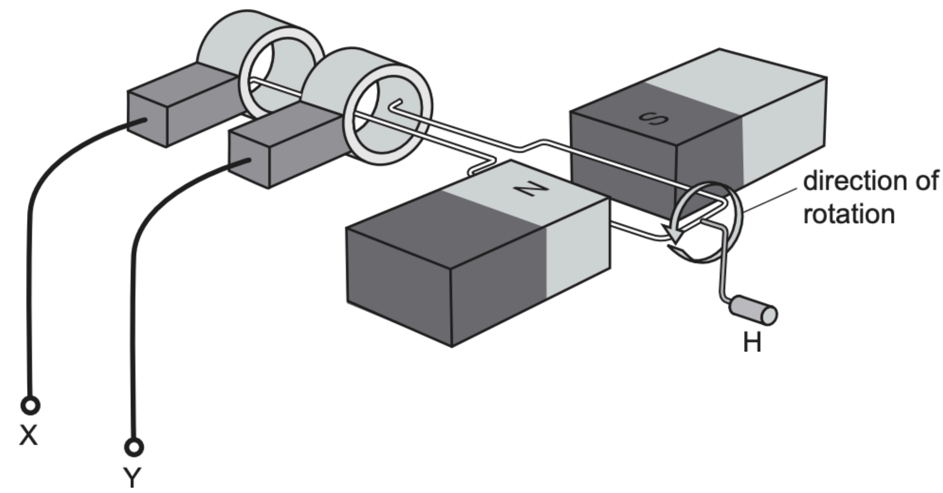
1. **When explaining direction of field/force/motion/current**
   - Magnetic field, motion and current are mutually perpendicular/ mutually at right angles
   - State direction in which each of them acts (left, right, up, down, into, out of. etc)

2. **Electromotive force**
   Energy supplied by a source in driving unit charge around a complete circuit.

3.

Fig. 7.1 represents an alternating current (a.c.) generator.



A student rotates the handle H, as shown in Fig. 7.1.

(i) On Fig. 7.2, sketch a graph to show how the electromotive force (e.m.f.) between terminals X and Y varies with time during **two** complete revolutions of the coil.

- y-axis labelled e.m.f. and
- x-axis labelled time
- two complete cycles of a sinusoidal wave
- constant amplitude and constant period for first two periods of a sinusoidal wave

The student turns the handle more quickly. State two ways in which the e.m.f. between terminals X and Y changes.

- (amplitude / maximum e.m.f.) increases
- (e.m.f.) changes direction more often or greater frequency

Terminals X and Y are connected to the primary coil of a transformer. State and explain what happens in the transformer as the student turns the handle of the a.c. generator.

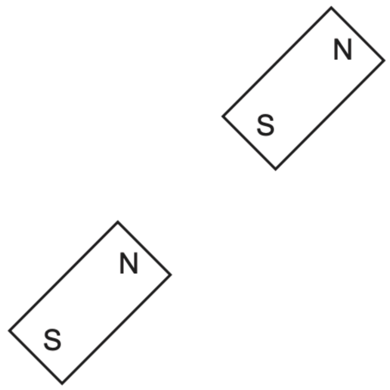
- alternating current in primary coil
- alternating / changing magnetic field // magnetic field cuts secondary coil (continuously)
- (alternating) e.m.f. induced in the secondary coil

4. **After a few hours, the reading on a voltmeter connected across a thermistor increases. Explain what can be deduced from this observation**
   - larger proportion of the e.m.f. / p.d. (across thermistor) // smaller voltage across the other resistor
   - temperature (of thermistor) is smaller / has decreased
   - resistance of thermistor / circuit is large(r)

5.

Fig. 7.2 is a repeat of Fig. 7.1 showing the two magnets.

On Fig. 7.2, draw the position of a plotting compass needle when it comes to rest in the gap between the N pole and the S pole.



needle perpendicular to end faces AND
{arrow pointing to S OR correctly labelled N OR S}

Explain why the needle comes to rest in this position.

- Compass needle points in direction of magnetic field
- North pole of needle attracted to south pole of magnet// opposite poles attract

6. Describe a method of demagnetising a bar magnet.

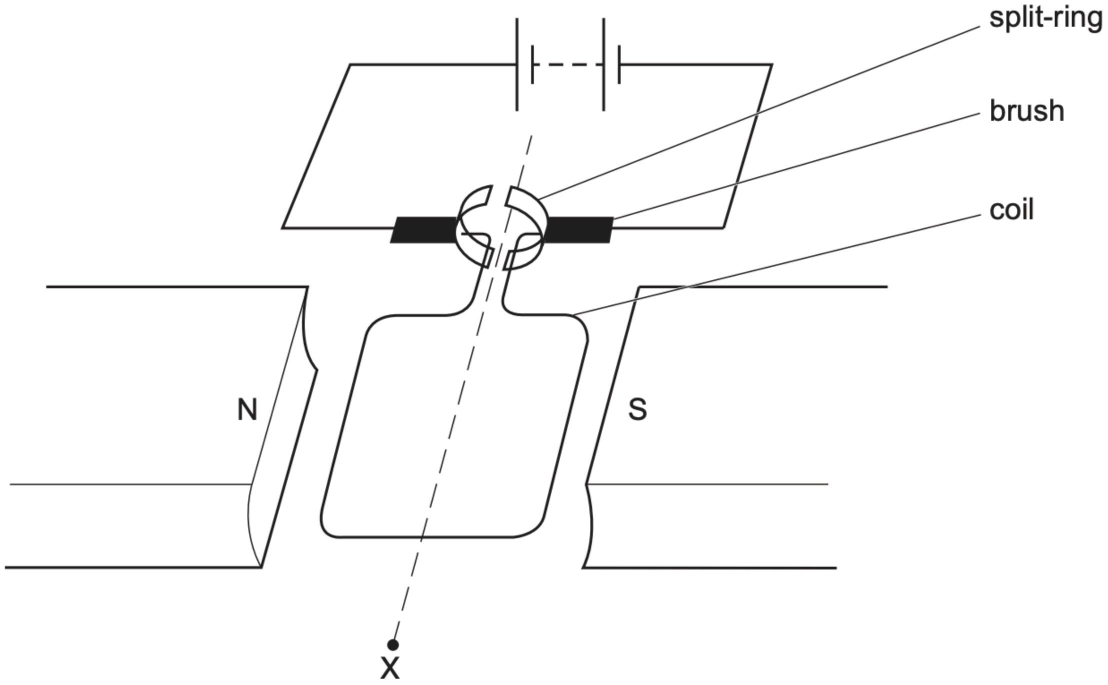
- heat OR hammer
- with magnet lying (magnetically)

OR

- place in coil / solenoid with a.c.
- withdraw magnet OR reduce current to 0

7.

