



eduresourceza.com

NAME: _____

TEACHER: KB / KC

St Andrew's College & Diocesan School for Girls

ST ANDREW'S COLLEGE

THE DIOCESAN SCHOOL
FOR GIRLS**GRADE 12****PHYSICAL SCIENCES: PAPER 1 (PHYSICS)**

Date: Monday 17 July 2023

Time: 08h00

Examiner: K Bryan

Moderator: K Cobbing

Duration: 3 hours

200 marks

READ THE FOLLOWING INSTRUCTIONS CAREFULLY:

1. Write your name on the front cover of your question paper.
2. Please check that your paper is complete:
 - This question paper has 24 printed pages, including this cover sheet.
 - There should be a loose, double-sided **data sheet** provided as an insert in this question paper.
3. Read the questions carefully.
4. Present your work neatly and legibly.
5. Answer ALL the questions in the spaces provided.
6. You may answer the questions in any order.
7. All working out must be shown and units must be given with answers.
8. Where appropriate, express answers to TWO decimal places.
9. TWO blank pages (pages 22 & 23) are included at the end of the paper. If you run out of space for a question, use these pages. Clearly indicate the question number of your answer should you use this extra space.
10. A spare piece of graph paper is included on page 24, should you need it.

Q1	Q2	Q3	Q4	Q5	Q6	Q7	TOTAL
20	39	40	25	22	28	26	200

QUESTION 1 MULTIPLE CHOICE

On the ANSWER GRID, mark the letter that corresponds to your answer with a cross (X).

10 x (2) marks

e.g.

X	B	C	D
----------	---	---	---

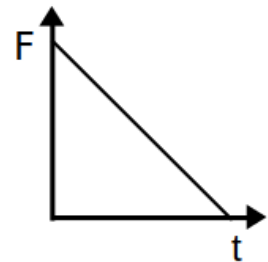
 Here the correct answer is A.

1.1	A	B	C	D
1.2	A	B	C	D
1.3	A	B	C	D
1.4	A	B	C	D
1.5	A	B	C	D
1.6	A	B	C	D
1.7	A	B	C	D
1.8	A	B	C	D
1.9	A	B	C	D
1.10	A	B	C	D

- 1.1 Which of the following pairs of quantities contain two vectors?
- A. Momentum and position
 - B. Work and acceleration
 - C. Velocity and force
 - D. Energy and charge
- 1.2 A person conducts an experiment on a cliff ledge with two stones. They simultaneously drop one stone and throw the second stone upwards. Both stones eventually hit the ground below the cliff. Which of the following statements must be TRUE?
- A. The stone that was thrown will have a greater acceleration.
 - B. The stone that is thrown upwards will hit the ground with a greater velocity than the stone that is dropped.
 - C. Both stones hit the ground at the same time.
 - D. Both stones will hit the ground with the same velocity.
- 1.3 A car's engine has a 20% efficiency when converting energy. If 900 kJ of chemical energy is supplied to the engine, how much mechanical energy does it produce?
- A. 180 kJ
 - B. 200 kJ
 - C. 900 kJ
 - D. 4500 kJ

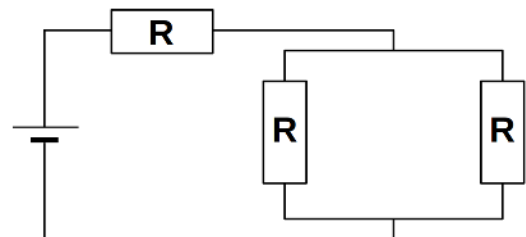
- 1.4 A skydiver deploys their parachute as they are falling through the air. The skydiver then continues to fall towards the ground at a constant velocity. While the skydiver is falling at a constant velocity, which ONE of the following statements is FALSE?
- A. The upward force of the air on the parachute is equal to the downward force of the parachute on the air.
 - B. The force of the Earth on the skydiver is greater than the force of the skydiver on the Earth.
 - C. There is no resultant force acting on the skydiver.
 - D. The downward force of gravity is equal to the upward force of the parachute on the skydiver.

- 1.5 In an experiment, a safety engineer tests the force required to bring a moving vehicle to a complete stop in a given time interval. For different stopping forces, the engineer measures the required time for the vehicle to stop and plots the results on a graph shown alongside. What does the area under the curve on the graph represent?



