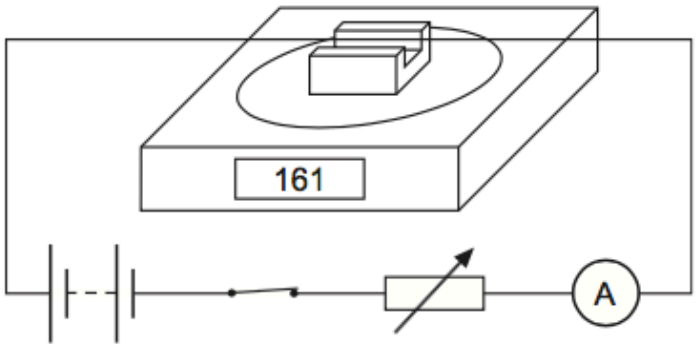
1)

The diagram shows a rigidly-clamped straight horizontal current-carrying wire held mid-way between the poles of a magnet on a top-pan balance. The wire is perpendicular to the magnetic field direction.



The balance, which was zeroed before the switch was closed, read 161 g after the switch was closed. When the current is reversed and doubled, what would be the new reading on the balance?

A –322 g

B –161 g

C zero

D 322 g

2)

Which one of the following statements is correct?

An electron follows a circular path when it is moving at right angles to

A a uniform magnetic field.

B a uniform electric field.

C uniform electric and magnetic fields which are perpendicular.

D uniform electric and magnetic fields which are in opposite directions.

3)

A lamp rated at 12 V 60 W is connected to the secondary coil of a step-down transformer and is at full brightness. The primary coil is connected to a supply of 230 V. The transformer is 75% efficient.
What is the current in the primary coil?

A 0.25 A

B 0.35 A

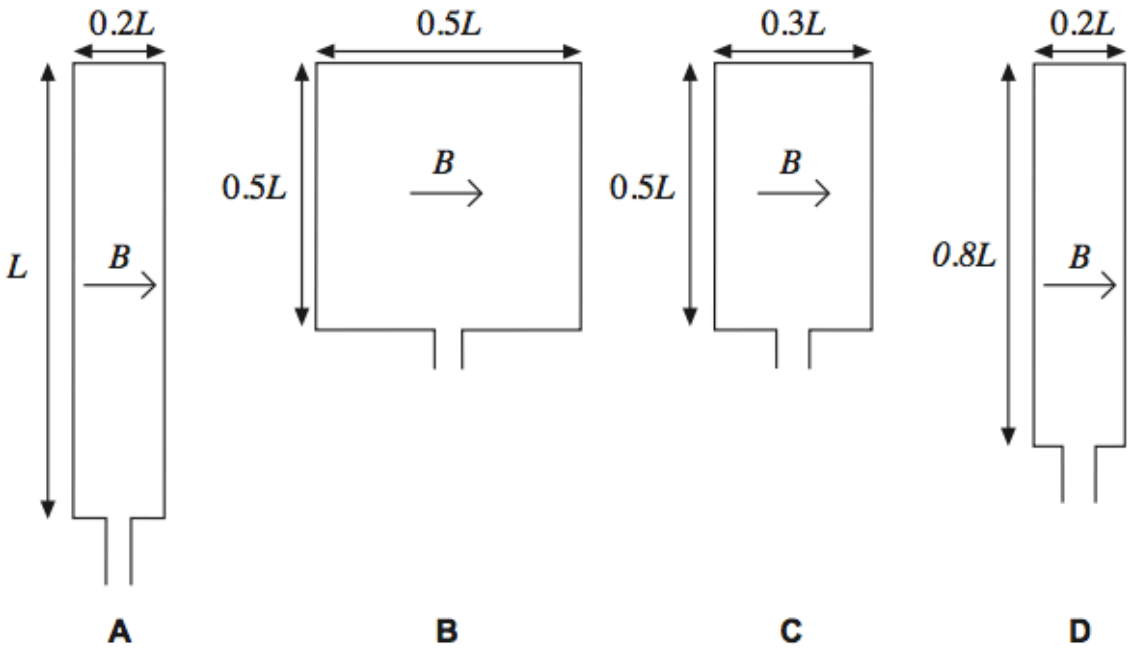
C 3.75 A

D 5.0 A

4)

Four rectangular loops of wire **A**, **B**, **C** and **D** are each placed in a uniform magnetic field of the same flux density B. The direction of the magnetic field is parallel to the plane of the loops as shown.

