a place of mind

FACULTY OF EDUCATION

Department of
Curriculum and Pedagogy

Physics
Electromagnetism

Science and Mathematics Education Research Group

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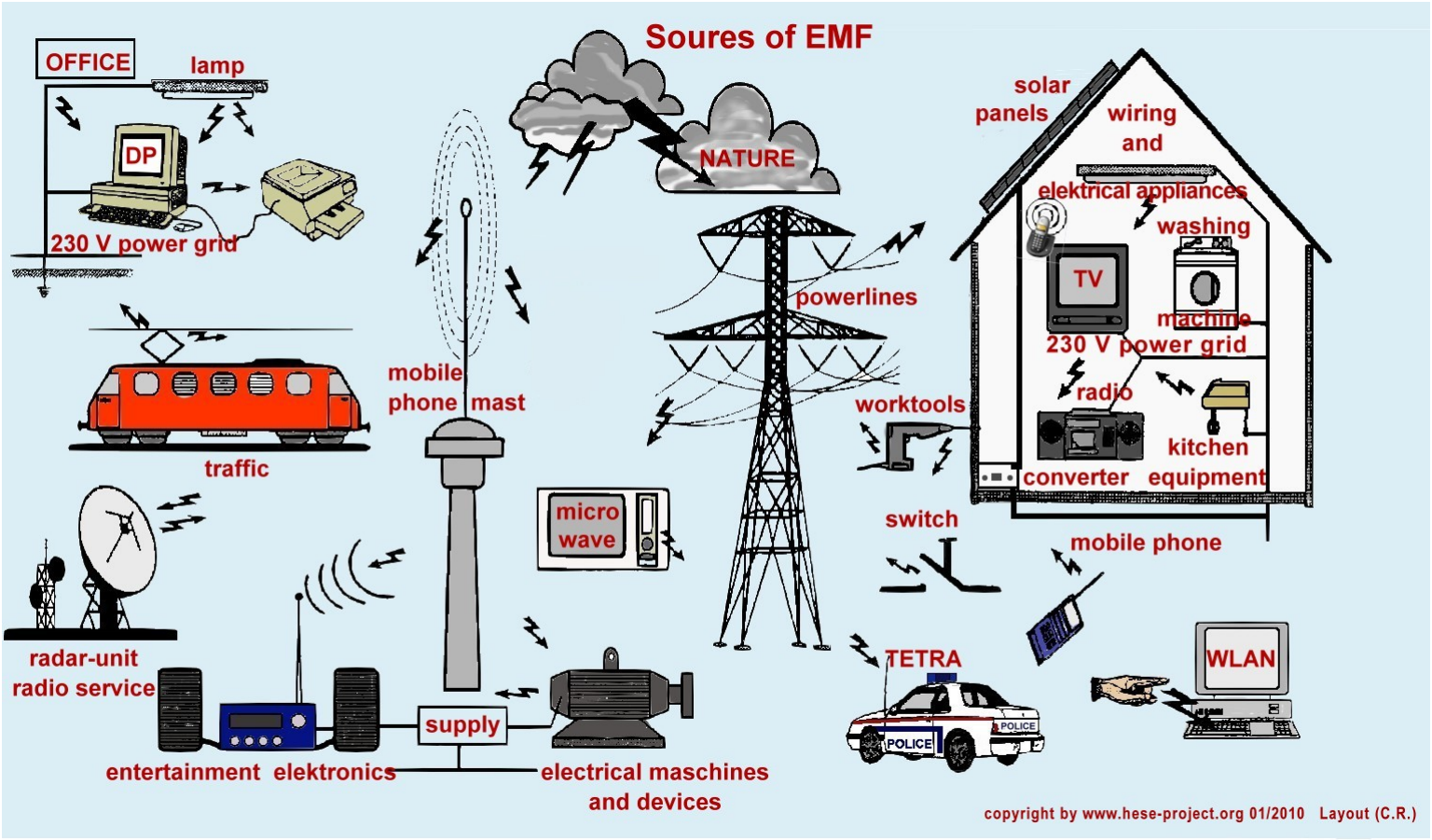
Electromagnetism



