



eduresourceza.com



PRELIMINARY EXAMINATION 20 AUGUST 2019

PHYSICAL SCIENCES – PAPER 1 (PHYSICS)

Time: 3 hours
Examiner: T. Rodrigues

200 marks
Moderator: S. Pillay

Name: _____

Exam Number:

--	--	--	--	--	--	--	--	--	--	--	--

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This QUESTION PAPER consists of 13 pages, a yellow ANSWER SHEET of 2 pages (i-ii) and a green DATA SHEET of 2 pages (i-ii). Please make sure that your question paper is complete.
2. **Write your name and exam number on the front page of your QUESTION PAPER and the blue ANSWER BOOK and the yellow ANSWER SHEET.**
3. There are 10 questions. Answer **ALL** questions on the foolscap paper provided in your ANSWER BOOK. Do **NOT** answer any questions on the question paper.

QUESTION 10.2 must be answered on your yellow ANSWER SHEET.

4. Read the questions carefully.
5. Write on **BOTH SIDES** of the paper.
6. Use the data and formulae whenever necessary.
7. **QUESTION 1** consists of 10 multiple-choice questions. There is only one correct answer to each question. The questions are to be answered on the answer sheet provided on the **inside cover** of your blue answer book. The letter that corresponds with your choice of the correct answer must be marked with a cross as shown in the example below:

A	B	☒ C	D
---	---	---------------------------------------	---

Here the answer C has been marked.

8. **START EACH QUESTION ON A NEW PAGE.**
9. It is in your own interests to write legibly and set your work out neatly.
10. Show your working in all calculations.
11. Units need not be included in the working of calculations, but appropriate units should be shown in the answer.
12. Where necessary, round off your FINAL answer to **2 decimal places**.

QUESTION 1 EENIE MEENIE MINY MO

Answer these questions on the inside front cover of your Answer Book. Make a cross (X) on the letter of the response which you consider to be the most correct.

- 1.1 Two balls, **A** and **B**, are dropped from different heights. Ball **A** is dropped from a height h and reaches the ground with a speed v . From what height was ball **B** dropped if it reaches the ground with a speed of $4v$?

- A. $\sqrt{2} \cdot h$
- B. $2 \cdot h$
- C. $4 \cdot h$
- D. $16 \cdot h$

- 1.2 A parachutist is falling and has almost reached terminal velocity. Which one of the following describes her velocity and acceleration?

	Velocity	Acceleration
A.	Upward	Upward
B.	Upward	Downward
C.	Downward	Upward
D.	Downward	Downward

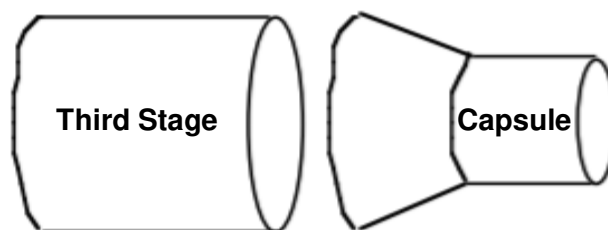
- 1.3 The formula $\Delta x = v_i \Delta t$ describes the linear motion of an object:

- A. accelerating uniformly from rest
- B. accelerating uniformly from some nonzero initial velocity
- C. moving with constant velocity
- D. which is at rest

- 1.4 A car has kinetic energy E when travelling at a speed v . The expression giving the momentum of the car is:

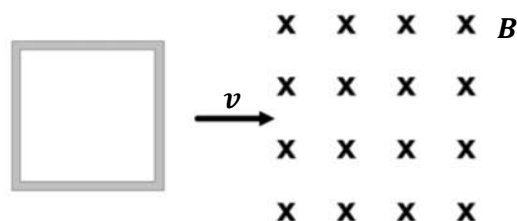
- A. $\frac{Ev}{2}$
- B. $\frac{E}{2v^2}$
- C. $\frac{2E}{v^2}$
- D. $\frac{2E}{v}$

- 1.5 At one phase in a space launch, an explosion separates the third stage of the rocket from the space capsule. The mass of the third stage is 4 times that of the capsule.