Fig. 8.3 shows a simple direct current (d.c.) electric motor with a split-ring commutator.



The coil is rotated through 180° from the position shown. By considering the forces on the coil, explain how split-ring commutator enables motor to turn continuously.

- current in coil reverses OR changes direction
- force(s) (on wires in new positions) still up on L OR down on R

8.

Fig. 10.2 shows a circuit containing component K.

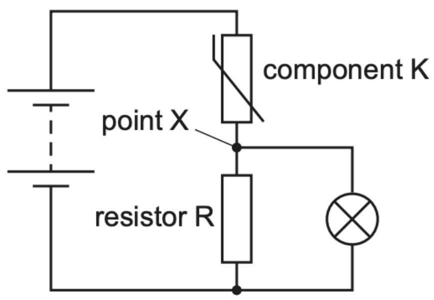


Fig. 10.2

At low temperature, component K has a much greater resistance than resistor R.

At high temperature, component K has a much smaller resistance than resistor R.

State and explain the effect on the lamp when the temperature changes from very low to very high.

Refer to the voltage at point X in your explanation.

Statement: the lamp glows brighter

Explanation:

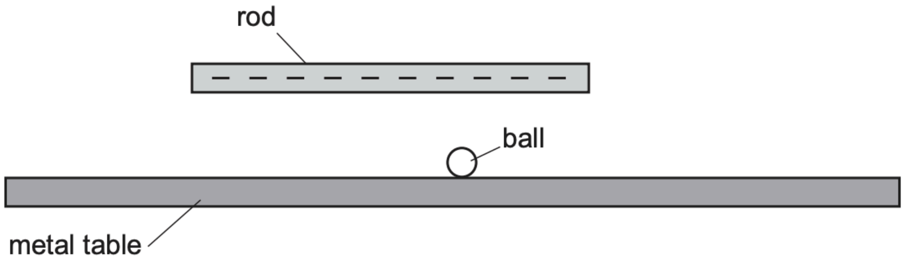
- resistance of thermistor / component / K reduced
- voltage / p.d. of point X / across R increases
- larger current in lamp

9. How transformer works

- alternating voltage in primary
- alternating / varying / changing magnetic field (in iron core)
- voltage is induced in the secondary coil

10.

A light, conducting ball is at rest on a metal table. When the rod is brought close to the ball, as shown in Fig. 7.1, the ball jumps up towards the rod.



Explain why the ball jumps up towards the rod

- ball charged by induction
- ball positively charged
- opposite charges attract

The ball touches the rod and falls back down to the table.

- negatively charged (by rod)
- repelled by rod

OR

- ball discharges / becomes neutral
- pulled down by gravity / its weight

11.

A circuit contains two fixed resistors and a light-dependent resistor (LDR). Fig. 8.1 shows that the power supply is a 9.0 V battery.

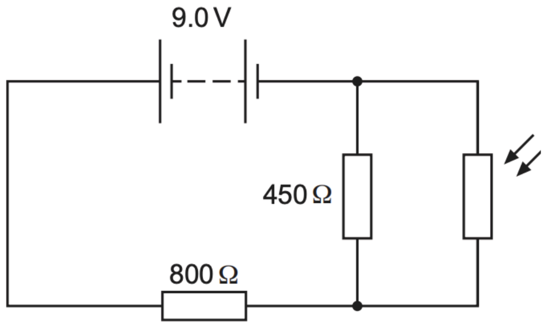


Fig. 8.1

The current in the 450 Ω resistor is 0.012 A.

The brightness of the light that is incident on the LDR increases.
Explain what happens to the potential difference (p.d.) across the 450Ω resistor

- resistance (of LDR) decreases
- resistance of parallel pair decreases
- resistance of parallel pair a smaller fraction of total resistance and p.d. across 450 Ω resistor decreases

OR

- resistance (of LDR) decreases
- current (in circuit) increases
- p.d. across 800Ω resistor increases and p.d. across 450Ω resistor decreases

12. Benefit of earthing a metal case.

- prevents electrocution OR metal case cannot become live OR metal case always at earth potential / voltage
- (if) live wire touches metal case

- there is a current to earth / in the earth wire (which blows the fuse)

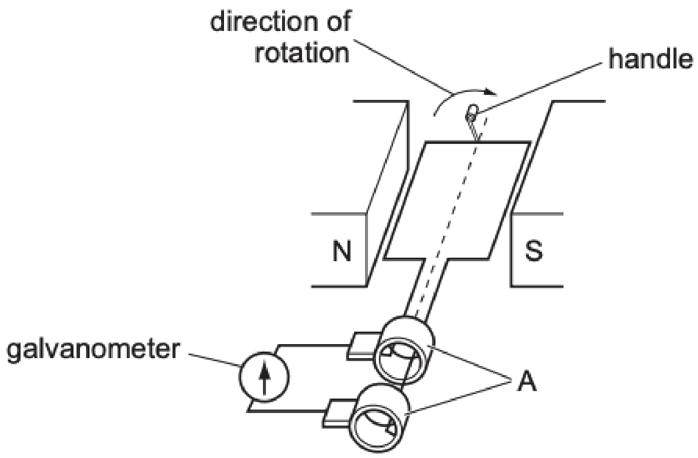
13. how a fuse protects a circuit.
- If current too high
- Fuse melts

NOTE: efficiency = (useful power output / power input) * 100%

14. Describe a practical use for a thermistor.
fire alarms, to keep computers cool (by operating fan), in incubators, electronic thermometer, electronic thermostat in kettle / car engine

15. Suggest one reason why d.c. motor cannot operate without a split-ring commutator.
coil does not continue to rotate in the same direction

16.