http://www.hese-project.org/hese-uk/en/niemr/

Electromagnetism

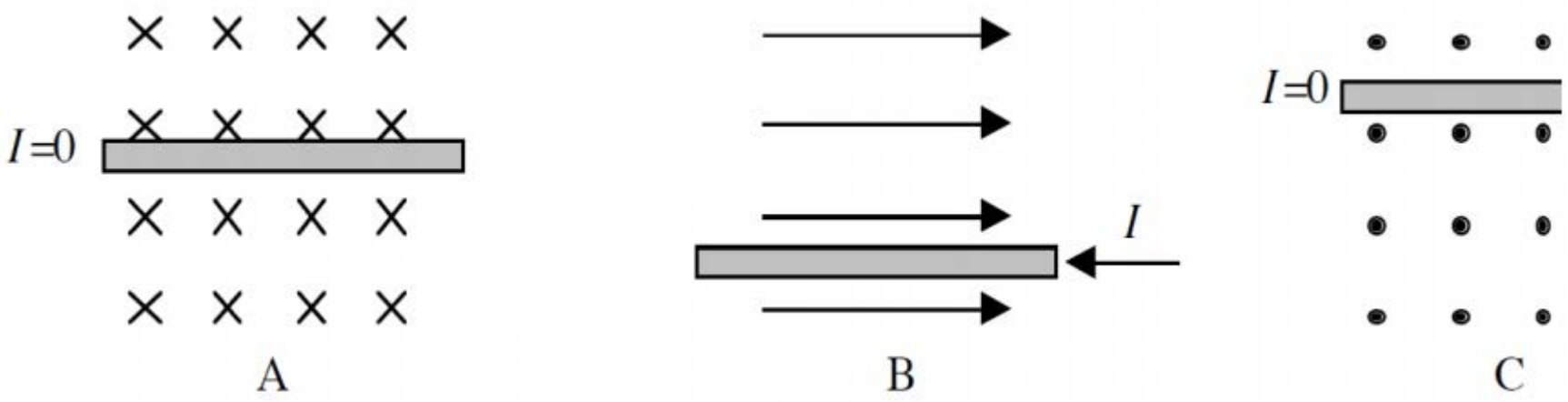
The following questions have been compiled from a collection of questions submitted on PeerWise (https://peerwise.cs.auckland.ac.nz/) by teacher candidates as part of the EDCP 357 physics methods courses at UBC.

Electromagnetism Problems I

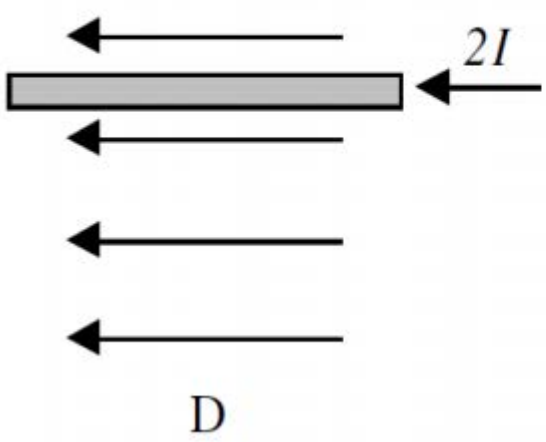
The figures below show straight wire segments carrying current in uniform magnetic fields (i.e. same strength). Can you rank these situations from the greatest to the least on the basis of the strength (magnitude) of the magnetic force on each wire. If the situations have the same strength, then rank them next alphabetically. Note that:

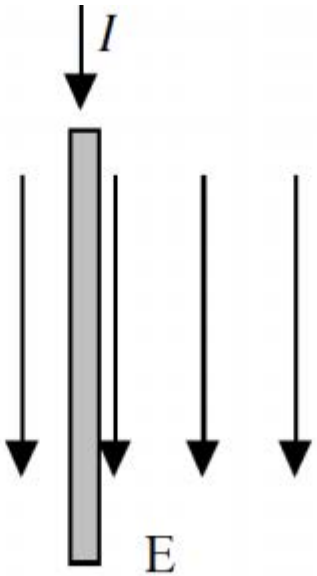
X – represents magnetic fields directed into the screen.