When a current of 1 A is passed through each of the loops, magnetic forces act on them. The lengths of the sides of the loops are as shown.
Which loop experiences the largest couple?



5)

Two electrons, X and Y, travel at right angles to a uniform magnetic field.
X experiences a magnetic force, F_X, and Y experiences a magnetic force, F_Y.

What is the ratio $\frac{F_X}{F_Y}$ if the kinetic energy of X is half that of Y?

A $\frac{1}{4}$

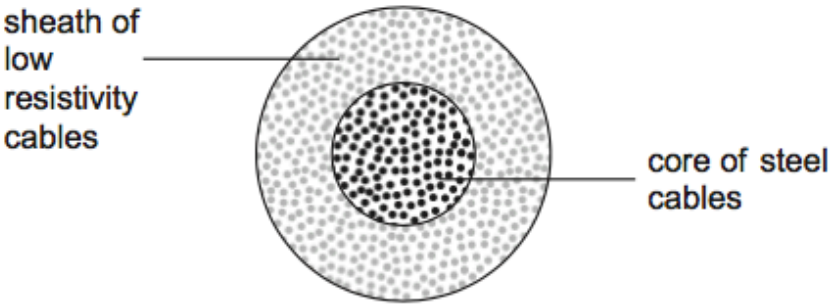
B $\frac{1}{2}$

C $\frac{1}{\sqrt{2}}$

D 1

6)

The overhead cables used to transmit electrical power by the National Grid usually consist of a central core of steel cables surrounded by a sheath of cables of low resistivity material, such as aluminium.



What is the main purpose of the steel core?

A to force more current into the outer sheath

B to provide additional current paths through the cables

C to reduce the power lost from the cables

D to increase the mechanical strength of the cables

7)

The path followed by an electron of momentum p, carrying charge $-e$, which enters a magnetic field at right angles, is a circular arc of radius r.

What would be the radius of the circular arc followed by an α particle of momentum $2p$, carrying charge $+2e$, which entered the same field at right angles?

A $\frac{r}{2}$

B r

C $2r$

D $4r$

8)

In which one of the following applications does electromagnetic induction **not** take place?

A the generators at a nuclear power station

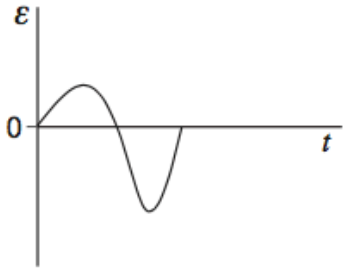
B the ac power adapter for a laptop computer

C the wings of an aircraft cutting through the Earth's magnetic field

D the back up capacitor of an electric timer

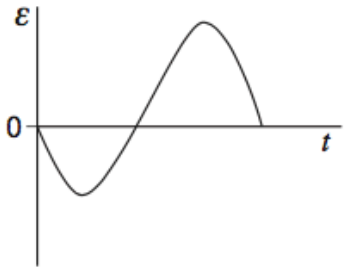
9)

When a magnet is dropped through an aluminium ring an emf is induced. A data logger connected to the ring records the variation of the induced emf ε with time t as shown below.

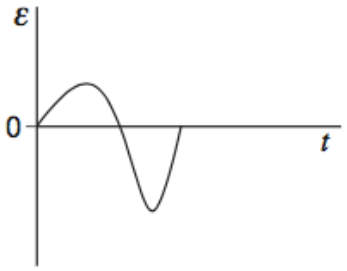


In a second experiment, the magnet is dropped from a greater height.

