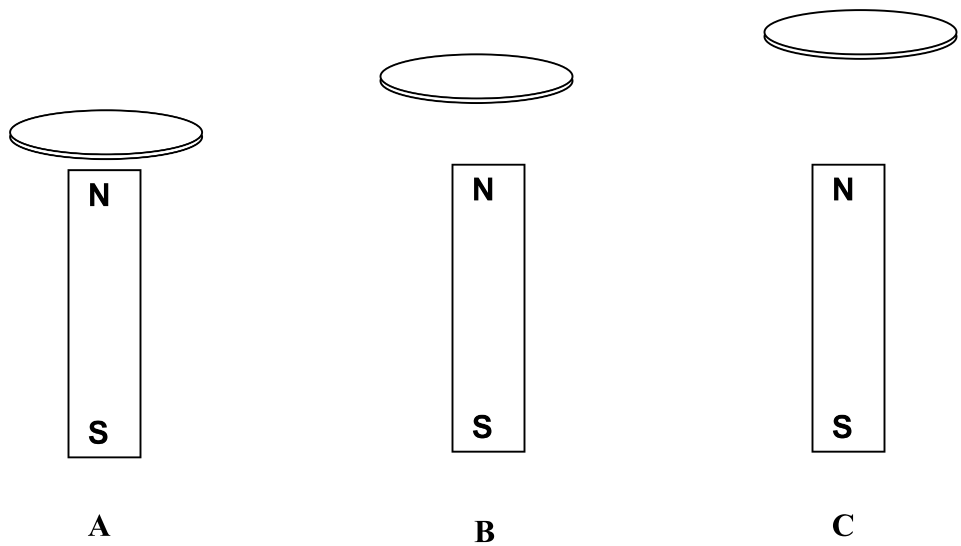
Magnetic Induction Worksheet

1. In diagrams A, B, and C, three identical bar magnets and three identical wire loops are shown. ***All three loops remain fixed in the positions shown.***



a) Is there any magnetic flux in:

Loop A? ________

Loop B? ________

Loop C? ________

b) Rank the magnitude of the magnetic flux in loops A, B, and C. If all three are zero, state that explicitly. Explain your answer.

c) Is there any current flowing in:

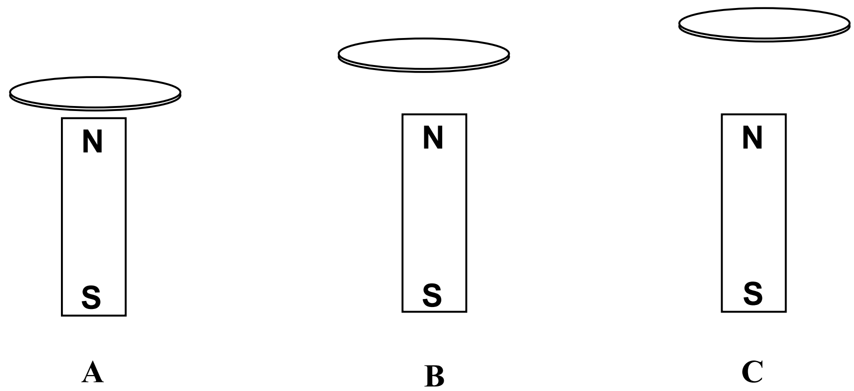
Loop A? ________

Loop B? ________

Loop C? ________

d) Rank the magnitude of the current flowing in loops A, B, and C. If all three currents are zero, state that explicitly. Explain your answer.

2. In this situation, the loop starts at position A, and then slowly and steadily moves out first to position B, and then on to position C.

