Name:	ANSWERS	Index Number:		Class:	

CATHOLIC HIGH SCHOOL
Term 3 Class Test
Year 4 (Integrated Programme)

PHYSICS

Moments, Energy, Work and Power, Current of Electricity, DC Circuits, Magnetism, Electromagnetism, Electromagnetic Induction

31 July 2023
40 minutes

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work that you hand in.
Write in dark blue or black pen.
Do not use paper clips, glue or correction fluid.
The use of an approved scientific calculator is expected, where appropriate.
At the end of the examination, fasten all your work securely together.

Section A: Multiple Choice
There are **ten** questions in this section. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice **in the table** provided at the end of this section.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.

Section B: Structured
You may use an HB pencil for any diagrams or graphs.

Answer **all** questions.

Candidates are reminded that **all** quantitative answers should include appropriate units.
Candidates are advised to show all their workings in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

The number of marks is given in brackets [ ] at the end of each question or part question.

For examiner's use only:

Section A	/ 10
Section B	/ 25
formula s.f.	□ □
Total	**/ 35**

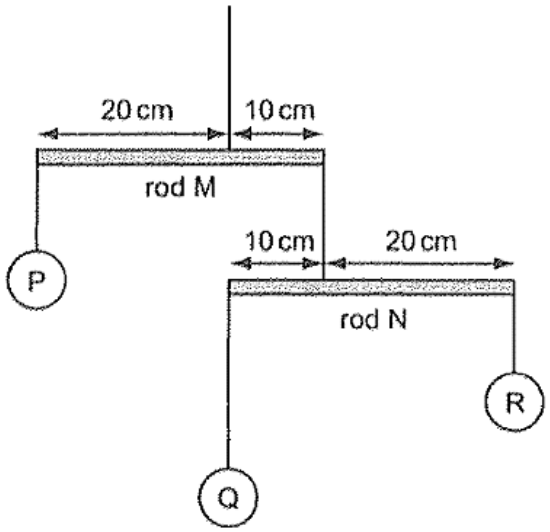
Section A

Answer **all** the questions in this section. Record your choice **in the table** below.

Answers for Section A

1		**2**		**3**		**4**		**5**	
6		**7**		**8**		**9**		**10**	

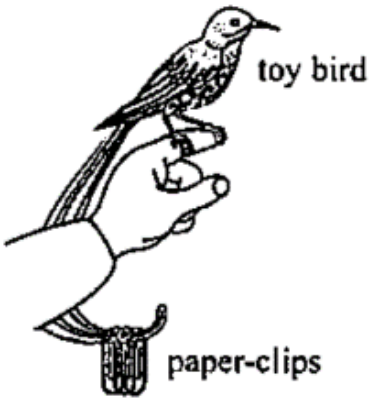
1 The diagram shows a decoration, which is made by suspending objects P, Q and R from light rods M and N. The masses of P, Q and R are such that the rods are horizontal.



Which row gives a possible combination of the masses of P, Q and R?

	mass of P / g	mass of Q / g	mass of R / g
A	10	10	10
B	15	10	10
C	15	20	10
D	20	40	20

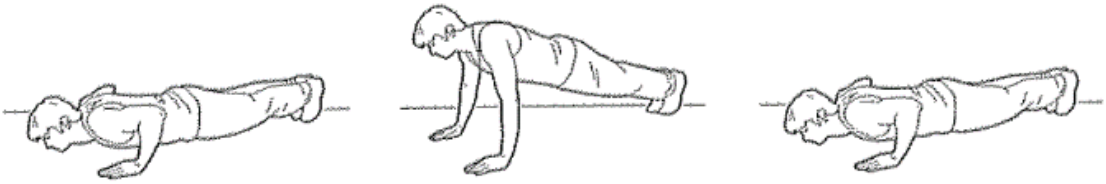
2 A girl uses paper clips to balance a toy bird on her finger as shown.



What is the effect of the paper clips?

A They do not affect the centre of gravity but increase the weight.
B They help to change the centre of gravity to be above her finger.
C They help to change the centre of gravity to be at her finger.
D They help to change the centre of gravity to be below her finger.

3 An athlete keeps fit by doing push-ups.



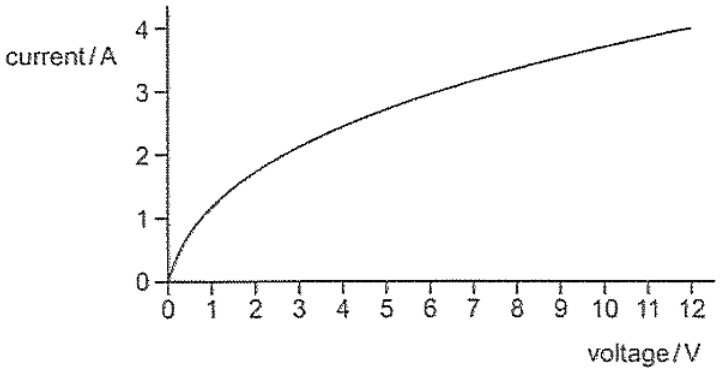
He applies a force of 300 N as he pushes up a distance of 0.5 m.

