O Level Pure Physics

Electromagnetism Test 2.0

Q1

Fig 10.1 shows an electric bell.

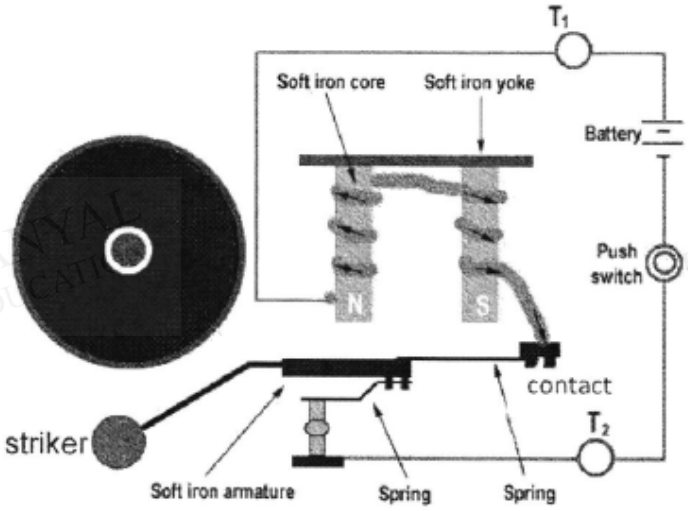

Fig 10.1

(a) Explain how the bell will ring when the push switch is closed.

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..... [2]

(b) Suggest with a reason what would happen if the armature was made of steel instead of soft iron.

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..... [1]

Q2

Fig 13.1 shows a DC motor that is designed to rotate anti-clockwise. A rheostat is used in the circuit to adjust the motor speed.

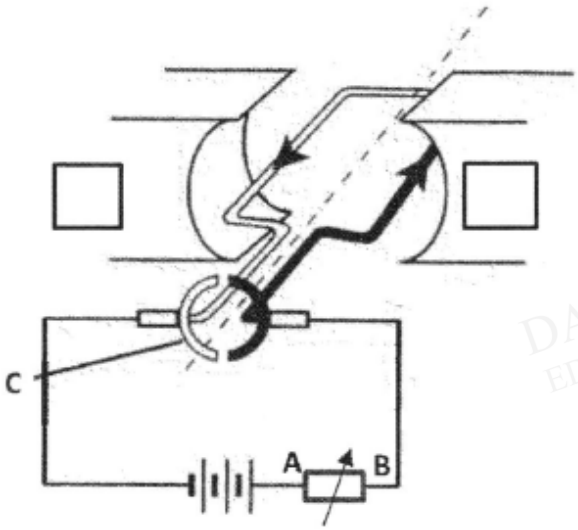

Fig 13.1

(a) Label the two poles of the permanent magnet in Fig 13.1. [1]

(b) Name component C and state its function.

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..... [2]

(c) Explain how the current causes the coil to rotate.

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..... [3]

(d) Fig 13.2 shows the rheostat that is connected to the DC motor.

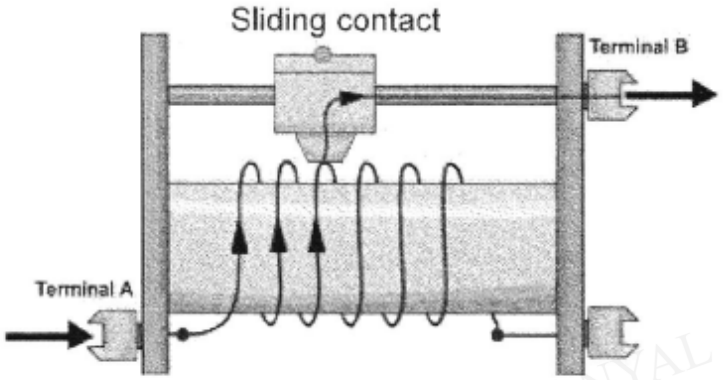

Fig. 13.2

The sliding contact is shifted towards the right.

State and explain the effect of shifting the contact on resistance of the circuit and hence the speed of the DC motor.

