

Physics Stage 3: Electricity and Magnetism

How Much Do You Know

Name: _____ (60 marks)

1. a. Draw the field around the two bar magnets below. (1 mark)



- b. Draw the field around the current carrying wire below. (1 mark)



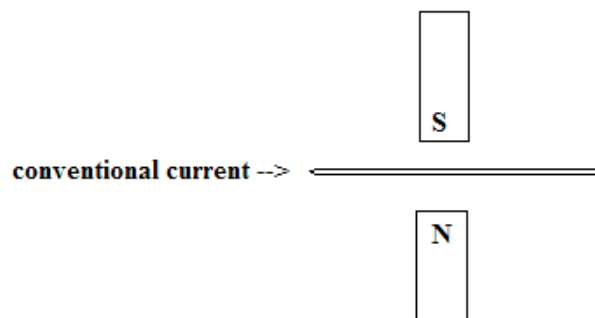
- c. Draw the field around the combination. (1 mark)



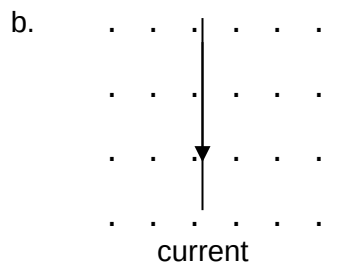
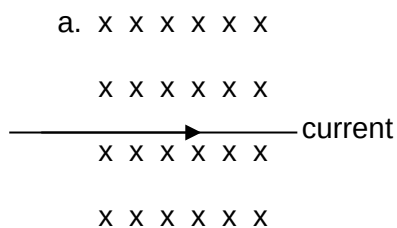
- d. Draw the field around these two magnets. (1 mark)



2. In which direction will a wire move in the following situation? _____ (1 mark)



3. What is the direction of force on the wire in the following situations. (2 marks)

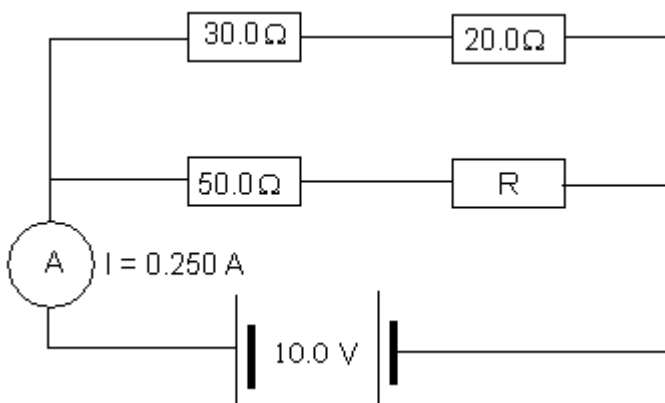


answer: _____

answer: _____

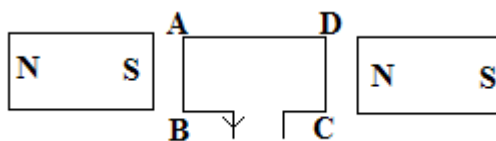
4. Near the north pole the Earth's magnetic field is almost vertical. Is the field direction here vertically upwards, or is it vertically downwards? Explain your answer. (2 marks)

5. Given the following information, what is the value of resistor R? (3 marks)



6. A wire 1.50 m long and carrying a current of 5.00 A is situated in a magnetic field of 10.0 T. What force does the wire experience if it is:
- a. parallel to the field? (1 mark)
- b. at right angles to the field? (1 mark)

7. A rectangular coil of wire, 2.00 cm by 4.00 cm (as shown below), consisting of 200 turns is placed in a magnetic field of 2.00×10^{-2} T. If a current of 4.00 A is flowing in the coil as shown,
- a. In which direction will side CD move? (1 mark) _____



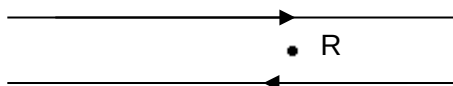
- b. Find the force on side AB of the motor. (2 marks)
- c. Find the maximum torque experienced by the coil. (2 marks)

8. A rectangular coil of wire has 100 turns, a length of 2.00 cm and a width of 4.00 cm. The coil is placed perpendicular to a magnetic field of 0.02 T. The coil is spun at 155 revolutions per minute. What is the average emf induced in the coil? (3 marks)

