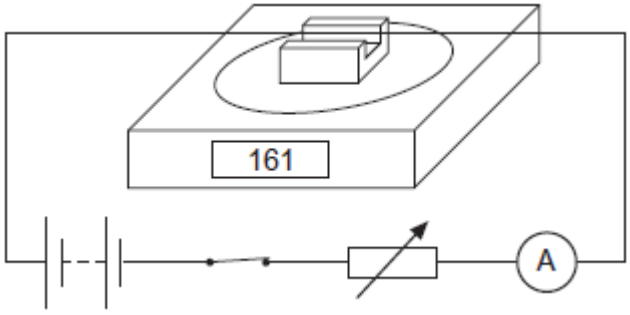
Q1. The diagram shows a rigidly-clamped straight horizontal current-carrying wire held mid-way between the poles of a magnet on a top-pan balance. The wire is perpendicular to the magnetic field direction.



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

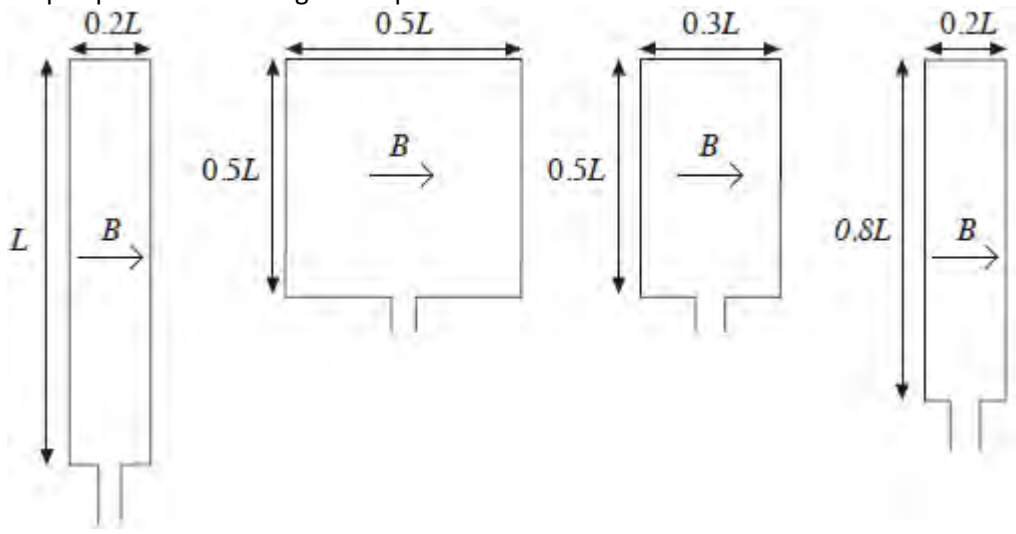
C zero

D 322 g

(Total 1 mark)

Q2. 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?



A **B** **C** **D**

(Total 1 mark)

Q3. 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.

(Total 1 mark)

Q4. 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

(Total 1 mark)

Q5. 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?

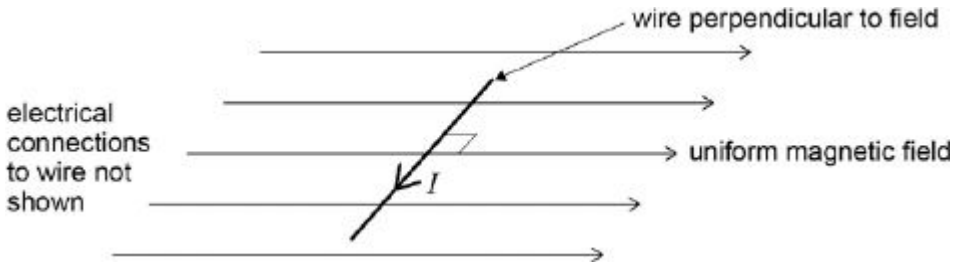
A 0.25 A

B 0.35 A

C 3.75 A

D 5.0 A

Q6. A horizontal straight wire of length 0.30 m carries a current of 2.0 A perpendicular to a horizontal uniform magnetic field of flux density 5.0×10^{-2} T. The wire 'floats' in equilibrium in the field.



What is the mass of the wire?

A 8.0×10^{-4} kg ⬭

B 3.1×10^{-3} kg ⬭

C 3.0×10^{-2} kg ⬭

D 8.2×10^{-1} kg ⬭

(Total 1 mark)

Q7. Charged particles, each of mass m and charge Q, travel at a constant speed in a circle of radius r in a uniform magnetic field of flux density B.

Which expression gives the frequency of rotation of a particle in the beam?

A $\frac{BQ}{2\pi m}$ ⬭

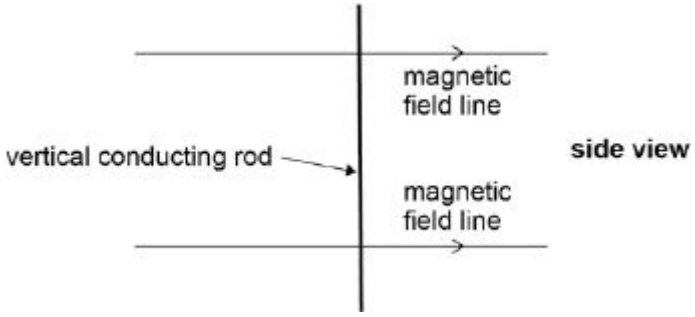
B $\frac{BQ}{m}$ ⬭

C $\frac{BQ}{\pi m}$ ⬭

D $\frac{2\pi BQ}{m}$ ⬭

(Total 1 mark)

Q8. A vertical conducting rod of length *l* is moved at a constant velocity *v* through a uniform horizontal magnetic field of flux density *B*.