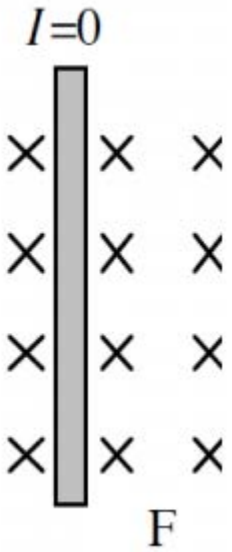
● – represents magnetic fields coming out of the screen.



Electromagnetism Problems I (cont.)







A. D, B, E, A, C, F

B. A, C, F, D, B, E

C. D, A, E, F, C, B

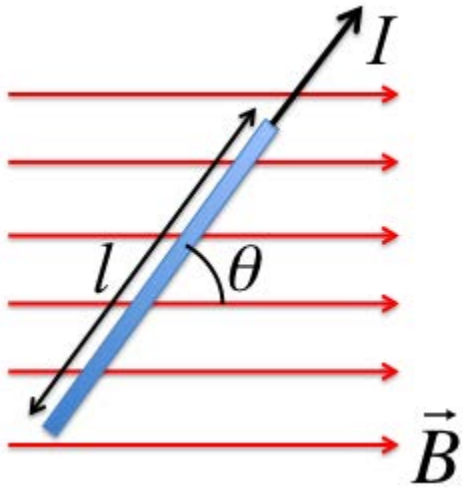
D. Same force in all six cases.

E. Impossible to rank the forces.

Solution

Answer: D

Justification: Remember, the force on a section of wire of length L carrying a current I through a magnetic field B is given by $F = I\,L\,B\,\sin(\theta)$, where θ is the angle between the wire and the magnetic field.



In figures A, C, and F, $I = 0 \rightarrow F = 0$.

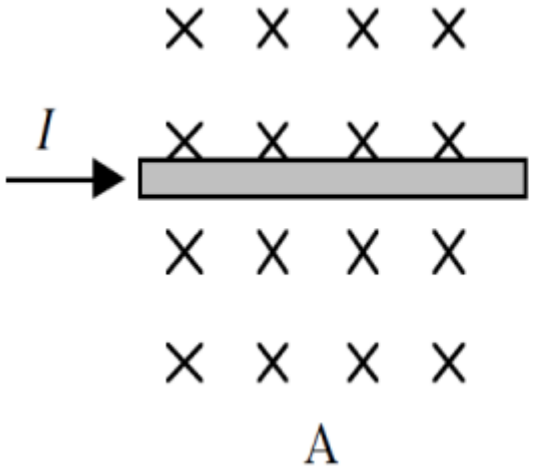
In figure B, $\theta = 180° \rightarrow \sin(180°) = 0 \rightarrow F = 0$.

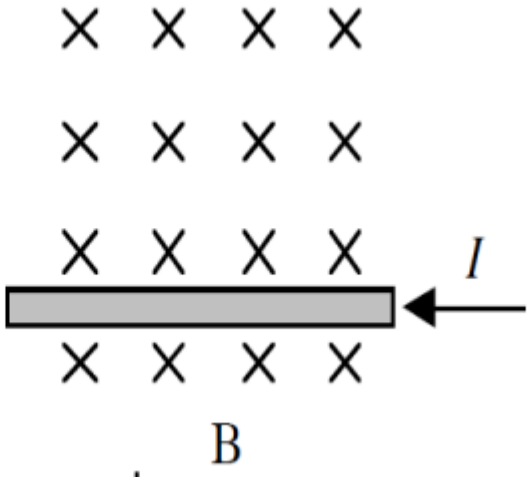
In figures D and E, $\theta = 0° \rightarrow \sin(0°) = 0 \rightarrow F = 0$.