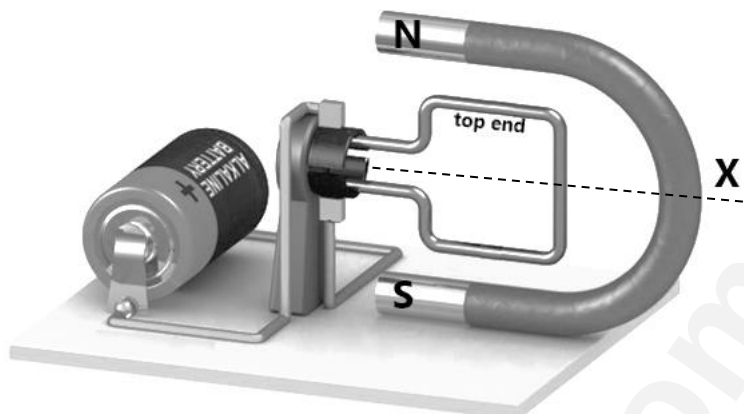
During the explosion, the ratio of the impulse on the space capsule to the impulse on the third stage of the rocket is:

- A. 1:1
 B. 1:4
 C. 4:1
 D. 1:16
- 1.6 Two objects attract each other with a force of magnitude F when they are a distance r apart. If each mass is doubled and the distance between the masses is increased by a factor of four, the new gravitational force between the masses is:
- A. $\frac{F}{4}$
 B. $\frac{F}{2}$
 C. F
 D. $4F$
- 1.7 Which ONE of the following is the unit of measurement for the rate of flow of charge?
- A. watt
 B. coulomb
 C. ampère
 D. volt
- 1.8 A square loop of wire is moved at constant velocity through a uniform magnetic field, B , as shown below. What is the direction of the induced current in the loop as it passes through the magnetic field?



	Entering the field	Leaving the field
A.	clockwise	clockwise
B.	clockwise	anticlockwise
C.	anticlockwise	clockwise
D.	anticlockwise	anticlockwise

