Education and Sport Development

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NORTH WEST PROVINCE

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

SEPTEMBER 2018

MARKS: 150

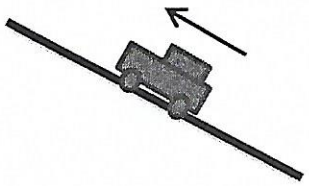
TIME: 3 hours

This question paper consists of 12 pages and 3 data sheets.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1–1.10) in the ANSWER BOOK, for example 1.11 D.

1.1 A toy car is given a push up a smooth ramp.



It moves up the ramp, stops and then moves down the ramp. The net force acting on the car after the push, …

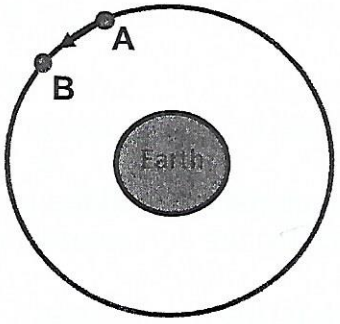
A is constant down the ramp.

B decreases down the ramp.

C increase down the ramp.

D decrease up the ramp. (2)

1.2 A satellite is moving at a constant speed on a circular orbit around the Earth. The only force acting on the satellite is the gravitational force of the Earth.



Which ONE of the following statements is TRUE as the satellite moves from **A** to **B** in its orbit:

A Work done by the gravitational force is zero.

B Work done by the gravitational force is negative.

C Gravitational potential energy decreases.

D Velocity remains unchanged. (2)

1.3 Which ONE of the following statements about linear momentum is TRUE?

Momentum ...

A is a force.

B of an object is always positive.

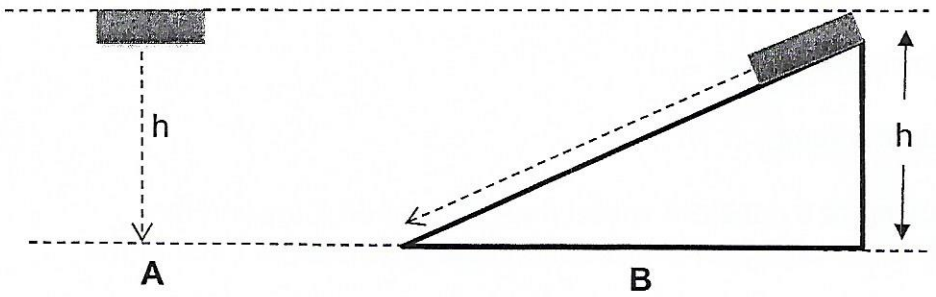
C is a scalar quantity.

D and impulse have the same units. (2)

1.4 Consider the situations **A** and **B** below

Situation **A:** A heavy block is dropped from a height *h*.

Situation **B**: The same block slides down a frictionless surface to the bottom, as shown in the diagram.



Which ONE of the following statements about **A** and **B** is CORRECT?

A The magnitude of the gravitational force on the block is smaller in **A** than gravitational force parallel to the surface on the block in **B**.

B The magnitude of the gravitational force on the block in **A** is equal to the gravitational force parallel to the surface on the block in **B**.

C The work done on the block by the gravitational force is the same in both cases.

D The work done on the block by the gravitational force in **B** is less than in **A**. (2)

1.5 When the wavelength of sound detected by a stationary listener decreases because the source is moving, it means that the source is ...

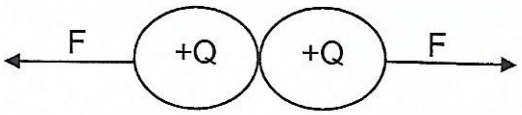
A rotating in a circular track on a fixed radius.

B moving away from a stationary listener.

C moving closer towards a stationary listener.

D stationary. (2)

1.6 Two small identical objects, each with a net charge of +Q, are placed next to each other in a vacuum tube. They move apart.



Which ONE of the following statements is CORRECT?

The electrostatic force will ...

A decrease at constant rate.

B decrease exponentially.

C stay the same.

