



eduresourceza.com



Gr 12 Physical Science

JULY EXAMINATIONS

8 July 2019

Examiner: K Trenor & S Crossman

Moderator: D Henry

Time: 3 Hours

200 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 14 pages, an Answer Sheet of 4 pages (i-iv) and a Data Sheet of 2 pages (i-ii). Please check that your question paper is complete.
2. Answer ALL the questions.
3. Read the questions carefully.
4. Use the data and formulae whenever necessary.
5. Start each question on a new page.
6. Show your working in all calculations.
7. Units need not be included in the working of calculations, but appropriate units should be shown in the answer.
8. Answers must be expressed in decimal format, not left as proper fractions.
9. Where appropriate express answers to TWO decimal places.
10. It is in your own interest to write legibly and to present your work neatly.

QUESTION 1: MULTIPLE CHOICE

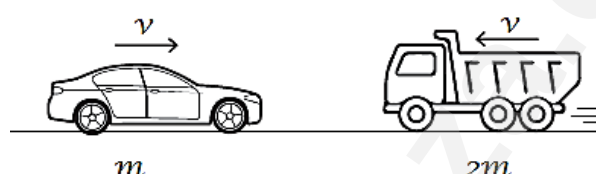
Answer these questions on the Multiple-choice Answer Sheet. Make a cross (X) in the box corresponding to the letter that you consider to be correct.

- 1.1 Which of the following pairs of physical quantities are both **vector quantities**?
- A velocity and impulse
 - B force and work
 - C power and current
 - D distance and displacement
- (2)
- 1.2 Which of the following descriptions correctly describes the motion of an object travelling with uniform acceleration along a straight line?
- The object moves
- A with increasing speed.
 - B the same distance in equal time intervals.
 - C the same increase in distance in equal time intervals.
 - D the same increase in speed in equal time intervals.
- (2)
- 1.3 A person stands on a scale in an elevator (a lift). He notices that the scale reading is lower than his usual weight. Which of the following could possibly describe the motion of the elevator (the lift)?
- A It is moving down at constant speed.
 - B It is moving down and slowing down.
 - C It is moving up and slowing down.
 - D It is moving up and speeding up.
- (2)

1.4 A laptop rests on a table. According to Newton's 3rd law, what is the reaction force to the weight of the laptop?

- A The upward force of the table on the laptop.
- B The upward force of the laptop on the earth.
- C The downward force of the Earth on the laptop.
- D The normal force on the laptop. (2)

1.5 A car of mass m moving at velocity v collides head-on with a truck of mass $2m$ moving in the opposite direction at velocity v . Immediately after the collision the truck is brought to rest.



Ignore any effects of friction. Which ONE of the following is CORRECT?

	Final momentum of car	Mechanical energy
A	Zero	Conserved
B	$-mv$	Conserved
C	Zero	Not conserved
D	$-mv$	Not conserved

1.6 The magnitude of the gravitational force exerted by the Moon on asteroid **A** is **F**. What is the magnitude of the gravitational force, in terms of **F**, of the Moon on asteroid **B** which is twice the distance away from the Moon and has three times the mass of asteroid **A**?

- A $\frac{1}{4} F$
- B $\frac{3}{4} F$
- C $4F$
- D $\frac{4}{3} F$ (2)

- 1.7 Three point charges of magnitude $-3\mu\text{C}$, $+3\mu\text{C}$ and $+2\mu\text{C}$ are placed at the three corners of a triangle, as shown in the diagram below.

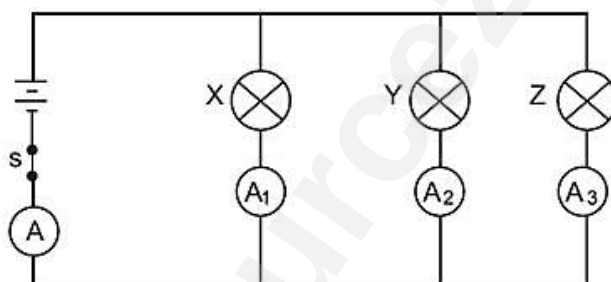


Which of the following best represents the direction of the resultant force exerted on the $+2\mu\text{C}$ charge by the other two charges?