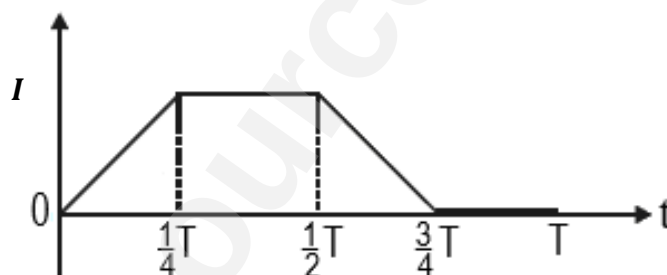
1.9 Consider the apparatus shown below



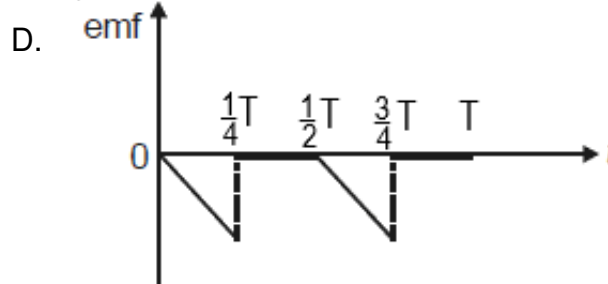
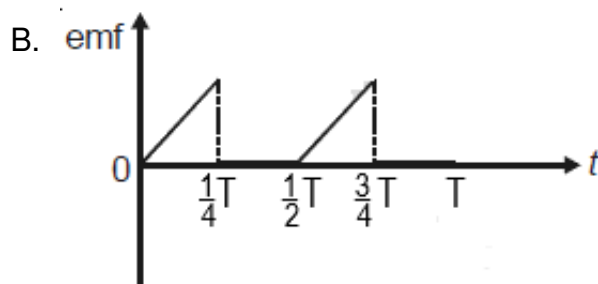
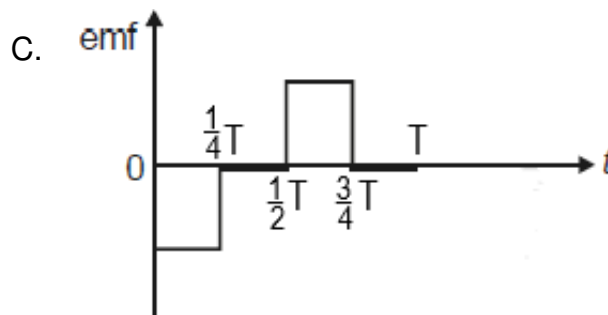
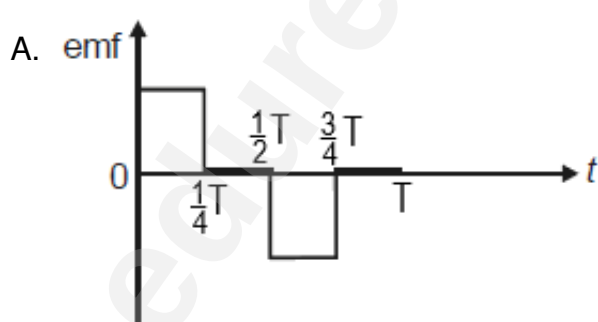
As viewed from position **X**, what direction does the armature rotate?

- A. Anticlockwise continuously
- B. Clockwise continuously
- C. Clockwise for half a rotation, then anticlockwise
- D. Anticlockwise for half a rotation, then clockwise

1.10 The current, I , in a **primary coil** of a transformer varies with time as shown in the graph below.



The variation of induced emf vs time in the **secondary coil** would be:

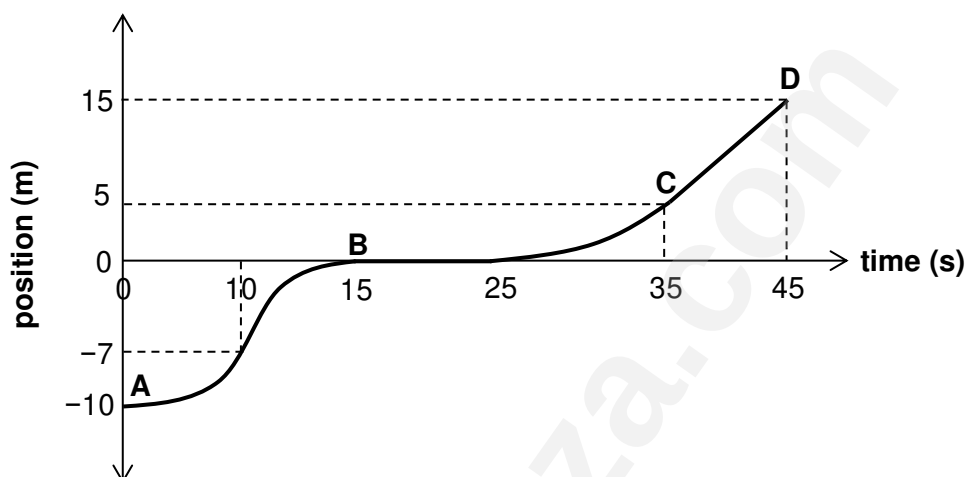


[20]

QUESTION 2

THERE ARE TWO PEOPLE IN THIS WORLD: 1) THOSE THAT CAN EXTRAPOLATE FROM INCOMPLETE DATA

A cat runs from rest along a horizontal lawn in an **easterly** direction. She begins at the house (point **A**), runs toward a lawn chair (point **B**), then proceeds to the other end of the lawn through points **C** and **D**. The cat's position-time graph (NOT TO SCALE) is shown below.