D increase at constant rate. (2)

1.7 A positive charge is placed at rest at the center of a region of space in which there is a uniform, three-dimensional electric field. (A *uniform field* is one where field strength and direction are the same at all points within the field.)

When the positive charge is released from rest in this uniform electric field, what will its subsequent motion be?

The charge will ...

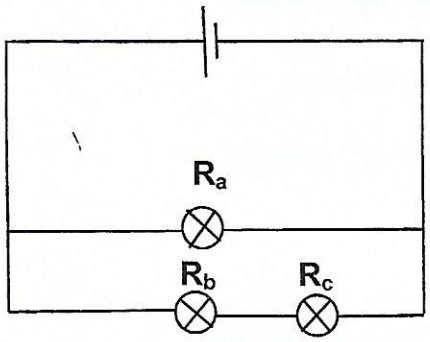
A move at a constant speed.

B move at a constant velocity.

C remain at rest in its initial position.

D move at a constant acceleration. (2)

1.8 In the circuit below, three bulbs are connected to a battery. The connecting wires have no resistance and the battery has no internal resistance. R_a is equal to R_b and resistor R_c is ½ R_b.



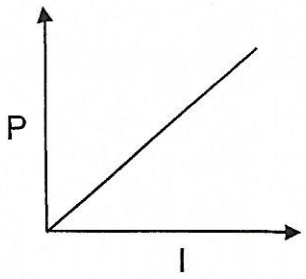
Which ONE of the potential difference combinations across bulbs R_a, R_b and R_c respectively will be CORRECT?

	Potential Difference		
	R_a	R_b	R_c
A	$\frac{3}{2}$ V	V	$\frac{1}{2}$ V
B	V	$\frac{1}{2}$ V	$\frac{1}{2}$ V
C	2 V	$\frac{3}{2}$ V	$\frac{1}{2}$ V
D	V	V	$\frac{1}{2}$ V

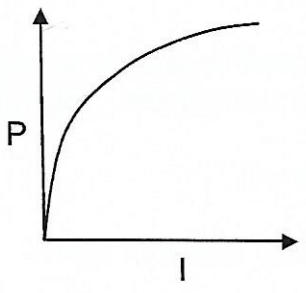
(2)

1.9 Which ONE of the following graphs best represents the relationship between the electrical power and the current in a given ohmic conductor?

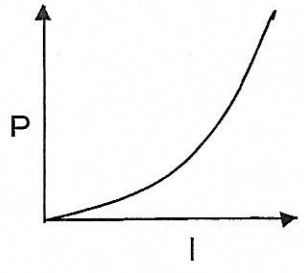
A



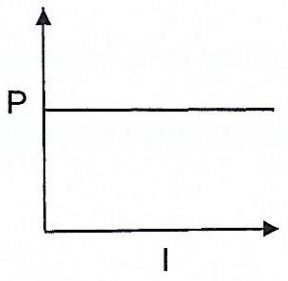
B



C



D



(2)

1.10 Monochromatic light with a frequency of X Hz is shone onto a clean zinc surface. The cut off frequency for zinc is $(X - 5)$ Hz.

What is the maximum kinetic energy of the electrons leaving the zinc metal surface?

A $5\ h$

B $\frac{5}{h}$

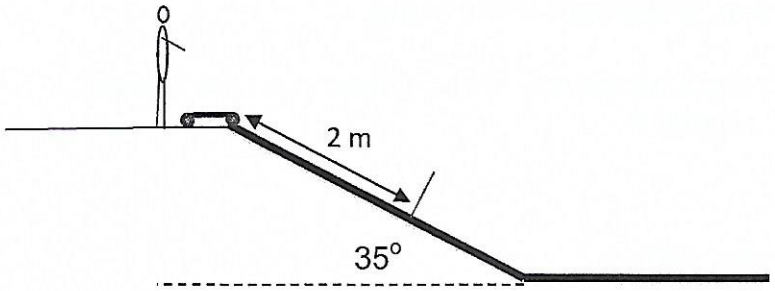
C $\frac{X + 5}{h}$

D $(X + 5)\ h$ (2)

[20]

QUESTION 2 (Start on a new page.)

Jerry gives his skateboard a push down a steep frictionless slope.