[4]

Q3

Fig. 11.1 shows the top view of a simple physics demonstration, which comprises of a plotting compass being placed above a copper wire.

When there is no current flowing through the wire, the plotting compass points towards the North.

A large direct current then flows through the wire from point **J** to point **K**.

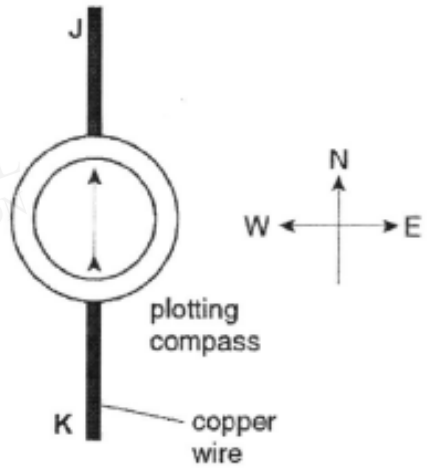

Fig. 11.1

(a) (i) State what happens to the compass needle.

..... [1]

(ii) State what happens to the compass needle if the compass were placed under the wire.

..... [1]

(iii) State and explain what is observed if there were a 50 Hz alternating current flowing through the wire.

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..... [2]

(b) Fig. 11.2 shows a coil in a magnetic field. The coil is able to rotate about the axis. The ends **X** and **Y** of the coil are connected directly to a d.c. power supply. The arrows on the sides of the coil show the direction of the current in the coil.

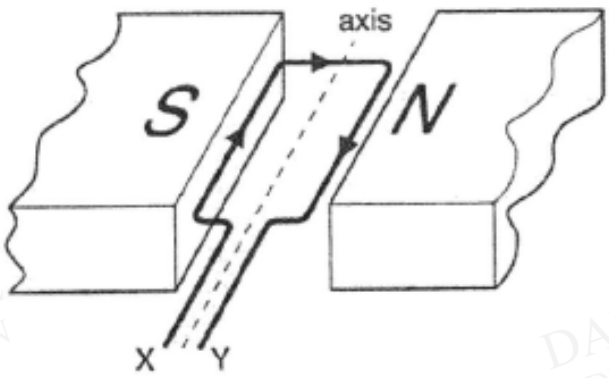

Fig. 11.2

(i) On Fig. 11.2, draw arrows to show the directions of the forces acting on the sides of the coil. [1]

(ii) Explain why the forces act on the sides of the coil.

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..... [3]

(iii) An observer (not shown in Fig. 11.2) looks at the coil while standing at point **X**. Describe the motion of the coil as viewed by the observer.

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..... [2]

Q4

10 **Fig. 10.1** shows a diagram of a simple d.c. motor.

