ALEXANDER ROAD HIGH SCHOOL

April 2021 | **PHYSICAL SCIENCES CONTROL TEST** | 55 MINUTES

JA | **GRADE 11** | TOTAL = 50

Instructions:

- The question paper consists of 4 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 on the back of the answer sheet.

SECTION A

(answer on the answer sheet)

QUESTION 1:

Four possible options are provided as answers to the following questions. Each question has only one correct answer. Choose the correct answer and write the letter (A – D) next to the relevant question number (1.1 – 1.5) on the answer sheet.

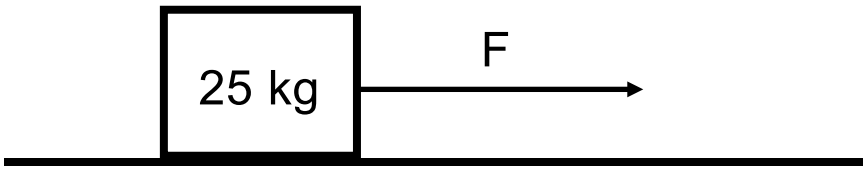
1.1 The reaction force to the normal force on a rugby ball lying on a grass field is the…

A. Weight of the rugby ball
B. Force of the rugby ball on the Earth
C. Force of the grass field on the rugby ball
D. Force of the rugby ball on the grass field

1.2 When a 56 N force is applied to 7 kg object, the object accelerates at 8 $m.s^{-2}$. If the same force is applied to a 14 kg object, the object will have an acceleration of…

A. 2 $m.s^{-2}$
B. 4 $m.s^{-2}$
C. 8 $m.s^{-2}$
D. 16 $m.s^{-2}$

1.3 A force F causes a 25 kg block to accelerate to the right at 15 $m.s^{-2}$ as shown in the diagram below.



The magnitude of the frictional force acting on the block is 75 N. The magnitude of F is…

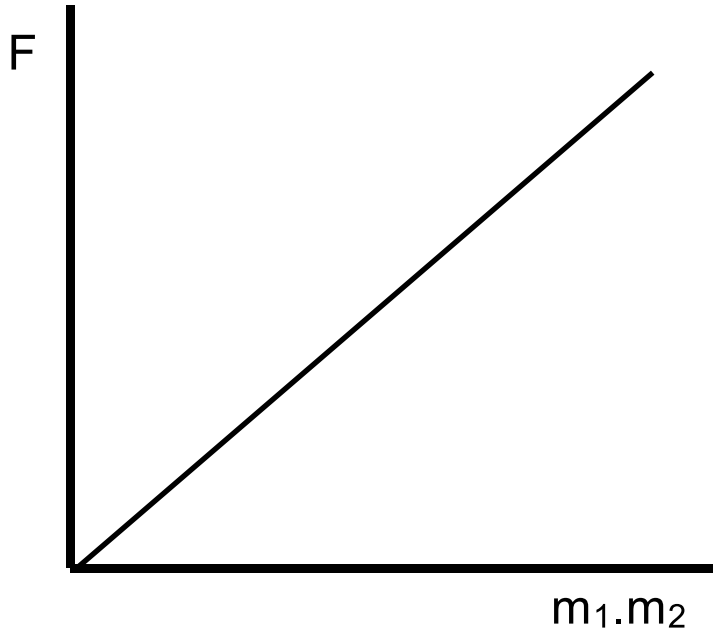
A. 75 N

B. 300 N

C. 375 N

D. 450 N

1.4 The relationship between the magnitude of the gravitational force **F** and the distance **r** between two objects with mass $\mathbf{m_1}$ and $\mathbf{m_2}$ respectively is investigated and the following graph is obtained.



The gradient of the graph is…

A. G

B. $\frac{1}{r^2}$

C. $\frac{G}{r^2}$

D. $6{,}67 \times 10^{-11}\ N.m^2.kg^{-2}$

1.5 When two objects with mass are a distance **r** apart, the gravitational force between them is **F**. If one object's mass is quartered (i.e. 4 times smaller), the other object's mass is doubled and the distance between them is doubled, then the new force will be…