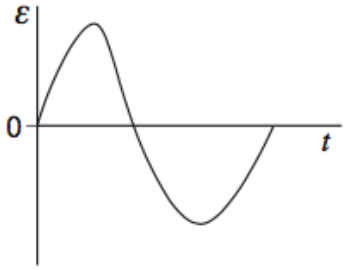
Which one of the following graphs best represents the induced emf in the second experiment?



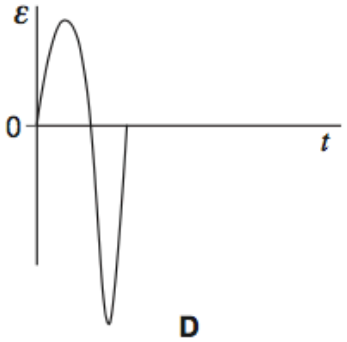
A



B



C



D

10)

A transformer has 1150 turns on the primary coil and 500 turns on the secondary coil. The primary coil draws a current of 0.26 A from a 230 V ac supply. The current in the secondary coil is 0.50 A. What is the efficiency of the transformer?

A 42%

B 50%

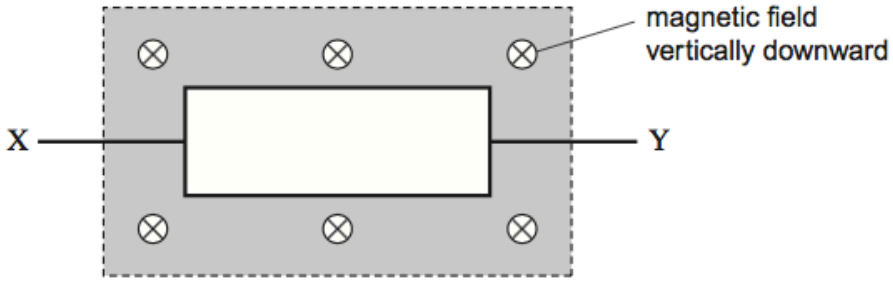
C 84%

D 100%

11)

A rectangular coil of area A has N turns of wire. The coil is in a uniform magnetic field, as shown in the diagram.

When the coil is rotated at a constant frequency f about its axis XY, an alternating emf of peak value ε_0 is induced in it.



What is the maximum value of the magnetic flux linkage through the coil?

A $\frac{\varepsilon_0}{2\pi f}$

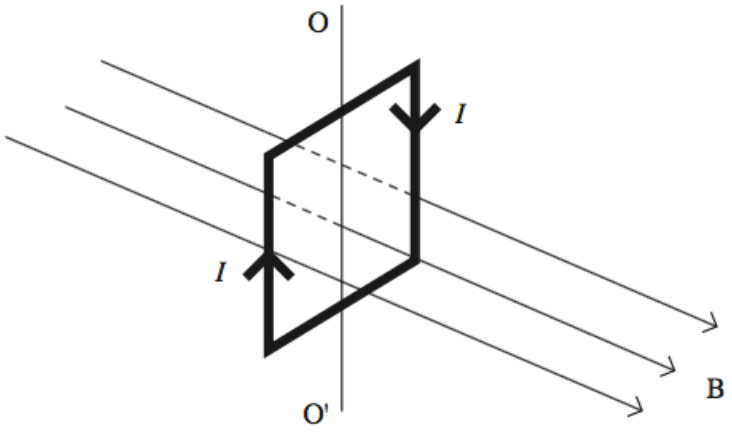
B $\frac{\varepsilon_0}{\pi f}$

C $\pi f \varepsilon_0$

D $2\pi f \varepsilon_0$

12)

The diagram shows a vertical square coil whose plane is at right angles to a horizontal uniform magnetic field B. A current, I, is passed through the coil, which is free to rotate about a vertical axis OO'.



Which one of the following statements is correct?

A The forces on the two vertical sides of the coil are equal and opposite.