- 2.1 What reference point was chosen for the cat's motion? (1)
- 2.2 Define *displacement*. (2)
- 2.3 Write down the cat's total displacement. (2)
- 2.4 Distinguish between *average* and *instantaneous velocity*. (3)
- 2.5 Determine the cat's average velocity between $t = 0$ s (Point **A**) and $t = 15$ s (Point **B**). (4)
- 2.6 What particular feature of the graph could one use to determine the instantaneous velocity of the cat at 30 s? (1)

During the time period $t = 10$ s and $t = 15$ s, the cat has a constant acceleration of magnitude $0,12 \text{ m} \cdot \text{s}^{-2}$.

- 2.7 What is the direction of the cat's acceleration during the time period $t = 10$ s and $t = 15$ s? (2)
- 2.8 Calculate the speed of the cat at $t = 10$ s. (4)
- 2.9 Sketch the corresponding velocity-time graph for the cat's entire motion. Consider any period of acceleration as constant. Show points **A** to **D** on your graph. (6)

[25]

QUESTION 3 AIR RESISTANCE IS A DRAG

At the recent Cricket World Cup, every match began with a coin toss by the match referee to determine who decides to bat or field first.

At once such coin toss, the match referee tosses the coin directly upwards, from a height of 1,6 m above the ground. From the moment the coin leaves the hand of the referee, it is in free fall until it reaches the ground. It reaches the ground in 1,45 s.

- 3.1 Explain what is meant by the term 'free fall'? (2)
- 3.2 Show that the speed at which the coin leaves the referee's hand is $6 \text{ m}\cdot\text{s}^{-1}$. (4)
- 3.3 How long does it take the coin to reach its maximum height? (4)
- 3.4 Give the coin's acceleration at the moment it reaches its maximum height. (2)

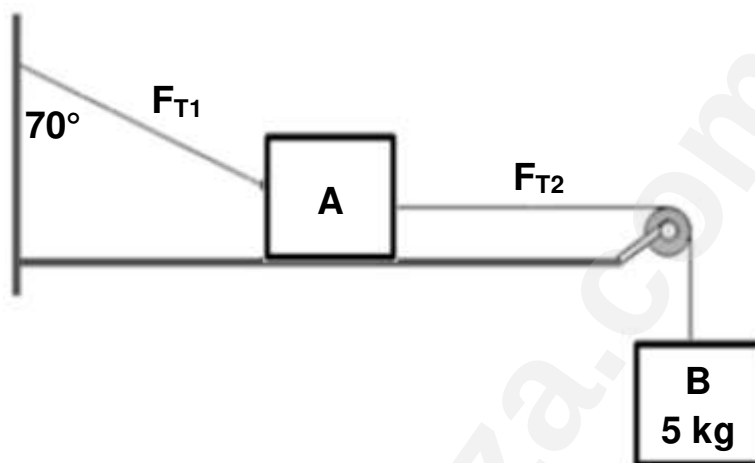
On the way back to his hotel room, the referee rides in a lift that accelerates upward at $1,8 \text{ m}\cdot\text{s}^{-2}$. The moment the lift begins to move, he accidentally drops his coin from a height of 1,2 m above the lift floor. You may assume that the velocities of both the lift and the coin are zero at the moment the coin is dropped.

- 3.5 Determine how long it takes the coin to reach the lift floor. (6)

[18]

QUESTION 4**A PULLEY IS ALWAYS THE CENTRE OF A TENSION**

Block **A** of unknown mass is connected to Block **B** (of mass 5 kg) by a light, inextensible string, which is passed over a frictionless pulley. Block **A** is fastened to the wall with a second, similar string, making angle to the wall of 70° as shown, with a tension, F_{T1} , of **5,4 N**. Once released, the system remains at rest but is on the point of slipping on the rough surface.



- 4.1 State *Newton's first law*. (2)
- 4.2 Determine the magnitude of the tension, F_{T2} . (2)
- 4.3 Draw a free-body diagram for Block **A**. (5)
- 4.4 The normal force acting on Block **A** is **78,44 N**. Determine the mass of Block **A**. (3)
- 4.5 Determine the magnitude of the frictional force acting on block **A**. (3)
- 4.6 Calculate the coefficient of static friction for block **A** and the surface. (3)

The string connecting blocks **A** and **B** is cut. The normal force acting on block **A** is now **80,26 N** and Block **A** remains at rest.