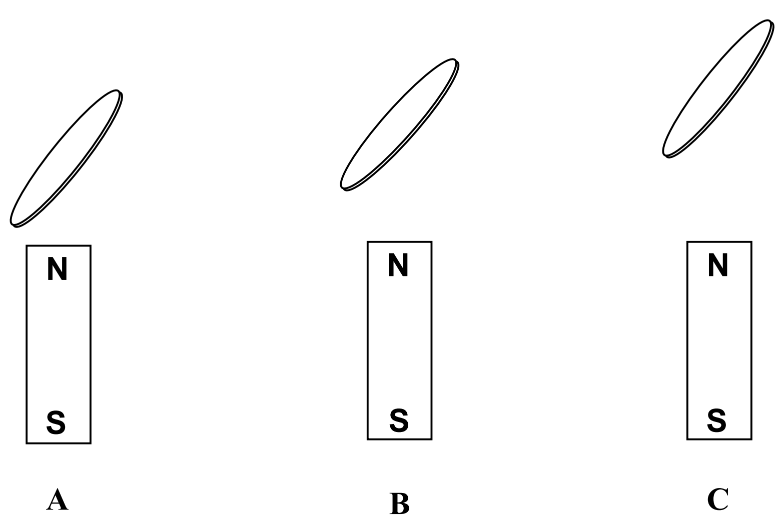


a) As the loop moves away from the magnet, does the magnitude of the magnetic flux in the loop *increase*, *decrease, remain the same (but not zero),* or *remain constant at zero*?

b) As the loop moves away from the magnet, will a current flow in the loop?

c) If the loop is moved away from the magnet in just half the time it took to move it in part (b), will the magnitude of the current flowing in the loop be (1) *zero as it is in (b); (2) the same value as in (b), but not zero; (3) larger than in (b);* or *(4) smaller than in (b)*? Explain.

d) In this case, the loop is moved the same distance away from the magnet, in the same amount of time as in (b), but now the loop is tilted as shown. Will a current flow in the loop now? If yes, how will the magnitude of the current compare to that in (b)? Explain your answer.



3. A conducting loop is placed in a uniform magnetic field indicated by the arrows. The area of the loop is 1 m^2, and its resistance is 1 Ω; both remain constant. Angle θ is 60°, and the direction of the magnetic field does not change. However, the *magnitude* of the magnetic field varies as shown in the graph

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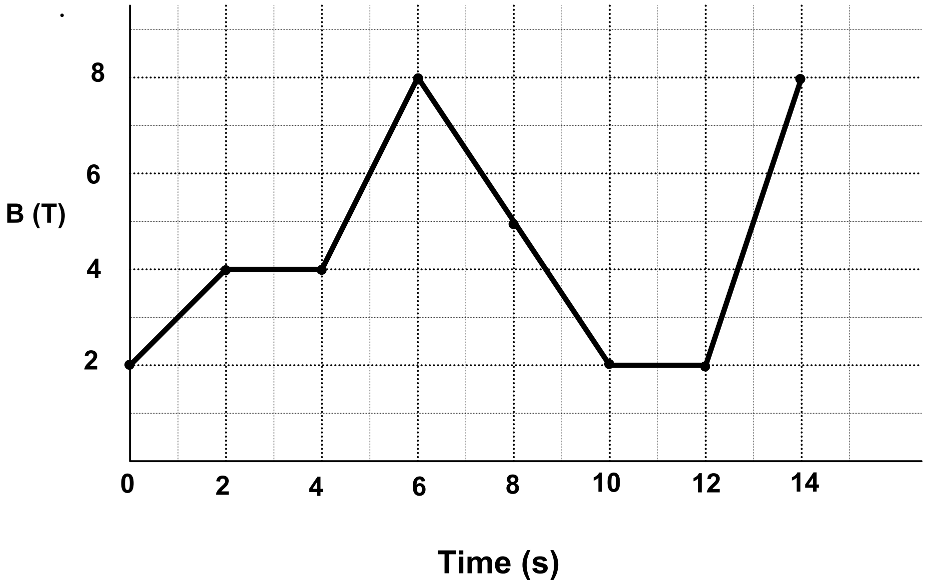
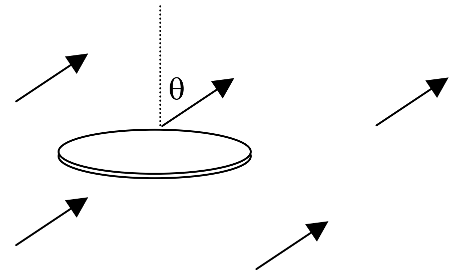




