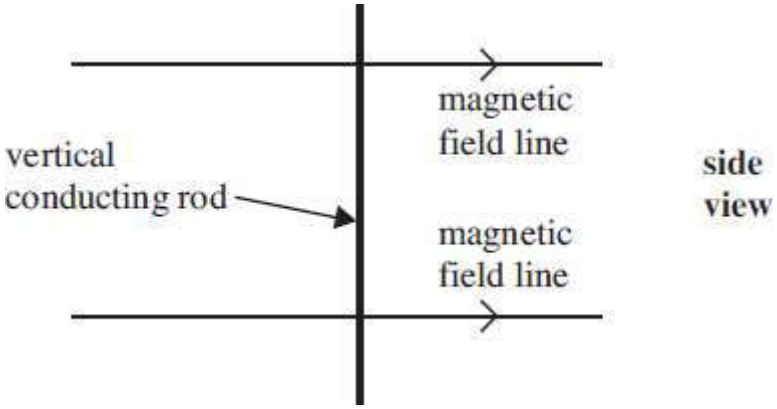
Electromagnetic Induction

TOPIC QUESTIONS

Level	A Level
Subject	Physics
Exam Board	AQA
Paper Type	Multiple Choice

Time Allowed : 30min

1. 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 stateddirection of the motion of the rod?

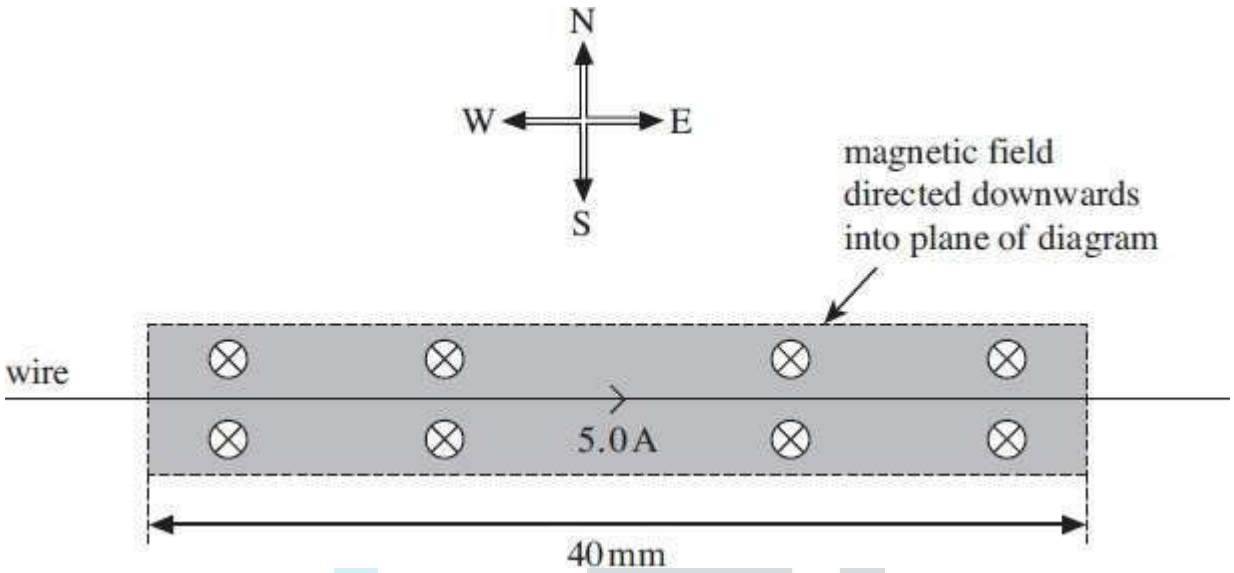
	direction of motion	induced emf
A	vertical	$\frac{B}{lv}$
B	horizontal at right angles to the field	*Blv*
C	vertical	*Blv*
D	horizontal at right angles to the field	$\frac{B}{lv}$

2. 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 has24 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

3. 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.



