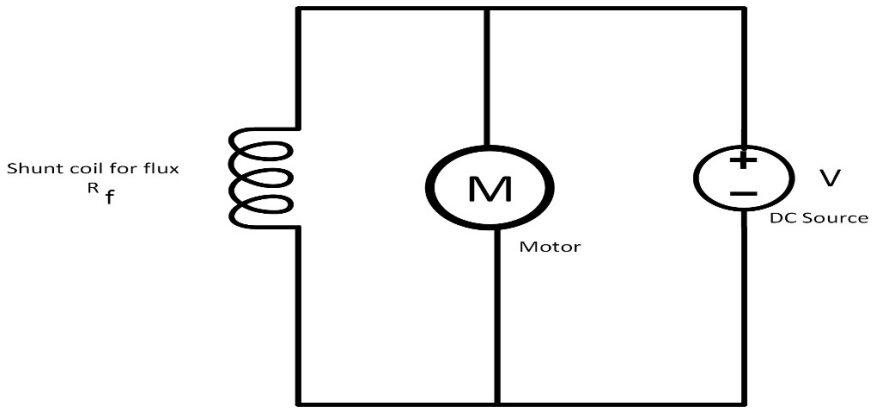
Disclaimer: The problem that are solved here is best to my knowledge. I cannot be held responsible for the mistakes in neither exams nor your personal life. I have confidence that the answers presented here is error free. If you find any misunderstanding or issue, please solve it yourself.

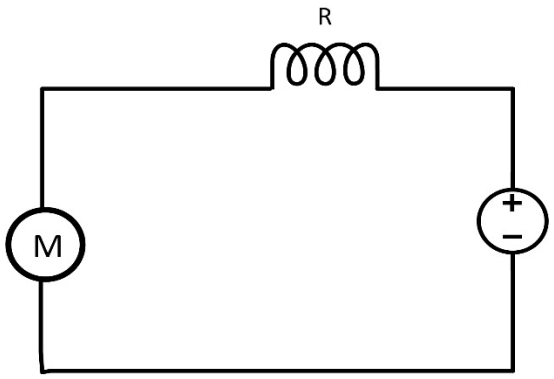
# DC Motors.

## For reference. Take this circuit diagrams.

1. Shunt DC Motor.




2. Series DC Motor.




3. Important things to notice.
   - Armature coil of motor has its own resistance, $R_a$. It is not shown in figure here.
   - We need current carrying wire to generate flux, its resistance will be denoted by $R_f$. In second figure, inductor coil is also flux generating coil in series.
   - Back emf is produced in armature of motor due to Faraday's law. It will be denoted by E.
   - Armature current will be denoted by $I_a$ and flux current will be denoted by $I_f$.
   - Torque in motor is proportional to armature current times generated flux.
   - Back emf is proportional to motor speed and flux. Motor speed is denoted by 'N' in rpm.
   - Please refer to the book for ideas and IOE syllabus app for old questions.

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# Old questions solutions.

2076 Back. 3. B.

Here,

It is a shunt motor,

Field current, $I_f$ = 220/110 = 2A

Therefore, $I_a$ = 25-2 = 23A

Apply KVL, we get back emf E = 220-23*0.1 = 217.7V

Also, when shunt resistance is increased by 50 Ohm. $I_{f2}$ = 220/160 = 1.38 A

We know, torque is proportional to $I_f$*$I_a$.

From question, new torque = $T_1$-10% of $T_1$ = 0.9$T_1$

So, $T_1/0.9T_1 = (I_{f1}/I_{f2})*(I_{a1}/I_{a2})$.

Therefore, $I_{a2}$ = 30.1 A.

Again apply KVL for 30.1 A, and back emf will be, $E_2$ = 216.98V

Now we have,

$E_1/E_2 = (N_1/N_2)*(I_{a1}/I_{a2})$.  Since, $N_1$ = 1200 rpm

$N_2$ = 914 rpm. That's it.

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2075 Bhadra, Regular 4. A.

Here,

It is DC shunt motor. Look the reference circuit.

Field current, $I_f$ = 220/220 = 1A

So, armature current, $I_a$ = 20-1 = 19 A

Apply KVL, so back emf E = 220-19*0.2 = 216.2 V

We know, torque is proportional to flux*$I_a$, flux is proportional to $I_f$,

Increased torque = 1.1 T, if T is original

Now, the field current is same on both cases,

$1.1T/T = I_{a2}/I_{a1}$

So, $I_{a2}$ = 20.9 A

Again apply KVL with new armature current and new resistance value ( 0.2+0.1 ),

Back emf, $E_2$ = 220-20.9*0.3 = 213.73V

Also, we have,

$E_2/E_1 = (N_2/N_1)$

$N_2$ = 1384 rpm.

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2075 Baisakh Back, 4. B.

Here,

It is a dc series motor, from reference figure, $I_a = I_f$

Apply KVL, 200 = E + I*(0.6+0.4),

i.e. E = 185V

Again, for 5 ohm added in series with similar current and voltages, the back emf produced is ,

E = 110V

Now, $E_2/E_1 = (I_2/I_1)*(N_2/N_1)$

Therefore, $N_2$ = 476 rpm.

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That's it. Try to do all other problems in similar way.