Find the magnitude and direction of the current flowing in the loop at the following times (the direction at t = 1s is given):

1 s: magnitude: _________ direction: clockwise

3 s: magnitude: _________ direction: ________________

5 s: magnitude: _________ direction: ________________

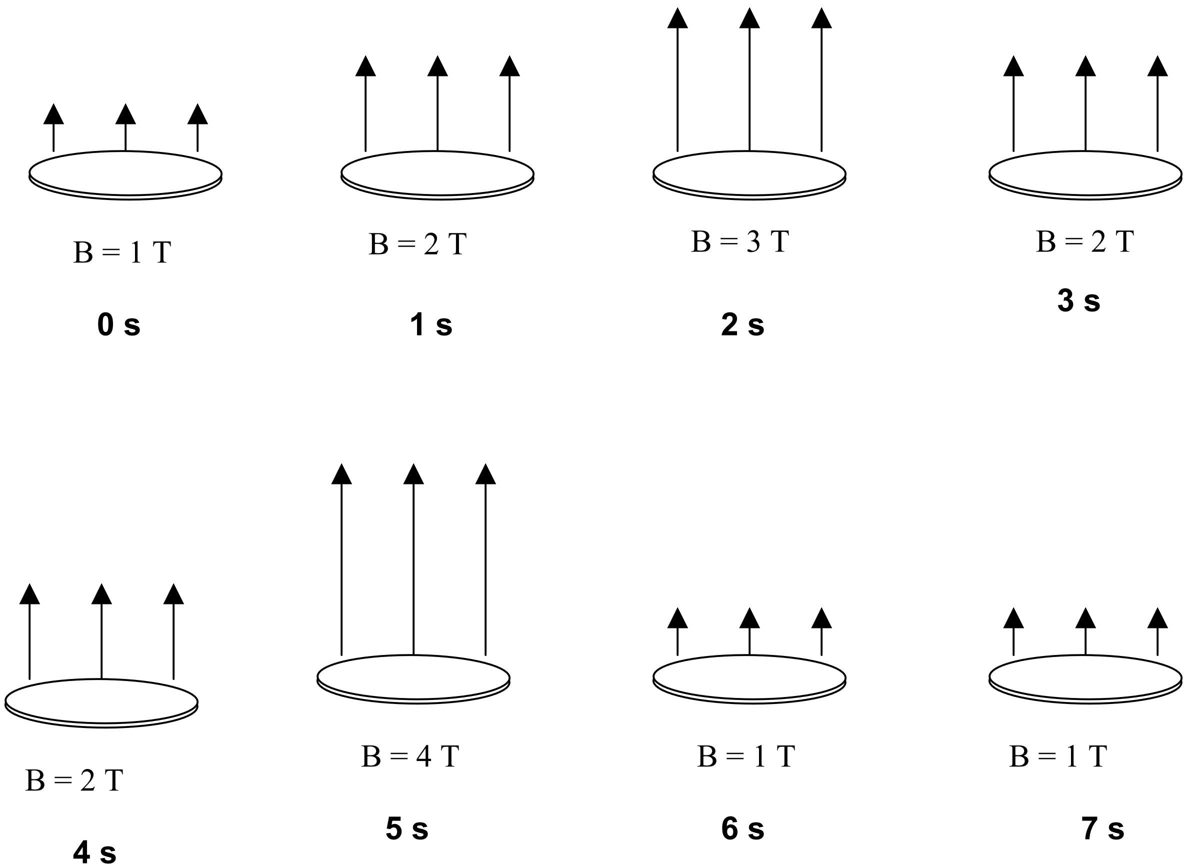
7 s: magnitude: _________ direction: ________________

9 s: magnitude: _________ direction: ________________

11 s: magnitude: _________ direction: ________________

13 s: magnitude: _________ direction: ________________

4. These diagrams show the magnitude of the magnetic field present in the region where the loop is located. The field varies in magnitude as shown (its value at different times is given).



