education

Department of Education
FREE STATE PROVINCE

CONTROL TEST

GRADE 11

PHYSICAL SCIENCES

MARCH 2018

MARKS: 100

TIME: 2 HOURS

This paper consists of 10 pages and TWO data sheets.

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INSTRUCTIONS AND INFORMATION

1. Write your name and other information in the appropriate spaces on the ANSWER BOOK.

2. This question paper consists of SEVEN questions. Answer ALL the questions in the ANSWER BOOK.

3. Start EACH question on a NEW page in the ANSWER BOOK.

4. Number the answers correctly according to the numbering system used in this question paper.

5. Leave one line between two sub-questions, for example between QUESTION 2.1 and QUESTION 2.2.

6. You may use a non-programmable pocket calculator.

7. You may use appropriate mathematical instruments.

8. You are advised to use the attached DATA SHEETS.

9. Show ALL formulae and substitutions in ALL calculations.

10. Round off your FINAL numerical answers to a minimum of TWO decimal places where applicable.

11. Give brief motivations, discussions, et cetera where required.

12. Write neatly and legibly.

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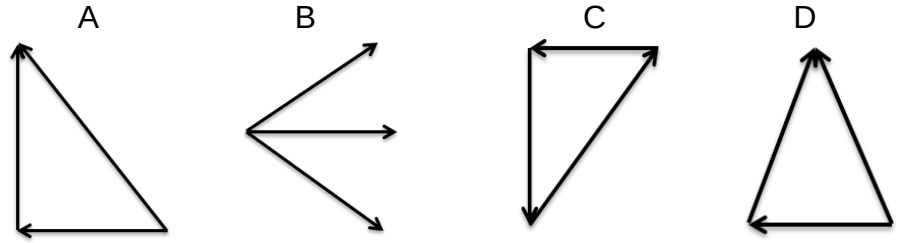
QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write down only the letter A, B, C or D next to the question number (1.1–1.10) in your ANSWER BOOK.

1.1 In which one of the following vector diagrams is the resultant vector equal to zero?



(2)

1.2 A book is placed on a coffee table and it exerts a force of 5 N on the surface of the table. If this force is called the *action force*, which one of the following represents the *reaction force*?

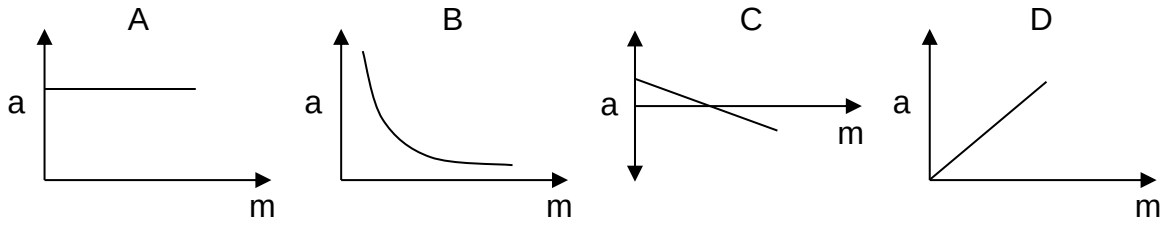
A Book's weight of 5 N

B Force of 5 N of the table on the book

C Force of 5 N of the book on the earth

D Force of 5 N of the earth on the book (2)

1.3 The same constant net force is applied to objects with different masses in a series of experiments. Which one of the following graphs represents the relationship between the acceleration and mass of the objects?



(2)

1.4 A number of unequal forces are acting on a body while it is moving at a constant velocity across a horizontal surface. Which one of the following statements is true?

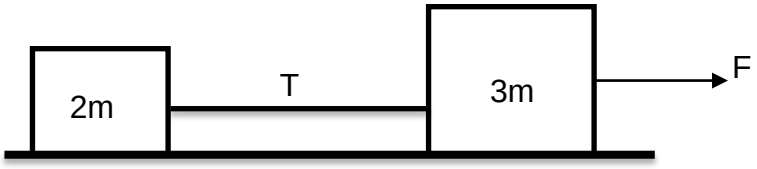
A The net force on the body is zero.

B At least two of the forces must act in the same direction.

C Friction on the body causes a non-zero net force acting in the direction of motion.

D The vector sum of the forces causes a non-zero net force acting in the direction of motion. (2)

1.5 Two crates, masses 2*m* and 3*m* respectively, are connected by a light, inelastic string and then placed on a smooth, horizontal surface. A horizontal force *F* is then applied to the 3*m* crate as indicated.



What is the tension *T* in the string in terms of *F*?

A $\frac{3}{2}$F

B $\frac{2}{3}$ F

C $\frac{3}{5}$ F

D $\frac{2}{5}$ F (2)

1.6 The centres of two small asteroids are 2 000 km apart and each one attracts the other one with a force *F*. What is the magnitude of the force, in terms of *F*, if their centres are 6 000 km apart?