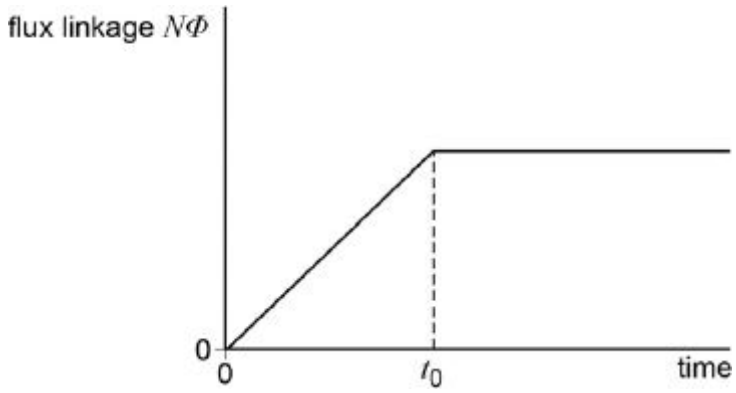


Which of the rows gives a correct expression for the induced emf between the ends of the rod for the stated direction of the motion of the rod?

	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	$\frac{B}{lv}$	⬭

(Total 1 mark)

Q9. 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 decreases then becomes zero after time t_0. ⬭

B increases then becomes constant after time t_0. ⬭

C is constant then becomes zero after time t_0. ⬭

D is zero then increases after time t_0. ⬭

(Total 1 mark)

Q10. 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 $4r$

(Total 1 mark)

Q11. In which one of the following applications does electromagnetic induction **not** take place?

A the generators at a nuclear power station

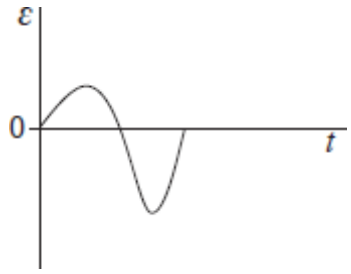
B the ac power adapter for a laptop computer

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

D the back up capacitor of an electric timer

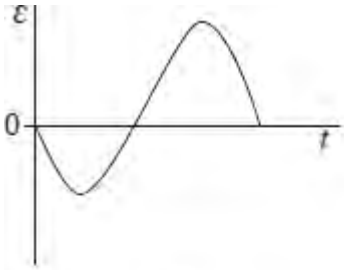
(Total 1 mark)

Q12. 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.

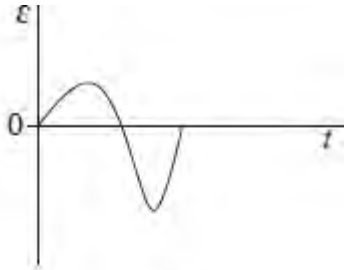


In a second experiment, the magnet is dropped from a greater height.

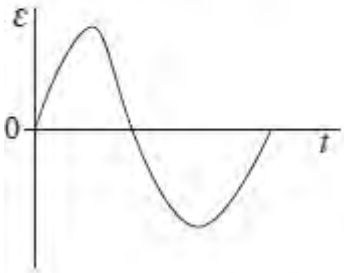
Which one of the following graphs best represents the induced emf in the second experiment?



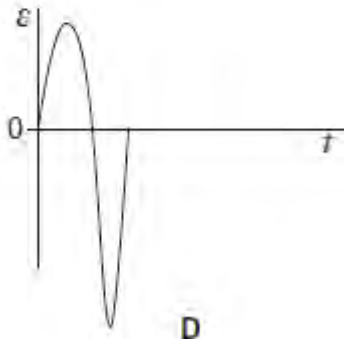
A



B



C

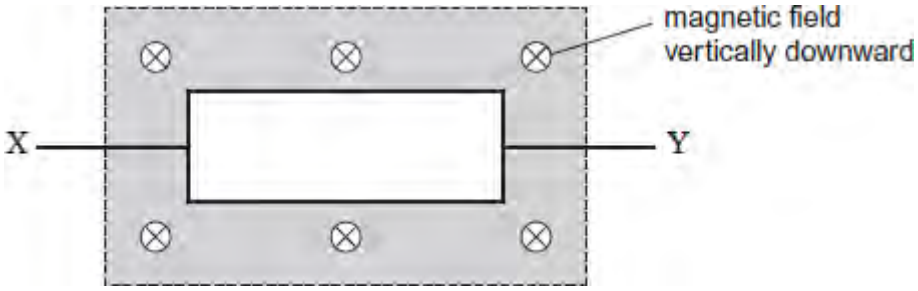


D

(Total 1 mark)

Q13. 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 $2\pi f \varepsilon_0$

(Total 1 mark)