He does 10 push-ups in 30 seconds.

What is the total work done by him in 30 seconds?

A 50 J **B** 150 J **C** 1 500 J **D** 15 000 J

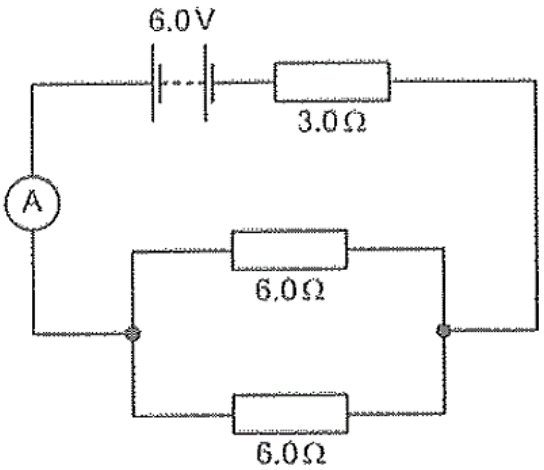
4 The graph shows the variation with voltage of the current in a 12 V lamp.



From the graph, which statement about the resistance of the lamp is correct as the voltage increases?

A The resistance of the lamp decreases throughout the voltage range.
B The resistance of the lamp increases throughout the voltage range.
C The resistance of the lamp increases at first and then decreases.
D The resistance of the lamp remains constant.

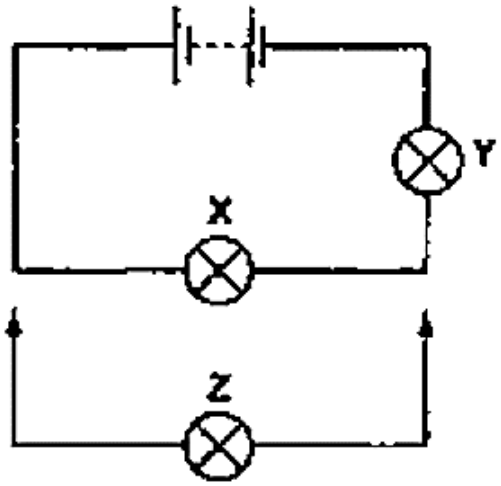
5 The following circuit is set up.



What is the reading on the ammeter?

A 0.33 A **B** 0.50 A **C** 0.67 A **D** 1.0 A

6 The diagram shows identical lamps X and Y connected in series with a battery. The lamp lights with normal brightness. A third lamp Z is connected in parallel with lamp X.



What happens to the brightness of the lamp Y?

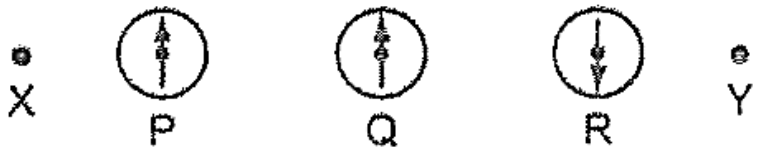
A Brighter than normal
B Normal
C Dimmer than normal
D Very dim (cannot be seen)

7 An electromagnet is produced by passing an electric current through a coil of copper wire wrapped around a core made from a suitable material.

Which material produces the strongest electromagnet?

A aluminium
B copper
C iron
D steel

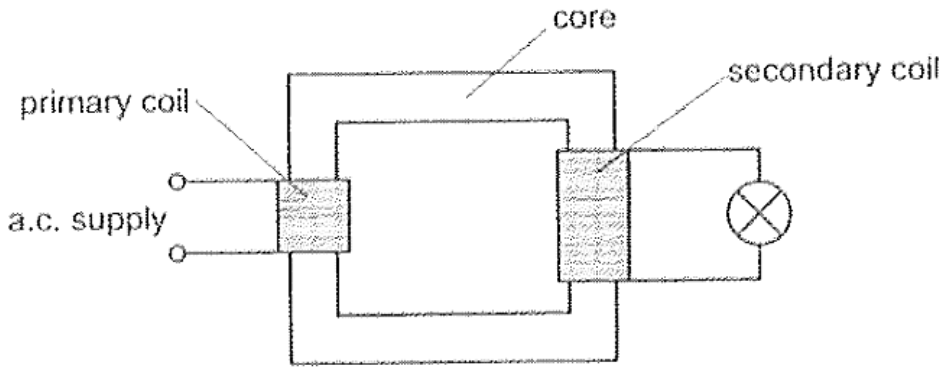
8 X and Y are wires carrying current either into or out of the page. P, Q and R are plotting compasses. Any effect of the Earth's magnetic field can be ignored.