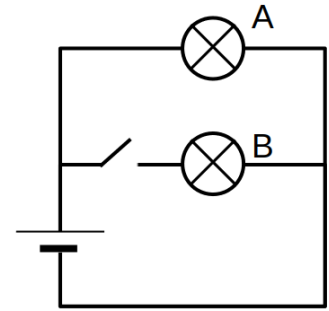
- A. Change in momentum.
 - B. The stopping force.
 - C. Initial momentum.
 - D. Acceleration.
- 1.6 A 10 kg mass is pulled along a horizontal frictionless surface by a constant force of 100 N, applied at an angle of 60° to the horizontal ground. If the mass moves a horizontal distance of 12 m, how much work is done on the block?
- A. 100 J
 - B. 600 J
 - C. 900 J
 - D. 1200 J

- 1.7 Three identical resistors, each with a resistance R , are connected as shown. Which expression could be used to calculate the power of the entire combination of resistors?



- A. $\frac{1}{3} I^2 R$
- B. $\frac{2}{3} I^2 R$
- C. $\frac{3}{2} I^2 R$
- D. $3 I^2 R$

- 1.8 Two identical light bulbs, A and B, are connected to a cell with negligible internal resistance as shown. What will happen to light bulb A when the switch is closed?

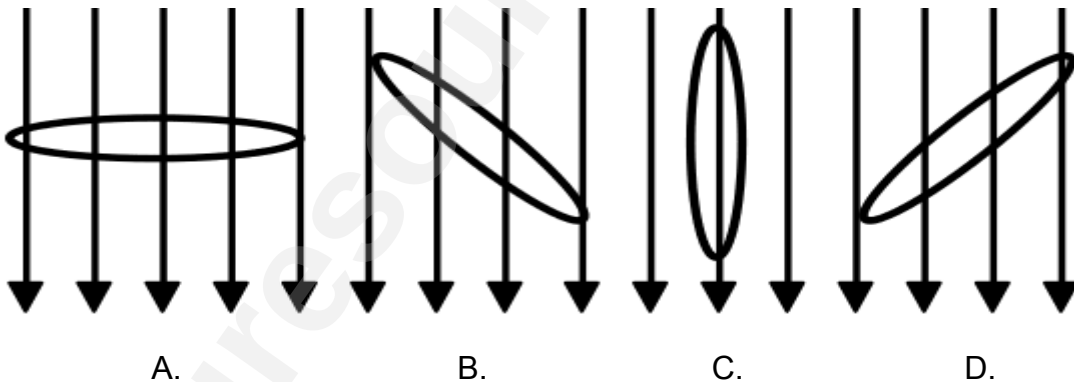


- A. Light bulb A will dim.
- B. Light bulb A will turn off.
- C. Light bulb A will brighten.
- D. There will be no change to light bulb A.

- 1.9 A distant planet has a radius r and a mass M . The gravitational field strength on the surface of the planet is g . At what distance from the center of the planet will the gravitational field strength be $\frac{1}{4}g$?

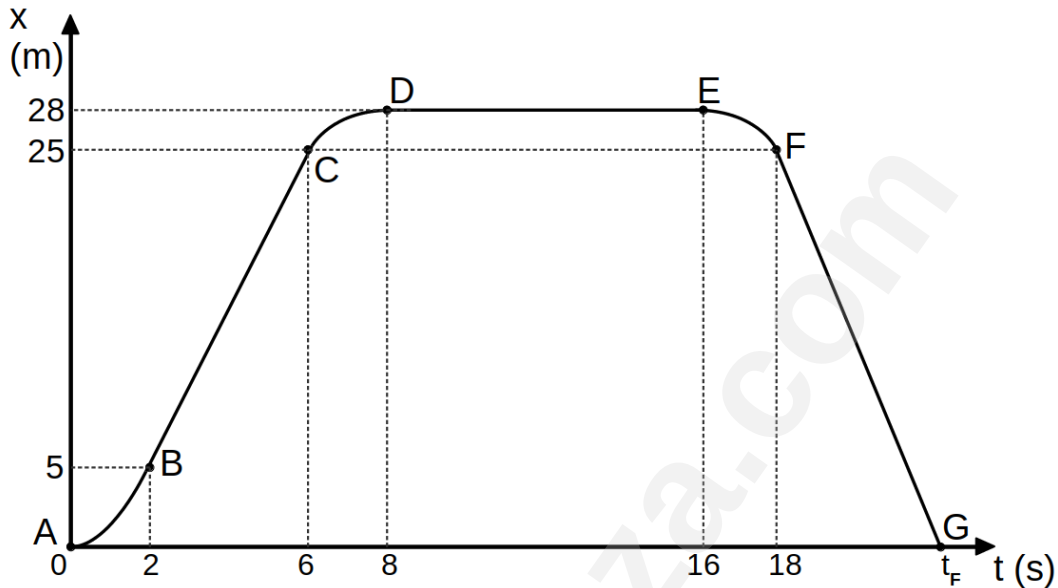
- A. $\frac{1}{2}r$
- B. r
- C. $2r$
- D. $4r$