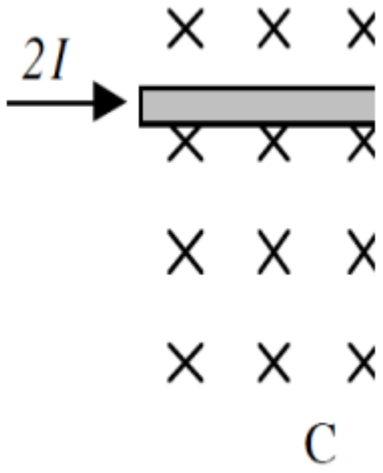
In all the cases, the strength of the magnetic force on each wire is the same, that is $F = 0$. Therefore, **D** is the correct answer.

Electromagnetism Problems II

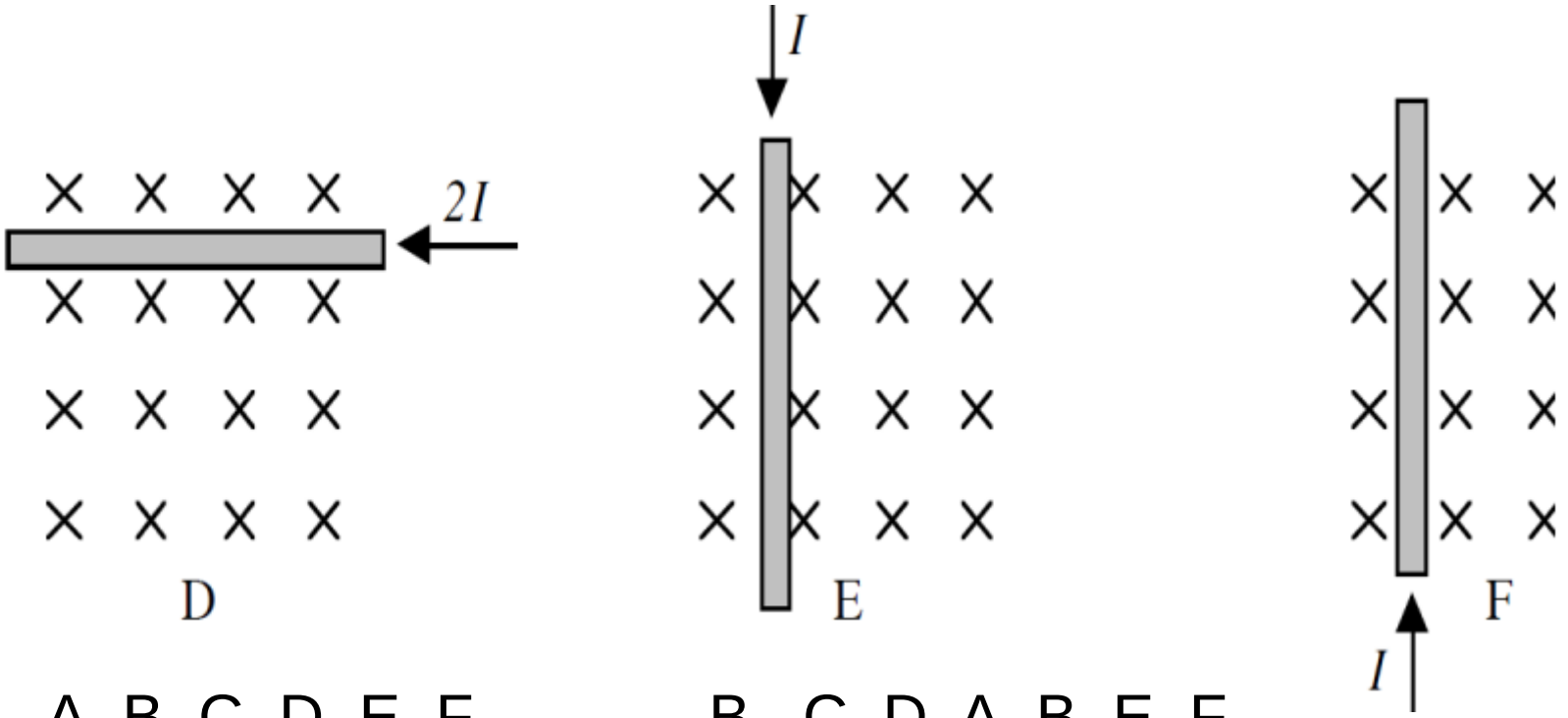
The figures below show straight wire segments carrying current in uniform magnetic fields (i.e. same strength) directed into the screen. Can you rank these situations from the greatest to the least on the basis of the strength (magnitude) of the magnetic force on each wire. If the situations have the same strength, then rank them next alphabetically.