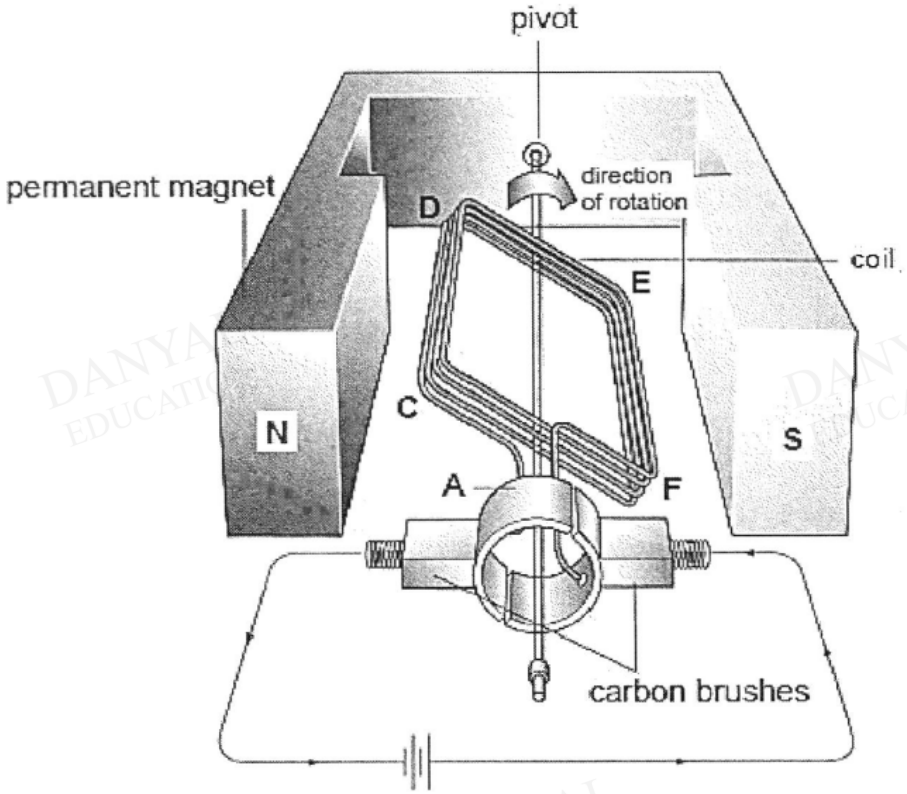

Fig 10.1

a) The gap between two-halves of component **A** is so wide that only one carbon brush will only touch one half of component **A** at any point in time.

The advantage is that this will protect the circuit. However, a drawback is that sometimes, the motor will not start rotating when switched on.

(i) Explain how current that flows into the coil **CDEF**, causes it to rotate clockwise as shown in **Fig. 10.1**. [2]

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(ii) **Fig 10.2** shows the side view the carbon brushes touching both halves of component **A** at the same time. Why is this not allowed? [2]

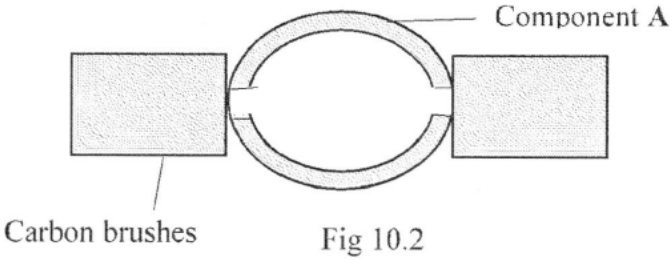

Fig 10.2

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(iii) Suggest and explain a possible situation when the motor does not start rotating when switched on, even if there is no friction. [2]

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b) **Fig. 10.3** shows how the moment acting on the coil varies with time when the coil rotates at constant speed.

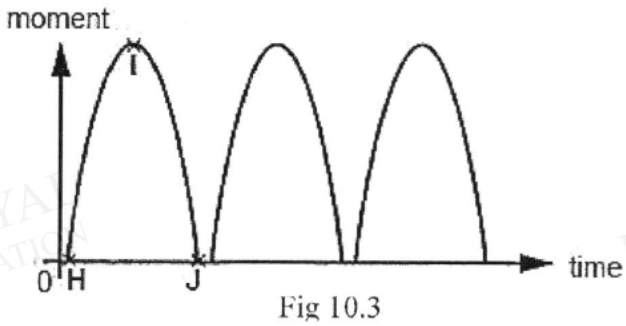

Fig 10.3

(i) Which point(s) **H**, **I** or **J**, on **Fig. 10.3**, indicate(s) that the coil is in vertical position? [1]

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(ii) The frequency of the rotation is increased. Suggest a change that this causes to the graph in **Fig. 10.3**. [1]

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c) Instead of using permanent magnets in **Fig 10.1**, electromagnets can also be used. [2]

Complete the wiring from the battery **Z** to the iron bars so that the polarity on the left remains North and the polarity on the right remains South in **Fig 10.4**.