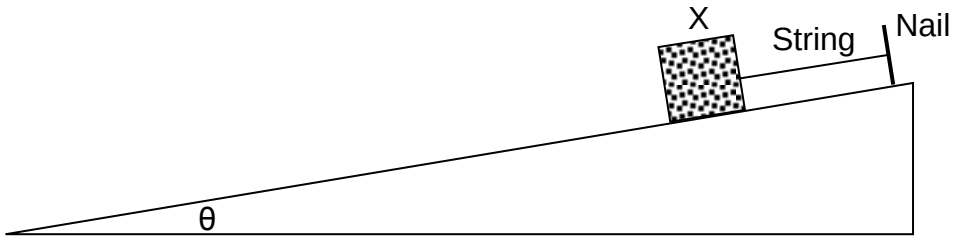
A $\frac{1}{9}$F

B $\frac{1}{3}$F

C 3F

D 9F (2)

1.7 A inelastic string is used to keep a block **X**, mass *m*, at REST on a frictionless, inclined surface. One end of the string is tied to the block and the other end is tied to a nail. The inclined surface makes an angle θ with the horizontal. When the string is cut, block **X** moves down the inclined surface at an acceleration *a*.



What would the block's acceleration be, in terms of *a*, if its mass was 2*m*?

A 0,5a

B a

C 2a

D Enough information is not available to give an answer. (2)

1.8 Which molecule is the result of a dative covalent bond?

A NH_3

B $NC\ell_3$

C CH_4

D NH_4^+ (2)

1.9 What bond angle do you expect in CH_4?

A 107°

B 109,5°

C 120°

D 180° (~~2~~)

The inclusion of bonding angles are not clearly prescribed in the curriculum (sad!). It was decided to take this question out of the question paper. The marks were used in Q7.1.3 and Q7.1.6.

1.10 What type of bond takes place when hydrogen and phosphorus react?

A Dative covalent

B Polar covalent

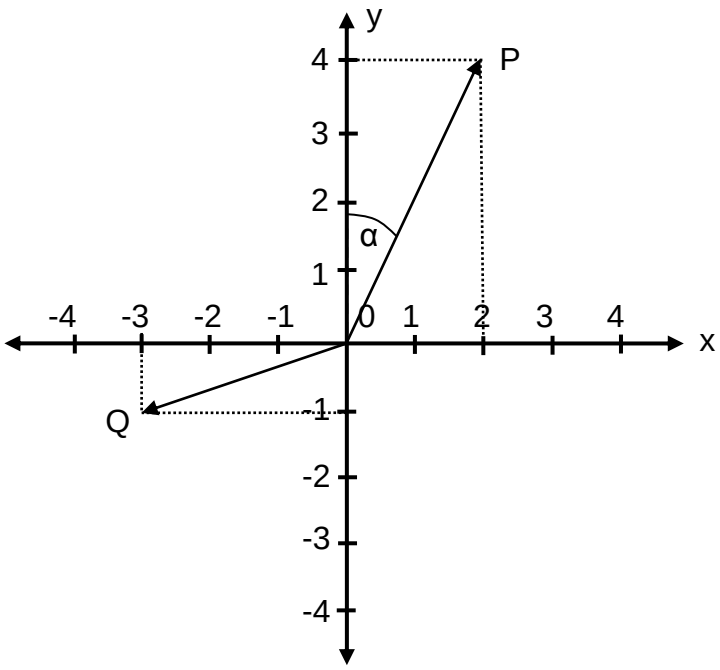
C Covalent

D Ionic (2)

[18 ~~20~~]

QUESTION 2

Forces **P** and **Q**, each one measured in newton, are drawn on the Cartesian plane as shown below.



2.1 Define the term *resultant of two forces* in words. (2)

2.2 Calculate the magnitude of:

2.2.1 Force **P** (2)

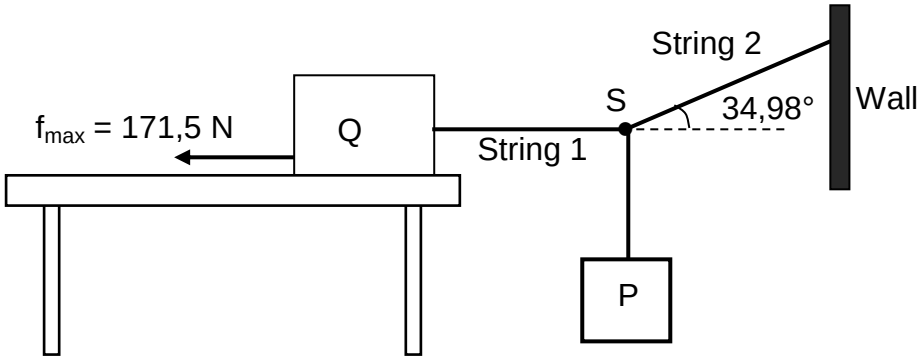
2.2.2 Angle alpha (α) (2)