2.1 Describe the motion of the skateboard after it has travelled 2 metres. (2)

2.2 After the first two meters, what part of motion remains constant over equal time intervals? (1)

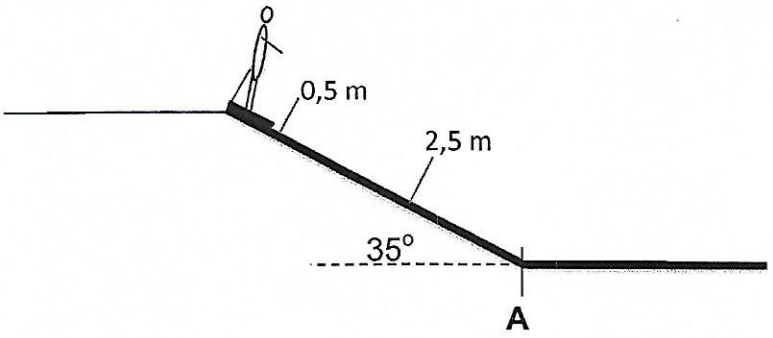
2.3 Jerry makes the following statement:

"The speed of the skateboard at the bottom of the slope will be the same, whether I am on my skateboard or not."

2.3.1 Explain why Jerry's statement is correct. (3)

2.3.2 Will Jerry's statement still be valid if frictional force was present? Explain. (3)

2.4 Jerry, on his skateboard, pushes the board for the first 0,5 m down another 35° slope and reaches a velocity of 1,5 m·s^{-1}. Thereafter Jerry slet another 2 m down the slope with a constant velocity. Jerry and the skateboard have a combined mass of 75 kg. The coefficient of friction between the surfaces is 0,2.



2.4.1 Calculate the magnitude of Jerry's acceleration for the first 0,5 m after he pushes himself down the slope. (3)

2.4.2 Calculate the frictional force acting on the skateboard. (3)

2.4.3 Calculate the force Jerry applied on him and his skateboard for the first 0,5 m, at the start of the slope. (4)

2.4.4 Calculate Jerry's acceleration when moving on the horisontal surface after point **A**. (2)
[21]

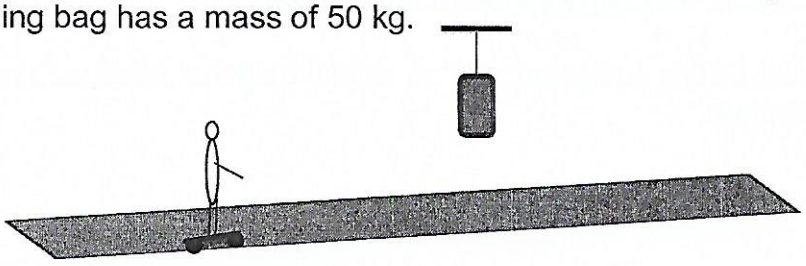
QUESTION 3 (Start on a new page.)

An advertisement of a battery-powered 25 kg skateboard claims that it can carry an 80 kg person at a maximum speed of 8,5 m·s^{-1}. The skateboard motor supplies a net force of 75 N.

3.1 Define the concept *impulse*. (2)

3.2 How long will it take to attain a maximum speed from rest? (4)

Peter, with mass 80 kg, drives a battery-powered skateboard at the constant maximum speed of 8,5 m·s^{-1}. He fails to stop and collides against a punching bag, hanging at rest. He continues in a straight line forward with a velocity of 2 m·s^{-1}. The punching bag has a mass of 50 kg.



