LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

SEPTEMBER 2020

EPHSCP1

MARKS: 150

TIME: 3 hours

This question paper consists of 16 pages and 3 data sheets.

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INSTRUCTIONS AND INFORMATION

1. Write your NAME in the appropriate space on the ANSWER BOOK.
2. This question paper consists of 10 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 subquestions, for example between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable 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.
11. Give brief motivations, discussions, et cetera where required.
12. Write neatly and legibly.

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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 E. Each question has only ONE correct answer.

1.1 The *net force* acting on the moving object is **zero**. The object will continue its motion with …

A Constant acceleration.

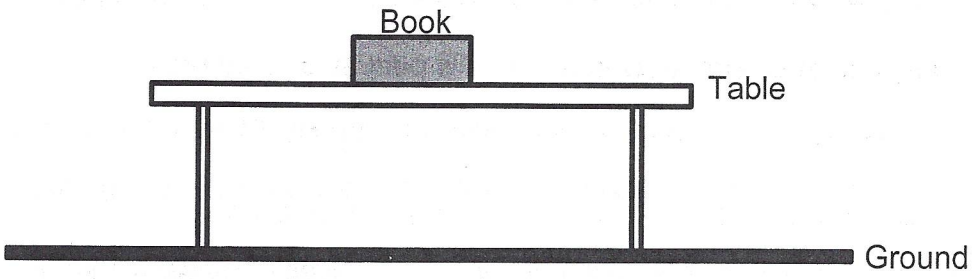
B Constant velocity.

C Increasing velocity.

D Decreasing acceleration.

(2)

1.2 A book is at rest on a table, as the diagram below illustrates.



Which ONE of the following is the CORRECT *Newton's* action-reaction *force* pair?

A $F_{book\ on\ table}$ and $F_{book\ on\ Earth}$

B $F_{book\ on\ table}$ and $F_{Earth\ on\ book}$

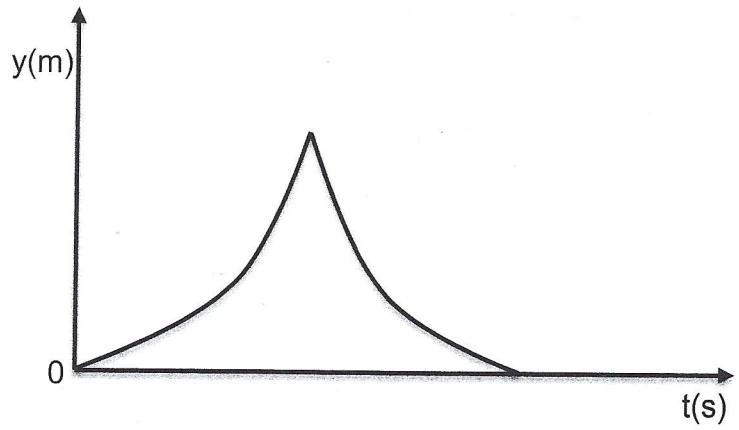
C $F_{Earth\ on\ book}$ and $F_{book\ on\ Earth}$

D $F_{table\ on\ book}$ and $F_{table\ on\ Earth}$

(2)

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1.3 Consider the position versus time graph for the motion of a projectile.



Which ONE of the following statements BEST describes the motion of this projectile?

A It is thrown straight upwards and falls back to its original projection

B It is thrown straight upwards and falls past its original projection

C It is thrown downwards and hit a barrier, but continued to move downwards

D It is dropped, moves downwards and bounces back to its original projection

(2)

1.4 A 5 kg object, initially at rest, explodes into two pieces of masses 1 kg and 4 kg. The speed of the 1 kg piece compared to that of the 4 kg piece is …

A four times greater.

B five times greater.

C one quarter as large.

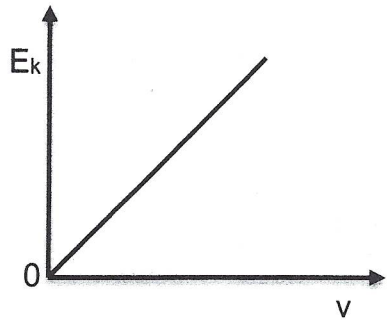
D one fifth as large.

