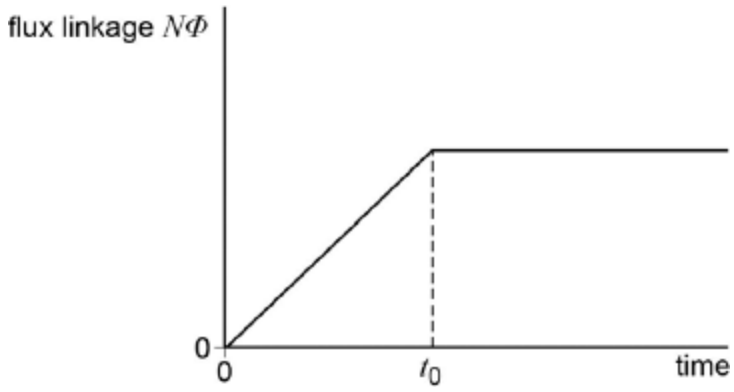
1 The graph shows how the flux linkage, $N\Phi$, through a coil changes when the coil is moved into a magnetic field.



The emf induced in the coil

A decreases then becomes zero after time t_0. ⬭

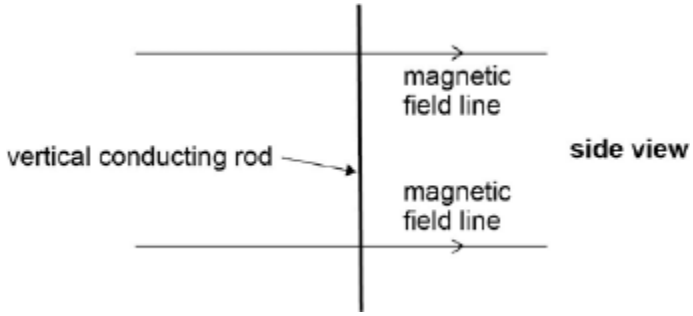
B increases then becomes constant after time t_0. ⬭

C is constant then becomes zero after time t_0. ⬭

D is zero then increases after time t_0. ⬭

(Total 1 mark)

2 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)

3 A train is travelling at 20 m s^{-1} along a horizontal track through a uniform magnetic field of flux density 4.0×10^{-5} T acting vertically downwards.

What is the emf induced between the ends of an axle 1.5 m long?

A 3.0×10^{-6}V
B 5.3×10^{-4}V
C 1.2×10^{-3}V
D 7.5×10^{5}V

(Total 1 mark)

4 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)

5 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

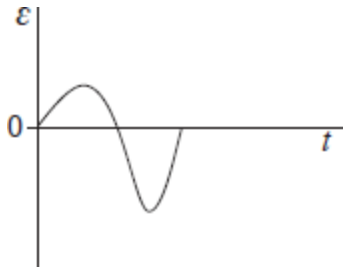
B 16 m V

C 30 m V

D 80 m V

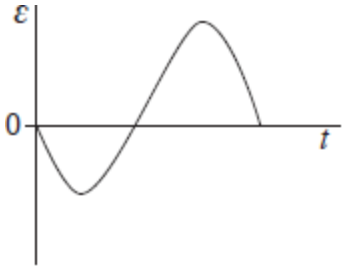
(Total 1 mark)

6 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.

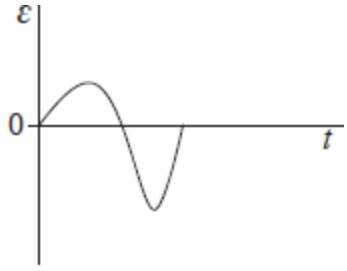


In a second experiment, the magnet is dropped from a greater height.

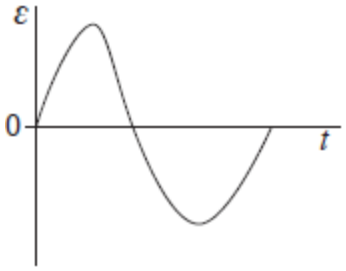
Which one of the following graphs best represents the induced emf in the second experiment?