(2)

- 1.8 Three light bulbs, **X**, **Y** and **Z**, with resistances $3R$, $2R$ and R respectively, are connected in a circuit as shown in the circuit diagram below. The battery has negligible internal resistance. The reading on ammeter **A** is 2,75 A.



Bulb **Z** burns out after 1 minute. Which of the following gives the correct reading on **A**₂ when bulb **Z** is removed?

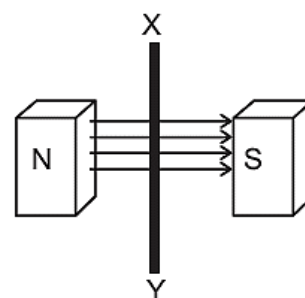
- A 0,50 A
- B 0,75 A
- C 1,50 A
- D 2,25 A

(2)

- 1.9 A conducting wire, **XY**, moves between two magnets as shown in the diagram alongside. Which one of the following actions will lead to an increased induced current in the wire?

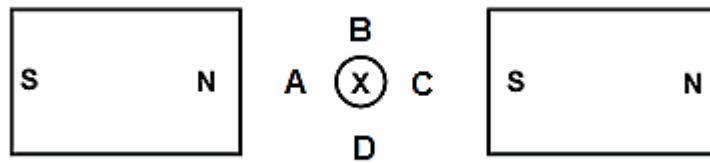
Move the wire

- A quickly and parallel to the magnetic field.
- B slowly and parallel to the magnetic field.
- C quickly and perpendicular to the magnetic field.
- D slowly and perpendicular to the magnetic field.



(2)

- 1.10 The diagram below shows the cross-section of a current-carrying conductor placed in a uniform magnetic field.



In which direction does force act on the conductor?

- A
- B
- C
- D

(2)

[20]

QUESTION 2: KINEMATICS

- 2.1 The 2019 Comrades Marathon took place on 9th June with an “UP” run from Durban to Pietermaritzburg. The race distance is approximately 87 km. Edward Mothibi won the Men’s Race in a time of 5 h 31 mins 33 seconds.

2.1.1 Calculate Edward’s average speed in $\text{km}\cdot\text{h}^{-1}$. (3)

A helicopter flew along a straight path from the start of the race in Durban to land at the finish at Scottsville Racecourse in Pietermaritzburg. It travelled for 30 minutes at an average speed of $120 \text{ km}\cdot\text{h}^{-1}$.

2.1.2 Distinguish between *distance* and *displacement*. (3)

2.1.3 Calculate the magnitude of Edward’s displacement at the end of the race. (2)

- 2.2 At 0,4 s after it is launched, **Ball A** reaches its maximum height above the position from which it is thrown up into the air. It reaches the ground below its initial launch position, 1,6 s after it is launched. Ignore any effects of air resistance.

2.2.1 Calculate the initial (launch) velocity of **Ball A**. (4)

2.2.2 Calculate the velocity of **Ball A** just before it reaches the ground. (3)

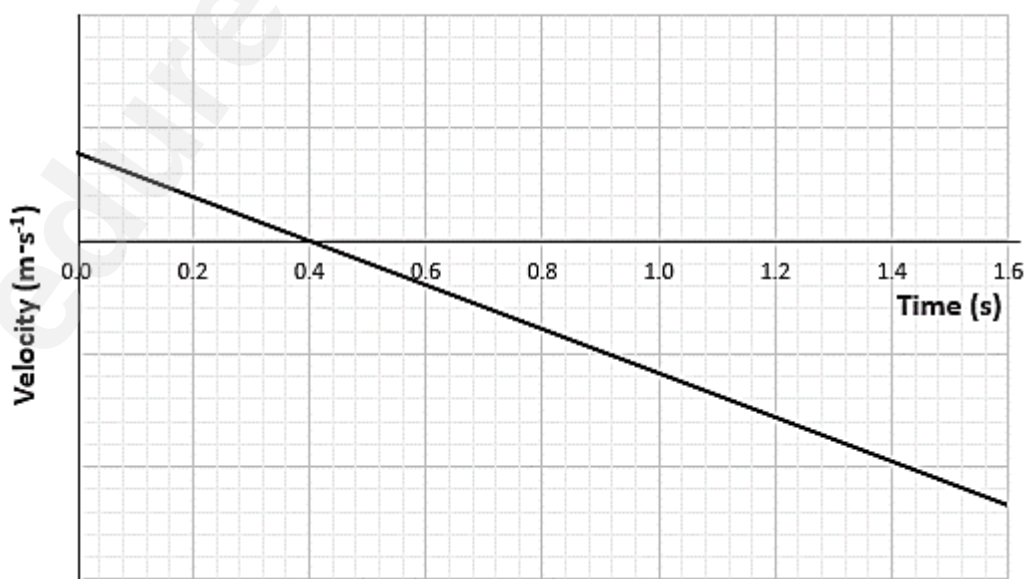
2.2.3 Calculate the height above the ground from which was **Ball A** launched. (3)