A. 0,125 × F

B. 0,25 × F

C. 2 × F

D. 32 × F

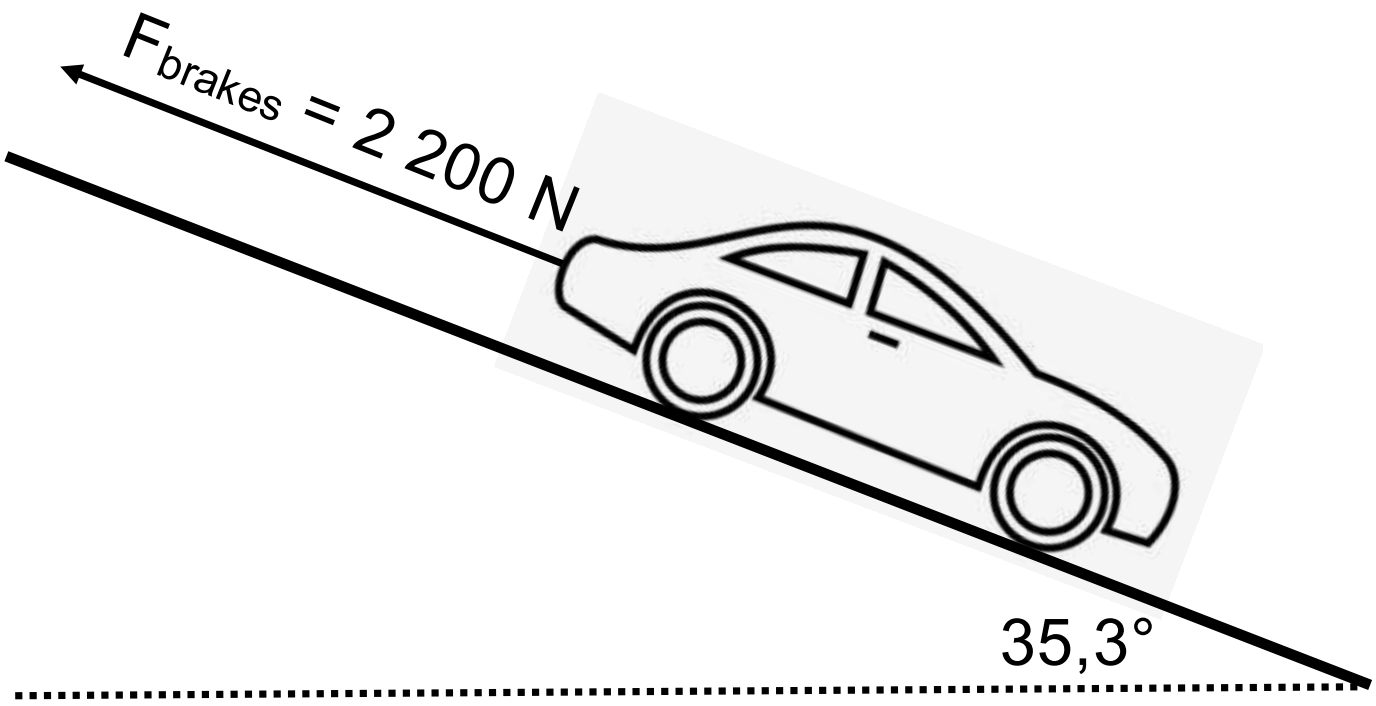
TOTAL SECTION A = [10]

SECTION B

(answer on folio paper)

QUESTION 2:

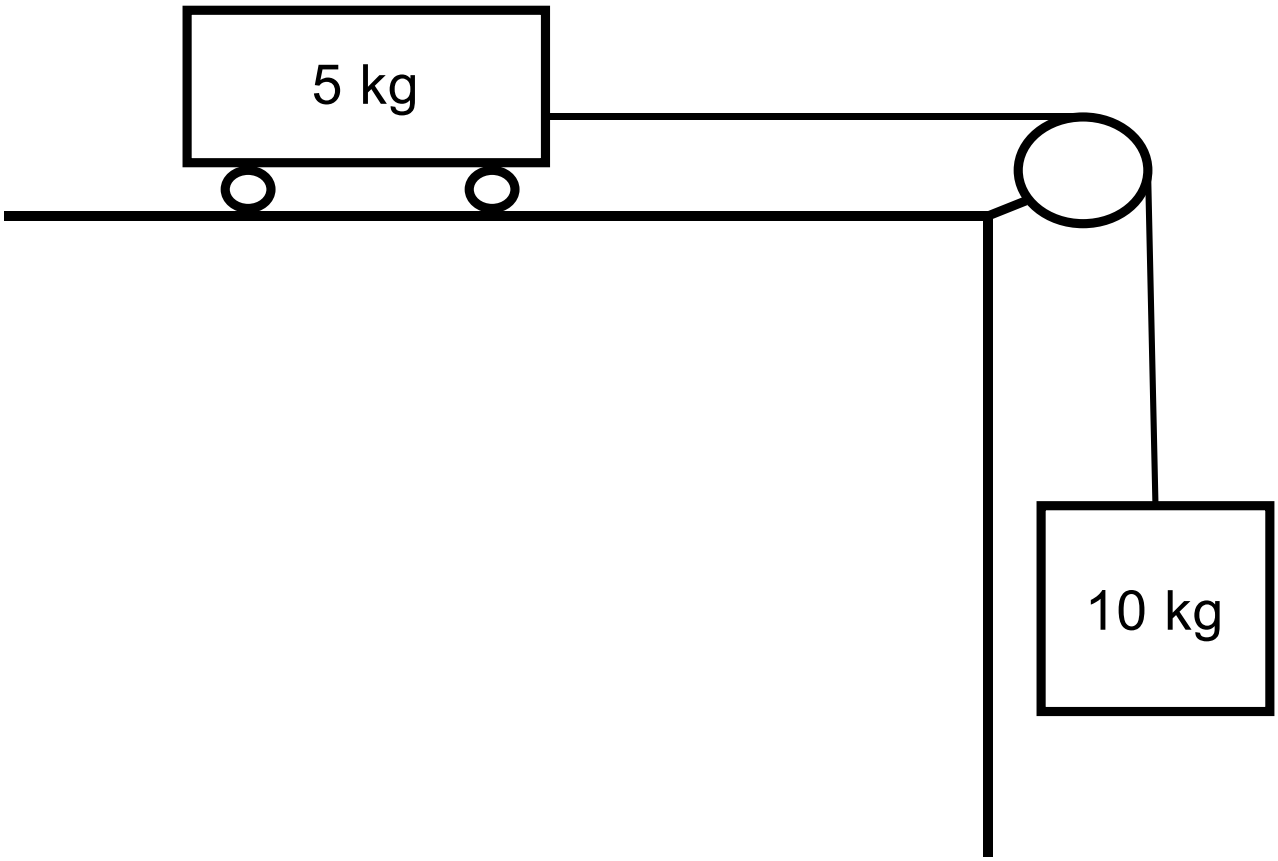
An Uber car rolls down a hill inclined at 35,3° to the horizontal as shown in the diagram below. The car, Uber driver and passenger have a combined mass of 900 kg. The Uber car's brakes produce an applied force of 2 200 N up the hill.



2.1	State *Newton's 2nd Law of Motion* in words.	(2)
2.2	Draw a free-body diagram showing ALL forces acting on the Uber car.	(4)
2.3	Calculate BOTH components of the weight.	(2)
2.4	The coefficient of friction between the Uber car's wheels and the road is 0,17. Calculate the magnitude of the frictional force acting on the Uber car.	(3)
2.5	Calculate the acceleration of the Uber car.	(3)
		[14]

QUESTION 3:

A 5 kg trolley, initially held at rest on a rough horizontal surface, is connected to a 10 kg block by a light inextensible string passing over a frictionless pulley as shown in the diagram below. Ignore the effects of air resistance.



Once the 5 kg trolley is released it experiences a kinetic frictional force of 23 N.

3.1	State *Newton's 3rd Law of Motion* in words.	(2)
3.2	Draw a free-body diagram showing all the forces acting on the 5 kg trolley.	(4)
3.3	After the 5 kg trolley is released, calculate:	
3.3.1	The magnitude of the acceleration of the system.	(6)
3.3.2	The magnitude of the tension in the string.	(2)
3.4	Would the acceleration calculated in question 3.3.1 INCREASE, DECREASE or REMAIN THE SAME if air resistance was not ignored?	(1)
		[15]

QUESTION 4:

The average distance between the centres of the Earth and Mars is $2{,}80 \times 10^8$ km. The mass of Mars is $6{,}39 \times 10^{23}$ kg.

4.1 State *Newton's Universal Law of Gravitation* in words. (2)

4.2 Calculate the magnitude of the gravitational force between the Earth and Mars. (4)

4.3 An astronaut measures his mass by standing on a scale. Whilst he is still on the surface of the Earth, the scale reads 65 kg. However, when the same astronaut stands on the same scale on the surface of Mars, the scale reads 24,7 kg. Calculate the radius of Mars. (5)

[11]

TOTAL SECTION B = [40]

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	$6,38 \times 10^6$ m
Mass of Earth	M	$5,98 \times 10^{24}$ kg

Formulae:

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

$F_{net} = ma$	$w = mg$
$F = \frac{Gm_1m_2}{r^2}$	$\mu_s = \frac{f_{s(max)}}{N}$
$\mu_k = \frac{f_k}{N}$	$g = \frac{GM}{R^2}$