Q14. 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%

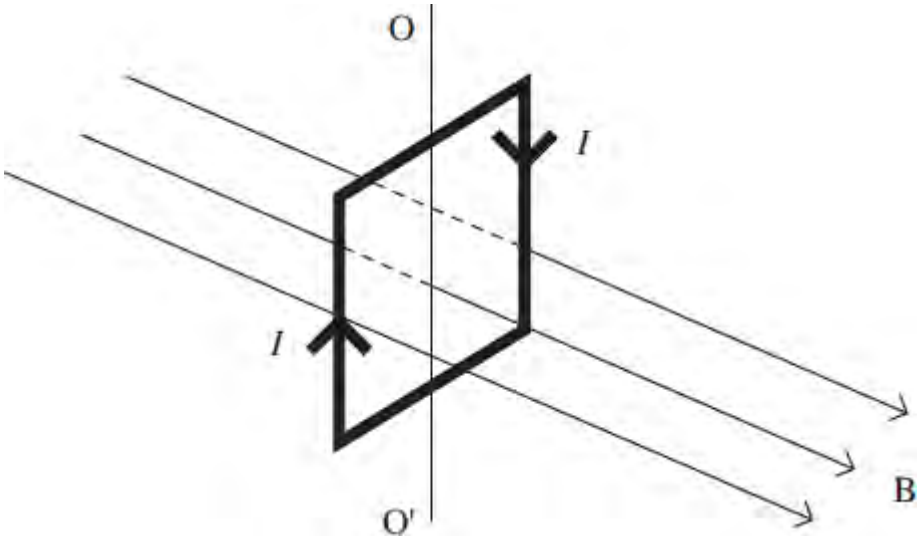
B 50%

C 84%

D 100%

(Total 1 mark)

Q15. 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.

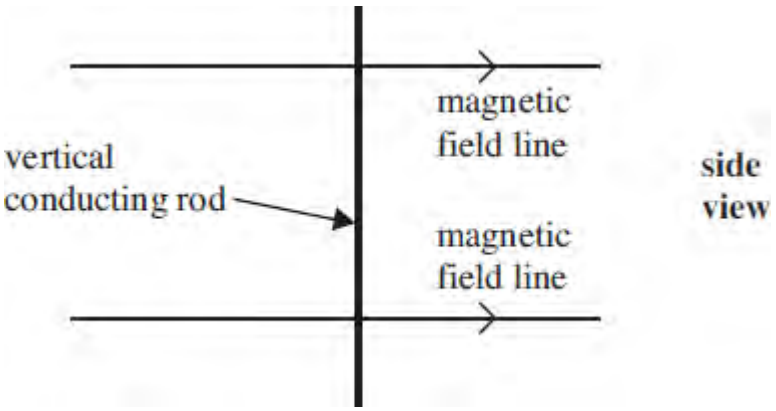
B A couple acts on the coil.

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.

(Total 1 mark)

Q16. 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	$\frac{B}{lv}$

(Total 1 mark)

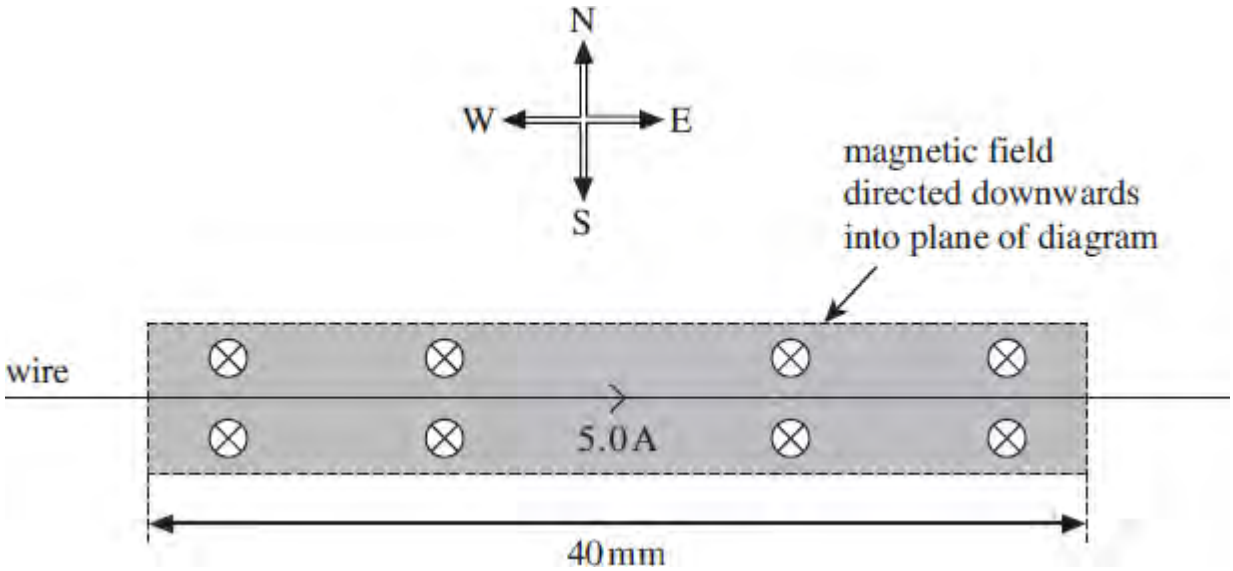
Q17. A transformer, which is not perfectly efficient, is connected to a 230 V rms mains supply and is used to operate a 12 V rms, 60 W lamp at normal brightness. The secondary coil of the transformer has 24 turns.