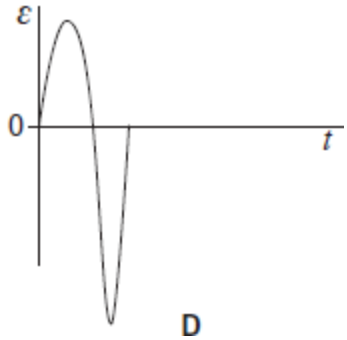
A



B



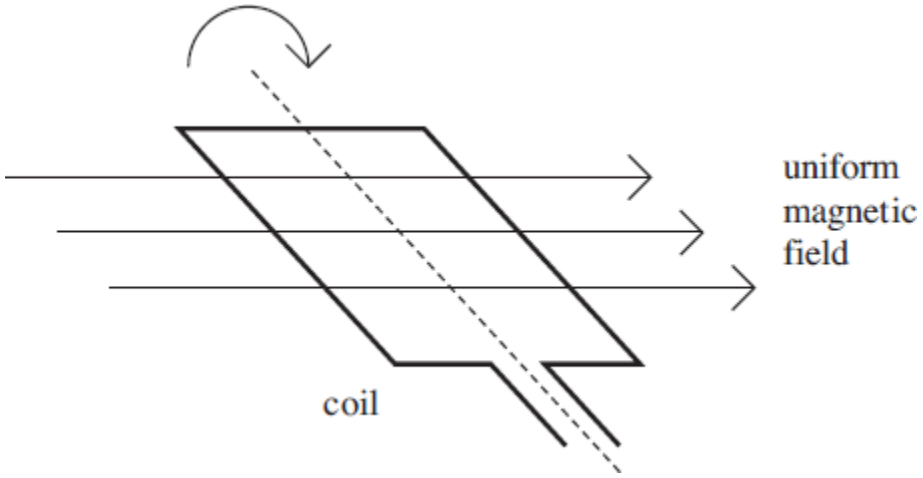
C



D

(Total 1 mark)

7 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

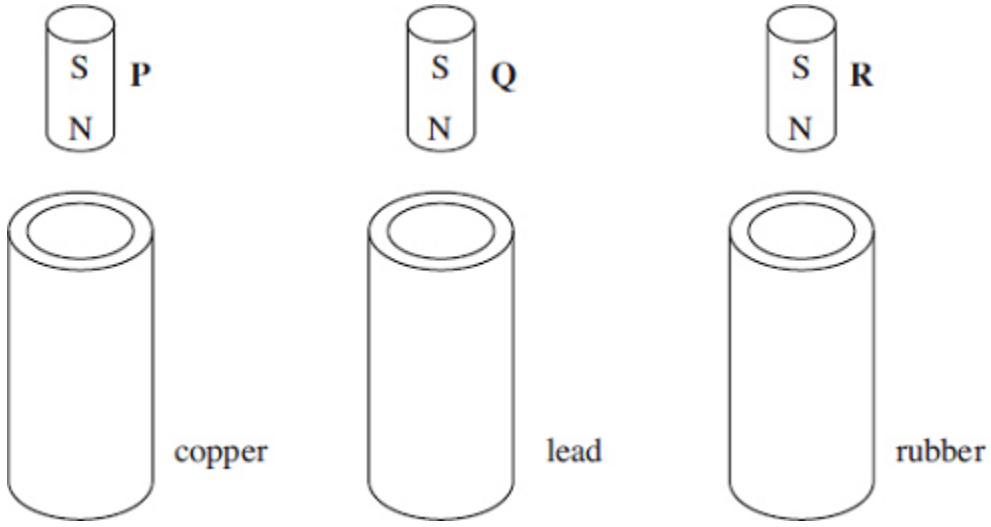
$\varepsilon = 20 \sin (100 \pi t)$

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)

8 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 $= 1.7 \times 10^{-8}\ \Omega m$

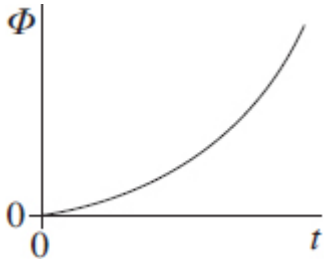
resistivity of lead $= 22 \times 10^{-8}\ \Omega m$

resistivity of rubber $= 50 \times 10^{13}\ \Omega m$

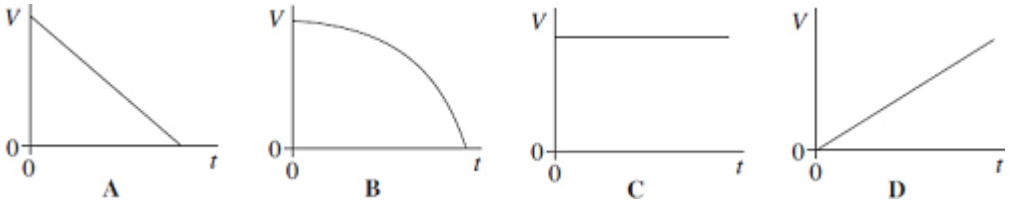
	emerges first	emerges second	emerges third
A	**P**	**Q**	**R**
B	**R**	**P**	**Q**
C	**P**	**R**	**Q**
D	**R**	**Q**	**P**