9. A student in a practical lesson set up a circuit consisting of a solenoid of 500 turns, a lamp and a transformer. She first connected the lamp, solenoid and transformer in series, with the transformer set on 12 V DC. Upon placing some iron rods in the centre of the coil, no obvious changes occurred. She repeated this with the transformer set on 12 V AC and this time found that the lamp dimmed and the rods vibrated and became hot. Explain the student's observations. (3 marks)

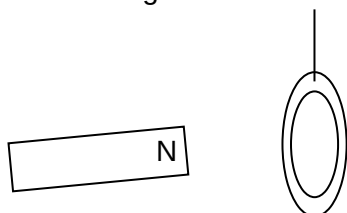
10. An all-metal plane, which is flying horizontally due East, has wing tips which are 30.0 m apart. If the vertical component of the earth's magnetic field at this point is 6.00×10^{-5} T upwards, calculate the induced emf when the aircraft is travelling at a speed of 3.00×10^2 km h⁻¹. (2 marks)

11. Two parallel wires carry current of 3A and 4A respectively as shown below. In what direction is the magnetic field at point R, which is midway between the wires? (1 mark)



Answer: _____

12. Consider the following situation in which the north end of a magnet is approaching an aluminium ring. Which of the following answers is correct? (1 mark)

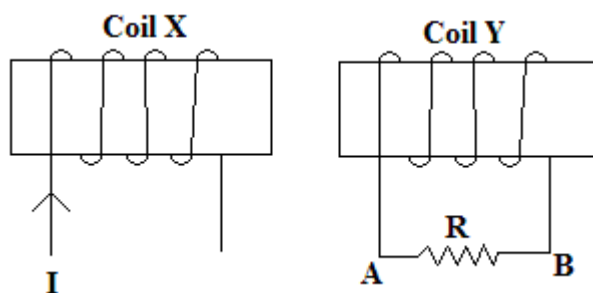


Answer: _____

- A current is induced in a clockwise direction setting up a north pole.
- A current is induced in a clockwise direction setting up a south pole.
- A current is induced in an anticlockwise direction setting up a north pole.
- A current is induced in an anticlockwise direction setting up a south pole.

13. The Earth's magnetic field is about $50 \mu\text{T}$. Estimate the maximum amount of magnetic flux that could be enclosed by a netball ring. (2 marks)

14. Look at the following coils:



- a. What is the direction of the induced current through R while the magnetic flux density is decreasing? (2 marks)
-
- b. Given that the area of each loop of the coil is $1.00 \times 10^{-2} \text{ m}^2$ and the flux decreases from 0.500 Wb to 0.200 Wb in 2.00 s , find the magnitude of the induced emf in each loop. (2 marks)
15. No motor is 100% efficient. Consider a starter motor in a car which is 60.0% efficient. To operate it needs 1.10 kW to start the 12.0 V battery. What current will it need to draw in order to operate? (2 marks)

16. My portable stereo runs on 9.0 V, but can be connected safely to the 250 V mains through a power cord with a 'black box' in it.
- What is the black box called? (1 mark) _____
 - Sketch a labelled diagram of the device inside the black box, showing the input and output. (1 mark)

- If the secondary coil has 30 turns, how many turns has the primary coil? (2 marks)

17. How do power companies minimized the loss of power incurred in transmitting electricity through power lines, and explain why less power is lost this way? (3 marks)

18. An Aluminium disc rotates on a spindle. When a strong horseshoe magnet is placed so that the disk is within the magnet, the disk is rapidly slows down and stops. Explain why. (3 marks)

19. Draw the electrical field for the following situations:

a. two positive charges
(2 marks)

b. positive charge above a negative plate
(2 marks)

20. An electric kettle is rated at 2.20 kW when connected to a 240 V supply. The kettle runs for 2.50 minutes.

a. What current runs through the heating element? (2 marks)

b. How much electrical energy is converted to heat energy? (2 marks)

c. What charge flowed through the kettle in this time? (2 marks)

21. An electrician needs to add a fuse into an electrical circuit in a factory. She has a choice of 1.00 A, 2.00 A, 5.00 A and 10.0 A. The total power drawn from the circuit will be 450 W with a total resistance of $115\ \Omega$. Which fuse should she use so as to ensure that the electrical devices operating on that circuit will not be damaged by excess current? (3 marks)