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

(Total 1 mark)

Q18. A horizontal straight wire of length 40 mm is in an east-west direction as shown in the diagram. A uniform magnetic field of flux density 50 mT is directed downwards into the plane of the diagram.



When a current of 5.0 A passes through the wire from west to east, a horizontal force acts on the wire. Which line, **A** to **D**, in the table gives the magnitude and direction of this force?

	magnitude / mN	**direction**
A	2.0	north
B	10.0	north
C	2.0	south
D	10.0	south

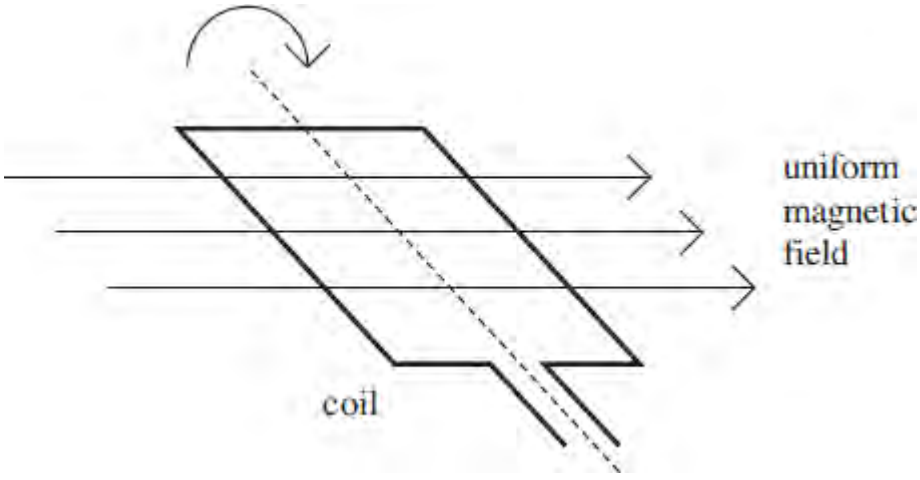
(Total 1 mark)

Q19. Which line, **A** to **D**, in the table correctly describes the trajectory of charged particles which enter separately, at right angles, a uniform electric field, and a uniform magnetic field?

	uniform electric field	**uniform magnetic field**
A	**parabolic**	**circular**
B	**circular**	**parabolic**
C	**circular**	**circular**
D	**parabolic**	**parabolic**

(Total 1 mark)

Q20.A rectangular coil is rotated in a uniform magnetic field.



When the coil is rotated at a constant rate, an alternating emf ε is induced in it. The variation of emf ε, in volts, with time t, in seconds, is given by

$$\varepsilon = 20 \sin (100 \pi t)$$

Which line, A to D, in the table gives the peak value ε_0 and the frequency f of the induced emf?

	ε_0 / V	f / Hz
A	**10**	**50**
B	**10**	**100**
C	**20**	**50**
D	**20**	**100**

(Total 1 mark)

Q21.The magnetic flux through a coil of 5 turns changes uniformly from 15×10^{-3} Wb to 7.0×10^{-3} Wb in 0.50 s. What is the magnitude of the emf induced in the coil due to this change in flux?

A 14 m V

B 16 m V

C 30 m V

D 80 m V

(Total 1 mark)

Q22.Which one of the following statements concerning power losses in a transformer is incorrect?

Power losses can be reduced by

A laminating the core.

B using high resistance windings.

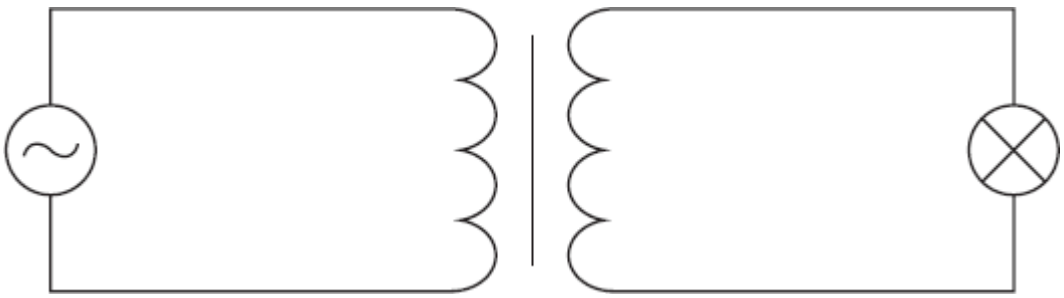
C using thick wire.

D using a core made of special iron alloys which are easily magnetised.

(Total 1 mark)

Q23.A transformer with 3000 turns in its primary coil is used to change an alternating pd from an rms value of 240 V to an rms value of 12 V.

When a 60 W, 12 V lamp is connected to the secondary coil, the lamp lights at normal brightness and a rms current of 0.26 A passes through the primary coil.



Which line, A to D, in the table gives correct values for the number of turns on the secondary coil and for the transformer efficiency?

	number of turns on the secondary coil	efficiency
A	**150**	**96%**
B	**60 000**	**96%**
C	**150**	**90%**
D	**60 000**	**90%**

(Total 1 mark)

Q24. **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 2*B* when the current is 0.25 *I*?