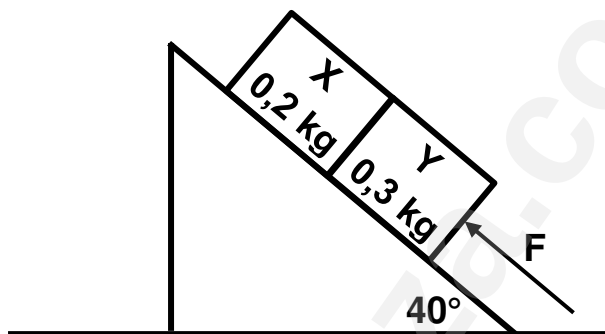
- 4.7 What is the frictional force acting on Block **A** now? (2)

[20]

QUESTION 5**WHAT IS HERMIONE'S PREFERRED METHOD OF GETTING DOWN AN INCLINE? WALKING...JK, ROLLING!**

Two blocks **X** and **Y**, of masses **0,2 kg** and **0,3 kg** respectively, are pushed up a plane, inclined at 40° , by an unknown force, **F**. The force **F** is such that the blocks **slow down uniformly**. The force that Block **Y** exerts on Block **X** is **0,78 N**. Both block experience the same frictional force of **0,6 N**.

Take **DOWN THE SLOPE** as **POSITIVE**.



- 5.1 State *Newton's second law*. (2)
- 5.2 Calculate the acceleration of Block **X**. (5)
- 5.3 Comment on whether the direction of your calculated acceleration in QUESTION 5.2 is reasonable. (2)
- 5.4 Calculate the magnitude of force **F**. (5)
- 5.5 Fully explain what would happen to the frictional force on Block **X** if the angle of the slope were decreased. (4)
- 5.6 Explain briefly why both blocks might have the same frictional force, even though they have different masses. (2)

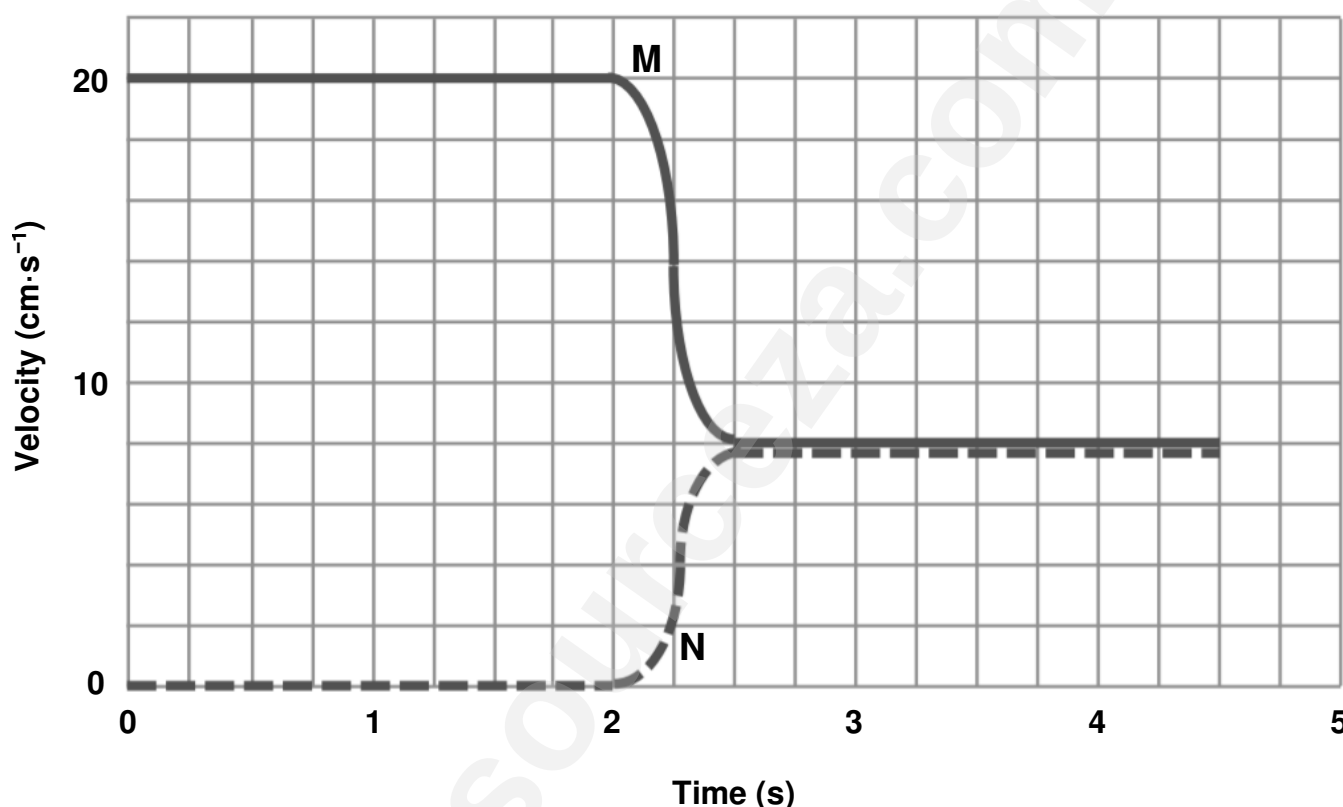
[20]