Which row about the directions and sizes of the currents in X and in Y is correct?

	directions of currents	sizes of currents
A	same	larger in X than in Y
B	same	smaller in X than in Y
C	different	larger in X than in Y
D	different	smaller in X than in Y

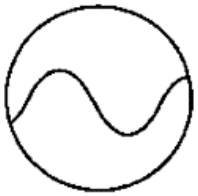
9 The diagram shows a simple transformer with more turns on the secondary coil than on the primary coil.



Which statement is correct?

A An alternating current in the primary coil gives rise to a voltage in the secondary coil.
B The current in the secondary coil is larger than the current in the primary coil.
C There is a current from the primary coil to the secondary coil through the core.
D Transformers are more efficient when using d.c. currents.

10 A cathode ray oscilloscope is connected to an a.c. generator. A wave is shown on the screen below.



What is the effect on the trace if the generator's speed of rotation is doubled?

	number of waves on the screen	amplitude of waves on the screen
A	doubled	same
B	doubled	doubled
C	same	doubled
D	same	same

Section B

Answer **all** the questions in this section.

11 Fig 11.1 is a circuit diagram. The circuit uses a light-dependent resistor (LDR) and a fixed resistor *R* of resistance 8.0 kΩ.

The LDR has a resistance of 500 Ω in bright light.

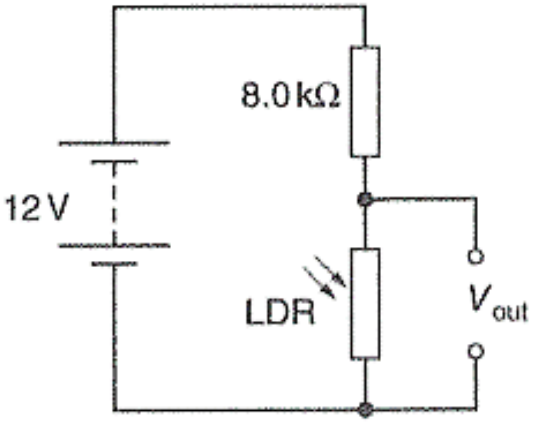


Fig. 11.1

(a) Calculate the output voltage V_{out} when the LDR is in bright light.

By Potential Divider Principle,
$V_{out} = R_{LDR} / (R_{LDR} + R) \times V_{EMF}$
$= 500 / (500 + 8\,000) \times 12$ [B1]
$= 0.706$ V (3 s.f.) [B1]

V_{out} = ... [2]

(b) An engineer wishes to replace the 8.0 kΩ resistor by a lead wire of the same resistance.

The resistivity of lead is 2.2×10^{-7} Ωm, and the diameter of the wire is 7.6×10^{-3} m.

Using appropriate calculations, state and explain whether this is feasible.

$R = \rho l / A$
$= \rho l / (\pi(d/2)^2)$
$l = \pi R d^2 / 4\rho$
$= (3.14)(8\,000)(7.6 \times 10^{-3})^2 / (4 \times 2.2 \times 10^{-7})$ [M1]
$= 1.65 \times 10^{6}$ m [M1]

As the length of lead wire required is too large, it is (costly and hence) not feasible. [A1] [3]

(c) The output voltage is connected to an electronic switch and lamp.

Explain one practical application of this circuit.

As the light intensity around the LDR decreases, its resistance increases, causing V_{out} to increase and the lamp to switch on. [B1] [1]

12 Fig. 12.1 shows two identical magnets placed close to each other.

Fig. 12.1

(a) On Fig. 12.1, draw the magnetic field around and between the two magnets. [3]

[B1] correct shape and direction of magnetic field lines
[B1] symmetrical field pattern above and below both magnets
[B1] no field lines along the vertical line equidistant from N poles of both magnets

(b) State and explain what happens when a small piece of soft iron is placed equidistant from the North poles of both magnets.