3.3 State Newton's First Law of Motion. (2)

3.4 If the time of impact is 0,4 s, calculate the net force the bag exerts on Peter. (3)

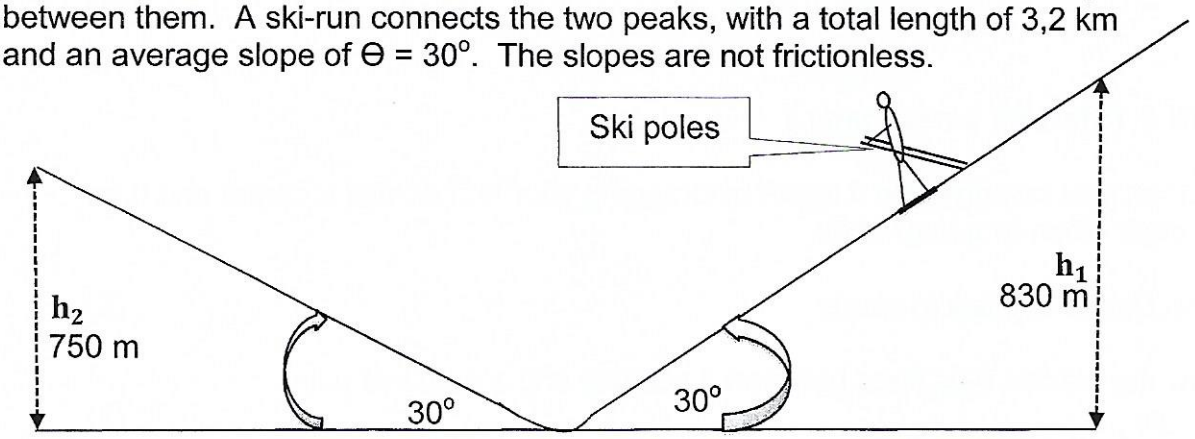
3.5 Show by calculation that the collision between Peter and the bag was inelastic. (6)

3.6 Write down the principle of conservation of mechanical energy in words. (2)

3.7 How high will the bag swing after Peter collides with the bag? (5)
[24]

QUESTION 4 (Start on a new page.)

Two snowy peaks are at heights $\mathbf{h_1}$ = 830 m and $\mathbf{h_2}$ = 750 m above the valley between them. A ski-run connects the two peaks, with a total length of 3,2 km and an average slope of $\Theta = 30°$. The slopes are not frictionless.



Jack starts skiing from rest at a height of 830 m on the higher peak, not using his ski poles.

4.1. State Newton's Third Law of Motion in words. (2)

4.2. Draw a labelled free-body diagram of the forces acting on Jack as he skis down the slope. (3)

4.3. Jack came to rest exactly at the top of the lower peak. Jack, with his skis, have a combined mass of 80 kg.

Calculate the average kinetic friction coefficient between the snow and the skis. (6)

Most skiers use ski poles when skiing down a slope.

4.4. What is the main purpose of the ski poles? (2)

4.5 A second skier, with the same mass as Jack, passed him at a speed of 2 $m \cdot s^{-1}$ the moment Jack starts moving from rest. Draw a labelled speed-time graph of both the skiers for the first 4 s of motion. Ignore friction. (4)
[17]

QUESTION 5 (Start on a new page.)

A French submarine is approaching a stationary US submarine in the cold Artic waters at a speed of 50 km·h^{-1}. The French submarine sends out a 1 x 10^3 Hz signal. Sonar waves travel at 5 470 km·h^{-1} in cold water.

5.1 Define the Doppler Effect. (2)

5.2 Calculate the frequency of the signal that the US submarine detects. (5)

5.3. Calculate the frequency of the reflected signal as detected by the French submarine. (4)
[11]

QUESTION 6 (Start on a new page.)

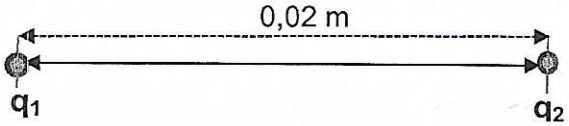
In dry weather, you can produce a spark by dragging your feet across a carpet and then hold your finger close to a door knob.

6.1. State Coulomb's law in words. (2)

6.2. Draw the electric field lines between a positive and a negative point charge. (3)

6.3. How do we distinguish between strong and weak electric fields when drawing field lines? (2)

Two positively charged particles are fixed on the *x*-axis as shown below. The charges $\mathbf{q_1}$ = 1,6 x 10^{-19} C and $\mathbf{q_2}$ = 3,2 x 10^{-19} C are 0,02 m apart.



