ALEXANDER ROAD HIGH SCHOOL

TERM 1 2020 60 MIN

PHYSICAL SCIENCE CONTROL TEST (PART 2)

JA TOTAL = 50

GRADE 11

Instructions

- The question paper consists of 5 questions.
- Answer all the questions.
- Answer section A on the answer sheet provided AND section B on folio sheets.
- A non-programmable calculator may be used.
- Number the answers correctly according to the numbering system.
- Round off to two (2) decimal places where necessary.
- A formula sheet has been provided at the end of the question paper.
- A periodic table has been provided on the back of the answer sheet.

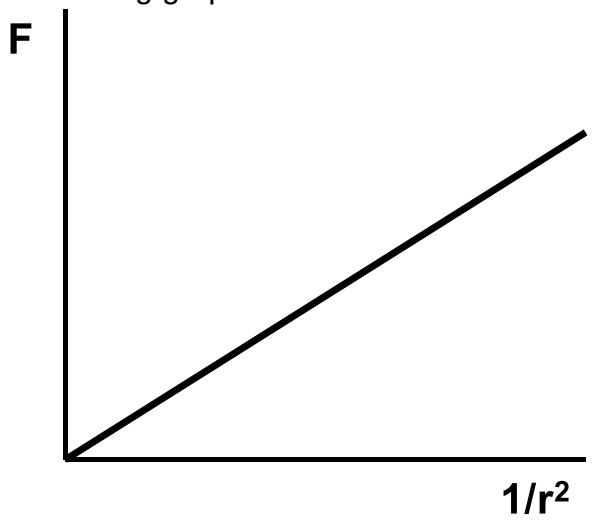
SECTION A

- Answer on the answer sheet -

QUESTION 1: Multiple choice

Four possible options are provided as answers to the following questions. Each question has only 1 correct answer. Choose the correct answer and write the letter (A – D) next to the relevant question number (1.1 – 1.6) on the answer sheet.

1.1 A scientist conducts an experiment to investigate the relationship between the electrostatic force **F** between two charges $\mathbf{q_1}$ and $\mathbf{q_2}$ and the distance **r** between their centers. He obtains the following graph:



The gradient of the graph is…

A. k

B. q_1

C. q_2

D. $k.q_1.q_2$

1.2 The electrostatic force between two point charges – $\mathbf{q_1}$ and $\mathbf{q_2}$ – a distance **R** apart is **F**. When the distance between the charges is changed to **r**, the electrostatic force is 9 times smaller. The relationship between **r** and **R** is…

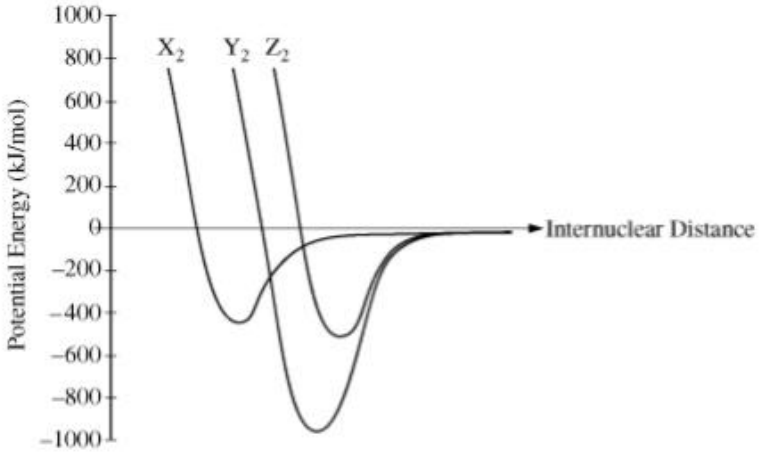
A. r = 9.R

B. r = 3.R

C. r = $^1/_3$.R

D. r = $^1/_9$.R

1.3 The potential energy bonding graphs for three different diatomic elements are shown below.



Based on the data in the graph, which ONE of the following correctly identifies the diatomic molecules X_2, Y_2 and Z_2?