(2)

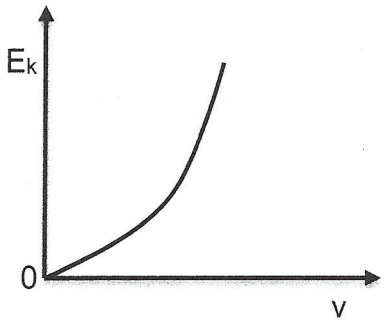
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1.5 Which ONE of the following graphs BEST represents the kinetic energy (E_k) of a moving object as a function of speed (v)?

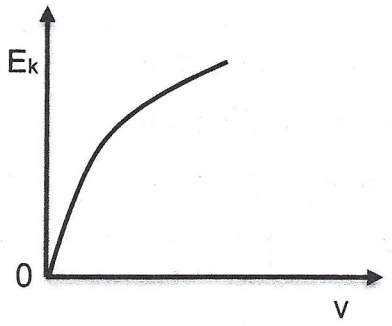
A



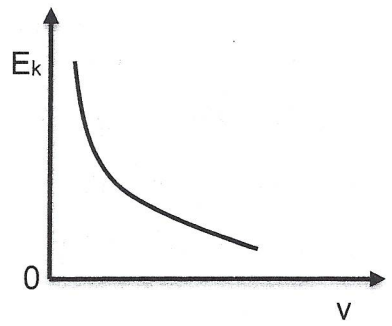
B



C



D



(2)

1.6 Which ONE of the following statements is the correct reason as to why the observed pitch on a police vehicle increases as the vehicle moves towards a stationary observer?

A Wavelength of the sound wave increases

B Amplitude of the sound wave increases

C Wavelength of the sound wave decreases

D Amplitude of the sound wave decreases

(2)

1.7 Consider the charged particles in diagrams **1 – 4** below.

1 ⊕ ⊕ •

2 ⊕ • ⊖

3 ⊖ ⊕ •

4 ⊕ • ⊕

The charges have the same magnitude. In which case does the electric field **at the dot (•)** have the LARGEST magnitude?

A 1

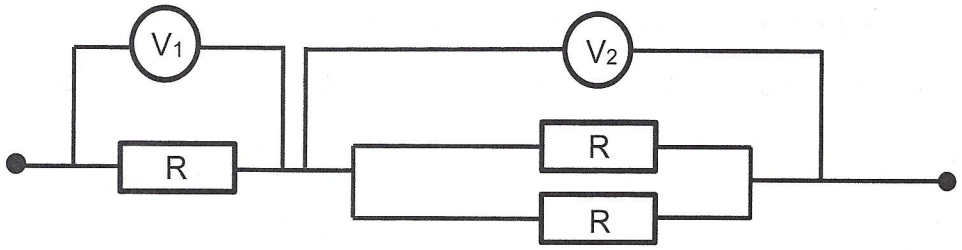
B 2

C 3

D 4

(2)

1.8 The diagram below represents part of an electric circuit. All resistors are identical.



V_1 and **V_2** represent readings on two separate voltmeters. When current flows in the circuit, which ONE of the following BEST represents the readings?

A $V_1 = V_2$

B $V_1 = \frac{1}{3}V_2$

C $V_1 = \frac{1}{2}V_2$

D $V_1 = 2V_2$

(2)

1.9 Which ONE of the following parts of a simple DC motor reverses the direction of the current through the coil every half cycle?

A Armature

B Carbon brushes

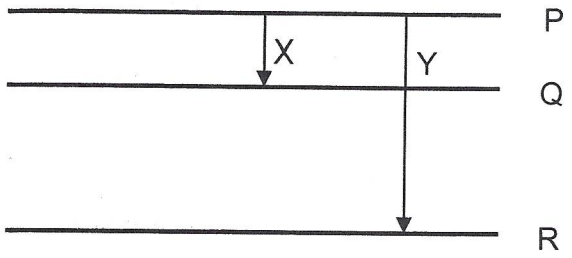
C Commutator

D Slip rings

(2)

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1.10 The diagram below represents 3 energy levels **P**, **Q**, and **R** in a certain atom.



Which ONE of the following statements is TRUE?

Compared to that of transition **Y** ...