Label part A
slip rings

How rotating coil continuously causes galvanometer needle to show alternating current.
- as coil rotates it cuts magnetic field between the magnets
- this induces an e.m.f. / voltage / p.d. in the coil
- this produces a current in the coil, which is transferred to the galvanometer via the slip rings and carbon brushes
- direction of current flow changes with each 180 degree rotation of coil

17. Reason when asked to label direction of force/current/field
- Field direction, motion of wire and induced current are mutually perpendicular

- State the direction of the parameters given: eg. magnetic field from N to S AND current is from positive to negative

NOTE

Digital: A signal that has one of two possible states

18. Potential difference

- work done in passing charge through / across a component
- work done per unit charge

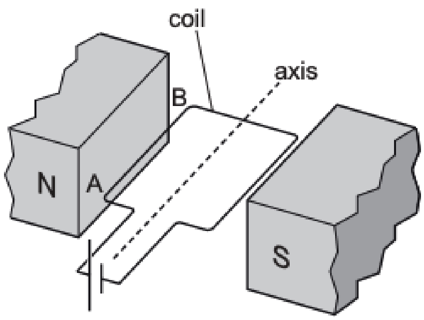
19. Equation which defines electromotive force (e.m.f.) *E*

E = W/Q

20. Symbol for d.c power supply: 

21. Circuit consists of a d.c. power supply, a lamp and a thermistor connected in series. Explain what happens in the circuit when the temperature of the thermistor is increased.

- resistance (of thermistor) decreases when temperature increases
- resistance of circuit decreases OR greater current in lamp so brightness of lamp increases OR greater p.d. across lamp so brightness of lamp increases



22. Explain what happens to the coil as it reaches the vertical position.

- at vertical the coil stops OR the coil overshoots and comes back OR the coil vibrates about the vertical

any one from:

- as the coil approaches vertical the turning effect decreases
- at vertical the turning effect is zero
- past vertical the turning effect reverses / changes direction

To operate as a motor, a split-ring commutator and brushes are added to the parts shown. Explain effects of split-ring commutator and brushes on the action of the motor.

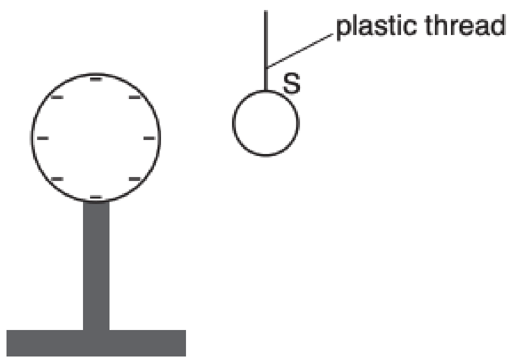
- reverses the current

any 2 from:

- brushes ensure current is maintained
- coil rotates continuously / continues to move in the same direction
- allows current to change direction without wires getting tangled
- reverses the current every half turn / 180 degrees / OR reverses the current when the coil is vertical / at right angles to the magnetic field

23.

A smaller, uncharged metal sphere S is suspended by a plastic thread and brought close to the negatively charged sphere. Fig. 5.2 shows the two spheres.



By drawing on Fig. 5.2, indicate the distribution of charge on S

- positive charges on left and negative charges on right of S
- equal numbers

State what happens to S

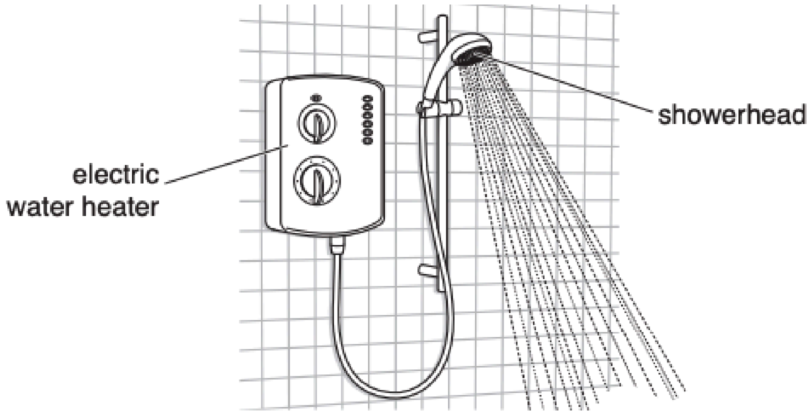
- Gets attracted to/ moves towards negatively charged sphere

An earth wire is then touched against S. Describe what happens in the wire and state how this affects the charge on S.

- electrons / negative charges move along the wire towards Earth / towards ground
- S becomes positively charged

24.

Fig. 6.1 shows a shower that takes in cold water. The water passes through an electric water heater and emerges from the showerhead at a higher temperature.



Current in heater when switched on = 39A

25.

(a) Fig. 7.1 shows a coil of wire wound on a thin plastic cylinder. The plastic has no effect on any magnetic field. The galvanometer is extremely sensitive.

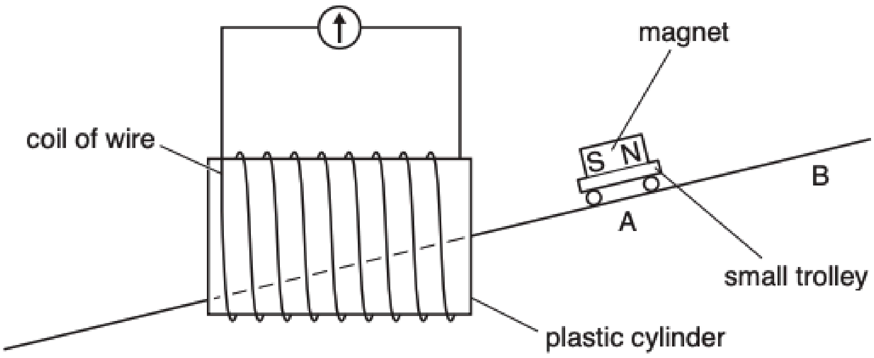


Fig. 7.1

A magnet is fixed to a small trolley that runs without friction on a track through the cylinder and coil.