(Total 1 mark)

9 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)

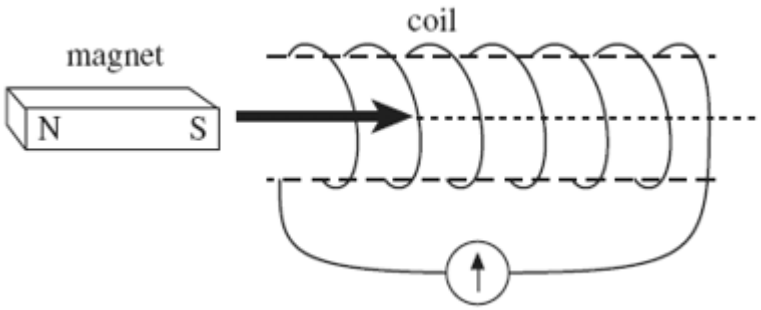
10 The output electromotive force (emf) of a simple ac generator can be increased by any of the four factors listed.

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)

11 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.

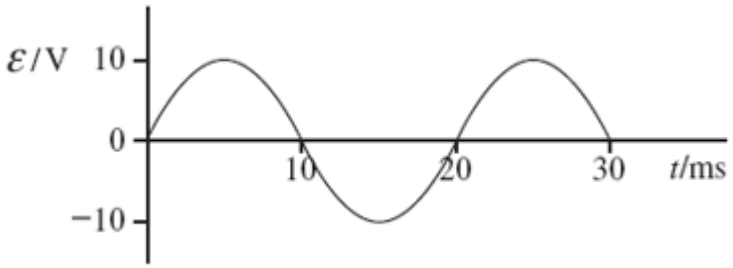
B The magnetic flux linkage in the coil increases then becomes constant.

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

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

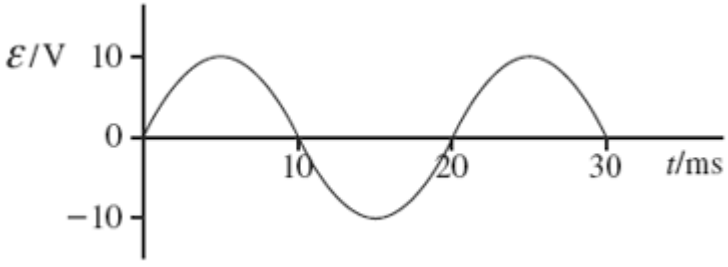
(Total 1 mark)

12

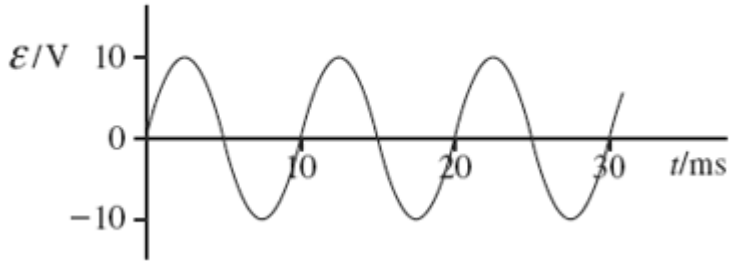


The above graph shows how the output emf, ε, varies with time, t, for a coil rotating at angular speed ω in a uniform magnetic field of flux density B. Which one of the following graphs shows how ε varies with t when the same coil is rotated at angular speed 2ω in a uniform magnetic field of flux density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