A the wavelength of a photon emitted as a result of transition **X** is longer.

B the wavelength of a photon emitted as a result of transition **X** is shorter.

C the frequency of a photon emitted as a result of transition **X** is lower.

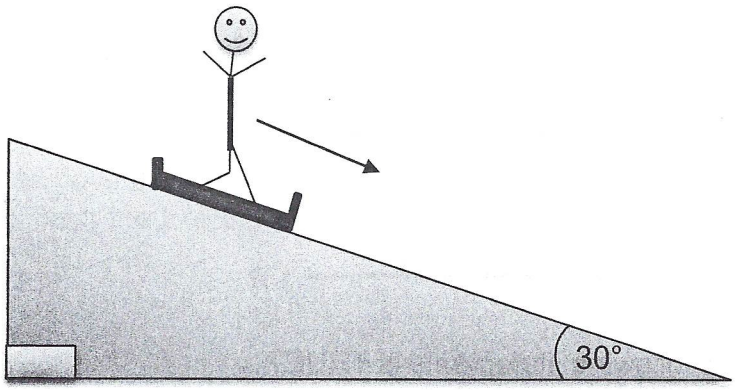
D t he frequency of a photon emitted as a result of transition **X** is the same. (2)

[20]

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QUESTION 2 (Start on a new page)

The skier in the diagram below has just begun (from rest) descending the 30° slope. The coefficient of kinetic friction is 0,10.



Neglect the effects of air resistance.

2.1 Define, in words, the term *acceleration* as applied in physics. (2)

2.2 State, in words, *Newton's Second Law of motion* in terms of acceleration. (2)

2.3 Draw a labelled free-body diagram for the skier whilst in motion. (3)

2.4 Calculate the:

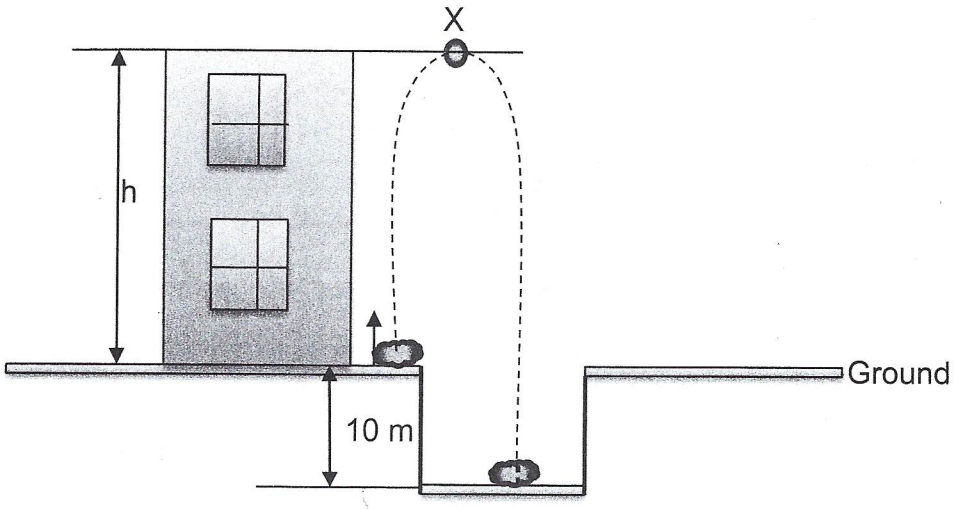
2.4.1 Acceleration of the skier (5)

2.4.2 Speed of the skier after 6,0 s (3)

[15]

QUESTION 3 (Start on a new page)

3.1 A stone near a tall building, is tossed straight up with a speed of 20 m · s^{-1}. When it returns, it falls into a hole 10 m deep, as the diagram below illustrates.



Neglect air resistance and **take upwards direction as positive**.