A $\frac{F}{4}$

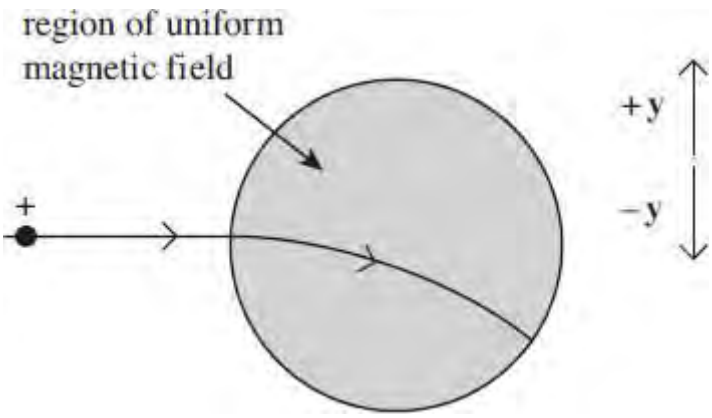
B $\frac{F}{2}$

C ***F***

D ***2F***

(Total 1 mark)

Q25. **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**

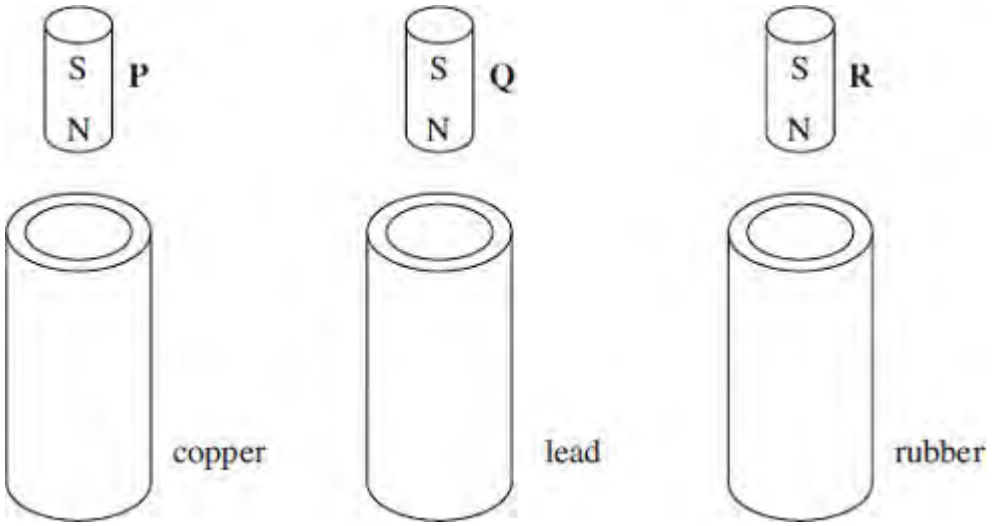
B **into the page and perpendicular to it**

C **in the direction indicated by +*y***

D **in the direction indicated by -*y***

(Total 1 mark)

Q26.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 = 1.7×10^{-8} Ωm

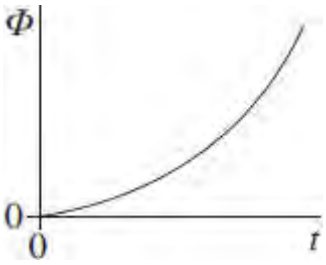
resistivity of lead = 22×10^{-8} Ωm

resistivity of rubber = 50×10^{13} Ωm

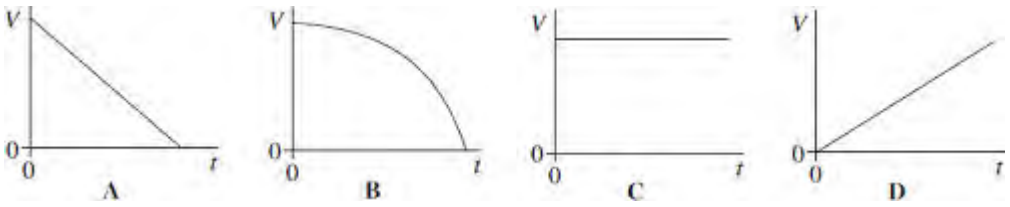
	emerges first	emerges second	emerges third
A	P	Q	R
B	R	P	Q
C	P	R	Q
D	R	Q	P

(Total 1 mark)

Q27. **The graph shows how the magnetic flux, *Φ*, passing through a coil changes with time, *t*.**

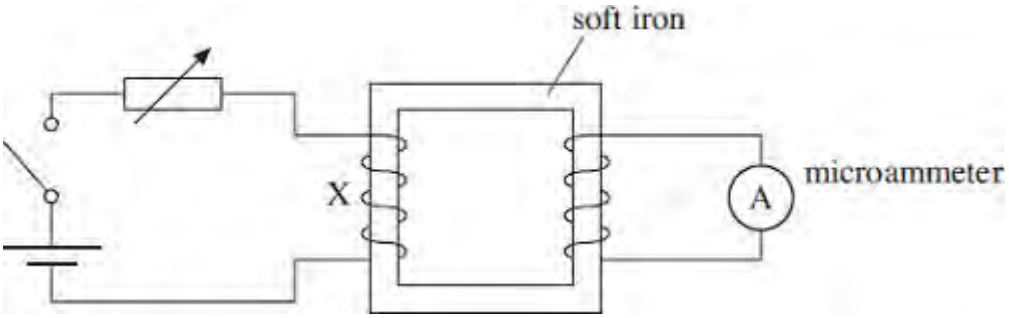


Which one of the following graphs could show how the magnitude of the emf, *V*, induced in the coil varies with *t*?