Ball B is launched from a height of 3 m above the ground at 0,4 s after **Ball A** is launched. **Ball B** strikes the ground at the same time as **Ball A**.

2.2.4 Calculate the initial velocity of **Ball B**. (4)

The graph below shows how the velocity of **Ball A** varies with time. The answer sheet contains a copy of this graph.

Velocity-Time Graph of Objects in Free-fall.



2.2.5 Fill in the following values on the velocity-time graph on the Answer Sheet:

a The initial velocity of **Ball A** on the graph. (1)

b The final velocity of **Ball A** on the graph. (1)

2.2.6 On the same set of axes, draw the velocity-time graph for **Ball B**. (3)

2.2.7 Use the velocity-time graph to calculate the maximum height of **Ball A** above the ground. (3)

2.2.8 The axes of a displacement-time graph are drawn on the Answer Sheet. Values have been provided for the time axis.

a Fill in the relevant values of displacement for **Ball A** on the y-axis. (1)

Draw the graph of displacement against time for

b **Ball A**. (2)

c **Ball B**. (2)

2.3 Two boys are in a friendly bicycle race. John accelerates from rest with a constant acceleration of $0,5 \text{ m}\cdot\text{s}^{-2}$. Paul gives John a head start of 5 s, and then accelerates from rest with a constant acceleration of $1,0 \text{ m}\cdot\text{s}^{-2}$.

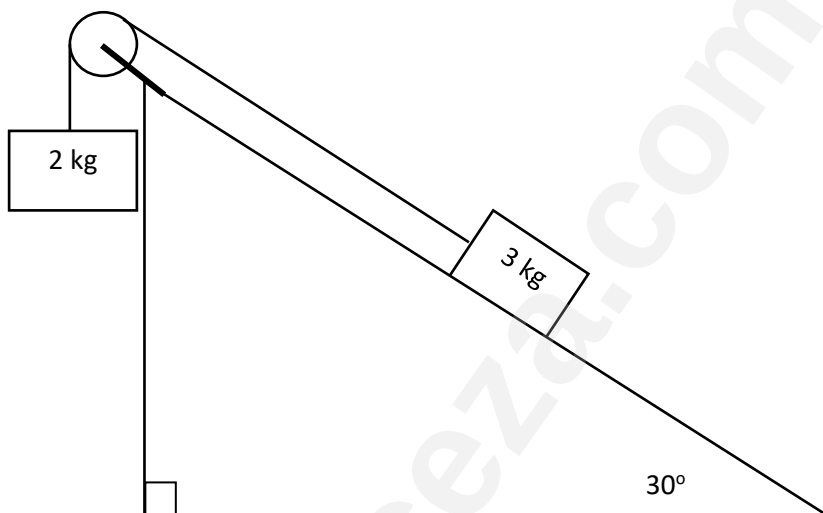
Calculate how long it takes for Paul to catch John from the time John started cycling. (7)

[44]

QUESTION 3: NEWTON'S LAWS AND ITS APPLICATIONS

Consider the string attached to the 3 kg mass and the trolley to be inextensible and to have negligible mass. The pulley is frictionless. The surface of the inclined plane is rough; a frictional force acts on the 3 kg block. The 2 kg block accelerates downwards at a rate of $0,25 \text{ m}\cdot\text{s}^{-2}$.

The coefficient of static friction is 0,5.