3.1.1 Explain what is meant by the term *projectile*. (2)

3.1.2 Immediately after being released, is the magnitude of the stone's acceleration **greater than g**, **less than g**, or **equal to g**? (1)

3.1.3 Just before hitting the bottom of the hole, is the magnitude of the stone's acceleration **greater than g**, **less than g**, or **equal to g**? (1)

Use the *equations of motion* to calculate the:

3.1.4 Velocity of the stone as it hits the bottom of the hole (3)

3.1.5 Time for which the stone is in the air from the instant it is released until it hits the bottom of the hole (3)

3.2 In a physics laboratory experiment, a learner releases a small steel ball at various heights above the ground and measures the ball's velocity just before it strikes the ground. He/she plots the data on a graph that has the *release height* (in m) on the vertical axis and the *square of the final velocity* (in m^2 · s^{-2}) on the horizontal axis. In this graph the data points **lie on a straight line**. Ignore the effects of air resistance.

3.2.1 Sketch the height versus square of velocity graph for this experiment. (2)

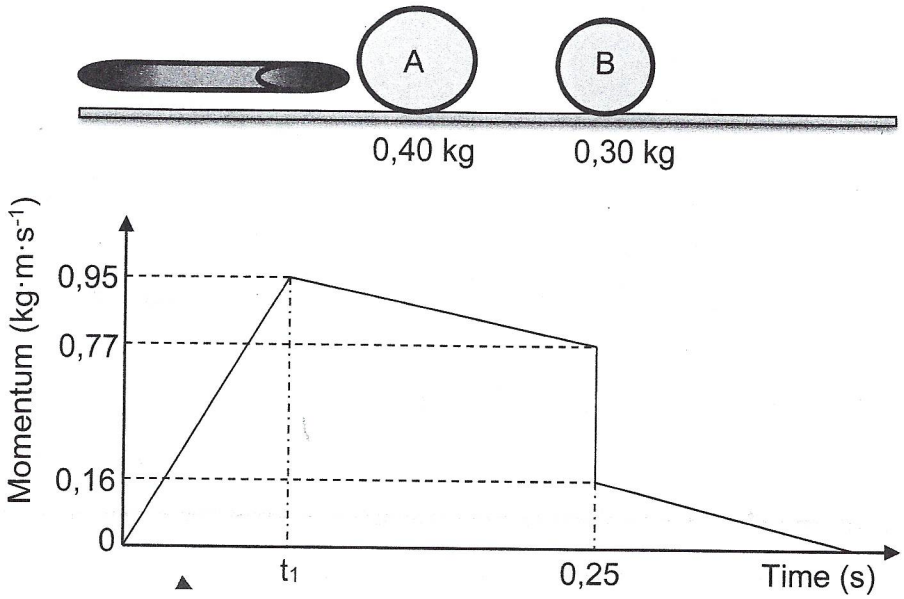
3.2.2 Determine the numerical value of the slope of this straight line, include the correct units. Show clearly how you arrived at the answer. (4)

[16]

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QUESTION 4 (Start on a new page)

In a game of snooker/8 ball pool, the cue strikes ball **A** of mass 0,40 kg, as shown in the diagram below. Ball **A** rolls across the table and collides with ball **B** of mass 0,30 kg.



The momentum versus time sketch graph is drawn (as shown above) for ball **A** from the moment it is struck by the cue (t = 0 s), as it leaves the cue (t = t_1 s) and as it collides with ball **B** (t = 0,25 s).

4.1 Define, in words, the term *impulse* as applied in physics. (2)

4.2 **Use the information on the graph** to:

4.2.1 Calculate the value of the time t_1, if the force exerted by the cue is 65 N (4)

4.2.2 Explain why it is correct to say that the *table surface is rough* (2)

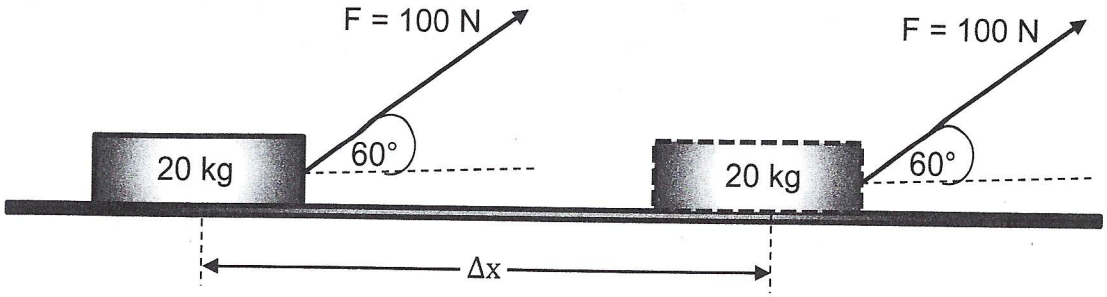
4.2.3 Calculate the velocity of ball **B** immediately after the collision (4)

[12]

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QUESTION 5 (Start on a new page)

A 20 kg box is pulled *from rest*, as shown in the diagram below, across a **rough** floor.