(Total 1 mark)

Q28. **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.**

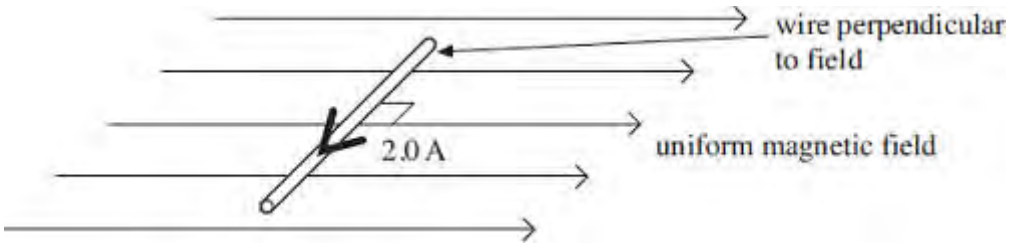
(Total 1 mark)

Q29. 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

(Total 1 mark)

Q30. A horizontal straight wire of length 0.30 m carries a current of 2.0 A perpendicular to a horizontal uniform magnetic field of flux density 5.0×10^{-2} T. The wire 'floats' in equilibrium in the field.



What is the mass of the wire?

A 8.0×10^{-4} kg

B 3.1×10^{-3} kg

C 3.0×10^{-2} kg

D 8.2×10^{-1} kg

(Total 1 mark)

Q31. When a β particle moves at right angles through a uniform magnetic field it experiences a force *F*. An α particle moves at right angles through a magnetic field of twice the magnetic flux density with velocity one tenth the velocity of the β particle. What is the magnitude of the force on the α particle?

A 0.2 *F*
B 0.4 *F*
C 0.8 *F*
D 4.0 *F*

(Total 1 mark)

Q32. Charged particles, each of mass m and charge Q, travel at a constant speed in a circle of radius r in a uniform magnetic field of flux density B. Which expression gives the frequency of rotation of a particle in the beam?

A $\frac{BQ}{2\pi m}$

B $\frac{BQ}{m}$

C $\frac{BQ}{\pi m}$

D $\frac{2\pi BQ}{m}$

(Total 1 mark)

Q33. A 500 turn coil of cross-sectional area 4.0×10^{-3} m^2 is placed with its plane perpendicular to a magnetic field of flux density 7.5×10^{-4} T. What is the value of the flux linkage for this coil?

A 3.0×10^{-6} Wb turns
B 1.5×10^{-3} Wb turns
C 0.19 Wb turns
D 94 Wb turns

(Total 1 mark)

Q34. The output electromotive force (emf) of a simple ac generator can be increased by any of the four factors listed.

Which one of these factors should not be changed if the frequency of the output is to remain unaffected when the emf is increased?

A the area of the coil
B the number of turns on the coil
C the speed of rotation
D the strength of the magnetic field

(Total 1 mark)

Q35. Which one of the following would not reduce the energy losses in a transformer?

A using thinner wire for the windings
B using a laminated core instead of a solid core
C using a core made from iron instead of steel
D using a core that allows all the flux due to the primary coil to be linked to the secondary coil

(Total 1 mark)

Q36. **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 $T_P = T_Q$

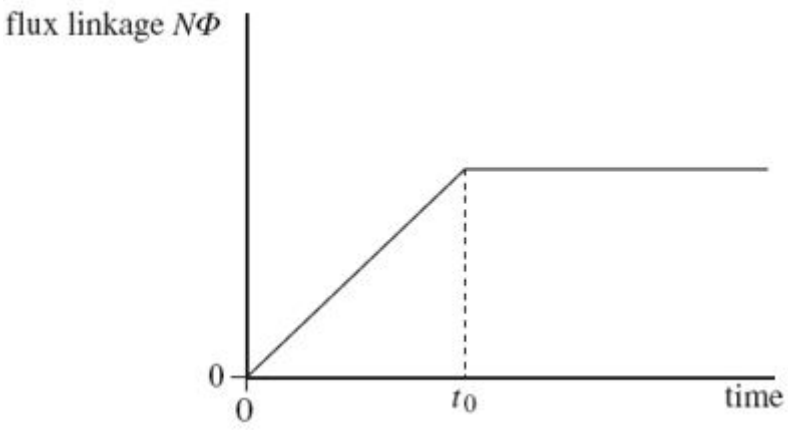
B $T_P > T_Q$

C $T_P < T_Q$

D $T_P - T_Q = 1$

(Total 1 mark)

Q37. **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.**

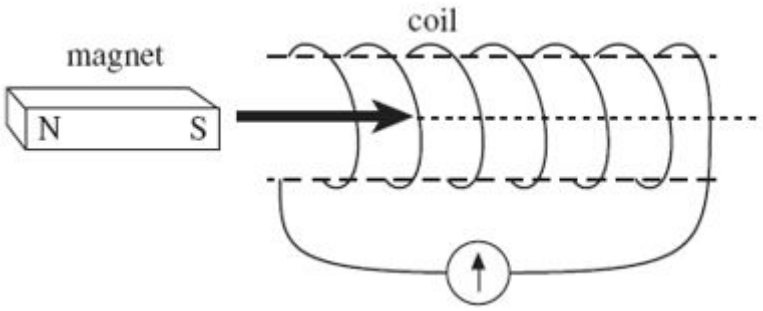
B **is constant then becomes zero after time t_0.**