(i) The trolley is released from point A so it runs through the coil from right to left.

State and explain what is observed on the galvanometer.

- deflection
- (then) reverse deflection / current / voltage OR deflection for shorter time OR change of (magnetic) field / flux

(b) Fig. 7.2 shows an extension lead used to supply power to a 3 kW electric heater on a cool evening.

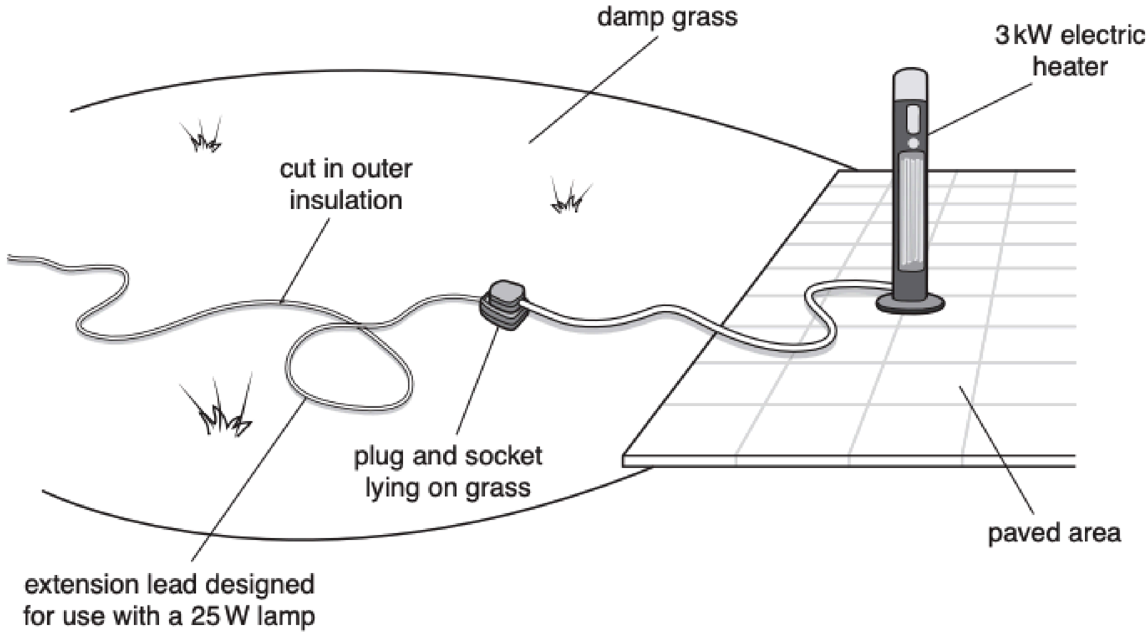


Fig. 7.2

State and explain three dangers with this arrangement.

- The power is too high: overheating / fire /trip hazard
- Cut in insulation: short circuit / shock / electrocution
- Plug & socket on damp grass: short circuit / shock / electrocution

NOTE

Electric field: the region where an electric charge experiences a force.

26.

Fig. 9.1 shows two parallel conducting plates connected to a battery.

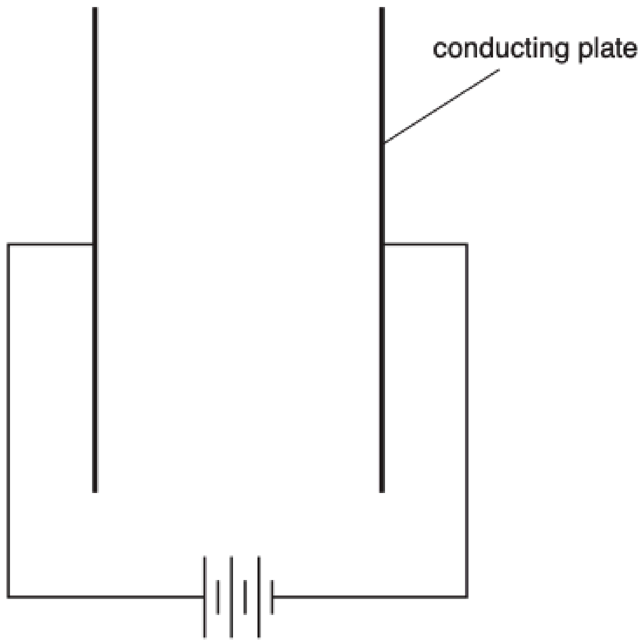


Fig. 9.1

On Fig. 9.1, draw **five** lines to show the electric field pattern between the two plates. [2]

- All criteria must be met:
  - 5 lines with both ends within 2 mm of plates by eye
  - middle 3 lines straight and within 10° of horizontal by eye
  - top / bottom lines, straight or with outward smooth curves, ends vertically <= 16 mm below / above ends of plates, if curved
  - horizontally symmetrical by eye
  - spacing between lines: 7 mm ⩽ spacing ⩽ 23 mm
- At least 1 arrow left to right NOT any arrow R to L

27.

Fig. 9.1 shows a circuit containing an LED and two resistors in parallel, each of resistance R.

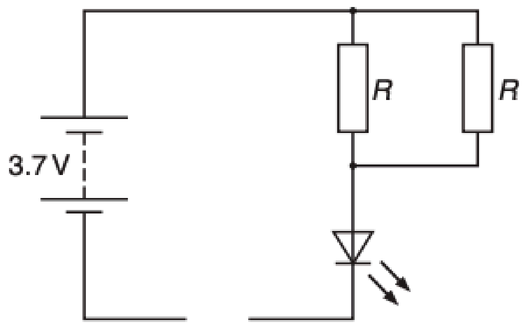


Fig. 9.1

The normal operating voltage of the LED is 2.1 V and the normal current is 0.19 A.