Electromagnetism Problems II (cont.)



A. A, B, C, D, E, F

B. C, D, A, B, E, F

C. E, F, C, D, A, B

D. Same force in all six cases.

E. Impossible to rank the forces.

Solution

Answer: B

Justification: Remember, the force on a section of wire of length L carrying a current I through a magnetic field B is given by $F = I\ L\ B\ \sin(\theta)$, where θ is the angle between the wire and the magnetic field. Note that $\theta = 90°$ in all the cases.

Since L, B and θ are constant, we know that F is proportional to I, that is $F \propto I$.

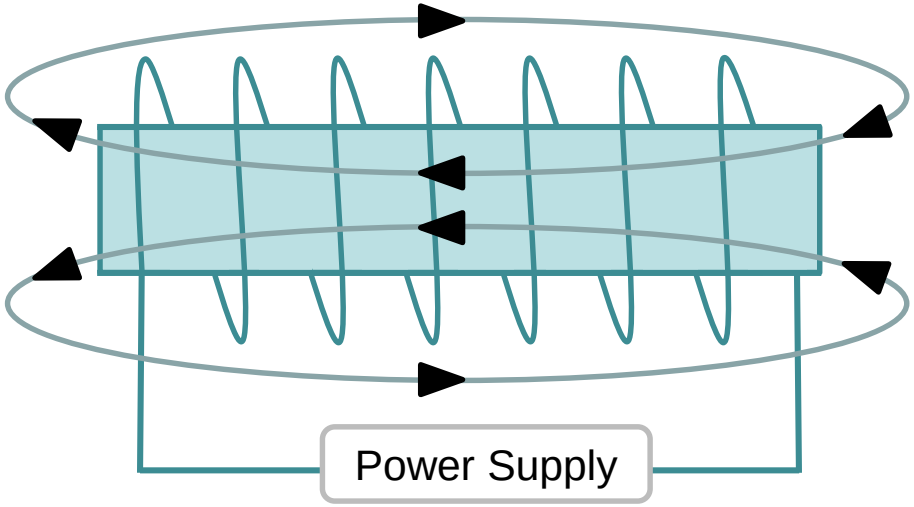
In figures A, B, E, and F, $F = I\ L\ B$. In figures C and D, $F = 2\ I\ L\ B$.

Thus, $F_C = F_D > F_A = F_B = F_E = F_F$. Therefore, **B** is the correct answer.