- 1.10 A generator armature is rotated inside a uniform magnetic field. In which position is the emf generated at a maximum?



QUESTION 2 KINEMATICS

A stationary car is parked on a street. The car begins to move forward and its position is plotted on the position-time graph shown below.



2.1.1 Define *displacement*. (2)

2.1.2 What is the total displacement of the car during the interval AG? (1)

2.1.3 During what interval is the car stationary? (1)

2.1.4 What is the car's speed during the interval BC? (3)

2.1.5 If the speed of the car during the interval FG is 6 m/s, determine t_F . (4)

2.1.6 Determine the magnitude of the acceleration of the car during the interval AB. (3)

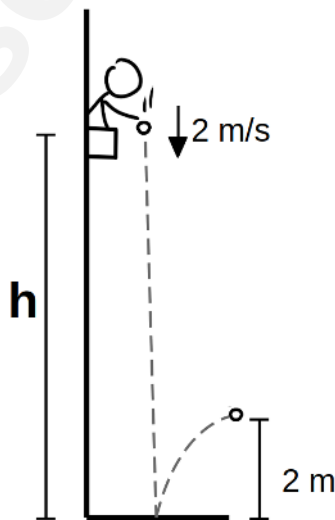
- 2.1.7 Sketch a velocity-time graph for the car during the interval AG.
Include any available values.

(5)



[19]

A student leaning out of the window of a tall building throws a rubber ball downwards with a speed of 2 m/s. The ball takes 2 seconds to reach the ground. The ball is in contact with the ground for 1,2 seconds. It then bounces upwards to a height of 2 m.



- 2.2.1 What height above the ground, h , was the ball thrown from?

(3)

2.2.2 What is the magnitude of the velocity of the ball just before it hits the ground? (3)

2.2.3 Determine the velocity of the ball after the bounce, as it leaves the ground. (4)

2.2.4 Define *acceleration*. (2)

2.2.5 Calculate the acceleration of the ball while it is in contact with the ground. (4)

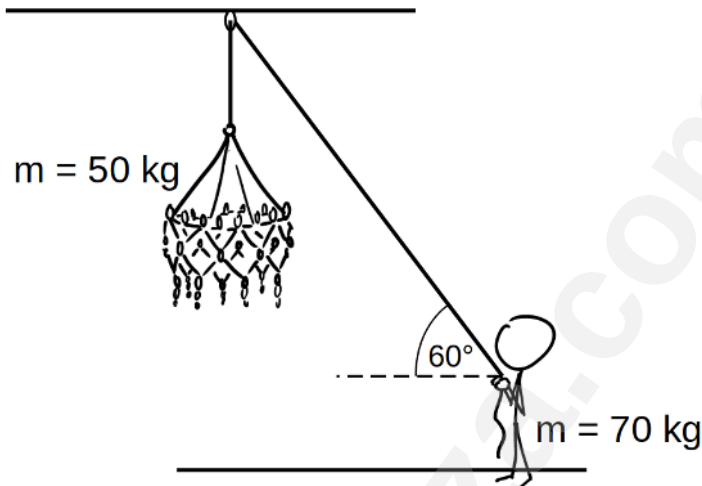
2.2.6 Sketch an acceleration-time graph for the ball. Include any available values. (4)

[20]

39

QUESTION 3 NEWTON'S LAWS

A chandelier with a mass of 50 kg is raised by means of a rope. The rope passes through a frictionless hook on the ceiling and an interior decorator with a mass of 70 kg holds the other end. The rope is kept at an angle of 60° to the ground and both the chandelier and the interior decorator are stationary.