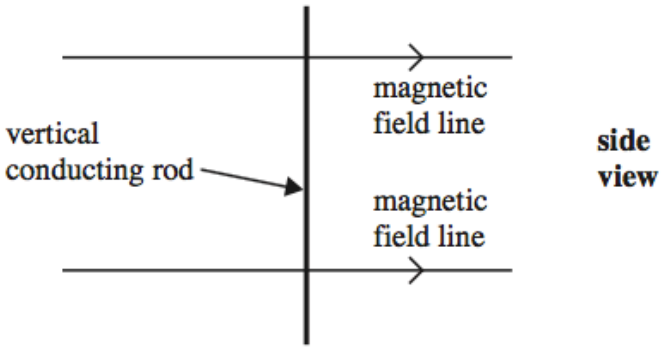
B A couple acts on the coil.

C No forces act on the horizontal sides of the coil.

D If the coil is turned through a small angle about OO' and released, it will remain in position.

13)

A vertical conducting rod of length l is moved at a constant velocity v through a uniform horizontal magnetic field of flux density B.



Which line, **A** to **D**, in the table gives a correct expression for the induced emf for the stated direction of the motion of the rod?

	direction of motion	induced emf
A	vertical	$\frac{B}{lv}$
B	horizontal at right angles to the field	Blv
C	vertical	Blv
D	horizontal at right angles to the field	$\frac{B}{lv}$

14)

A transformer, which is not perfectly efficient, is connected to a 230 V rms mains supply and is used to operate a 12 V rms, 60 W lamp at normal brightness. The secondary coil of the transformer has 24 turns.

Which line, **A** to **D**, in the table is correct?

	number of turns on primary coil	rms current in primary coil
A	92	less than 0.26 A
B	92	more than 0.26 A
C	460	less than 0.26 A
D	460	more than 0.26 A

15)

A section of current-carrying wire is placed at right angles to a uniform magnetic field of flux density B. When the current in the wire is I, the magnetic force that acts on this section is F.

What force acts when the same section of wire is placed at right angles to a uniform magnetic field of flux density $2B$ when the current is $0.25I$?

A $\frac{F}{4}$

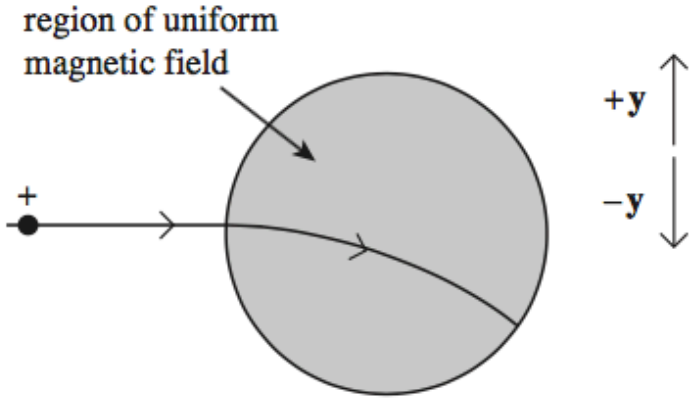
B $\frac{F}{2}$

C F

D $2F$

16)

A beam of positive ions enters a region of uniform magnetic field, causing the beam to change direction as shown in the diagram.