The frictional force between the box and the surface is 20 N.

Neglect the effects of air resistance.

5.1 Classify frictional force as a CONSERVATIVE FORCE or a NON-CONSERVATIVE FORCE. (1)

5.2 Draw a labelled free-body diagram for the box whilst in motion. (4)

5.3 Write down the *work-(kinetic) energy theorem* in words. (2)

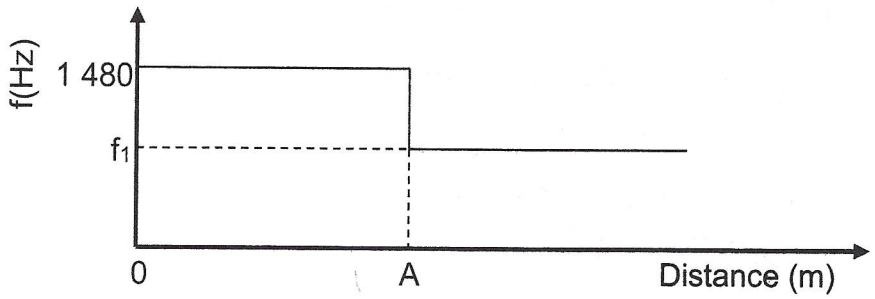
5,4 Use the theorem in QUESTION **5.3** above to calculate the momentum of the box after it has been displaced for 5 m. (5)

[12]

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QUESTION 6 (Start on a new page)

A bird watcher finds himself/herself at position **A** with regard to a reference point. The accompanying graph illustrates how the frequency of the bird's tweets being observed by the bird watcher changes as the bird flies closer to him/her, passes over his/her head, and flies away.



The wavelength of the sound wave the bird emits is 0,25 m, Take the speed of sound in air as 340 $m \cdot s^{-1}$.

6.1 State the *Doppler effect* in words. (2)

6.2 Calculate the:

6.2.1 Speed at which the bird flies (6)

6.2.2 Value of f_1, shown on the graph (4)

6.3 Spectral lines of star **Y** at an observatory are observed to be *red shifted*.

Explain the term red shifted in terms of **frequency**. (2)

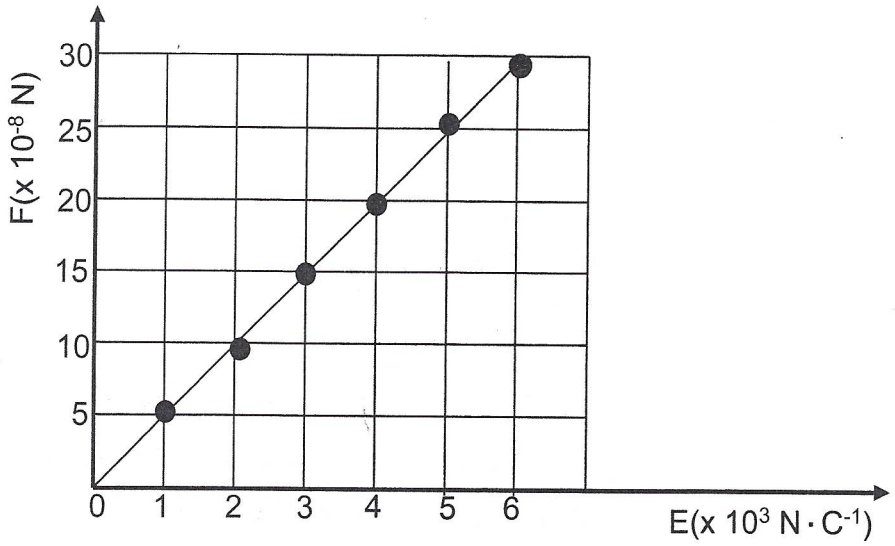
[14]

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QUESTION 7 (Start on a new page)

7.1 The relationship between the electrostatic force (**F**) experienced by a test charge and the magnitude of the electric field (**E**) the charge is placed in, is investigated.