QUESTION 6

I USED TO BE A SCALAR UNTIL YOU GAVE ME DIRECTION

The velocity vs time graphs of two trolleys, **M** and **N**, are shown on the same axes below. At some time during the 5 seconds shown, the trolleys *collide*.

The solid line represents Trolley **M** and the dashed line represents Trolley **N**. East has been taken as positive.



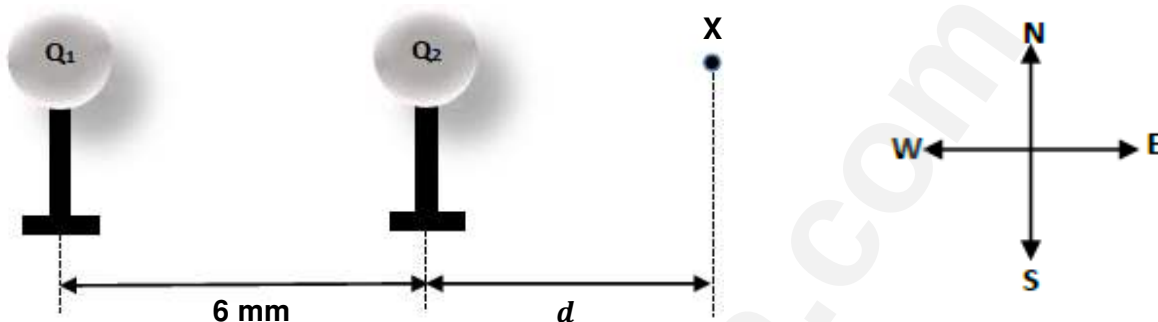
- 6.1 Classify the collision as ELASTIC or INELASTIC. Without doing any calculations, give a reason for your answer. (2)
- 6.2 What was the velocity of Trolley **M** before the trolleys collided? (2)
- 6.3 State the *law of conservation of linear momentum*. (2)
- 6.4 Trolley **M** has a mass of 500 g. Calculate the mass of Trolley **N**. (5)
- 6.5 How long did the collision last for? (1)
- 6.6 Calculate the magnitude of the force exerted by Trolley **M** on Trolley **N**. (4)

[16]

QUESTION 7

YOU WANT SOME NEUTRONS? THEY'RE FREE OF CHARGE.

Two very small identical spheres, Q_1 and Q_2 , with the same negative charges are placed on insulating stands with their centres 6 mm apart. The magnitude of the electrostatic force that Q_1 exerts on Q_2 is 4×10^{-3} N. Point **X** is a distance d east of Q_2 shown below. The diagram is NOT to scale.