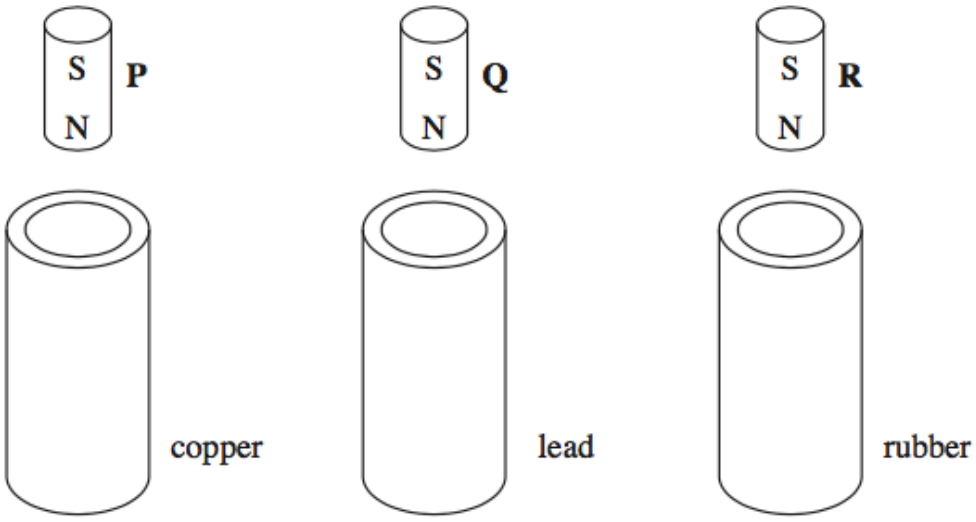


What is the direction of the magnetic field?

A out of the page and perpendicular to it
B into the page and perpendicular to it
C in the direction indicated by **+y**
D in the direction indicated by **–y**

17)

Three vertical tubes, made from copper, lead and rubber respectively, have identical dimensions. Identical, strong, cylindrical magnets **P**, **Q** and **R** are released simultaneously from the same distance above each tube. Because of electromagnetic effects, the magnets emerge from the bottom of the tubes at different times.



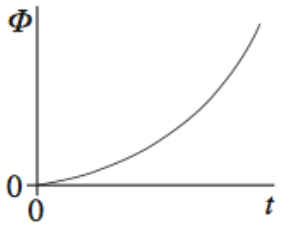
Which line, **A** to **D**, in the table shows the correct order in which they will emerge?

resistivity of copper = $1.7 \times 10^{-8}\Omega$m
resistivity of lead = $22 \times 10^{-8}\Omega$m
resistivity of rubber = $50 \times 10^{13}\Omega$m

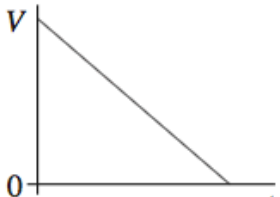
	emerges first	emerges second	emerges third
A	**P**	**Q**	**R**
B	**R**	**P**	**Q**
C	**P**	**R**	**Q**
D	**R**	**Q**	**P**

18)

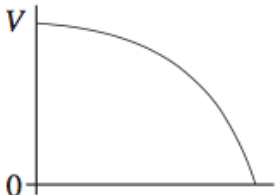
The graph shows how the magnetic flux, Φ, passing through a coil changes with time, t.



Which one of the following graphs could show how the magnitude of the emf, V, induced in the coil varies with t?

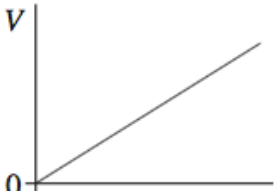


A



B

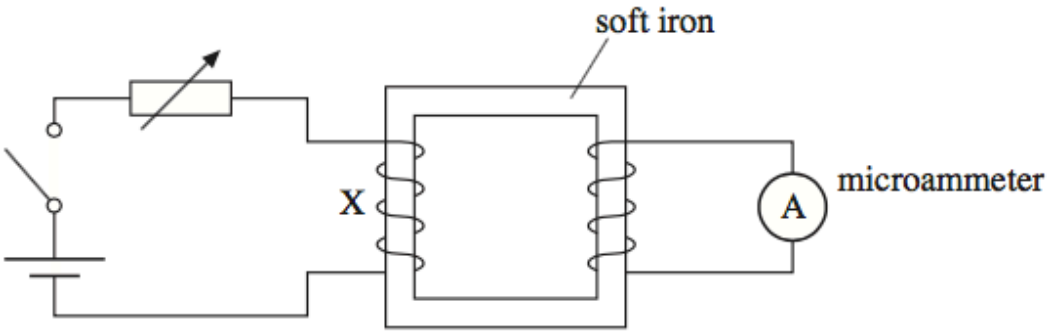
C



D

19)

Using the circuit shown, and with the switch closed, a small current was passed through the coil X. The current was slowly increased using the variable resistor. The current reached a maximum value and was then switched off.