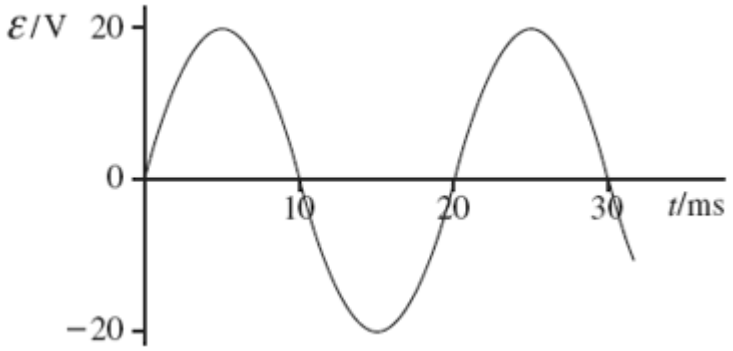
A



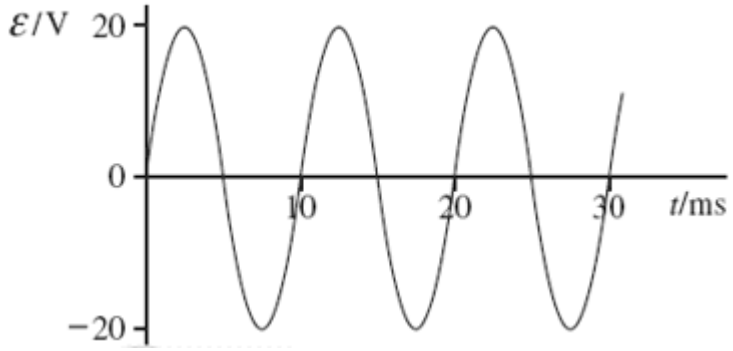
B



C

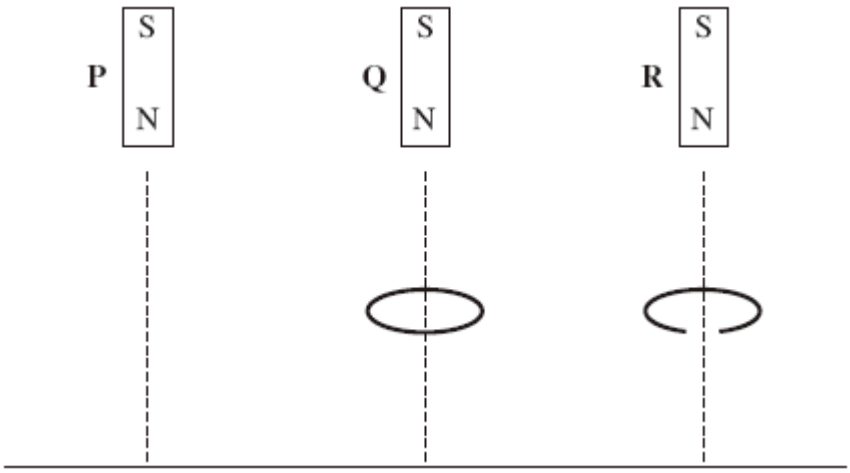


D



(Total 1 mark)

13



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**.

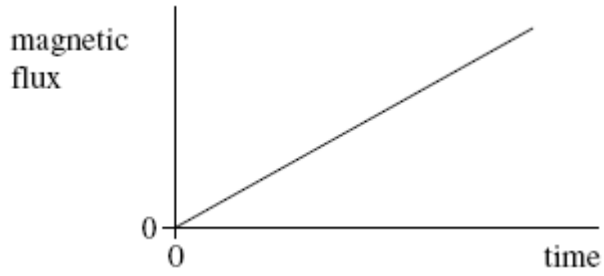
B **P** and **Q** arrive together followed by **R**.

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

D All three magnets arrive simultaneously.

(Total 1 mark)

14 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

(Total 1 mark)

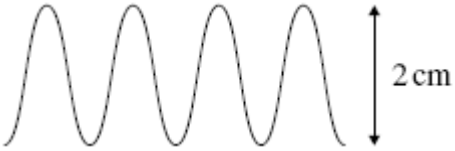
15 A coil rotating in a magnetic field produces the following voltage waveform when connected to an oscilloscope.

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

(Total 1 mark)

16 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 $\frac{E}{Nt}$

(Total 1 mark)

17 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 is induced across the wing tips of the plane?

A 0.09 V

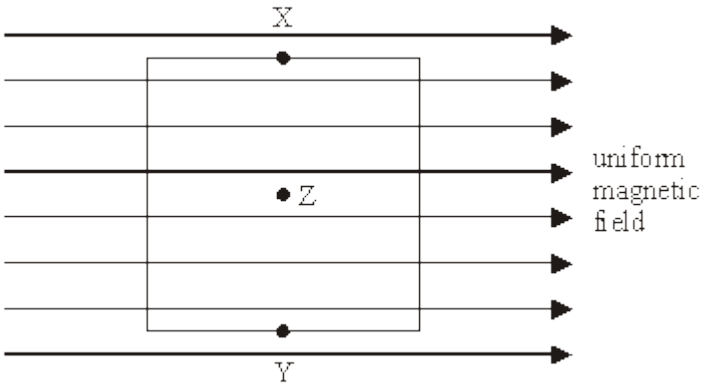
B 0.90 V

C 9.0 V

D 90 V

(Total 1 mark)

18



The diagram shows a square coil with its plane parallel to a uniform magnetic field. Which one of the following would induce an emf in the coil?