The soft iron remains stationary. [A1]
This is because it is located at a null/neutral point, so there is no (net) magnetic field (or zero magnetic field strength) at that point. [M1] [2]

13 Fig. 13.1 shows a d.c. motor.

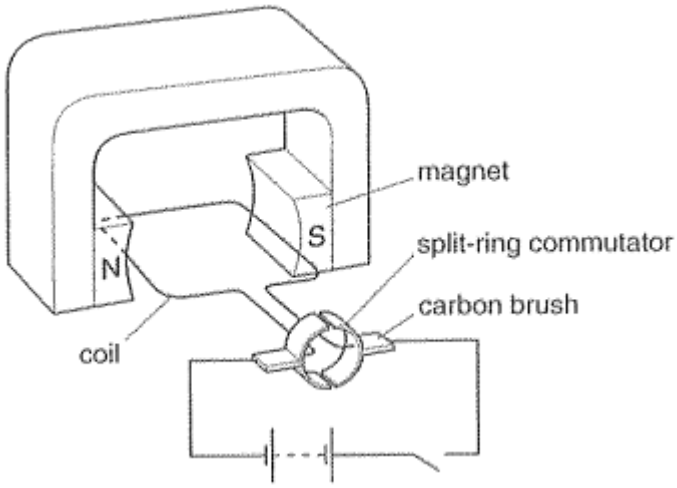


Fig. 13.1

The coil is horizontal, as shown in Fig. 13.1.

(a) **(i)** Explain why the coil turns when the switch is closed.

The magnetic fields of the magnet and current-carrying coil interact with one another. [B1]

This causes a pair of equal and opposite forces to act on opposite sides of the coil, producing a resultant moment (about its axis). [B1] [2]

(ii) Explain why the coil continues to turn in the same direction when it reaches the vertical position.

When the coil reaches the vertical position, there is no current through it as the split-ring commutators are not in contact with the carbon brushes.
OR
Due to inertia / Newton's First Law, the coil tends to move past its vertical position. [B1]
The split-ring commutator reverses the current direction in the coil and ensures the force acting on the side of the coil closest to a specific pole of the magnet continues to be in the same direction. [B1] [2]

(b) Fig. 13.2 shows how the moment acting on the coil depends on time.

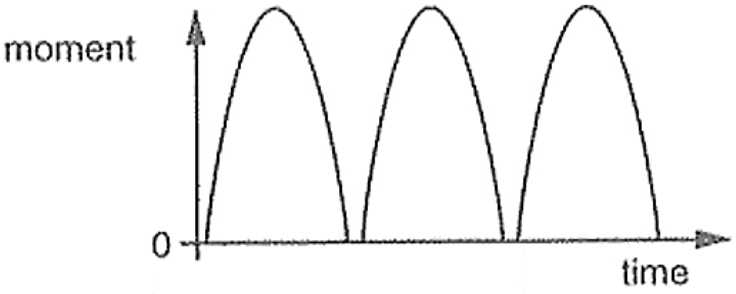


Fig. 13.2

(i) On Fig. 13.2, mark with a letter X one time when the coil is horizontal. [1]

Any of the three highest points on the graph. [B1]

(ii) The e.m.f. of the battery is increased.

Sketch, on Fig. 13.2, how the **new** moment acting on the coil depends on time. You should draw three cycles of the variation of moment with time. [2]

Larger maximum moment. [B1]
Smaller period. [B1]
[Deduct 1 mark if only 1 or 2 cycles are drawn]

14 A bar magnet is held above the centre of a wire loop in a horizontal plane, as shown below in Fig. 14.1. The wire loop is connected to a resistor R. The magnet is dropped with the south pole of the magnet above the loop.

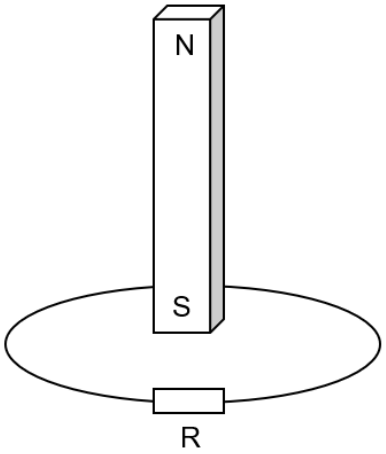


Fig. 14.1

(a) Explain why there is an induced current flowing through the resistor as the south pole of the magnet moves towards the wire loop.

The magnetic flux linkage between the magnet and the wire loop increases. [B1]

By Faraday's Law, there is an induced e.m.f. in the wire loop. [B1]

As the loop forms a closed circuit, an induced current flows through the resistor. [B1] [3]

(b) Indicate, on Fig. 14.1, the direction of the induced current flowing through the resistor.
Explain the direction of the induced current.
At least one arrowhead showing induced current flowing in a clockwise direction around the wire loop (viewed from the top) [B1].
By Lenz' Law, the induced current flows in a direction to create an induced South pole at the top of the wire loop to repel the incoming South pole of the magnet. [B1] [2]

(c) Describe the energy conversions that take place as the magnet moves towards the wire loop.

The initial gravitational potential energy of the magnet is converted to kinetic energy of the magnet [B1],

thermal energy of the surrounding air, and electrical energy of the resistor (and wire loop). [B1] [2]

END OF PAPER