The maximum reading on the microammeter occurred when

A the small current flowed at the start.
B the current was being increased.
C the current was being switched off.
D the current in X was zero.

20)

When a mobile phone is being recharged, the charger heats up. The efficiency of the transformer in the charger can be as low as 15% when drawing a current of 50 mA from a 230 V mains supply. If the charging current required is 350 mA, what is the approximate output voltage at this efficiency?

A 4.9 V
B 11 V
C 28 V
D 33 V

21)

Two charged particles, P and Q, move in circular orbits in a magnetic field of uniform flux density. The particles have the same charge but the mass of P is less than the mass of Q. T_P is the time taken for particle P to complete one orbit and T_Q the time for particle Q to complete one orbit. Which one of the following is correct?

A $T_P = T_Q$

B $T_P > T_Q$

C $T_P < T_Q$

D $T_P - T_Q = 1$

22)

Which one of the following is **not** a cause of energy loss in a transformer?

A good insulation between the primary and secondary coil
B induced currents in the soft iron core
C reversal of magnetism in the soft iron core
D resistances in the primary and secondary coil

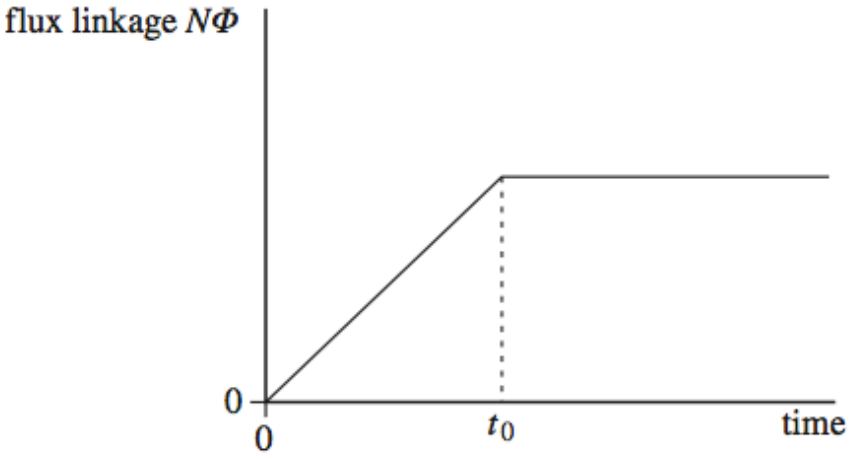
23)

An electron moving with a constant speed enters a uniform magnetic field in a direction at right angles to the field. What is the subsequent path of the electron?

A A straight line in the direction of the field.
B A straight line in a direction opposite to that of the field.
C A circular arc in a plane perpendicular to the direction of the field.
D An elliptical arc in a plane perpendicular to the direction of the field.

24)

The graph shows how the flux linkage, $N\Phi$, through a coil changes when the coil is moved into a magnetic field.

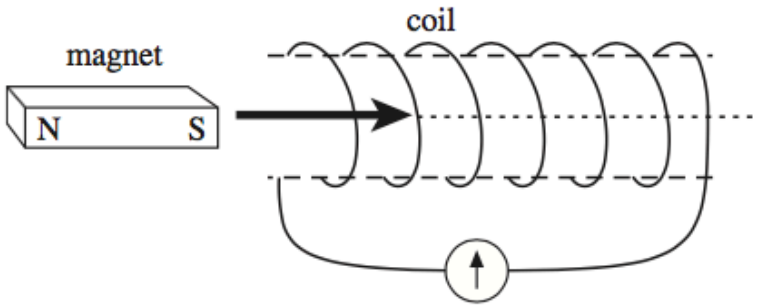


The emf induced in the coil

A increases then becomes constant after time t_0.
B is constant then becomes zero after time t_0.
C is zero then increases after time t_0.
D decreases then becomes zero after time t_0.