Calculate the value of R when the LED is operating normally

p.d. across two resistors in parallel = (3.7 – 2.1 =) 1.6 V	resistance of circuit = (3.7 / 0.19) = 19.5 Ω AND resistance of LED (= 2.1 / 0.19) = 11.1 Ω	**B1**
combined resistances of two resistors in parallel = R / 2 OR $1/R = 1/R_1 + 1/R_2$ OR $R = R_1 R_2 / R_1 + R_2$ OR current in either R = I / 2	resistance across parallel combination of resistors = (19.5 – 11.1) = 8.4 Ω	**B1**
$R = V / I$ in any form	$R = V / I$ in any form	**C1**
$R / 2 = 1.6 / 0.19$	$R / 2 = 8.4\ \Omega$	**C1**
17 Ω	17 Ω	**A1**

28.

A magnet and a coil are attached separately to a door and a door frame as shown in Fig. 10.1.

The purpose of the arrangement is to activate a circuit connected to an LED indicator when the door is opening or closing. This will provide a visual indication that the door is being used.

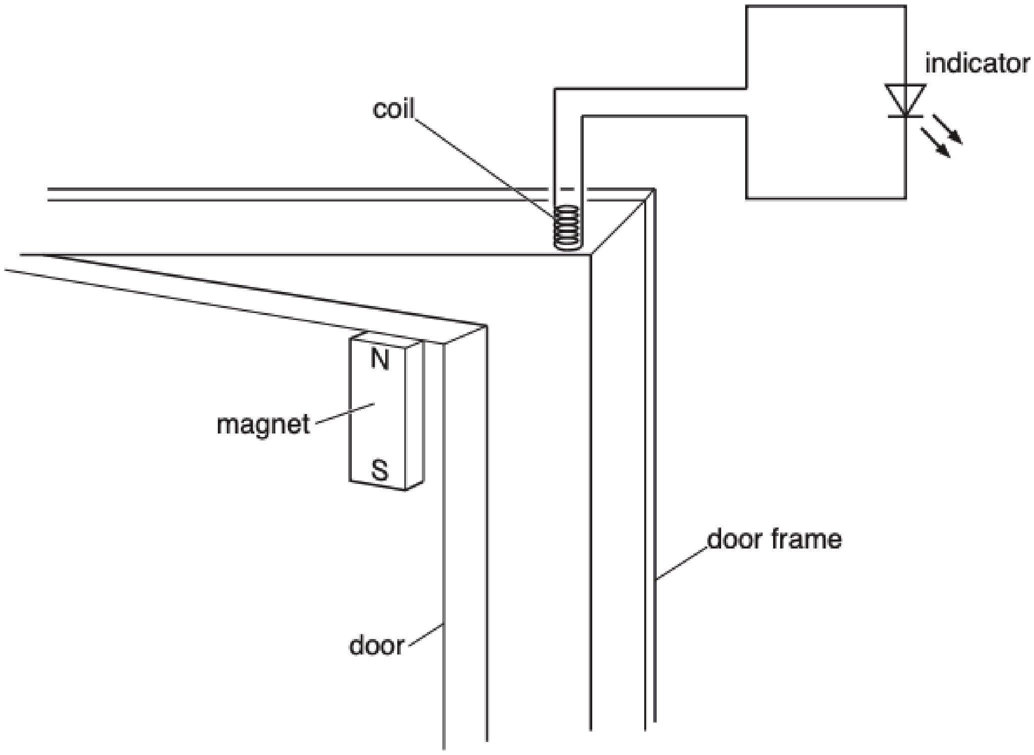


Fig. 10.1

Initially, the door is closed and then it is opened.

Explain why the indicator comes on and then goes off when the door is opened.

- movement of magnet relative to coil induces emf / pd / current (across / in LED)
- light goes off when magnet no longer directly below coil

The door shuts. The indicator comes on more brightly but for a shorter time than it did in (i). Suggest and explain why this happens.

- door closes more quickly than it was opened so higher current in LED
- door / magnet moving for shorter length of time

29. A circuit breaker is recommended for use with an electric lawnmower. Why?

- protects against electric shock
- protects against overheating
- avoids damage to lawn mower
- quick response
- Re-settable

NOTE: Increase in temperature = decrease in resistance of thermistor

30.

A student turns the handle of an alternating current (a.c.) generator and the coil rotates.

Fig. 8.1 represents the structure of the a.c. generator.

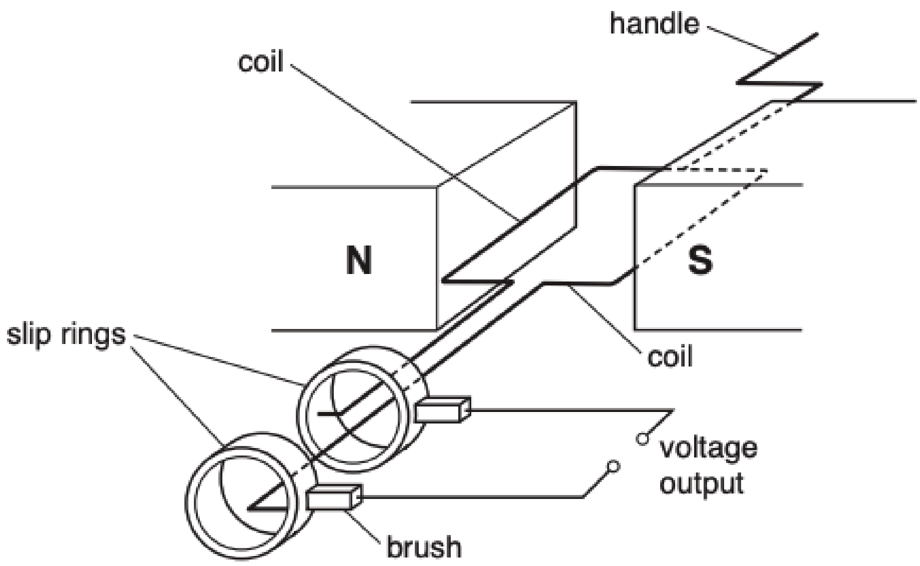


Fig. 8.1

(a) There is an alternating voltage output between the two terminals.