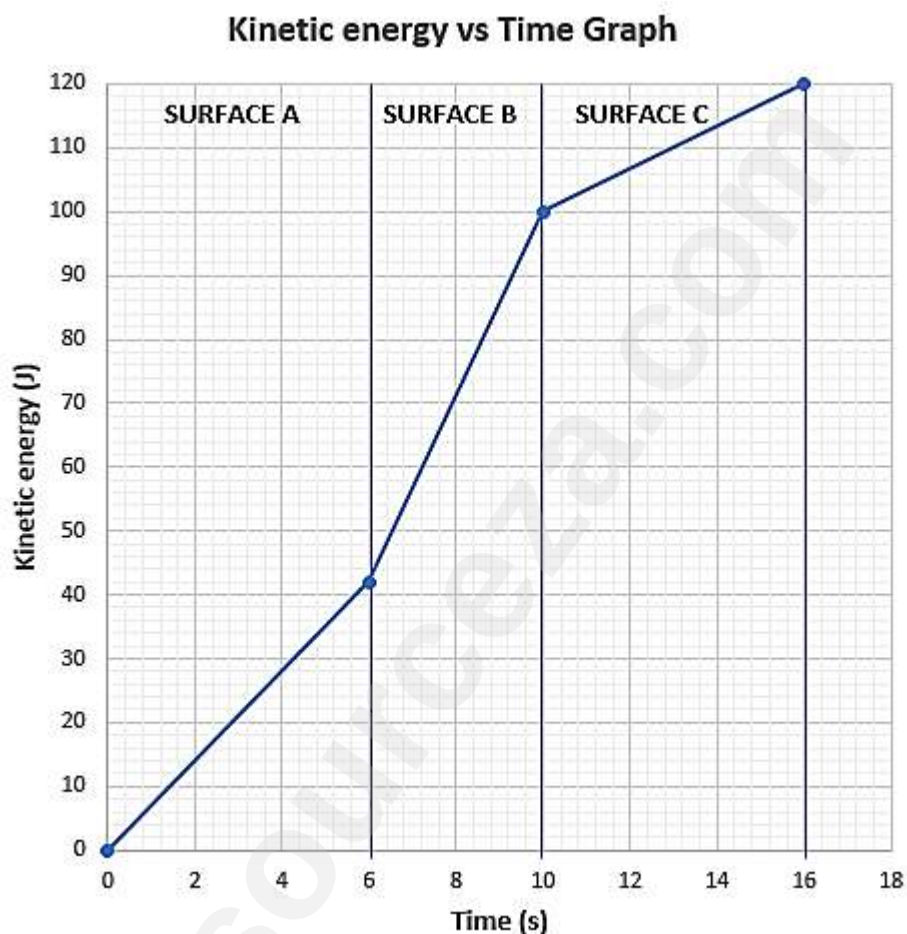


- 3.1 State Newton's 2nd Law of motion. (2)
- 3.2 Draw separate labelled free-body diagrams of the forces acting on
 - 3.2.1 the 2 kg block. (2)
 - 3.2.2 the 3 kg block. (4)
- 3.3 Determine the magnitude of the tension in the string. (3)
- 3.4 Calculate the frictional force acting between the block and the inclined plane. (6)
- 3.5 State what is meant by *the coefficient of kinetic friction*. (2)
- 3.6 Determine the coefficient of kinetic friction for the inclined plane and 3 kg block. (3)
- 3.7 What must the tension in the rope be to keep the block at rest. (2)
- 3.8 Determine the minimum mass **m** that must be added to the 3 kg block to keep the system at rest. (6)

[30]

QUESTION 4: MOMENTUM, WORK, ENERGY AND POWER

A graph of kinetic energy against time for the motion of a toy truck (mass 2 kg) across three different surfaces A, B and C is shown below. A constant force **F** is applied to the truck as it moves in a straight line across the three different surfaces.



- 4.1.1 State the *work-energy theorem*. (2)
- 4.1.2 Calculate the net work done on the object during the first 6 s of its motion. (2)
- 4.1.3 Calculate the magnitude of the net force acting on the object during the first 6 s of its motion. (6)
- 4.1.4 Which surface, A, B or C, has the greatest coefficient of kinetic friction? Justify your answer with reference to information from the graph. (4)
- 4.1.5 Find the acceleration of the truck as it travels on surface B. (3)
- 4.1.6 Determine the magnitude of the force **F** if the coefficient of friction of surface B is 0,25. (5)

- 4.2 If a hockey ball leaves Bayanda's stick at $144 \text{ km}\cdot\text{h}^{-1}$ and travels 60 m towards the goal, Khumo's reflexes will not allow him to respond in time to defend his goal. This fact can be used when practising a set move such as a corner.