25)

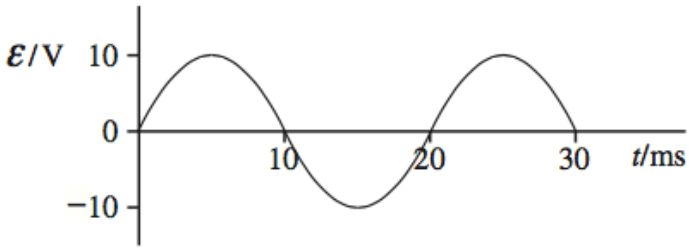
A bar magnet is pushed into a coil connected to a sensitive ammeter, as shown in the diagram, until it comes to rest inside the coil.



Why does the ammeter briefly show a non-zero reading?

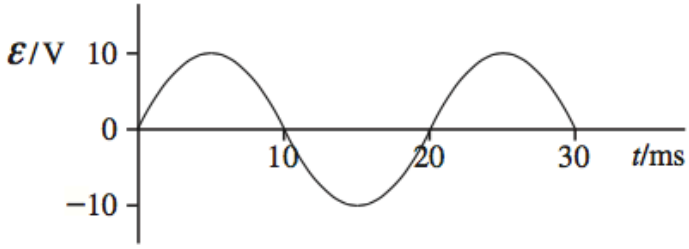
A The magnetic flux linkage in the coil increases then decreases.
B The magnetic flux linkage in the coil increases then becomes constant.
C The magnetic flux linkage in the coil decreases then increases.
D The magnetic flux linkage in the coil decreases then becomes constant.

26)

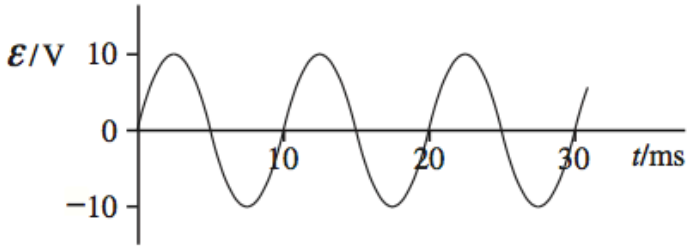


The above graph shows how the output emf, $\mathcal{E}$, varies with time, t, for a coil rotating at angular speed ω in a uniform magnetic field of flux density B. Which one of the following graphs shows how $\mathcal{E}$ varies with t when the same coil is rotated at angular speed 2ω in a uniform magnetic field of flux density $0.5\,B$?