2.3 Use the component method to calculate the magnitude of the resultant of **P** and **Q**. (4)

2.4 Calculate the direction (measured clockwise from the positive y-axis) of the resultant of **P** and **Q**. (4)
[14]

QUESTION 3

A block **Q** is at rest on a horizontal table. It is connected to block **P** and the wall by means of light, inelastic strings knotted at **S**. String 1 between **Q** and **S** is horizontal. String 2 connects **S** with the wall. A MAXIMUM static frictional force *f* of 171,5 N acts to the left on block **Q** to keep the block stationary. Knot **S** is in equilibrium.



3.1 Describe what a s*tatic frictional force* is. (2)

3.2 Describe what a *normal force* is. (2)

3.3 Draw a free-body diagram, with labels, to show all the forces acting on block **Q**. The lengths of your arrows should correctly represent the comparative magnitudes of the forces. (7)

3.4 Write down the magnitude of the horizontal component of the force that string 2 exerts on knot **S**. (1)

3.5 Calculate the magnitude of the vertical component of the force that string 2 exerts on knot **S** if the string makes an angle of 34,98° with the horizontal. (2)

3.6 Write down the magnitude of the weight of block **P**. (1)
[15]

QUESTION 4

A car is moving to the right across a horizontal surface due to a horizontal force of 4 400 N that is applied to the right on the car. The mass of the car is 1 000 kg. While the car is moving, the surface exerts a frictional force of 800 N on the car.

4.1 Write down *Newton's second law of motion* in words. (2)

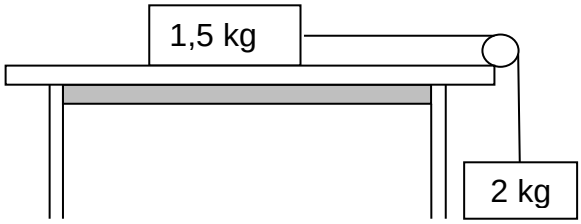
4.2 Calculate the magnitude of the acceleration of the car. (4)

4.3 In order to bring the car to a stop, the applied force of 4 400 N is replaced with a horizontal braking force. While the car is slowing down it experiences the same magnitude of frictional force as before and the magnitude of its acceleration is 4 $m \cdot s^{-2}$. Calculate the braking force on the car. (4)

[10]

QUESTION 5

In the diagram below, a 1,5 kg mass piece on a rough, horizontal surface is connected to a 2 kg mass piece by means of a light, inelastic string running over a frictionless pulley. When the mass pieces are released, the coefficient of kinetic friction for the 1,5 kg mass piece and the surface is 0,4.



5.1 Calculate the magnitude of the kinetic frictional force acting on the 1,5 kg mass piece. (3)

5.2 Calculate the magnitude of the acceleration of the 1,5 kg mass piece. You must do this by using Newton's second law of motion to write down an equation for EACH of the mass pieces. Solve the two equations to calculate the magnitude of the acceleration. (4)

5.3 The rough, horizontal surface is replaced with a frictionless, horizontal surface. The two masses are again released and they start to move.

5.3.1 Is the acceleration of the 1,5 kg mass piece GREATER THAN, THE SAME AS or LESS THAN its acceleration on the rough surface? Briefly explain your answer by referring to one of Newton's laws of motion. (3)

5.3.2 The 2 kg mass piece hits the ground before the 1,5 kg mass piece hits the pulley. Briefly describe the motion of the 1,5 kg mass piece for the period after the 2 kg mass piece has hit the ground, but before the 1,5 kg mass piece has hit the pulley. (2)

[12]

QUESTION 6

The sun exerts a gravitational force on the earth.

6.1 Write down *Newton's law of universal gravitation* in words. (2)

6.2 The mass of the sun is about 330 000 times greater than that of the earth. Calculate the magnitude of the gravitational force of the sun on the earth if you assume that the distance between their centres is 150×10^6 km. (4)

6.3 How does the magnitude of the gravitational force of the earth on the sun compare with the answer to QUESTION 6.2? Write down only GREATER THAN, LESS THAN or EQUAL TO and indicate which one of Newton's laws of motion is applicable. (2)

6.4 The moon has a diameter of $3\,474 \times 10^3$ m and a mass of $7{,}35 \times 10^{22}$ kg.

6.4.1 Calculate the magnitude of the gravitational acceleration *g* on the surface of the moon. (3)

6.4.2 Two objects, **X** and **Y**, with masses *m* and 100*m* respectively, are on the surface of the moon. Is the gravitational acceleration experienced by object **X** GREATER THAN, THE SAME AS or LESS THAN the gravitational acceleration experienced by object **Y**? Give a reason for your answer. (2)