Explain why rotating the coil produces an output voltage.

- magnetic field mentioned
- coil / wire cuts (magnetic) field OR changing (magnetic) field (through coil)
- e.m.f. / voltage induced OR produced by electromagnetic induction

31. State the position of the rotating coil when the alternating output voltage is at a maximum value and explain why the maximum output occurs at this position.

- (plane of coil) horizontal OR in position shown in diagram
- coil cutting magnetic field the fastest

32. A lamp and an open switch are connected in series to the output terminals of the a.c. generator. The switch is closed and the lamp lights up. The student has to apply greater force on handle. Explain why a greater force is needed to keep the lamp lit.

current in coil	OR	energy supplied to / lost from lamp
current in (magnetic) field experiences a force		student must do more work / supply more energy / more energy needed
opposes the change causing it		greater force to do more work

33. A conducting sphere is mounted on an insulating stand. Explain how you would use a positively charged rod of insulating material to charge the sphere by induction.

- bring charged rod close to sphere / touching sphere
- earth sphere
- remove earth connection AND keep rod close to sphere until earth removed

34. Describe how to demagnetise a bar magnet using alternating current (a.c.) in a coil.

- place magnet in coil

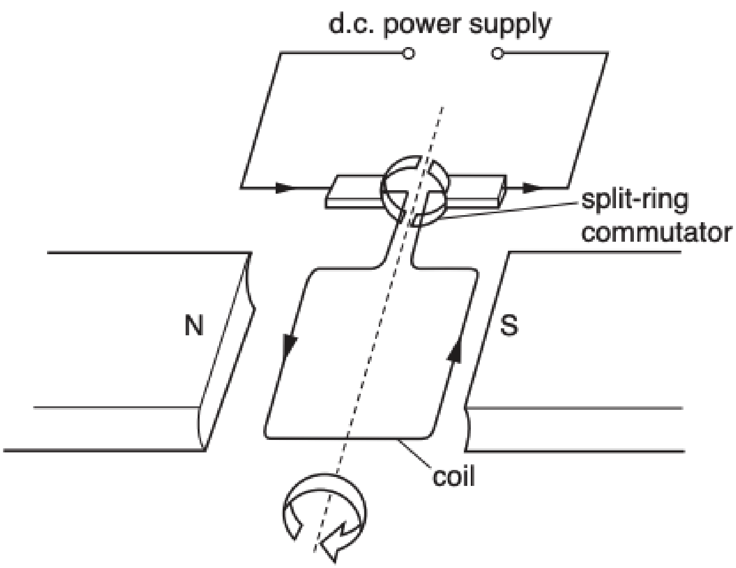
EITHER

- Gradually withdraw magnet
- With AC (in coil) switched on

OR

- reduce current
- to zero

35.



Explain purpose of the split-ring commutator

- keeps coil rotating in the same direction
- by changing direction of current in the coil
- every half cycle/180 degrees

The potential difference (p.d.) of a supply is increased so that the current in a lamp increases. State and explain any change in the resistance of the lamp.

- Resistance of the lamp increases
- Reason: temperature of the lamp increases

36. Reasons for choosing an appropriate fuse rating

- if too low it would break / blow / melt when the appliances are operating normally
- if fuse too high wouldn't break / blow until current was too high which would be dangerous (to people /wires /appliance)

37. Explain why fuses of a higher rating are made of thicker wire.

- Resistance inversely proportional to area so resistance of thicker wire is lower
- Fuse will melt at higher current
- Because less heating effect (for same current)

38.

Fig. 10.1 shows a simple alternating current generator.

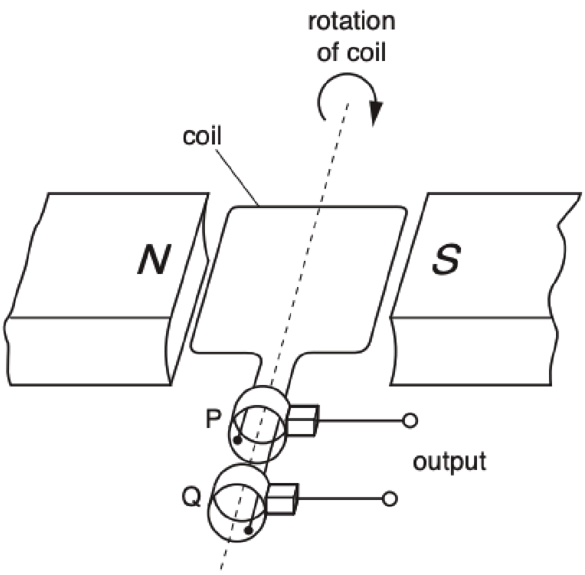


Fig. 10.1

(a) On Fig. 10.2, sketch a graph to show how the electromotive force (e.m.f.) induced varies with time for one revolution of the coil. Assume that the coil starts in the horizontal position, as shown in Fig. 10.1.
Label the points on the time axis where the coil has completed 1/4 revolution and 3/4 revolution. [3]

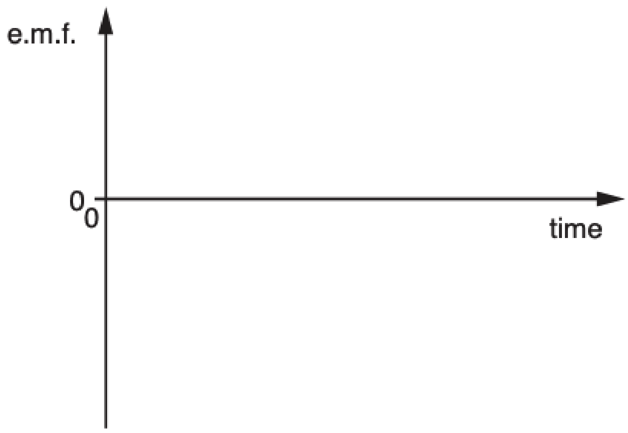


Fig. 10.2

- Correct shape of graph showing one rotation
- Graph starts from maximum voltage (positive or negative) (labelled horizontal)
- Graph passes through zero twice, labelled 1 / 4 and 3 / 4 revolution

39. State the name of the components labelled P and Q and state their purpose

Name: split rings

Purpose: (provide) continuous connection while coil rotating

40. State possible changes that cause a larger e.m.f. to be induced.

- increase strength of magnetic field
- increase speed of rotation of the coil
- increase numbers of turns of coil

41.