The mass of a men's field hockey ball is 158 g.

- 4.2.1 Define the term *impulse* in words. (2)
- 4.2.2 Convert $144 \text{ km}\cdot\text{h}^{-1}$ to $\text{m}\cdot\text{s}^{-1}$. (1)
- 4.2.3 Calculate the impulse that must be delivered to a stationary hockey ball to change its speed to $144 \text{ km}\cdot\text{h}^{-1}$. (3)
- 4.2.4 If Bayanda's hockey stick is in contact with the ball for 0,08 s, calculate the net force that he applies to the ball to accelerate it to a speed of $144 \text{ km}\cdot\text{h}^{-1}$. (2)
- 4.2.5 Give one way in which Bayanda can manage to accelerate the ball to the same speed, while applying less force to the ball. Explain your answer with reference to a principle or law of physics. (3)

[33]

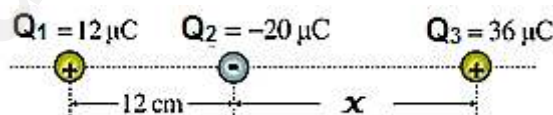
QUESTION 5: GRAVITATIONAL AND ELECTROSTATIC FIELDS

- 5.1 The table below shows the radius and mass of Mars.

Planet	Radius (km)	Mass (kg)
Mars	3 400	$6,4 \times 10^{23}$

- 5.1.1 Define *gravitational field*. (2)
- 5.1.2 Calculate the magnitude of the gravitational field on the surface of Mars. (4)
- 5.1.3 Define the term *weight*. (1)
- 5.1.4 Calculate the weight of a robot on Mars if its weight on Earth is 500 N. (3)

- 5.2 Three point charges, Q_1 , Q_2 and Q_3 , lie along a straight line as shown in the diagram below. There is no net electrostatic force on Q_2 .

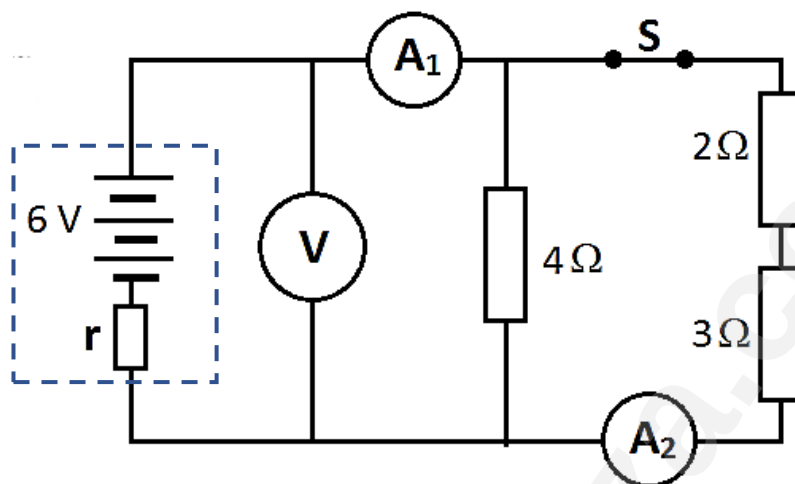


- 5.2.1 State *Coulomb's law*. (2)
- 5.2.2 Calculate the electrostatic force exerted by charge Q_1 on point charge Q_2 . (3)
- 5.2.3 Calculate the distance x (in cm) of charge Q_2 from charge Q_3 . (5)

[20]

QUESTION 6: ELECTRIC CIRCUITS

The connecting leads, ammeter and switch shown in the circuit diagram below have negligible resistance, whereas the voltmeter has a high resistance in comparison to the internal resistance and the resistors.



6.1 Define the *emf of a battery*. (2)

When switch **S** is closed, ammeter **A₁** reads 2 A.

6.2 Calculate the internal resistance of the battery. (6)

6.3 Calculate the reading on the voltmeter **V**. (3)

6.4 Calculate the reading on ammeter **A₂**. (2)

Switch **S** is now opened.

6.5 How are the following readings on the meters affected?

For each of 6.5.1 and 6.5.2 write only INCREASES, DECREASES or REMAINS THE SAME.