3.1.1 State *Newton's Second Law*. (2)

3.1.2 Calculate the tension in the rope holding up the chandelier. (3)

3.1.3 Draw a **labeled** free body diagram of the forces acting on the interior decorator. (4)

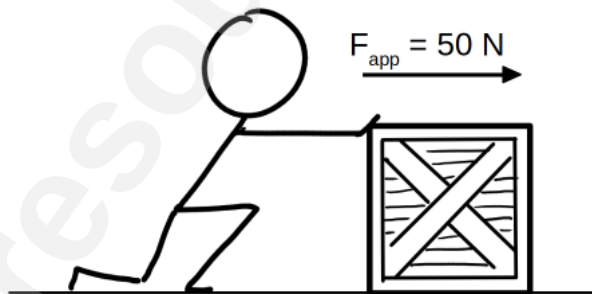
3.1.4 What is the magnitude of the frictional force acting on the interior decorator? (3)

3.1.5 Determine the magnitude of the normal force acting on the interior decorator. (4)

3.1.6 If the interior decorator was standing closer to the chandelier, would the normal force INCREASE, DECREASE, or STAY THE SAME? (2)

[18]

A person pushes a crate across a rough floor with a horizontal force of 50 N. The crate accelerates to the right at $0,04 \text{ m/s}^2$. The crate has a mass of 20 kg.



3.2.1 Calculate the magnitude of the resultant force acting on the crate. (3)

3.2.2 Calculate the magnitude of the frictional force acting on the crate. (3)

3.2.3 Hence, calculate the coefficient of dynamic friction.

The person stops pushing the crate, which then slows to a stop.

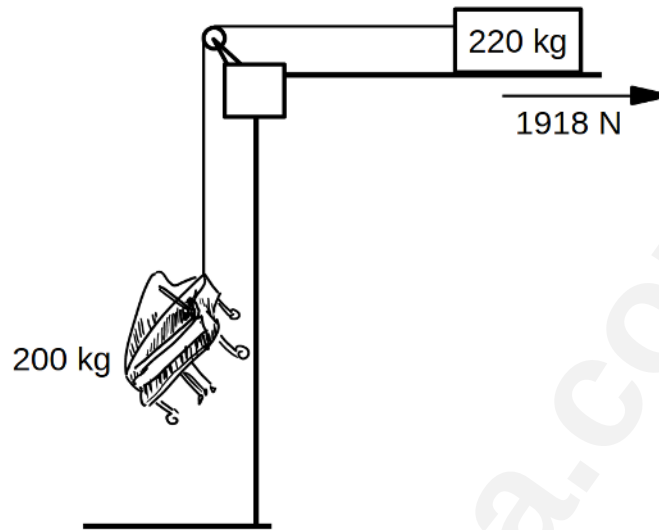
3.2.4 Calculate the magnitude of the acceleration of the crate as it stops. (3)

The person then applies a force to move the stationary crate. The coefficient of maximum static friction is 0,6.

3.2.5 Calculate the minimum force required to move the stationary crate. (4)

[16]

A piano with a mass of 200 kg is lowered slowly from a high stage by a rope. The rope runs over a frictionless pulley and is attached to a large block of mass 220 kg. As the piano descends, the mass slides along the rough stage floor experiencing a frictional force of 1918 N.