The electric starter motor in a car is switched on and off using a relay.

The relay consists of a plastic case and two flexible springy strips, X and Y, which are made of soft iron. These iron strips act as the switch when a circuit is connected between the terminals W and Z.

Fig. 7.1 shows X, Y and the plastic case.

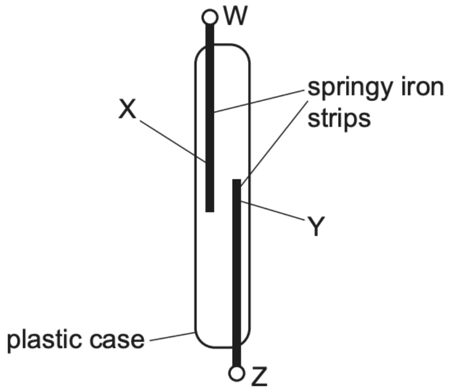


Fig. 7.1

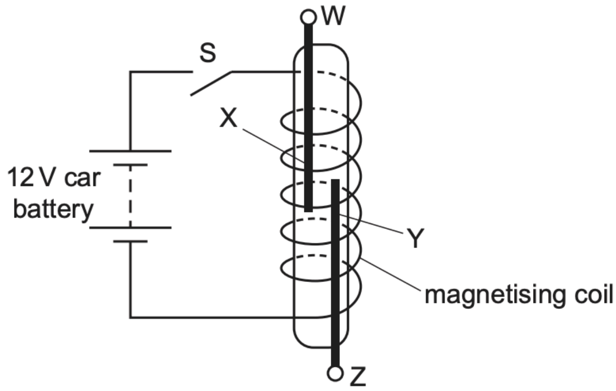


Fig. 7.2

Fig. 7.2 shows the equipment from Fig. 7.1 inside a magnetising coil. The magnetising coil is in series with the 12 V car battery and switch S, which is open.

Switch S is now closed. Explain what happens to the springy iron strips X and Y.

- X and Y become magnetised / they have poles
- Strips in the centre have opposite (magnetic) poles / X and Y attract
- X and Y touch / close switch / activate relay / complete circuit

Fig. 7.3 shows the relay and the symbols for the car battery and the starter motor.

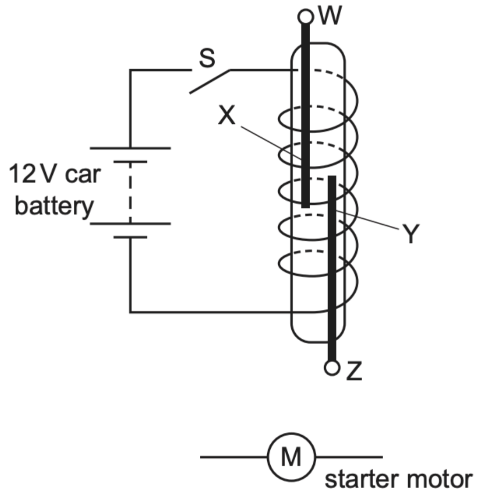
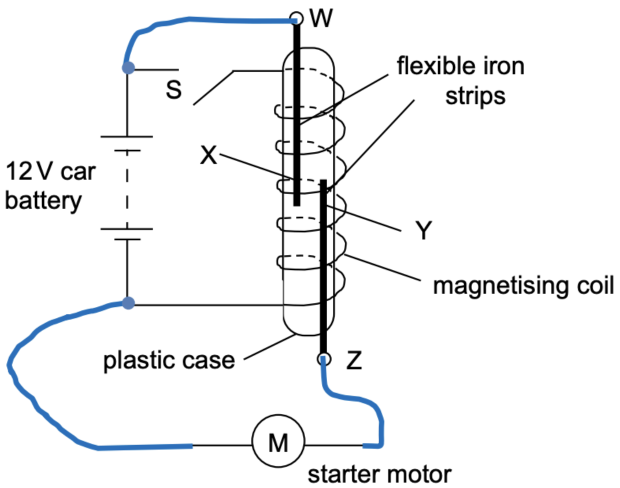


Fig. 7.3

The springy iron strips X and Y act as the switch for the starter motor circuit.

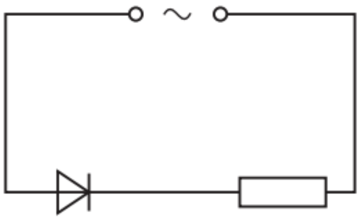
Complete the circuit diagram for the motor circuit.

flexible strips in series with motor
power supply in series with motor
expected answer: 

NOTE: when asked to describe and explain the direction of force exerted by/ on a magnet, state that: force is in direction of magnetic field

42.

Fig. 9.1 shows a circuit with an alternating current (a.c.) supply, a resistor and a diode.



The peak potential difference (p.d.) across the resistor is 340 V.

Fig. 9.2

On Fig. 9.2:

(i) sketch a graph to show how the p.d. across the resistor varies with time for two cycles [2]

- correct shape shown (sine curve)
- with rectification for two cycles

NOTE: in this graph, rectification is required because a diode allows current to flow in only 1 direction. No current can flow in the alternating (negative) direction.

43.

Fig. 11.1 shows a solenoid connected to a battery.