A movement of the coil slightly to the left

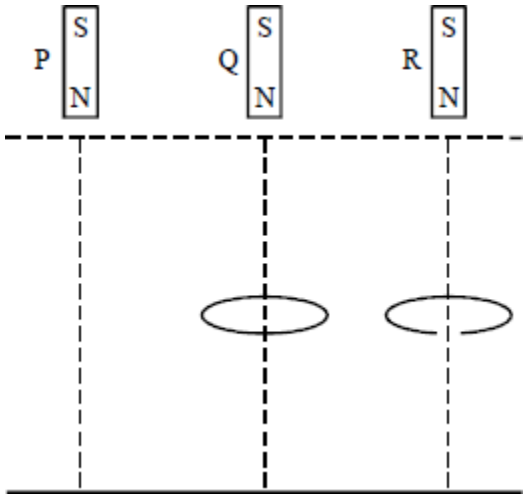
B movement of the coil slightly downwards

C rotation of the coil about an axis through XY

D rotation of the coil about an axis perpendicular to the plane of the coil through Z

(Total 1 mark)

19



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 describes 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, followed by Q which is followed by R.

D All three magnets arrive simultaneously.

(Total 1 mark)

20 The magnetic flux threading a coil of 100 turns drops from 5×10^{-3} Wb to zero in 0.1 s. The average induced e.m.f., in V, is

A 0.05

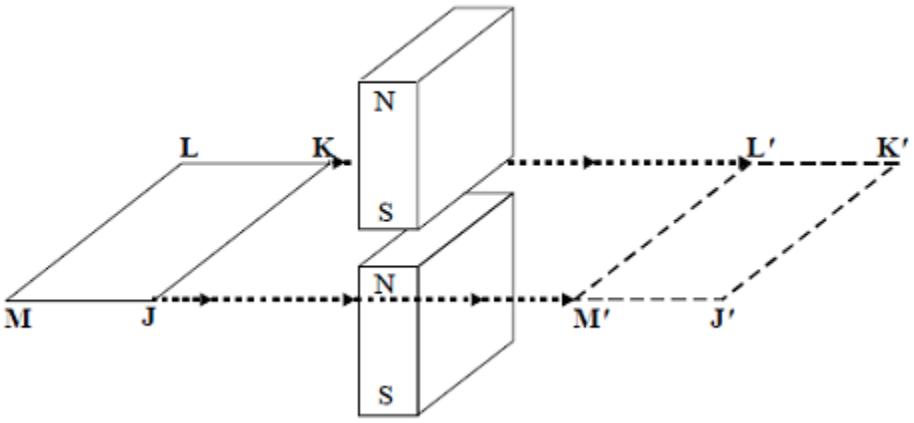
B 0.5

C 5

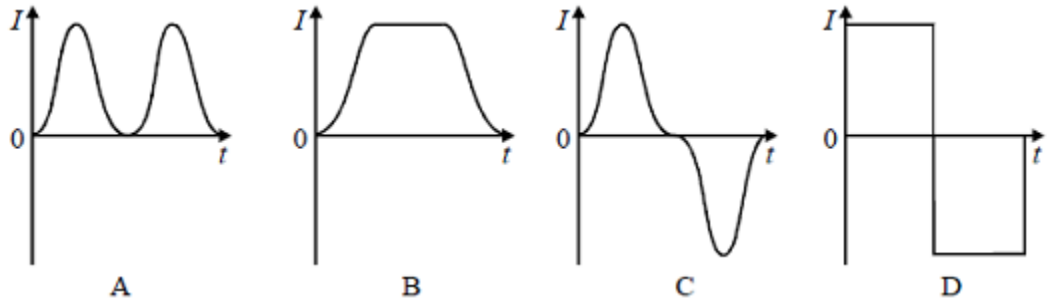
D 20

(Total 1 mark)

21 A rectangular conducting loop is pulled horizontally through the gap between two vertical magnets as shown in the diagram.



Which one of the graphs best represents the variation of loop current I with time t as the loop moves at a constant speed from **JKLM** to **J'K'L'M'**?



(Total 1 mark)