6.5.1 The reading on the ammeter **A₁**. (1)

6.5.2 The reading on the voltmeter **V**. (1)

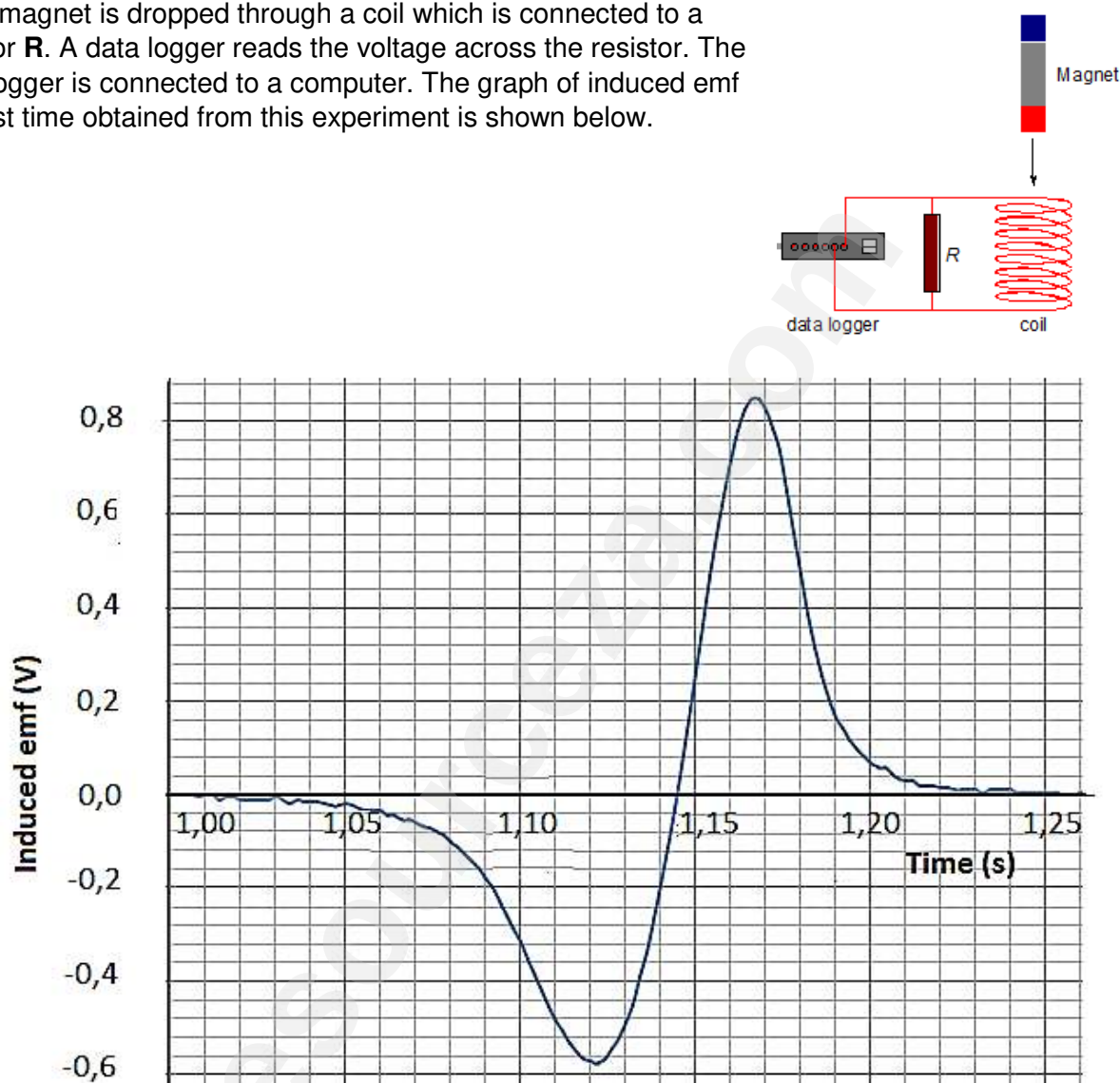
6.6 Explain the answer to 6.5.2. (3)

6.7 Compare the power that the **battery** produces when switch **S** is open and when it is closed. (5)

[23]

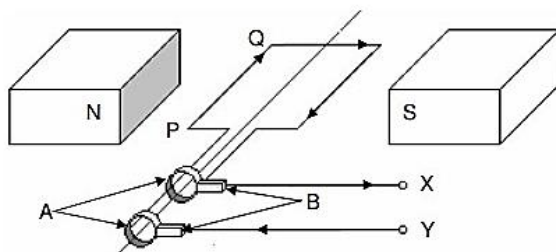
QUESTION 7: ELECTRODYNAMICS

A bar magnet is dropped through a coil which is connected to a resistor **R**. A data logger reads the voltage across the resistor. The data logger is connected to a computer. The graph of induced emf against time obtained from this experiment is shown below.