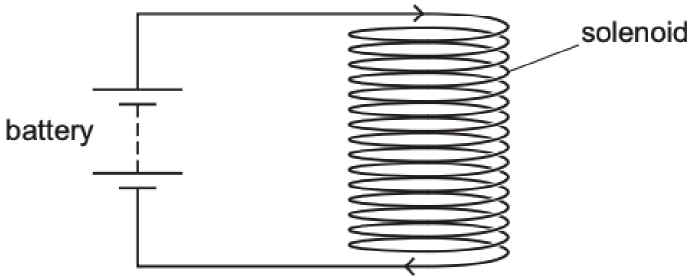
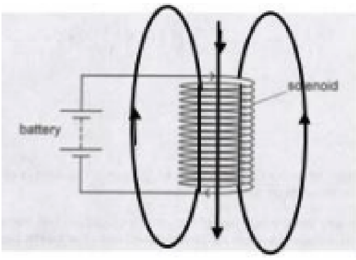


Fig. 11.1

On Fig. 11.1, draw the pattern of the magnetic field inside and around the solenoid. Indicate the direction of the magnetic field with an arrow. [3]

at least one line on the left and one line on the right, outside coil **AND** curved back over the top and under the base of the coil, towards the central core of the coil
at least two (straight vertical) lines inside coil
direction of arrow correct on at least one line and none wrong



44. Practical use of LDR

Turning on street lights // turning on security lights at night

45.

Fig. 9.1 shows a magnet on the end of a spring and a coil of wire connected to a sensitive centre-zero galvanometer. The magnet can move freely through the coil.

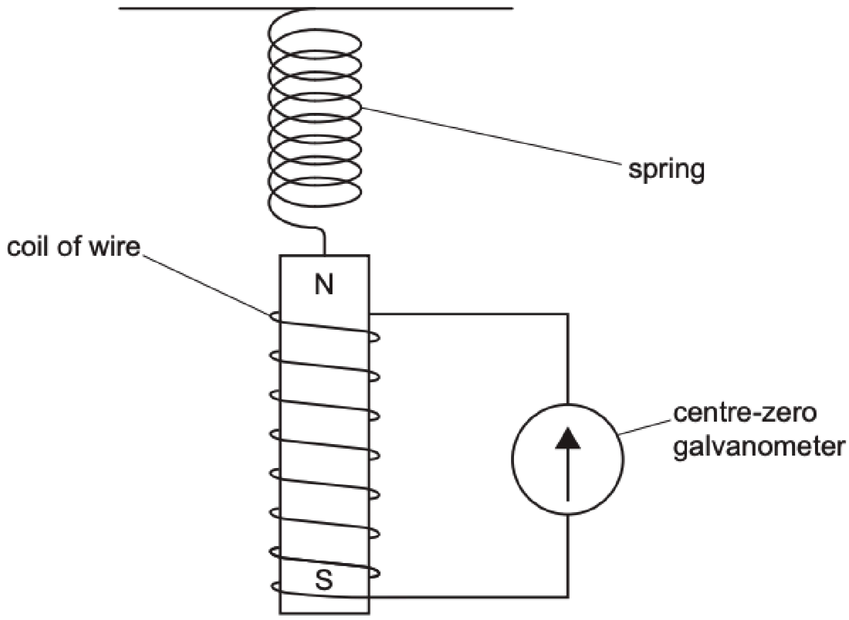


Fig. 9.1

The magnet is pulled down and released. Describe and explain what happens to the needle of the sensitive galvanometer.

- needle oscillates (as magnet moves up and down)
- coil cuts magnetic field / magnetic field changes (as magnet moves)
- changing (magnetic) field induces voltage/current
- induced voltage/current opposes the motion/change causing it
- force, magnetic field and induced current are mutually perpendicular

46. A magnet falls much more slowly in a copper tube than in a plastic tube. Explain why.

- (upwards / opposing) force on magnet
- force / magnetic field / e.m.f. / current opposes the change (producing it) / opposes motion or force on magnet due to magnetic field caused by current in tube

47.

Fig. 10.1 is a simplified top view of a flat coil. There is an alternating current (a.c.) in the coil.

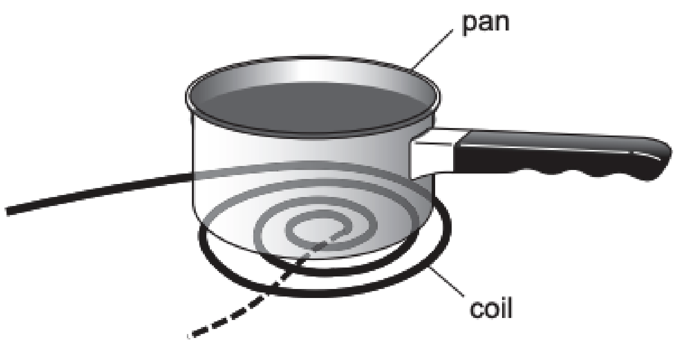
Fig. 10.1

Describe the magnetic effect of this alternating current.

- Produces a magnetic field
- magnetic field / magnetic flux / magnetic effect / magnetism) (it) alternates / changes direction / reverses

48.

Fig. 10.2 shows a pan placed above the coil. The base of the pan is made of steel.



State what quantity is induced in the base of the pan

- e.m.f. / p.d. / voltage

The pan contains water. State and explain the effect of the quantity induced in part (b) on the temperature of the water in the pan.

- Current in the base of the pan
- Thermal energy produced in the base of the pan
- This increases the temperature of the water in the pan

49. Describe what is meant by a potential divider

- (potential divider) splits / shares / divides the e.m.f. / voltage / potential difference / p.d. (of a power source / in a circuit)

- (e.m.f. is) split between (two) resistors / components (connected in series to power source)
- (potential divider shares e.m.f.) in proportion to the resistances (of the resistors / components)

50. When a plastic rod is rubbed with a woollen cloth, it becomes negatively charged. Explain why, in terms of particles

- Electrons move from cloth to rod
- Rod gains electrons

NOTE: when drawing the pattern of electric field around a charged object:

- Field lines should be evenly distributed
- Should touch the object
- Indicate direction using arrow

NOTE: for resistance dependence on length, cross-sectional area questions always state that resistance is directly proportional to length AND resistance is inversely proportional to cross sectional area, even if it is just a calculation.