Checkpoints Chapter 12 Motors

Question 477

The field from the magnet is from North to South, i.e. right to left across the page. The current is travelling down the page when it is closest to the north pole of the right hand magnet.
Using your right hand thumb to represent the current, the fingers to represent the field, right to left, then the force is into the page.
When viewed from above, this will be seen as an anti-clockwise rotation.

∴ B (ANS)

Question 478

The speed of rotation of the coil depends on the torque on the coil.
To decrease this speed of rotation you need to decrease the torque.
This is done by decreasing the length of wire in the field, by decreasing the number of turns, decreasing the area of the coil, this decreases the size of the lever arm, and decreasing g the current in the rotating coil, this decreases the force acting (F = nBIL).

∴ B, D, F (ANS)

Question 479

DC electromagnets (coils, with a current in them) will not change anything because the poles will stay constant, electromagnets act the same as permanent magnets.

∴ D (ANS)

Question 480

The right hand coil is acting like the north pole of a permanent magnet. The left hand coil is acting like the South end of a magnet. (Make sure that you understand this concept).
So the field from the electromagnets is from the right to the left. Put your fingers of your right hand in this direction. Have the palm facing out of the page, because we want side AB to rotate towards us, so this is the direction of the force acting on it. This means that your thumb must be pointing up, so the current is flowing from B to A.
For the coil to continue to rotate their will need to be some way of reversing this current a half cycle later.

∴ C (ANS)

Question 481

This would reverse the direction of one of the fields. As they are vectors this would mean that at the centre of the coil the field would be approximately zero, but at the edges of the coil, the fields would not be cancelled because the component from the coil nearest that side would be larger than the component from the other coil. There would still be some cancelling, but not anywhere near as complete.

∴ No (ANS)

Question 482

The left hand electromagnet produces a 'N' pole, and the right hand electromagnet produces a 'S' pole. The current source to the rotor must go through a split ring commutator so that the direction of the current reverses every half cycle.

This means that if the motor was connected to AC instead, then the direction of the 'poles' would be constantly changing, but this would not have any effect on the performance of the motor because the direction of the current in the rotor changes at the same time. This reversal of the field and reversal of the current would not affect the motor.

Question 483

The field is from the North pole to the South pole, ie from left to right. This will be the direction of your fingers. The current (your thumb) needs to go from W to X.
∴ the force on WX is **down.**
The force on ZY will be opposite,

∴ up. (ANS)

Question 484

F = nBIL
$= 30 \times 45 \times 10^{-3} \times 3.5 \times 0.1\text{m}$
(need to convert 10 cm to 0.1 m, watch the units of mT)

= 0.47 N (ANS)

Question 485

This is because the wire XY is parallel to the field.

∴ Zero (ANS)

Question 486

After a quarter cycle, ZY is at the top, the force acting on it is now upwards. This does not produce any rotation, so just before this point, the current stops. Just after a quarter cycle ZY has gone past the top, and to continue the rotation we now want the force to be acting downwards on it (and upwards on WX). To achieve this we need to reverse the direction of the current flowing in ZY, the commutator does this.

Question 487

F = nBIL
= 20 × 0.1 × 2 × 0.02m
(need to convert 2 cm to 0.02 m)
∴ = 0.08 N (ANS)

Question 488

This is because the wire AB is parallel to the field.
∴ Zero (ANS)

Question 489

The right thumb must point down in the direction of the current. If viewed from above, the side AD is moving into the page, so the fingers must be pointing from right to left. This means that the field is from right to left (the same).
∴ B (ANS)

Question 490

Use your fingers in the direction of the field, from N to S. The thumb is in the direction of the current, (from K to L) so the force (direction of palm) must be down.

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∴ B, B, B (ANS)

Question 491

Use your fingers in the direction of the field, from N to S. The thumb is in the direction of the current, (from M to L) so the force (direction of palm) must be forwards to the centre of the loop.

Use your fingers in the direction of the field, from N to S. The thumb is in the direction of the current, (from M to L) so the force (direction of palm) must be forwards to the centre of the loop.

Now the wire is parallel to the direction of the field so the force acting must be zero.
∴ E, E, NF (ANS)

Question 492

To turn a loop into a DC motor, you need to change the direction of the current every half cycle. This needs to occur when the loop is in a vertical plane. The role of the connections A and B is to change the current. This is the role of a commutator.

Question 493 (2012 Q2a, 1m, 70%)

With the field from North to South, the current from J to K, The force on JK will be down.
∴ B (ANS)

Question 494 (2012 Q2b, 2m, 66%)

The force on the current carrying wire is given by
F = nBiL
= 50 x 0.05 x 2.0 x 0.06
= 0.30 N (ANS)

Question 495 (2013 Q16a, 2m 60%)

Anticlockwise.
The current is from W to X, therefore the force of side WX is down. The force on side YZ is up. This will cause the loop to rotate anticlockwise.

Question 496 (2013 Q16b, 2m, 75%)

Use F = nBiL
∴ F = 20 x 500 x 10^{-3} x 0.5 x 0.05
∴ F = 0.25 N (ANS)

Question 497 (2013 Q16c, 2m, 55%)

No.
The direction of the force will reverse every half cycle, so the loop will oscillate.

Question 498 (2014 Q17a, 2m, 75%)

Use the right hand slap rule. The field is from left to right, the current flows from W to X to Y to Z.

∴ WX: down, YZ: up.

In both XY and ZW the current is parallel to the field. Therefore the force is zero.

∴ XY: no force, ZW: no force.

Question 499 (2014 Q17b, 2m, 75%)

Use F = nBil,

∴ F = 75 × 0.020 × 2.0 × 0.40

∴ F = 1.2 N (ANS)

Question 500 (2014 Q17c, 2m, 50%)

When the current flows, there will be a force on the current carrying wire. The force on WX is up, the force on YZ is down. This will produce a torque that will cause the coil to rotate.

Question 501 (2014 Q17d, 2m, 80%)

The role of the commutator is to reverse the direction of the current at this point, so that the coil will continue to rotate in the one direction.

∴ from W to X
No current
From X to W

At the vertical point, the brushes are not connected to the coil, as they are touching the insulator in the middle section, therefore there isn't a current.