3.3.1 Determine the magnitude of the acceleration of the system.

(4)

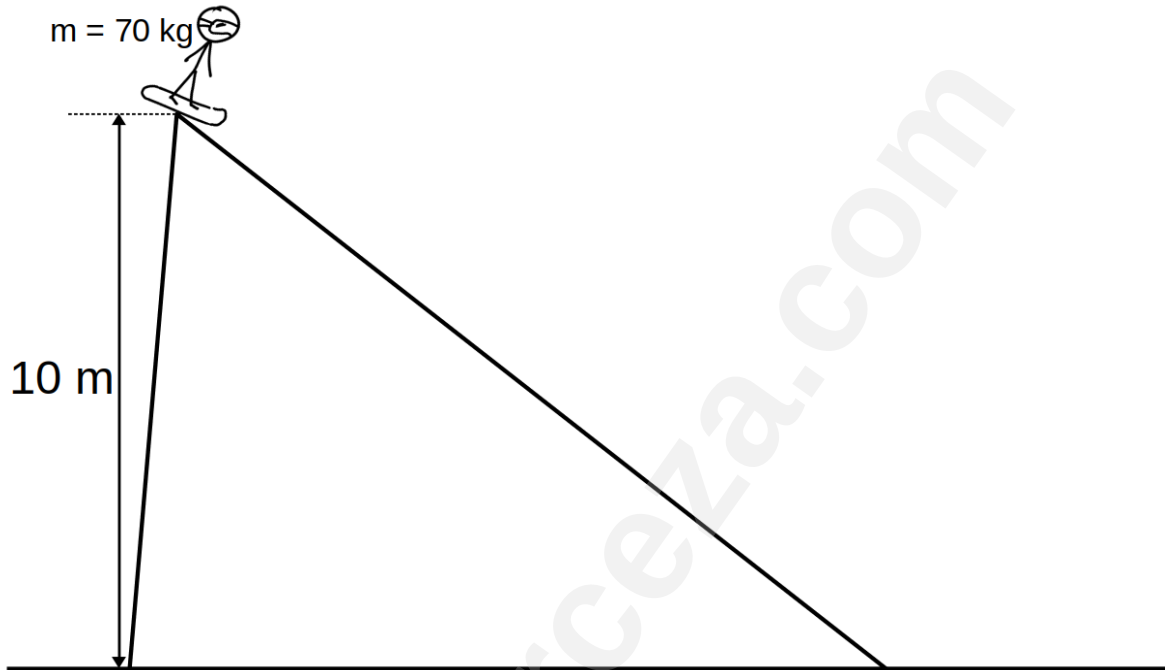
3.3.2 Hence, determine the tension in the rope.

(2)

[6]

QUESTION 4 MOMENTUM, WORK, ENERGY, AND POWER

A snowboarder with a mass of 70 kg is at rest at the top of a slope with a vertical height of 10 m. The snowboarder then slides down the slope. The friction between the snow and the snowboard is negligible.



- 4.1 How much gravitational potential energy does the snowboarder have when they are at the top of the slope? (3)
- 4.2 Calculate the speed of the snowboarder when they reach the bottom of the slope. (4)

At the bottom of the slope, the snowboarder maintains their speed as they slide to the right along the snow. They collide with a stationary spectator.

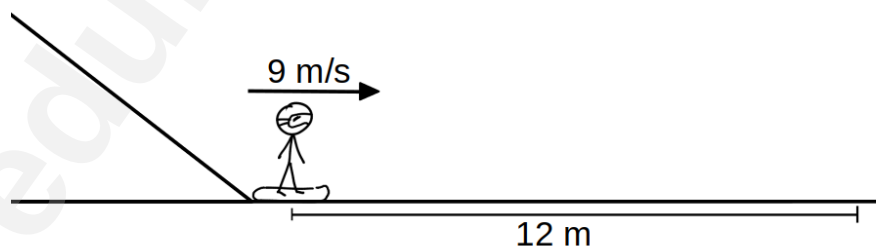


After the collision, the spectator moves to the right with a velocity of 14 m/s while the snowboarder moves to the left with a velocity of 3 m/s.

4.3 State the *law of conservation of momentum*. (2)

4.4 Determine the mass of the spectator. (4)

In summer, the snowboarder returns to the slope, which is now covered in grass. Once again, they start from a stationary position at the top of the slope and slide down on their snowboard. At the bottom of the slope, the snowboarder is moving at a speed of 9 m/s. They slide along for 12 m before coming to a stop.