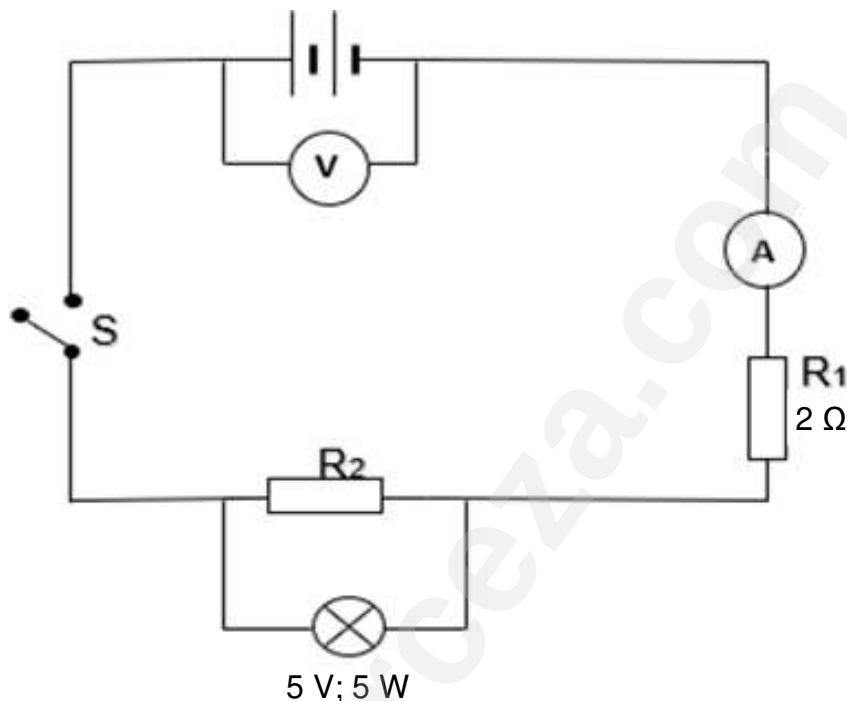
- 7.1 State *Coulomb's law*. (2)
- 7.2 Calculate the magnitude of the charge on each sphere. (4)
- 7.3 Define *electric field at a point*. (2)
- 7.4 The electric field at point **X** due to Q_1 only is $4,44 \times 10^5 \text{ N}\cdot\text{C}^{-1}$ west.
- 7.4.1. State the type of charge for Q_1 . State only POSITIVE or NEGATIVE. (1)
- 7.4.2. Calculate the magnitude of the distance d . (4)
- 7.5 Draw the resultant electric field pattern due to charges Q_1 and Q_2 . (3)

[16]

QUESTION 8

HERE IS SOME LIGHT READING

A bulb which is marked 5V; 5W is connected in parallel to an unknown resistor. This parallel connection is connected in series to a battery with an internal resistance of $1\ \Omega$, an ammeter **A** and a resistor of $2\ \Omega$. The ammeter reads 1,5 A when switch **S** is closed and the **bulb is functioning as rated**.