[13]

QUESTION 7

7.1 Ammonia readily reacts with water to form ammonium ions according to the following equation:

$$NH_3(aq) + H_2O(l) \rightarrow NH_4^+(aq) + OH^-(aq)$$

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

7.1.2 Draw the Lewis diagram/structure of an ammonia molecule. (2)

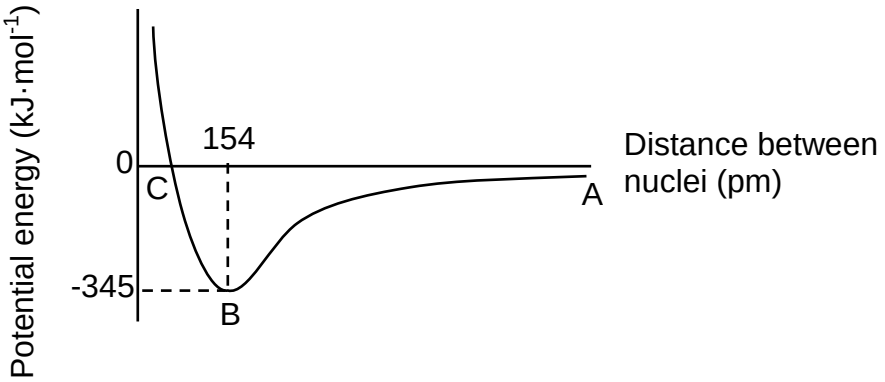
7.1.3 What is the molecular shape of an ammonia molecule? (2)

7.1.4 How many lone pairs does one water molecule have? (1)

7.1.5 What type of bond takes place between the atoms to form a water molecule? (1)

7.1.6 What is the molecular shape of a water molecule? (2)

7.2 Consider the following potential energy diagram for the formation of a molecule from two identical atoms. **A**, **B** and **C** are three points on the graph.



7.2.1 How does the potential energy change between points **A** and **B**? (1)

7.2.2 Why does the potential energy change between points **A** and **B**? (1)

7.2.3 Which point on the graph (**A**, **B** or **C**) represents the most likely situation where bonding will take place? Give a reason for your answer. (2)

7.2.4 Define the term *bond length*. (2)

7.2.5 How much is the bond length for this bond? (1)

7.2.6 How much energy is released during this bond? (1)

[18]

GRAND TOTAL: 100

DATA FOR PHYSICAL SCIENCES GRADE 11 (PHYSICS)
CONTROL TEST - TERM 1

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11 (FISIKA)
KONTROLETOETS - KWARTAAL 1

TABLE 1: PHYSICAL CONSTANTS / *TABEL 1: FISIESE KONSTANTES*

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekragversnelling*	g	$9{,}8\ m\cdot s^{-2}$
Gravitational constant *Swaartekragkonstante*	G	$6{,}67 \times 10^{-11}\ N\cdot m^2\cdot kg^{-2}$
Radius of Earth *Straal van Aarde*	R_E	$6{,}38 \times 10^{6}\ m$
Mass of the earth *Massa van die Aarde*	M	$5{,}98 \times 10^{24}\ kg$

TABLE 2: FORMULAE / *TABEL 2: FORMULES*

MOTION / *BEWEGING*

$v_f = v_i + a\Delta t$	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ or/*of* $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$v_f^{\,2} = v_i^{\,2} + 2a\Delta x$ or/*of* $v_f^{\,2} = v_i^{\,2} + 2a\Delta y$	$\Delta x = \left(\frac{v_f + v_i}{2}\right)\Delta t$ or/*of* $\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$

FORCE / *KRAG*

$F_{net} = ma$	$p = mv$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$F = \frac{Gm_1m_2}{r^2}$ $\quad$ $g = \frac{GM}{r^2}$
$\mu_s = \frac{f_{s(max)}}{N}$ / $\mu_s = \frac{f_{s(maks)}}{N}$	$\mu_k = \frac{f_k}{N}$

WEIGHT AND MECHANICAL ENERGY / *GEWIG EN MEGANIESE ENERGIE*

$w = mg$ or/*of* $F_g = mg$	$U = mgh$ or/*of* $E_p = mgh$
$K = \frac{1}{2}mv^2$ or/*of* $E_k = \frac{1}{2}mv^2$	

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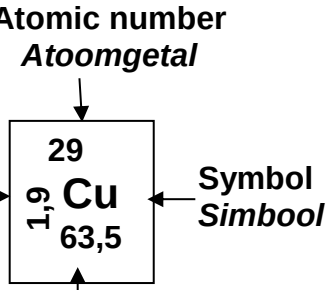
TABLE 3: THE PERIODIC TABLE OF ELEMENTS
TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE

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**

KEY/*SLEUTEL*



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