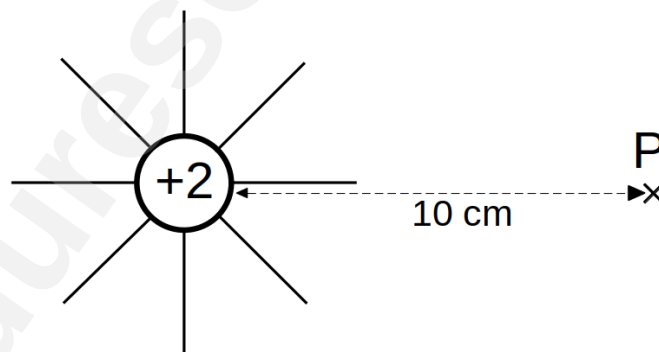
4.5 How much work is done by the friction between the snowboarder and the grass from the top of the slope to the bottom of the slope? (3)

- 4.6 If the snowboarder takes 30 seconds to slide down the slope, at what rate is energy dissipated as thermal energy? (3)
- 4.7 State the *work-energy theorem*. (2)
- 4.8 Determine the magnitude of the frictional force acting on the snowboarder from the bottom of the slope to the point where they come to a stop. (4)

25

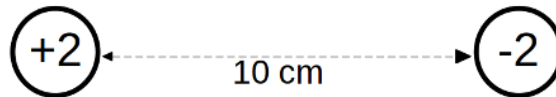
QUESTION 5 FIELDS

There is an electric field around a point charge of $+2 \text{ nC}$. The field lines are drawn in, but the arrows are not included. A point P is marked 10 cm from the point charge.



- 5.1.1 Add arrows to the field lines to show the direction of the electric field around the $+2 \text{ nC}$ charge. (1)
- 5.1.2 What is the magnitude of the electric field strength at point P? (4)

A second point charge of -2 nC is now placed at point P.



5.1.3 Calculate the the electrostatic force that the negative charge experiences at point P. (4)

5.1.4 What is the resultant electric field strength at the midpoint between the charges? (5)

[14]

A spaceship with a mass of 500 kg is orbiting Mars. The spaceship is a distance of $15\,000 \text{ km}$ from the center of Mars. The mass of Mars is $6,4 \times 10^{23} \text{ kg}$.

5.2.1 What is the gravitational force between Mars and the spaceship? (4)

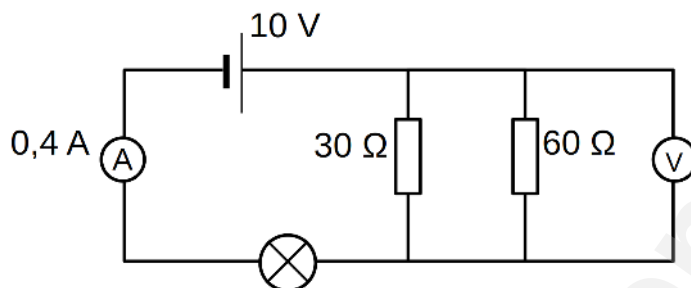
The astronaut in the spaceship makes their way to the surface of Mars. On the surface of the planet, the gravitational acceleration is $3,7 \text{ m/s}^2$.

5.2.3 Determine the radius of Mars. (4)

[8]

QUESTION 6**CIRCUITS**

A 10 V battery with negligible internal resistance is connected in a circuit as shown below.



The ammeter gives a reading of 0,4 A.

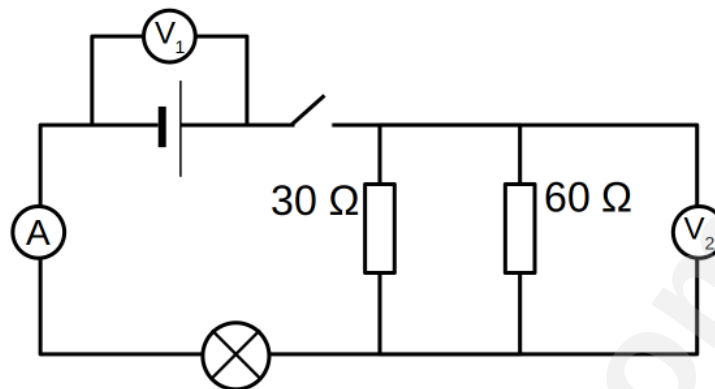
6.1. Define *current*. (2)

6.2 Calculate the total resistance of the parallel combination of resistors. (3)

6.3 Determine the reading on the voltmeter V. (3)

6.4 Calculate the resistance of the light bulb. (3)

The battery is now replaced by a battery with significant internal resistance and a switch is added. When the switch is open, voltmeter V_1 gives a reading of 10 V.