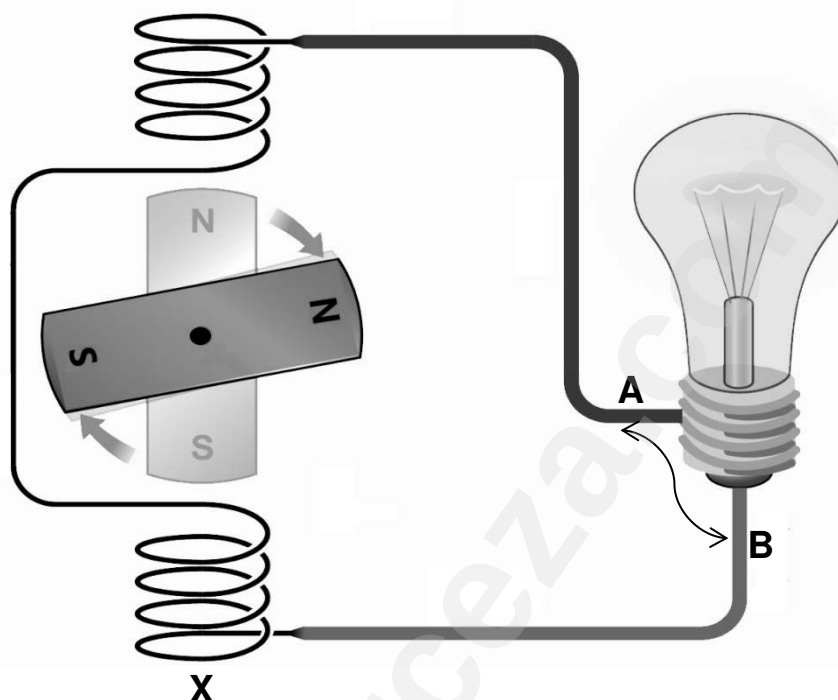
- 8.1 Define *resistance*. (2)
- 8.2 Calculate the current through the bulb. (4)
- 8.3 Calculate the resistance of resistor **R₂**. (4)
- 8.4 Calculate the reading on the voltmeter with switch **S** closed. (4)
- 8.5 Define *emf*. (2)
- 8.6 When switch **S** is opened, the voltmeter reads the emf. Calculate the emf of the battery. (4)
- 8.7 With switch **S** closed, the bulb burns out, preventing current from flowing through that branch. Fully explain why the temperature of the battery decreases. (5)

[25]

QUESTION 9

WHAT DO YOU GET WHEN YOU CROSS A PUN WITH A RHETORICAL QUESTION?

Consider the diagram shown below when answering the questions that follow.



- 9.1 State whether alternating current (AC), direct current (DC) or NO CURRENT will pass through the light bulb when the magnet is stationary. Give a reason for your answer. (3)
- 9.2 The magnet is being rotated in a **clockwise** direction as shown in the diagram. At the moment the magnet is in the vertical position, with the north end of the magnet at the top, determine:
- 9.2.1 State *Lenz's law*. (2)
- 9.2.2 the polarity of the bottom coil at position **X**. State only **NORTH** or **SOUTH**. (1)
- 9.2.3 which direction the current will flow through the light bulb. State only **A TO B** or **B TO A**. (2)
- 9.3 Name ONE method that could increase the brightness of the bulb without changing or replacing any components in the apparatus. (2)
- 9.4 With reference to a physical law or principle, explain your answer to QUESTION 9.3 above. (4)

[14]

QUESTION 10 BAD LIGHT ENDS UP IN PRISM

During an investigation, light of different frequencies is shone onto the metal cathode of a photocell. The maximum kinetic energy of the emitted photoelectrons is measured. The data recorded for the investigation is given in the table below.

Frequency of light ($\times 10^{14}$ Hz)	Maximum Kinetic Energy (eV)
10	0,413
12	1,24
14	2,06
16	2,89
18	3,71

- 10.1 Describe *the photoelectric effect*. (2)
- 10.2 Use the graph paper provided on your yellow ANSWER SHEET to plot a graph of maximum kinetic energy versus frequency for the data above, and extrapolate the best fit line so that it cuts the y -axis. (6)
- 10.3 Define *threshold frequency*. (2)
- 10.4 Use the graph to determine the threshold frequency of the metal used in the photocell. (2)
- 10.5 From your threshold frequency in QUESTION 10.4, calculate the work function of the metal used in the photocell. (3)
- 10.6 Using an appropriate equation, together with the graph you drew, determine what the physical quantity is that is represented by the gradient and the y -intercept of your graph. Show your reasoning clearly. (4)
- 10.7 Use the same axes from QUESTION 10.2 and sketch the graph for a photocell where the metal used has a higher work function. Use a **dashed** line. (2)
- 10.8 Calculate the maximum speed of the electrons ejected when the frequency of the light is 15×10^{14} Hz. (5)

[26]**Total: 200 Marks**