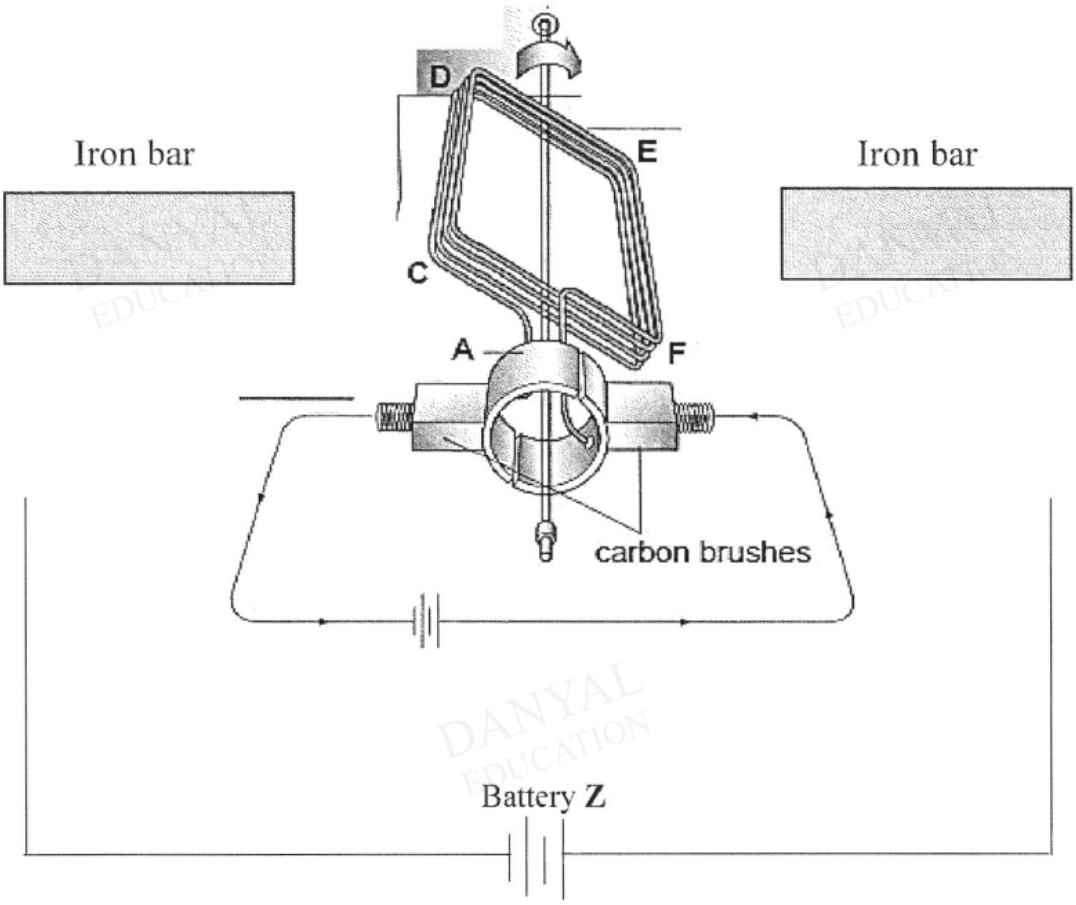
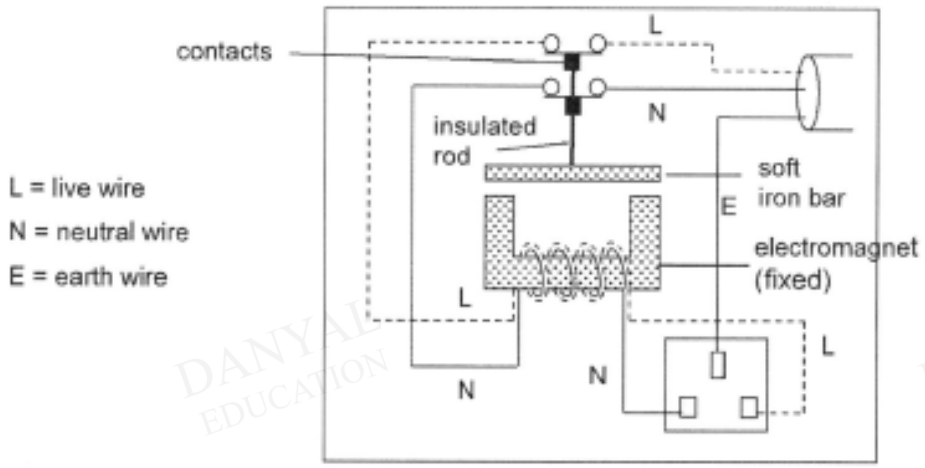


Fig 10.4

Q5

The figure below shows a circuit breaker with the contacts closed.