The switch is then closed and voltmeter V_2 gives a reading of 7,5 V.

6.5 Define *emf*. (2)

6.6 Determine the new reading on the ammeter. (3)

6.7 What is the total resistance of the entire circuit? (2)

6.8 Hence, determine the internal resistance. (3)

6.9 At what rate is energy dissipated through the light bulb? (3)

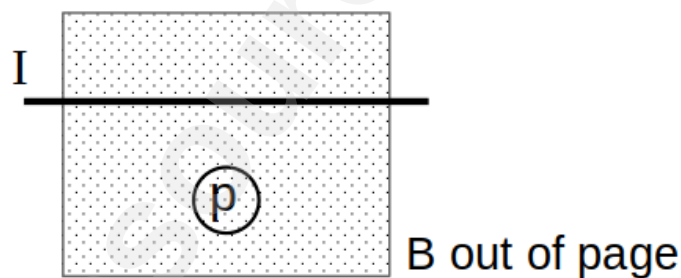
The cost of electricity is R2,56 per kilowatt-hour.

- 6.10 How much would it cost to run a light bulb with a power rating of 40 W for 2 hours?
(4)

28

QUESTION 7 ELECTRODYNAMICS

A current-carrying conductor is placed in a uniform magnetic field pointing out of the page as shown below.

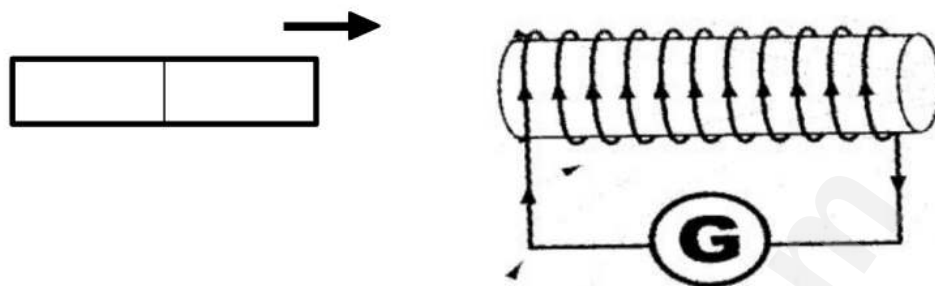


At point P, the **resultant** magnetic field is zero.

- 7.1.1 In which direction does the current in the wire flow? (Left to right, or right to left)
Justify your answer. (2)

- 7.1.2 In what direction does the electromagnetic force push the wire? (1)

A magnet is brought towards a solenoid. As the magnet approaches, a current is induced in the solenoid.



7.2.1 State *Lenz's Law*.

(2)

7.2.2 Is the NORTH POLE or SOUTH POLE of the magnet closest to the solenoid?

(2)

7.2.3 Identify two changes that could be made to increase the induced current in the solenoid.

(2)

[6]

An electrical engineer is testing a transformer. The number of turns on the primary coil of the transformer, N_p , is 100 and the primary voltage, V_p , is 240 V.

The engineer adjusts the number of turns N_s on the secondary coil of the transformer and records the resulting secondary voltage V_s .

The results of the experiment are recorded in the table below.