The results obtained are shown in the graph below.



7.1.1 Describe, in words, *an electric field*. (2)

7.1.2 For this investigation, write down the **independent variable**. (1)

7.1.3 State, in words, the relationship between **F** and **E** as depicted by the graph. (1)

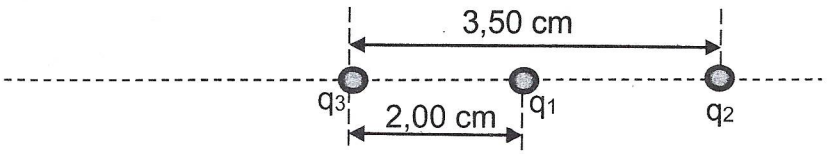
7.1.4 Write down the NAME of the physical quantity represented by the gradient of this graph. (1)

7.1.5 Calculate the value of the *gradient* of the graph. (3)

7.1.6 Hence, write down the magnitude of the *test charge* that is used. (1)

7.1.7 Calculate the number of electrons that are removed or added to obtain this test charge. (3)

7.2 Three point charges are arranged on a line, as shown in the sketch below. Charge q_1 has unknown *magnitude and sign*; charge q_2 = -2,00 nC, and charge q_3 = +5,00 nC.

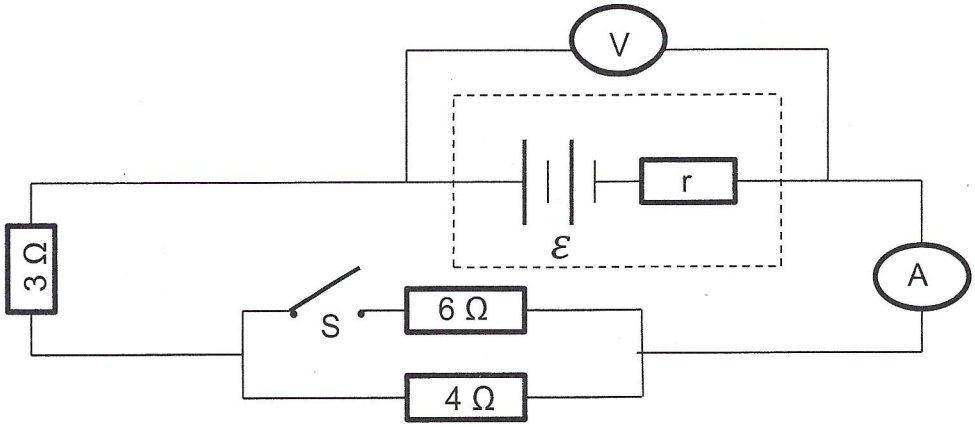


Calculate the charge (**magnitude and sign**) on q_1 if the net force on q_3 is **zero**. (6)

[18]

QUESTION 8 (Start on a new page)

8.1 An electric circuit is represented by the circuit diagram below. The internal resistance of EACH of the cells is 0,5 Ω.



8.1.1 Explain the term *internal resistance of a battery* in words. (2)

8.1.2 Write down the value of **r**, the internal resistance of the battery. (1)

The switch is now closed. The voltmeter **V** reads 10,8 V.

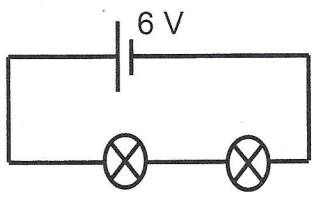
8.1.3 Calculate the emf ε of the battery. (5)

The switch is now opened.

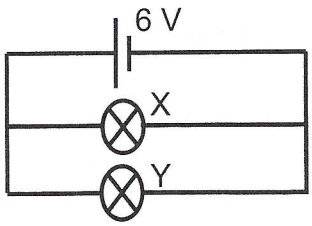
8.1.4 Is the ammeter reading **greater than**, **less than**, or **the same as** before? Provide a reason for the answer. (2)

8.2 When two bulbs **X** and **Y**, are connected to a 6 V source as in circuit diagram **A**, *bulb **X** glows brighter than bulb **Y**.*

Ignore the resistance of the connecting wires and the internal resistance of the source.