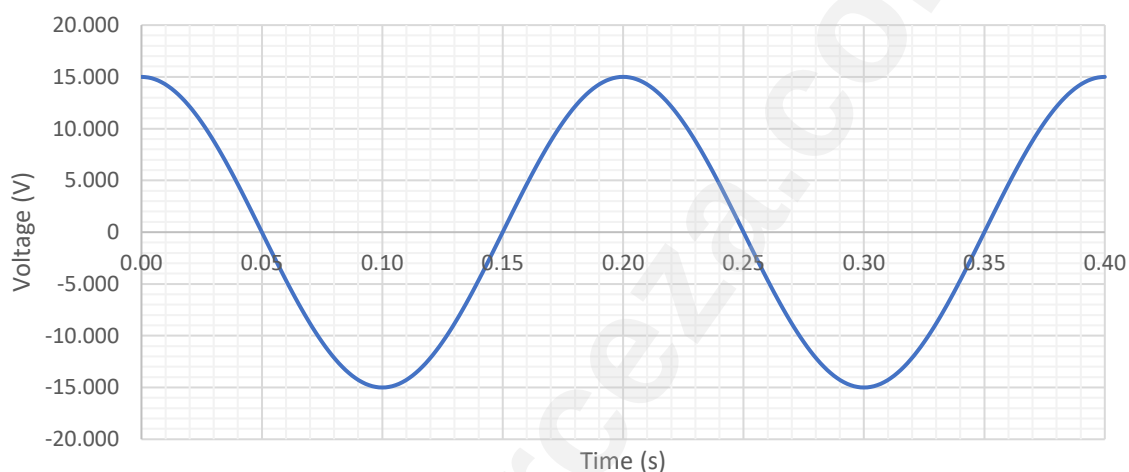
- 7.1.1 Explain how an emf is induced in the coil with reference to a law of physics. (3)
- 7.1.2 Explain why the graph curves during the period from 1,00 s to 1,10 s. (2)
- 7.1.3 Explain why the maximum emf in the first part of the graph is less than the maximum emf in the second part. (2)
- 7.1.4 Why does the graph have a positive and negative section? (2)
- 7.1.5 The area between the x-axis and the curve in the negative section is equal to the area under the graph in the positive section.
 - a) What quantity does the area between the graph and the x-axis represent? (1)
 - b) With the aid of Faraday's law, explain why these two areas are of equal size. (2)

7.2 The diagram below shows the essential parts of an AC generator.



- 7.2.1 Name the components shown by the letter **A**. (1)
- 7.2.2 Name the components shown by the letter **B** and describe their function. (2)
- 7.2.3 Current passes from P to Q when the coil is rotated. In which direction is the coil rotated: CLOCKWISE or ANTICLOCKWISE? (1)
- 7.2.4 The coil is rotated at 5 cycles per second starting from the position as shown in the diagram. On the axes provided on the Answer Sheet, draw the graph of induced emf against time when the coil starts rotating from the initial position shown in the diagram above. (3)
- 7.2.5 On the same set of axes draw the graph of induced emf against time when the coil is rotated at 2,5 cycles per second starting from the same position. (2)

- 7.3 An ideal transformer consists of a primary coil with 10 000 turns and a secondary coil of 3 333 turns. When the transformer is connected to an AC voltage of 15 000 V the current in the primary coil is 5 mA.
- 7.3.1 What kind of transformer is this? (1)
- 7.3.2 Calculate the voltage of the secondary coil. (3)
- 7.3.4 Calculate the current in the secondary coil. (3)
- 7.3.5 The graph of voltage in the primary coil against time is shown below. This graph is also shown on the Answer Sheet.



On the Answer Sheet draw the corresponding graphs of:

- a) Voltage against time for the secondary coil. (2)
- b) Flux in the transformer core against time. (2)

[32]