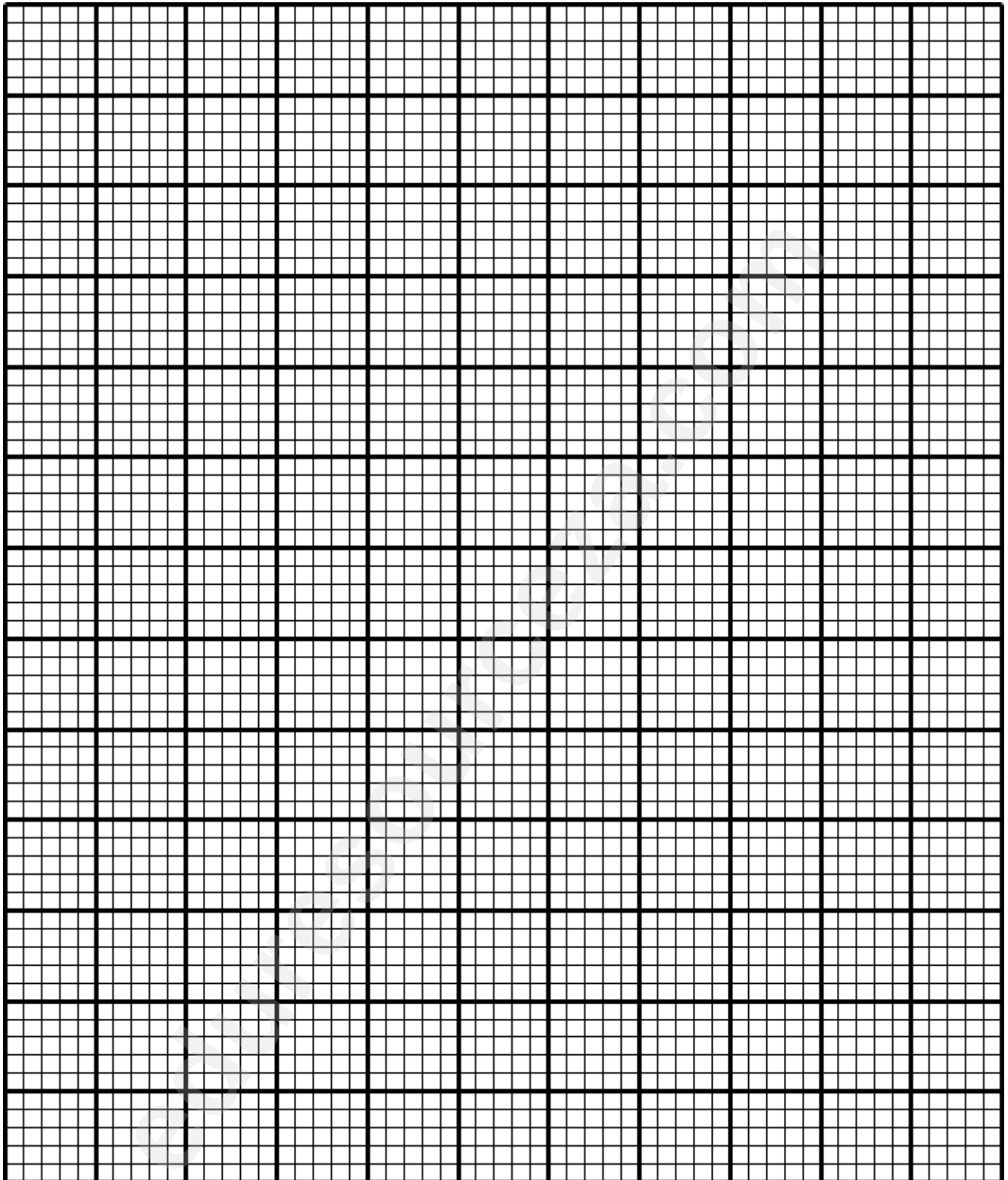
N_s (no unit)	V_s (V)
200	500
250	600
300	700
350	840
400	960
450	1080

7.3.1 How do transformers enable efficient electricity distribution? (2)

7.3.2 Plot the data given in the table above on the graph paper given on the opposite page. (8)

7.3.3 Determine the gradient of your best fit line. Show any points used on your graph. (4)

7.3.4 Rearrange the equation $\frac{N_p}{N_s} = \frac{V_p}{V_s}$ into the form $y = mx + c$ for your graph, and hence determine the primary voltage. (3)



[17]

26

END OF EXAM

ADDITIONAL SPACE (ALL questions)

REMEMBER TO CLEARLY INDICATE AT THE QUESTION THAT YOU USED THE ADDITIONAL SPACE TO ENSURE THAT ALL ANSWERS ARE MARKED

eduresourceza.com

ADDITIONAL SPACE (ALL questions)

REMEMBER TO CLEARLY INDICATE AT THE QUESTION THAT YOU USED THE ADDITIONAL SPACE TO ENSURE THAT ALL ANSWERS ARE MARKED

eduresourceza.com

Spare graph paper