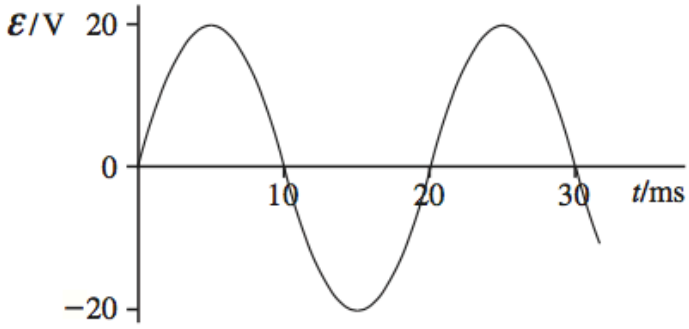
A



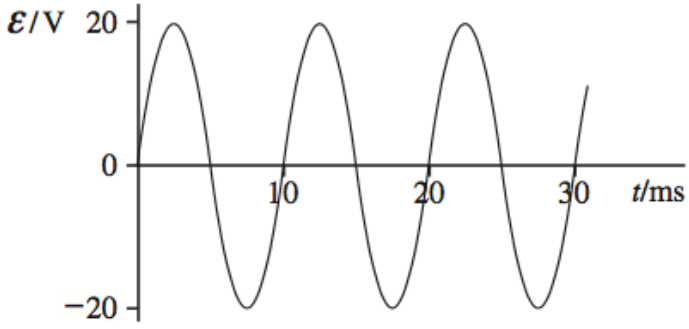
B



C

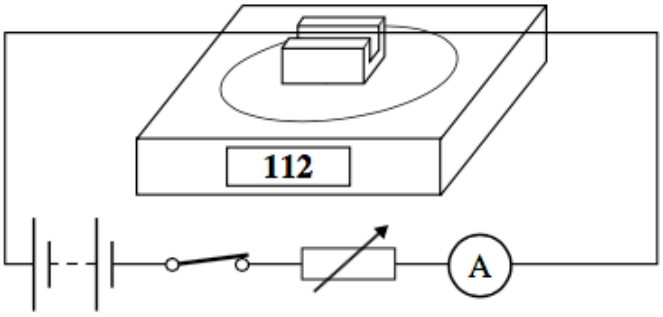


D



27)

The diagram shows a rigidly-clamped straight horizontal current-carrying wire held mid-way between the poles of a magnet on a top pan balance. The wire is perpendicular to the magnetic field direction.



The balance, which was zeroed before the switch was closed, reads 112 g after the switch is closed. If the current is reversed and doubled, what will be the new reading on the balance?

A –224 g
B –112 g
C zero
D 224 g

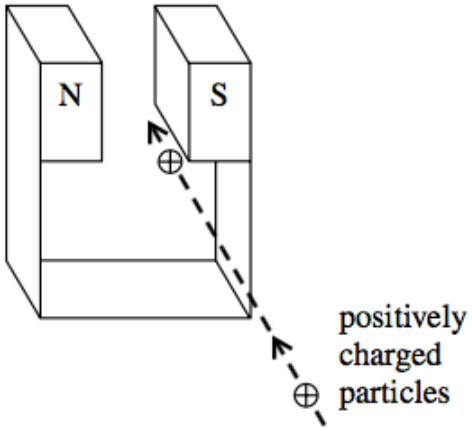
28)

Which one of the following could **not** be used as a unit of force?

A A T m
B $W s^{-2}$
C $kg m s^{-2}$
D $J m^{-1}$

29)

A jet of air carrying positively charged particles is directed horizontally between the poles of a strong magnet, as shown in the diagram.

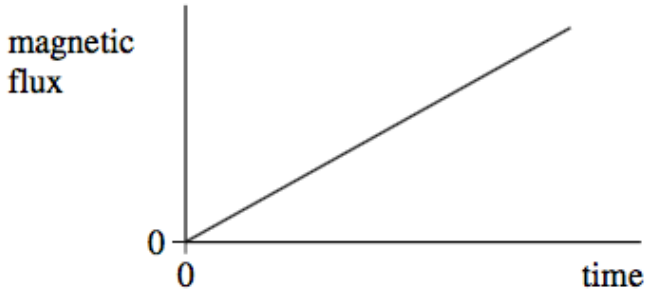


In which direction are the charged particles deflected?

A upwards
B downwards
C towards the N pole of the magnet
D towards the S pole of the magnet

30)

The graph shows how the magnetic flux passing through a loop of wire changes with time.



What feature of the graph represents the magnitude of the emf induced in the coil?

A the area enclosed between the graph line and the time axis
B the area enclosed between the graph line and the magnetic flux axis
C the inverse of the gradient of the graph
D the gradient of the graph

31)

A coil rotating in a magnetic field produces the following voltage waveform when connected to an oscilloscope.

With the same oscilloscope settings, which one of the following voltage waveforms would be produced if the coil were rotated at twice the original speed?

A

B

C

D

32)

A 230 V, 60 W lamp is connected to the output terminals of a transformer which has a 200 turn primary coil and a 2000 turn secondary coil. The primary coil is connected to an ac source with a variable output pd. The lamp lights at its normal brightness when the primary coil is supplied with an alternating current of 2.7 A.

What is the percentage efficiency of the transformer?

A 3%

B 10%

C 97%

D 100%