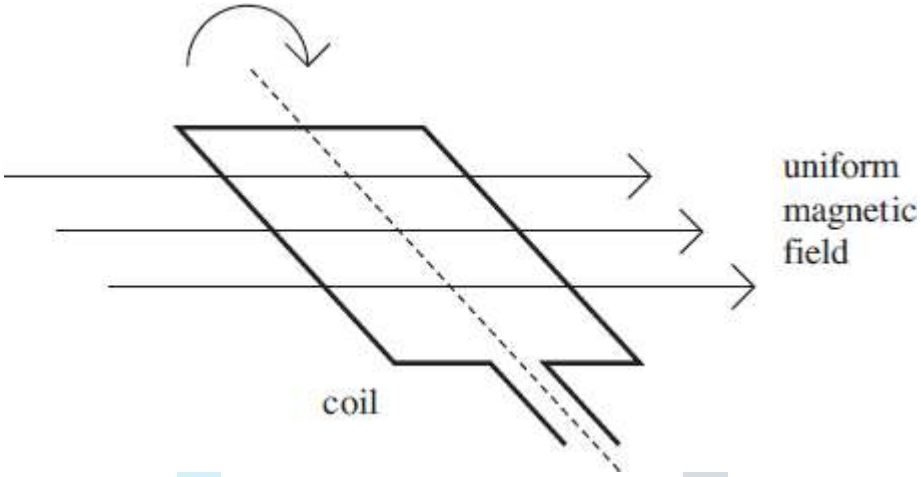
When a current of 5.0 A passes through the wire from west to east, a horizontal force acts on thewire. Which line, **A** to **D**, in the table gives the magnitude and direction of this force?

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

4. 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

5. 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 ofemf 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

6. 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 beproduced if the coil were rotated at twice the original speed?

A 

B 

C 

D 

7. A 230 V, 60 W lamp is connected to the output terminals of a transformer which has a 200turn primary coil and a 2000 turn secondary coil. The primary coil is connected to an ac sourcewith 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 %

8. An electron moves due North in a horizontal plane with uniform speed. It enters a uniform magnetic field directed due South in the same plane. Which one of the following statements concerning the motion of the electron in the magnetic field is correct?

   A It accelerated due West.

   B It slows down to zero speed and then accelerates due South.

   C It continues to move North with its original speed.

   D It is accelerated due North.

9. Particles of mass m, each carrying charge Q and travelling with speed v, enter a magnetic field of flux density B at right angles. Which one of the following changes would produce an increase in the radius of the path of the particles?

A an increase in Q

B an increase in m

C a decrease in v

D an increase in B

10. The magnetic flux through a coil of N turns is increased uniformly from zero to a maximum value in a time t. An emf, E, is induced across the coil.
What is the maximum value of the magnetic flux through the coil?

A $\frac{Et}{N}$

B $\frac{N}{Et}$

C $E\,t\,N$

D $\frac{E}{Nt}$

11. When an electron is moving at a speed v perpendicular to a uniform magnetic field of flux density B, it follows a path of radius R.

A second electron moves at a speed $\frac{v}{2}$ perpendicular to a uniform magnetic field of flux density $4B$.

What is the radius of the path of the second electron?

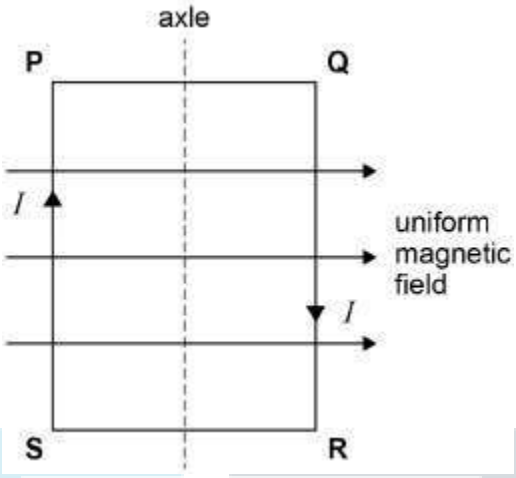
A $\frac{R}{8}$

B $\frac{R}{4}$

C $2R$

D $8R$

12. The plane of coil **PQRS** is parallel to a uniform magnetic field.



When a current I is in the coil

A there are no magnetic forces acting on **SP** and **QR**.