(a) State a hazard which happens in the household circuit which causes this device to be triggered.

_____ [1]

(b) Explain how this device helps to switch off the mains supply whenever the hazard stated in **(a)** occurs.

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_____

_____ [3]

(c) State two modifications which can be made if this circuit breaker is to be used to break a circuit at a lower current.

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_____

_____ [2]

Answers

Electromagnetism Test 2.0

Q1

)a	Current flow magnetizes two soft iron core The two cores induces opposite poles at the armature and attracts it Causing striker to hit bell (this will break the contact and stop the magnetization of the core and the arm will spring back to close the contact and repeat the cycle)	1 1
)b	Steel is not easily magnetized hence the core may not be magnetized fast enough and arm may have a delay time in striking bell OR Steel is not easly demagnetized and after current is cut off, the striker will remain at bell.	1

Q2

3a	S N	1
3b	Split ring commutator – changes direction of current every half a revolution so coil can rotate continuously.	1 1
3c	Current in coil produces a magnetic field This field interacts with the permanent magnetic field to produce a force at each branch These two forces at two branches produces a moment to rotate coil	1 1 1
3d	The slider moves right and increases the R length Since R = ρ L/A, R increases and current deceases the magnetic field due to the current and force decreases hence speed of rotation decreases	1 1 1 1

Q3

(a)(i)	Needle points to west / left	[1]
(a)(ii)	Needle points to east / right	
a)(iii)	• Needle will remain stationary / point to north / neither deflect left nor right / neither deflect east nor west / vibrates slightly about vertical axis. • (50 Hz a.c. causes) magnetic field around wire to reverse its direction 50 times per second / rapidly. Inertia of needle prevents it from deflecting / causes it to vibrate slightly about its vertical axis.	[1] [1]

1(b) (i)	Coil nearer to S-pole experiences vertically upward force AND Coil nearer to N-pole experiences vertically downward force.	[1]
1(b) (ii)	• Both the permanent magnet and the current carrying coil produce separate magnetic fields and they interact with each other. • Where the fields act in the same direction, they reinforce each other and create a stronger resultant field. Where the fields act in opposite directions, they create a weaker resultant field. • Difference in magnetic field strength results a net force to act from stronger field to weaker field.	[1] [1] [1]
1(b) iii)	• Coil rotates clockwise • For quarter of a rotation before it oscillates back and forth with decreasing amplitude, and then comes to rest in a vertical position.	[1] [1]

Q4

10a)	(i) Current in coil CDEF produces a magnetic field, interacts with the magnetic field of the permanent magnet. By Fleming's left hand rule, an upward force will be exerted on CD, while a downward force will be exerted on EF	A1 A1
	(ii) To prevent short-circuit. Otherwise, coil will not turn OR Components of DC motor may get "burnt" and damage the motor.	A1 A1
	(iii) When the coil is in vertical position, no contact between a carbon brush and the split ring commutator. Hence, no current flows into the coil.	A1 A1
b)	(i) H and J	A1
	(ii) Choose one: ☐ Amplitude increases. ☐ Period decreases / Frequency increases	A1
c)	Correct wiring on both bars	A2

Q5

(a) Short circuit **[1]**

(b) The large current causes the solenoid to become a stronger electromagnet **[1]**
that can attract the soft iron bar downwards. **[1]**
This causes the circuit to become open and current no longer flows through it. **[1]**

(c) Increase the number of turns of coil in the electromagnet **[1]**

Decrease the distance between the electromagnet and the soft iron bar. **[1]**