Watch: https://www.youtube.com/watch?v=nfSJ62mzKyY

Electromagnetism Problems III

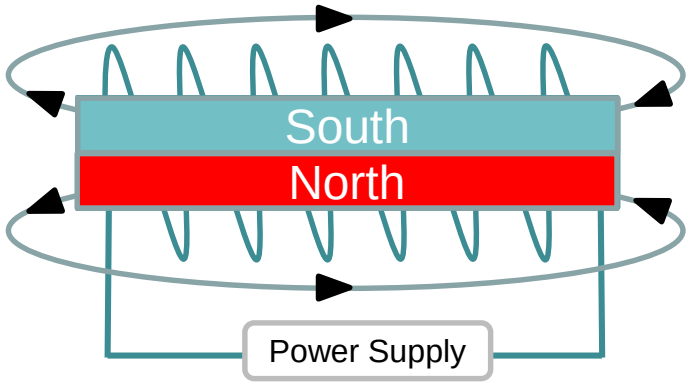
Consider the following solenoid circuit with a DC power supply. Given the magnetic field lines, which diagram best represents the induced magnetization of the metal bar within the coil of wire?



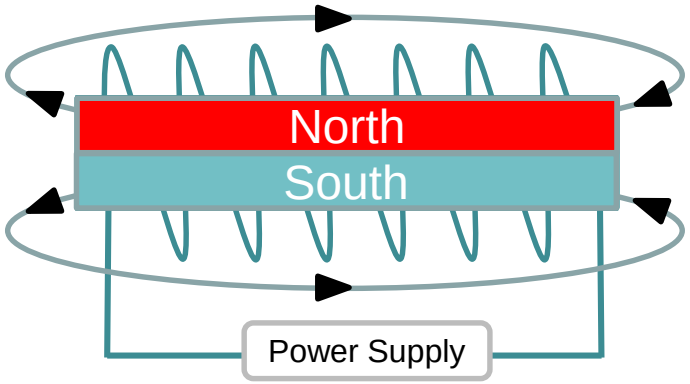
Options are presented in the next slide.

Electromagnetism Problems III (cont.)

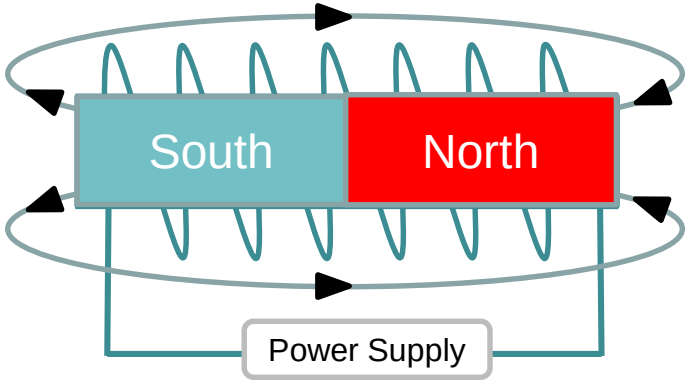
A



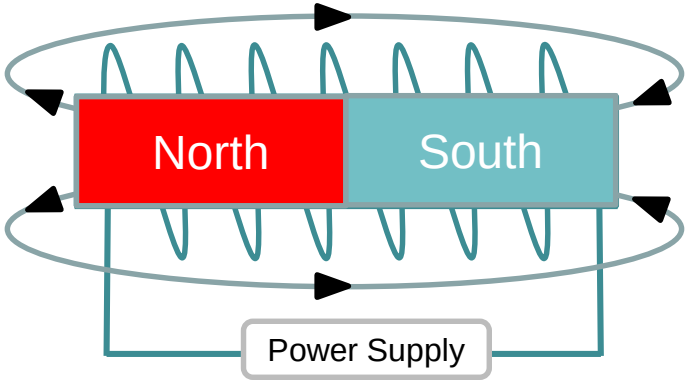
B



C



D



Solution

Answer: D

Justification: Note that we do not need to know the direction of the current. By convention, magnetic field lines emerge from the North pole of a magnet and enter at the South pole. Considering the magnetic field line, we see that the field lines are emerging from the left side of the solenoid and entering at the right side of the solenoid.

Therefore, **D** is the correct answer.

Watch: https://www.youtube.com/watch?v=V-M07N4a6-Y