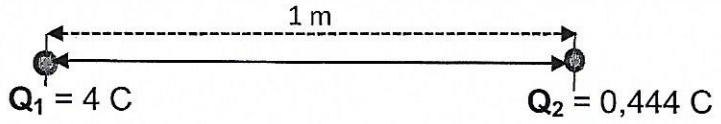
6.4 Calculate the magnitude and direction of the electrostatic force exerted on particle $\mathbf{q_1}$. (4)
[11]

QUESTION 7 (Start on a new page.)

7.1. Define the term electric field at a point. (2)

7.2. The electric field 50 cm away from a point charge is 2 N·C^{-1}. Calculate the magnitude of the point charge. (3)

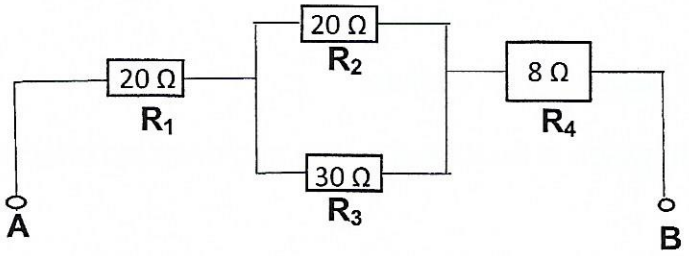
7.3. Two charges, Q_1 = 4 C and Q_2 = 0,444 C, lie on the *x*-axis.



Determine the distance from Q_1 where the net electrostatic field is zero. (6)
[11]

QUESTION 8 (Start on a new page.)

Consider the following circuit diagram.



8.1 Calculate the total resistance between **A** and **B**. (3)

An ALTERNATING current source is connected between the two terminals **A** and **B** and the average power dissipated in R_1 is 4 W.

8.2 Calculate V_{rms} across R_1. (3)

8.3 Calculate the maximum current through resistor R_3. (6)

8.4 Calculate P_{ave} dissipated in R_4. (3)

A DIRECT CURRENT source with emf 12 V is now connected to the two terminals **A** and **B**.

8.5 What is meant by the term *internal resistance*? (2)

8.6 Calculate the current through the battery if the internal resistance is 0,2 Ω. (2)

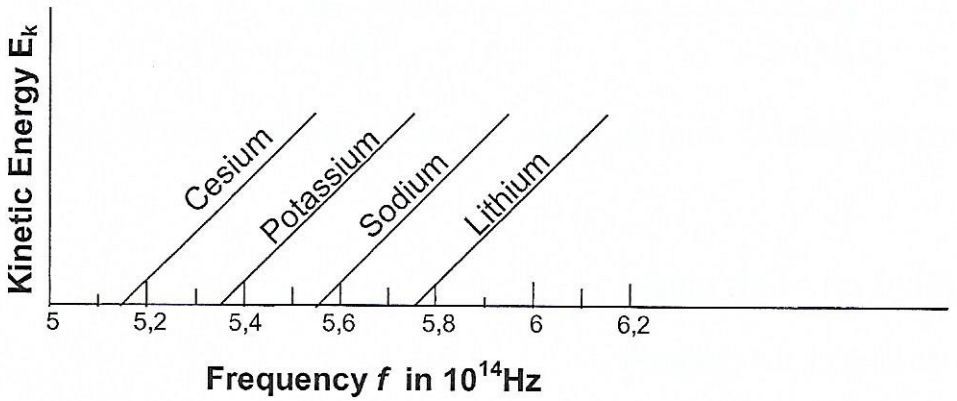
8.7 Calculate the power dissipated in R_2. (4)

8.8 Another 30 Ω resistor is connected in series with R_3. How will this affect the current through the battery? Write down only INCREASES, DECREASES or REMAINS THE SAME. (1)

8.9 Explain the answer to QUESTION 8.8. (2)
[26]

QUESTION 9 (Start on a new page.)

Consider the following kinetic energy versus frequency graph and answer the questions that follows.



9.1 Define *cut-off frequency*. (2)

9.2 Write down the threshold frequency for sodium. (2)

9.3 Name the property of light which is illustrated by the photoelectric effect of light. (1)

9.4 Calculate the speed of an electron with kinetic energy equal to the work function of lithium. (4)
[9]

TOTAL: 150