Circuit Diagram A



Circuit Diagram B

The same two bulbs are re-connected to the same 6 V source, as shown in the circuit diagram **B** above.

Explain, with reference to **potential difference**, **resistance**, and **power** how the brightness of bulbs **X** and **Y** will compare in circuit **B**. (5)

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8.3 An electric heater draws 15 A on a 120 V line.

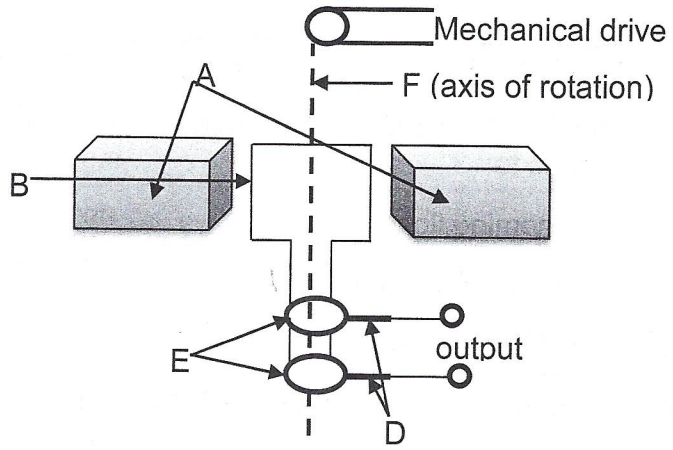
Calculate the **cost per month** (30 days) if it operates for 3,0 hours per day and the electric company charges 80 cents per kWh.

(3)

[18]

QUESTION 9 (Start on a new page)

The diagram below illustrates a simple form of an AC generator.



9.1 Write down the LETTERS shown on the diagram which label the following parts:

9.1.1 Brushes (1)

9.1.2 Armature (1)

9.1.3 Slip rings (1)

9.1.4 Field magnets (1)

9.2 State the energy conversion that takes place during the operation of this generator.

(1)

9.3 Write down TWO changes to this generator design which would results in an increase in the voltage output at a given speed of rotation.

(2)

9.4 On the same set of axes, sketch the graphs (on the provided grid) to compare the voltage outputs of an AC generator.

(i) At a certain rate of rotation. (Label it **(i)**, show TWO complete cycles)
(ii) At half that rate. (Label it **(ii)**)

Explain the differences between the two graphs, (5)

[12]

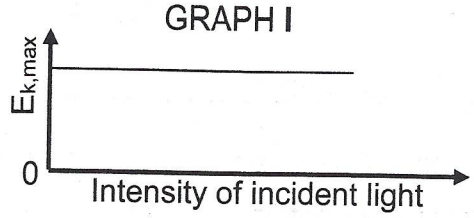
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QUESTION 10 (Start on a new page)

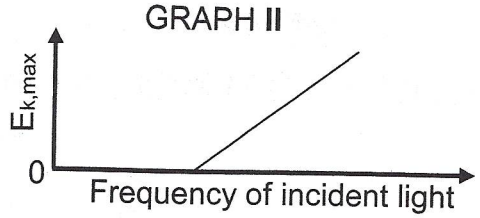
A certain photoelectric cell has a copper cathode. The graphs (**I** and **II**) below are derived from readings taken from the photoelectric cell.

Graph **I** is derived from the incoming light with a constant frequency.

GRAPH I



GRAPH II



10.1 Write down the conclusion that can be drawn regarding the energy of the photoelectrons with reference to:

10.1.1 Intensity of the incoming light (1)

10.1.2 The frequency of the incoming light (2)

10.2 Describe the *photoelectric effect* in words. (2)

10.3 Write down the NAME of the frequency f_0, shown in GRAPH **II**. (1)

The copper cathode is irradiated with monochromatic red light with wavelength of 600 nm. The work function of copper equals $6{,}2 \times 10^{-19}$ J.

10.4 Define, in words, the term *work function of a metal* as applied in physics. (2)

10.5 Use the given information and an appropriate calculation to indicate why photoelectrons are NOT ejected from the surface. (5)

[13]

TOTAL: [150]

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