C **is zero then increases after time t_0.**

D **decreases then becomes zero after time t_0.**

(Total 1 mark)

Q38. **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.**

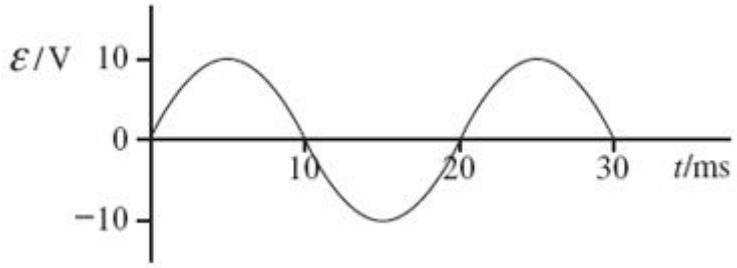
B **The magnetic flux linkage in the coil increases then becomes constant.**

C **The magnetic flux linkage in the coil decreases then increases.**

D **The magnetic flux linkage in the coil decreases then becomes constant.**

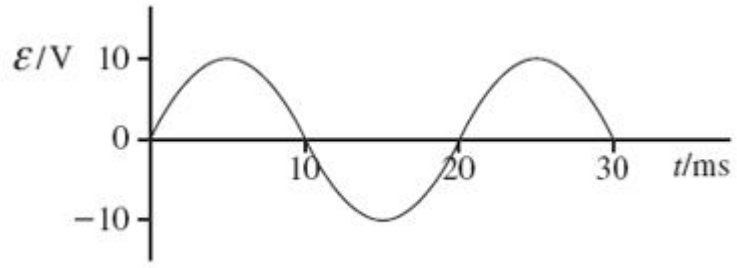
(Total 1 mark)

Q39.

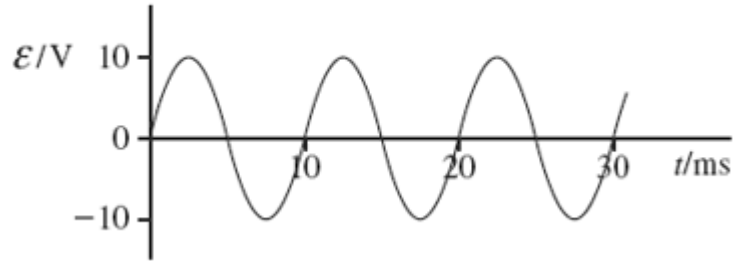


The above graph shows how the output emf, *ε*, varies with time, *t*, for a coil rotating at angular speed *ω* in a uniform magnetic field of flux density *B*. Which one of the following graphs shows how *ε* varies with *t* when the same coil is rotated at angular speed 2*ω* in a uniform magnetic field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

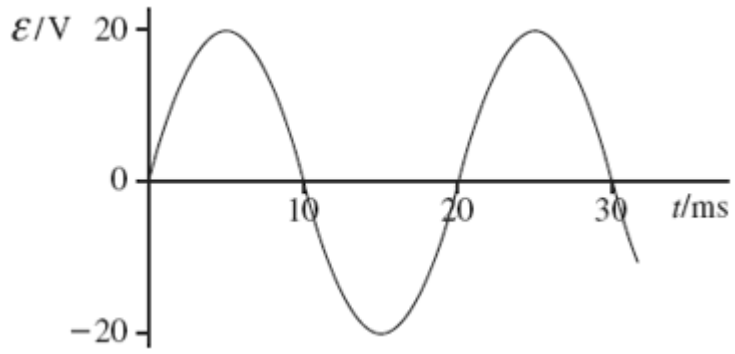
A



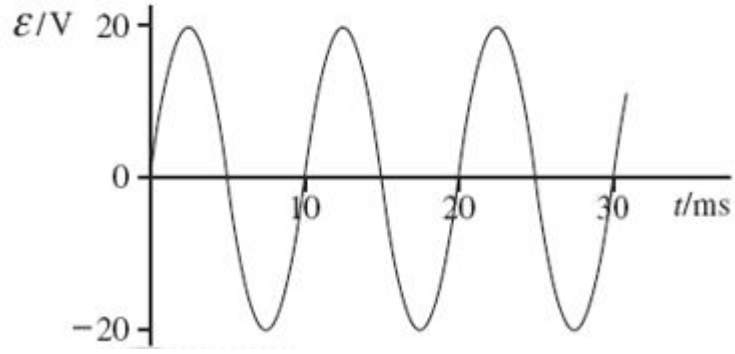
B



C



D



(Total 1 mark)

Q40. **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**

(Total 1 mark)

Q41. **A negatively charged particle moves at right angles to a uniform magnetic field. The magnetic force on the particle acts**

A **in the direction of the field.**

B **in the opposite direction to that of the field.**

C **at an angle between 0° and 90° to the field.**

D **at right angles to the field.**

(Total 1 mark)

Q42. **An electron moving with a constant speed enters a uniform magnetic field in a direction perpendicular to the magnetic field. What is the shape of the path that the electron would follow?**

A **parabolic**

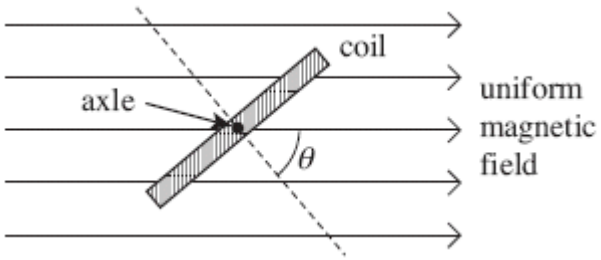
B **circular**

C **elliptical**

D **a line parallel to the magnetic field**

(Total 1 mark)

Q43.