Consider the following time periods:

A: 0 s – 1 s
B: 1 s – 2 s
C: 2 s – 3 s
D: 3 s – 4 s
E: 4 s – 5 s
F: 5 s – 6 s
G: 6 s – 7s

Rank the time periods in order of *magnitude of current flow in the loop*. (Note: A clockwise flow of 3 A and a counterclockwise flow of 3 A have the same *magnitude*).

Ranking: (largest) ________________________________(smallest)

5. A conducting loop is placed in a uniform magnetic field indicated by the arrows. The area of the loop is 1 m^2, and its resistance is 1 Ω; both remain constant. The magnitude of the magnetic field remains fixed at 5 T. The loop is continuously rotated, so that angle θ varies as shown in the graph.
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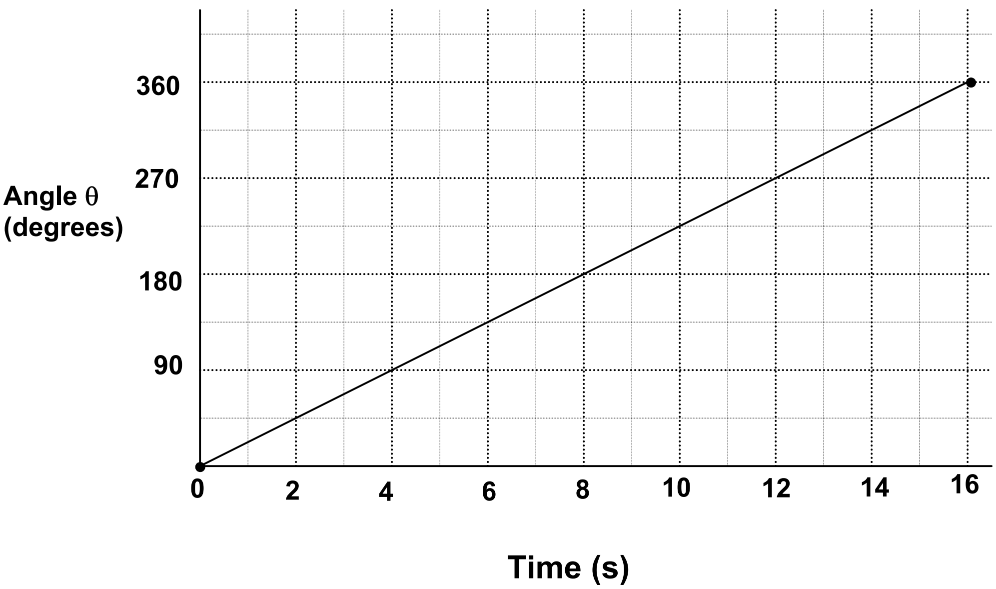

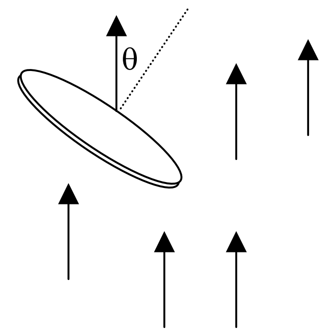

Find the ***average value*** of the magnitude of the current flowing in the loop during the following periods; also indicate the direction of the current. (the direction during the first period is given):

0 s – 2s: magnitude: _________ direction: counterclockwise

2 s – 4 s: magnitude: _________ direction: ________________

4 s – 6s: magnitude: _________ direction: ________________

6 s – 8 s: magnitude: _________ direction: ________________

8 s – 10 s: magnitude: _________ direction: ________________

Note: The average value of [$\Delta\Phi/\Delta t$] over a period is equal to [$\Phi_{final} - \Phi_{initial}$] ÷ [$t_{final} - t_{initial}$], where the initial and final values are taken at the beginning and end of the period.