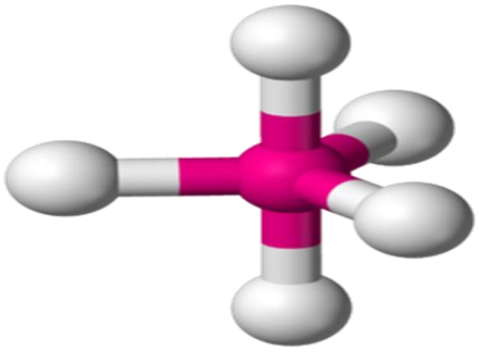
	X_2	**Y_2**	**Z_2**
A.	H_2	O_2	N_2
B.	H_2	N_2	O_2
C.	N_2	O_2	H_2
D.	O_2	H_2	N_2

1.4 Consider the Lewis diagram shown below:

Which ONE of the following combinations is correct?

	Name of Element X	**Name of Element Y**	**Molecular Shape**
A.	Carbon	Oxygen	Linear
B.	Sulphur	Oxygen	Bent
C.	Beryllium	Chloride	Linear
D.	Oxygen	Hydrogen	Angular

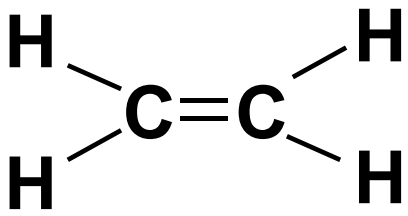
1.5 Consider the molecular shape (as predicted by VSEPR theory) shown below:



Which ONE of the following combinations is correct?

	Name of Shape	Example
A.	Trigonal pyramidal	PCl_5
B.	Trigonal bipyramidal	SF_6
C.	Trigonal bipyramidal	PCl_5
D.	Octahedral	SF_6

1.6 The Couper notation of ethylene (C_2H_4) – the most manufactured organic molecule in the world (150 million tones in 2016) – is given below.



The bond energy for various bonds is given in the table below.

C–C	C=C	C≡C	C–H
346 kJ.mol^{-1}	602 kJ.mol^{-1}	835 kJ.mol^{-1}	413 kJ.mol^{-1}

Using the data provided, the amount of energy needed to break **2 moles** of ethylene into its atoms is…

A. 2254 kJ
B. 2344 kJ
C. 4508 kJ
D. 4688 kJ

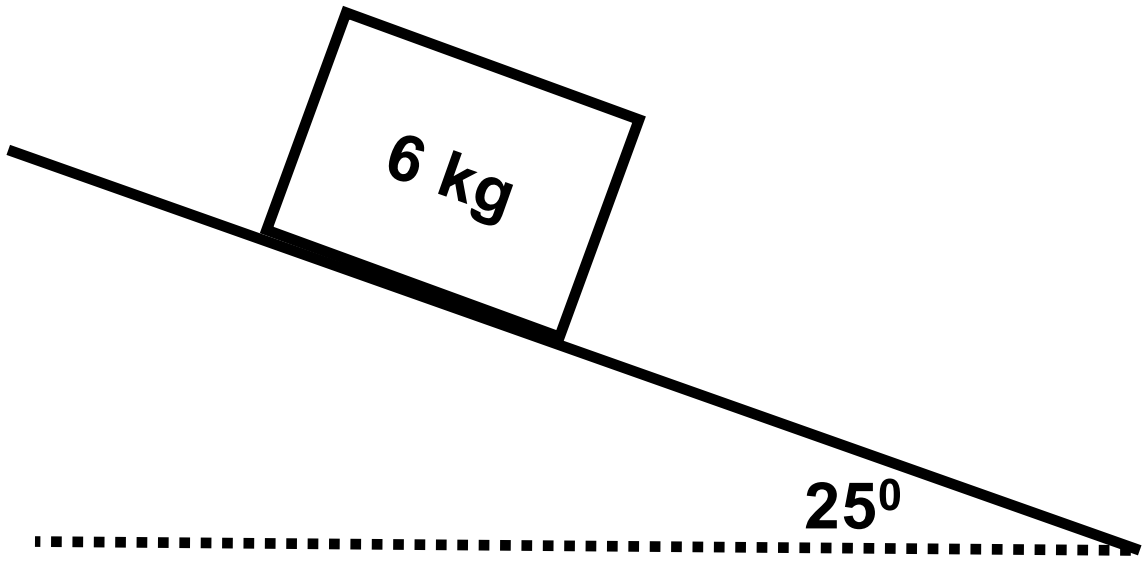
TOTAL SECTION A [12]

SECTION B

-Answer on folio paper-

QUESTION 2:

A 6 kg block slides down a rough slope inclined at 25° with the horizontal as shown in the diagram below.