B there are no magnetic forces acting on **PQ** and **RS**.

C an attractive magnetic force acts between **SP** and **QR**.

D an attractive magnetic force acts between **PQ** and **RS**.

13. A horizontal wire of length 0.50 m and weight 1.0 N is placed in a uniform horizontal magneticfield of flux density 1.5 T directed at 90° to the wire.

What is the current that just supports the wire?

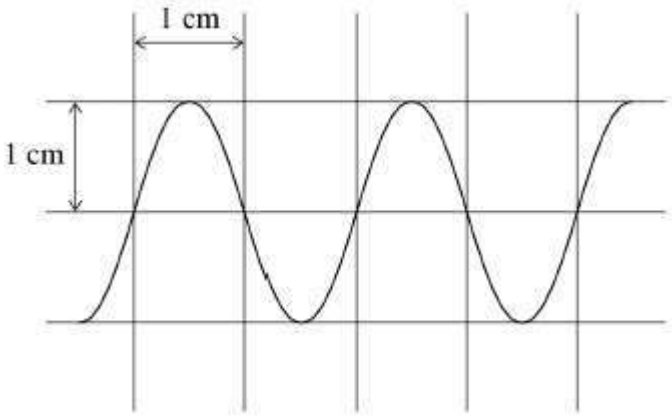
A 0.33 A

B 0.75 A

C 1.3 A

D 3.0 A

14. The figure shows an oscilloscope trace of a sinusoidal ac voltage.



The time base setting is 5 ms cm^{-1} and the Y-voltage gain is 10 V cm^{-1}.

Which row describes the ac voltage?

	rms voltage / V	**Frequency / Hz**
A	14	50
B	14	100
C	7	50
D	7	100

15. A steady current I dissipates power P in a resistor of resistance R.

An alternating current through a resistor of resistance $2R$ has a peak value of I. What is the power dissipated in the second resistor?

A $\frac{P}{\sqrt{2}}$

B P

C $\sqrt{2}P$

D $2P$

16. 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 emf isinduced across the wing tips of the plane?

A 0.09 V

B 0.90 V

C 9.0 V

D 90 V

17. Particles of mass *m* carrying a charge *Q* travel in a circular path of radius *r* in a magnetic fieldof flux density *B* with a speed *v*. How many of the following quantities, if changed one at a time, would change the radius of the path?

- *m*
- *Q*
- *B*
- *v*

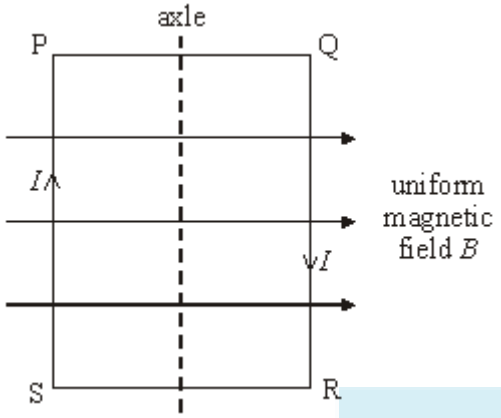
A one

B two

C three

D four

18.



A coil, mounted on an axle, has its plane parallel to the flux lines of a uniform magnetic field *B*, asshown. When a current *I* is switched on, and before the coil is allowed to move,

A there are no forces due to *B* on the sides PQ and RS.

B there are no forces due to *B* on the sides SP and QR.

C sides SP and QR attract each other.

D sides PQ and RS attract each other.

19. Protons, each of mass m and charge e, follow a circular path when travelling perpendicular toa magnetic field of uniform flux density B. What is the time taken for one complete orbit?

A

$\frac{2\pi eB}{m}$

B

$\frac{m}{2\pi eB}$

C

$\frac{eB}{2\pi m}$

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

20. The path followed by an electron of momentum p, carrying charge $-e$, which enters a magneticfield 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 $2p$, carryingcharge $+2e$, which entered the same field at right angles?

A $\frac{r}{2}$

B r

C $2r$

D $4r$