A coil of 50 turns has a cross-sectional area of 4.2×10^{-3} m^2. It is placed at an angle to a uniform magnetic field of flux density 2.8×10^{-2} T, as shown in the diagram, so that angle $\vartheta = 50°$.

What is the change in flux linkage when the coil is rotated anticlockwise until $\vartheta = 0°$?

A **The flux linkage decreases by 2.1×10^{-3} Wb turns.**

B **The flux linkage increases by 2.1×10^{-3} Wb turns.**

C **The flux linkage decreases by 3.8×10^{-3} Wb turns.**

D **The flux linkage increases by 3.8×10^{-3} Wb turns.**

(Total 1 mark)

Q44. **An aircraft, of wing span 60 m, flies horizontally at a speed of 150 m s^{-1}. If the vertical component of the Earth's magnetic field in the region of the plane is 1.0×10^{-5} T, what is the magnitude of the magnetic flux cut by the wings in 10 s?**

A 1.0×10^{-5} Wb

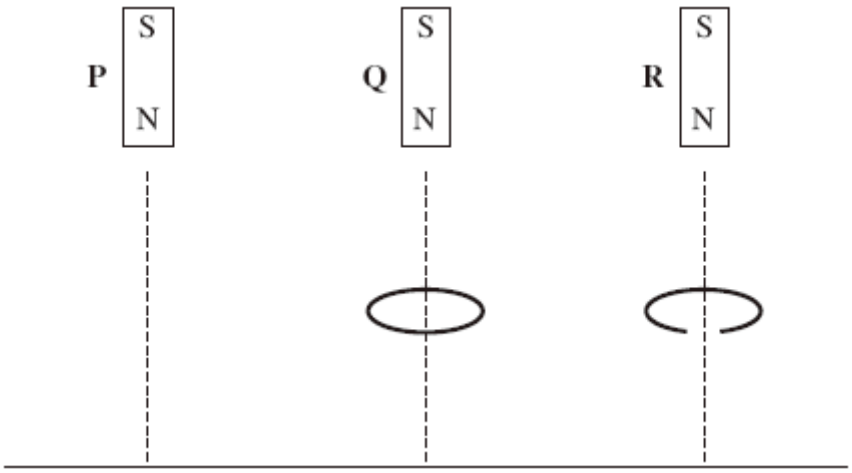
B 1.0×10^{-4} Wb

C 9.0×10^{-2} Wb

D 9.0×10^{-1} Wb

(Total 1 mark)

Q45.



Three identical magnets P, Q and R are released simultaneously from rest and fall to the ground from the same height. P falls directly to the ground, Q falls through the centre of a thick conducting ring and R falls through a ring which is identical except for a gap cut into it. Which one of the statements below correctly describe the sequence in which the magnets reach the ground?

A **P and R arrive together followed by Q.**

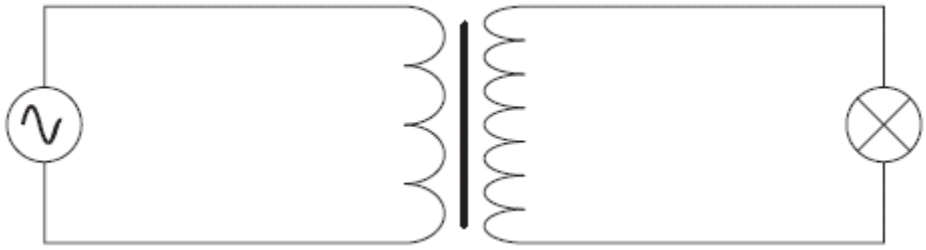
B **P and Q arrive together followed by R.**

C **P arrives first, follow by Q which is followed by R.**

D **All three magnets arrive simultaneously.**

(Total 1 mark)

Q46. **The primary coil of a step-up transformer is connected to a source of alternating pd. The secondary coil is connected to a lamp.**



Which line, A to D, in the table correctly describes the flux linkage and current through the secondary coil in relation to the primary coil?

	$\frac{\text{secondary magnetic flux linkage}}{\text{primary magnetic flux linkage}}$	$\frac{\text{secondary current}}{\text{primary current}}$
A	**>1**	**<1**
B	**<1**	**<1**
C	**>1**	**>1**
D	**<1**	**>1**

(Total 1 mark)

Q47. **A transformer has 1200 turns on the primary coil and 500 turns on the secondary coil. The primary coil draws a current of 0.25 A from a 240 V ac supply. If the efficiency of the transformer is 83%, what is the current in the secondary coil?**

A **0.10 A**

B **0.21 A**

C **0.50 A**

D **0.60 A**