2.1 State *Newton's 2nd law of motion* in words. (2)

2.2 Draw a free-body diagram showing ALL the forces acting on the 6 kg block. (3)

If the acceleration of the block is 6 $m.s^{-2}$ down the slope, calculate:

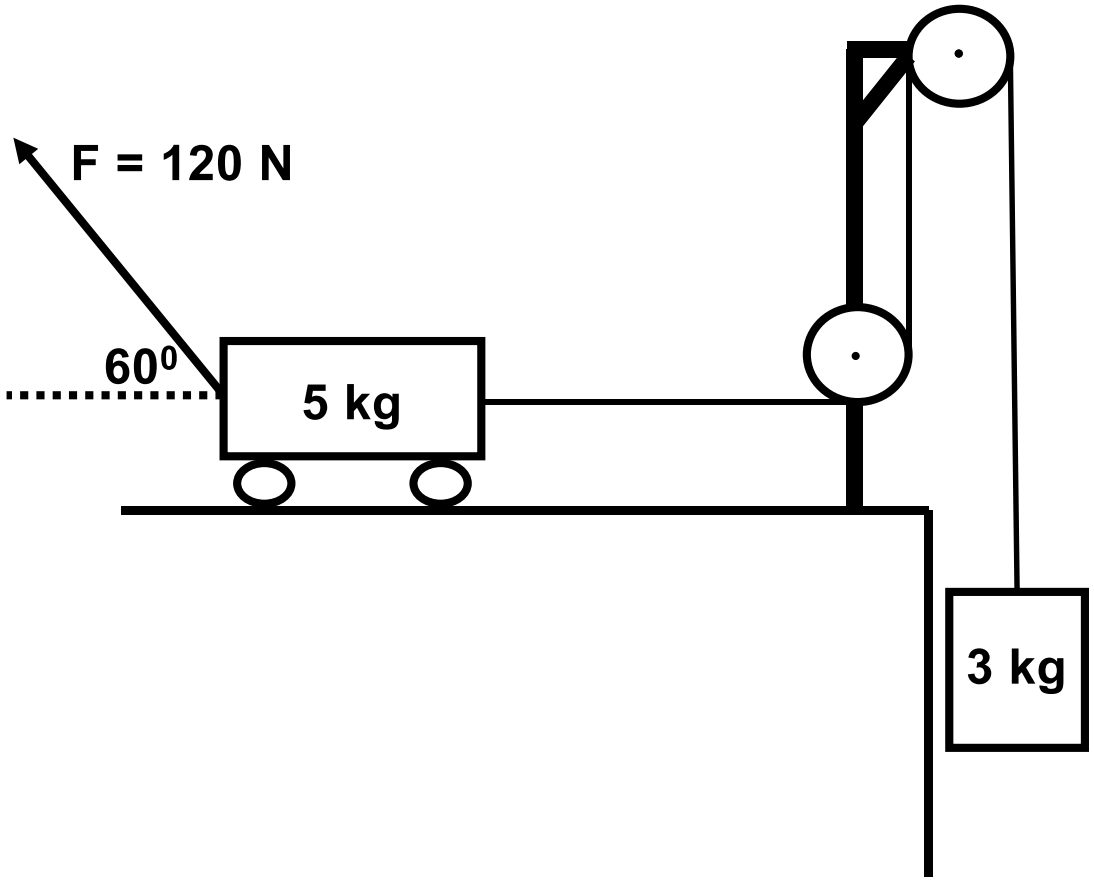
2.3.1 The magnitude of the frictional force acting on the block. (3)

2.3.2 The coefficient of kinetic friction. (3)

[11]

QUESTION 3:

A 5 kg trolley is pulled by a 120 N force acting at 60° to the horizontal. As the trolley moves to the left, it experiences a frictional force of 5 N. The trolley is connected to a 3 kg block by means of a string running over two frictionless pulleys as shown in the diagram below.



