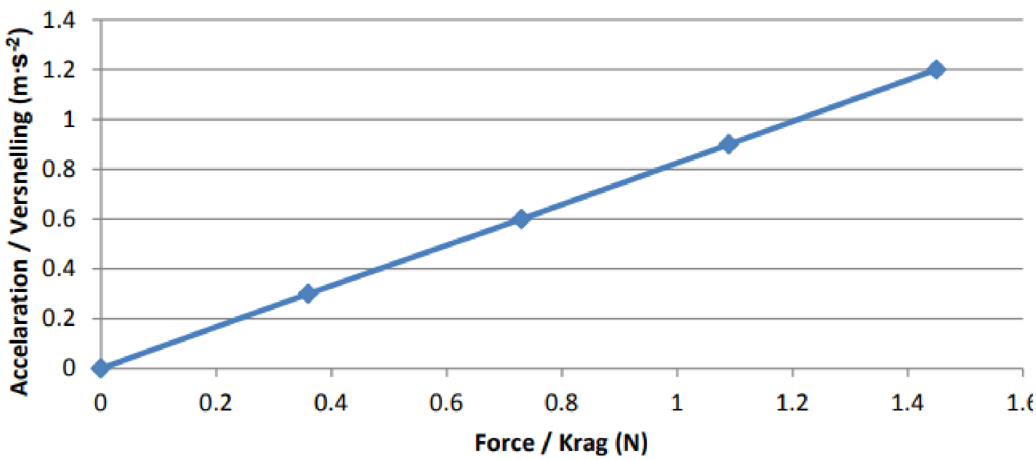
The (net) force is directly proportional to acceleration if the mass of the trolley is kept constant ✓✓ (2)

4.2 4.2.1 (Net) Force ✓ (1)

4.2.2 Mass of the trolley✓ (1)

4.3

Graph of acceleration versus net force.



Marking criteria for the graph

Axis with correct / appropriate scale	✓
3 or more coordinates correctely plotted	✓✓
Drawing a line of best fit	✓

(4)

4.4 Accept any set of coordinates from the graph

gradient $= \frac{1.45 - 0.36\checkmark}{1,2 - 0.3\ \checkmark} = 1.21\ \checkmark$ (3)

4.5 Positive marking from question 4.4

gradient $= \frac{a}{F} = \frac{1}{m}$

m $= \frac{1}{1.21}\checkmark = 0.83\ kg\checkmark$ (2)

[13]

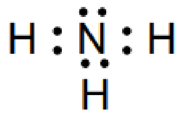
QUESTION 5		
5.1	<u>Every body /particles in the universe attracts every other body with a force that is directly proportional to the product of their masses</u> and <u>inversely proportional to the square of the distance between their centres.</u> ✓✓	(2)
5.2	Weightlessness is the sensation experienced when all contact forces are removed.✓✓	(2)
5.3	$F = G\frac{M1M2}{r^2}\checkmark$ $= 6.67\ X\ 10^{-11}\ \frac{(5.98\ X10^{24})(3800)}{((6.38\ X\ 10^6+(25\ X\ 10^6\ ))^2}\checkmark$ = 1539.23 N✓✓	(4)
5.4	Greater than,✓	(1)
5.5.	The mass is greater✓ and for the same force ✓the distance must also be greater. ✓ (because the product of the masses is directly proportional to the square of the distance between the centres.)	(3)
		[12]

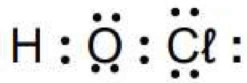
QUESTION 6

6.1. Marking guidelines:

If any of the underlined keywords/phrases are ommitted minus 1 mark.(2) ✓

<u>Two electrons shared between two atoms</u> in a covalent bond ✓✓ (2)

6.1.2 (a)  ✓✓ (2)

(b)  ✓✓ (2)

(c)  ✓✓ (2)

6.1.3	(a)	3 ✓	(1)
	(b)	2 ✓	(1)
	(c)	Trigonal pyramid ✓	(1)
6.1.4		O – H ✓ O – H ΔEN = 3,5 – 2-1 = 1.4 N – H ΔEN = 3 - 2,1 = 0,9 ✓	(2)
6.2.1		The average distance between the nuclei of two bonding atoms ✓✓	(2)
6.2.2		125 pm ✓	(1)
6,2,3		A measure of the bond strength of a chemical bond, ✓✓	(2)
6.2.4		Less than ✓	(1)
6.2.5		The shorter the bond length, ✓ the greater the bond erhergy✓	(2)
			[23]

TOTAL = 100 marks