3.1 NAME AND STATE the law which explains why the force exerted by the trolley on the block is the same as the force exerted by the block on the trolley. (2)

3.2 Draw a free-body diagram showing ALL the forces acting on the 5 kg trolley. (5)

3.3 Calculate:

3.3.1 The acceleration of the trolley. (7)

3.3.2 The magnitude of the tension in the string. (2)

3.4 If the effects of air resistance on the 3 kg block were NOT ignored, how would the magnitude of the acceleration on the trolley be affected? Write down only INCREASES, DECREASES or REMAINS THE SAME. Give a reason for your answer. (2)

[18]

QUESTION 4:

The earth revolves around the sun in an elliptical (i.e. oval-shaped) orbit. The earth is closest to the sun around the 4th of January each year at which time the distance between their centers is $1{,}47 \times 10^9$ km. The mass of the sun is approximately $1{,}989 \times 10^{30}$ kg.

4.1 State *Newton's universal law of gravitation* in words. (2)

4.2 Use the law stated in 4.1 to calculate the gravitational force between the sun and the earth on the 4th of January. (3)

Christina Koch recently broke the record for the longest continuous time in space by a woman (328 days). Whilst on the international space station, Christina had a weight of 520 N.

4.3.1 Explain what is meant by the term *weight*. (1)

4.3.2 How will Christina's weight on the international space station compare with her weight on Earth? Write only LARGER THAN, SMALLER THAN or EQUAL TO. (1)

[7]

QUESTION 5:

5.1 Define the term *covalent bond*. (2)

5.2 Give the shape of the molecule:

5.2.1 BF_3 (1)

5.2.2 NH_3 (1)

5.2.3 CCl_4 (1)

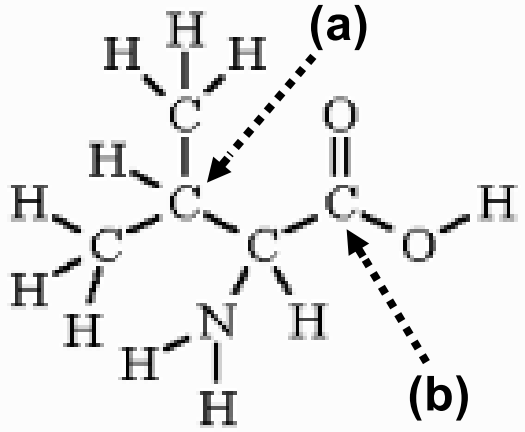
5.2.4 H_2S (1)

5.2.5 SO_2 (1)

5.3.1 Use Lewis diagrams to show the formation of the hydronium ion (H_3O^+) from water and the hydrogen ion (H^+). (2)

5.3.2 What is the name of the bond which forms between water and H^+? (1)

5.4 The Couper notation of valine – an amino acid used in the biosynthesis of proteins – is given below: (2)



Write down the shape of the PART of the molecule if…

5.4.1 …the carbon labelled (a) is taken to be the central atom. (1)

5.4.2 …the carbon labelled (b) is taken to be the central atom. (1)

[12]

TOTAL SECTION B [46]

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	$6{,}38 \times 10^{8}\ m$
Coulomb's constant	k	$9 \times 10^{9}\ N.m^{2}.C^{-2}$
Mass of Earth	M	$5{,}98 \times 10^{24}\ kg$

Formulae

Force	
$F_{net} = ma$	$w = mg$
$F = \frac{G.m_1.m_2}{r^2}$	$\mu_s = \frac{f_{s,max}}{N}$
$\mu_k = \frac{f_k}{N}$	
Electrostatics	
$F = \frac{k.Q_1.Q_2}{r^2}$	