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PHY 202 TEST 1 – ELECTRIC CIRCUITS & ELECTRONICS

Answer all questions **30 Minutes**

1. (a) Define electric current. [1 mark]
(b) Differentiate between a.c. and d.c. [1 mark]
(c) The circuit (Fig. 1) shows a battery of e.m.f. 6.0 V connected to a switch and to two resistors in parallel, each of resistance 3.0 Ω. The switch S is closed for a period of 5.0 minutes. Calculate:
(i) the current through each resistor. [2 marks]
(ii) the current through the battery. [2 marks]
(iii) the total charge which passes through the battery. [2 marks]
(iv) the energy supplied by the battery. [2 marks]
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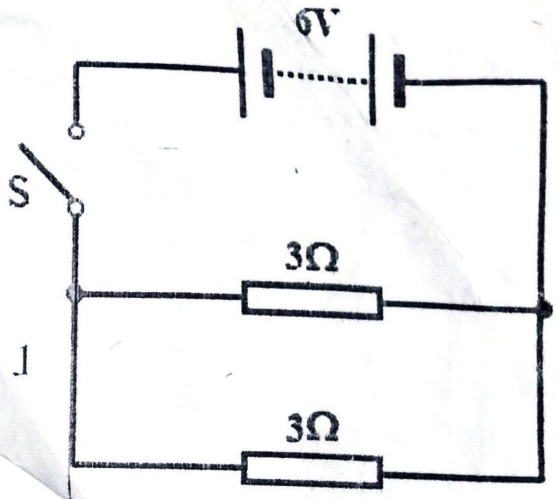

Fig. 1

2. In the circuit shown in Fig. 2, using Kirchhoff's laws find
(a) the current in resistor R; [3 marks]
(b) the resistance R; [4 marks]
(c) the unknown e.m.f. E. [3 marks]

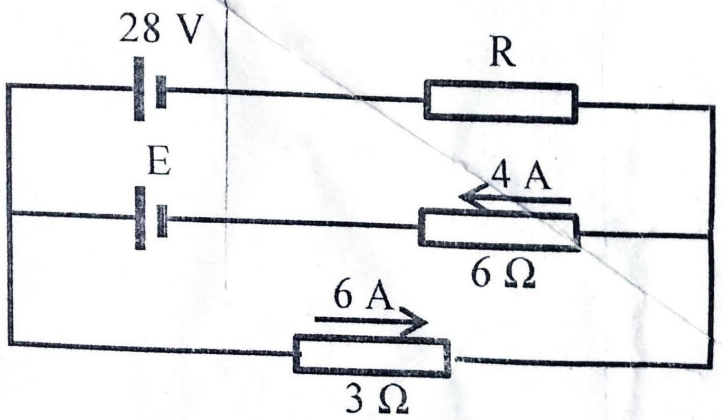

Fig. 2

3. (a) State one difference between electrical resistance and reactance. [1 mark]
(b) An alternating source of 10.0 V and frequency 100 Hz is connected in series with a 5 Ω resistor and 20 mH inductor.
(i) Draw the circuit diagram of the arrangement. [1 mark] Calculate the:
(ii) reactance of the inductor. (iii) impedance of the circuit. (iv) potential difference across the inductor. [8 marks]

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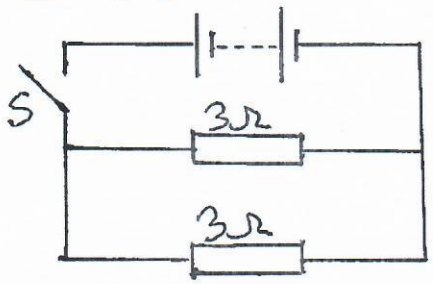
PHY 202 TEST 1 MARK SCHEME 2021-2022

1(a) Electric current is the rate of flow of electric charges (1)

(b) a.c. is characterised by periodical change in direction of current while d.c. is characterised by unidirectional flow of current. (1)

(c)



(i) P.d. across each resistor is 6V

$I = \frac{V}{R} = \frac{6V}{3\Omega} = 2A$ each (2)

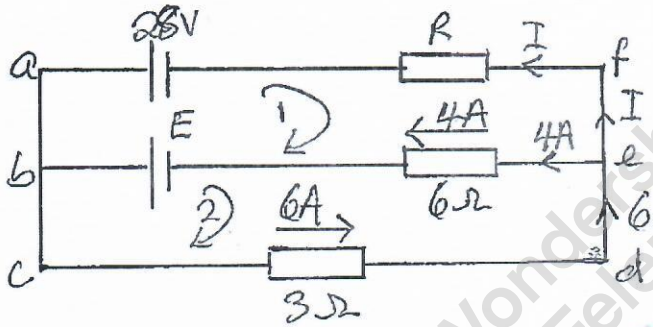
(ii) current I through the battery

$I = 2A + 2A = 4A$ (2)

(iii) $Q = It = 4 \times 5 \times 60 = 1,200C$ (2)

(iv) $E = IVt = 4 \times 6 \times 5 \times 60 = 7,200J$ (2)

2.



(a) At junction e: $I + 4 = 6$ (1)

$I = 6 - 4 = 2A$ (1)

$I = 2A$ (1)

(b) using loop 2: bedCb (1)

$-E + 4(6) + 6(3) = 0$ (1)

$-E + 24 + 18 = 0$ (1)

$24 + 18 = E$

$E = 42V$ (1)

(b) using loop 1: afeba (1)

$-28 + 2(R) - 4(6) + E = 0$ (1)

$-28 - 24 + 42 + 2R = 0$

$-10 + 2R = 0$

$2R = 10$

$R = 10/2$

$R = 5\Omega$ (1)

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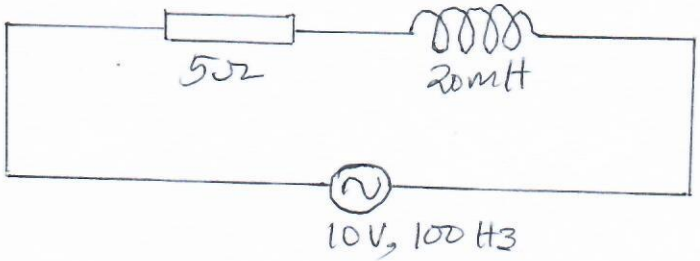
3(a) – Resistance dissipates electrical energy, reactance does not.

Any 1 x 1mk = (1)

– Reactance value depends on frequency of a.c., resistance does not.

(b) (i)



Complete diagram with the right circuit symbols (1)

(ii) $X_L = \omega L = 2\pi f L$ (1) $= 2\pi \times 100 \times 20 \times 10^{-3} = 12.6\Omega$ (1)

(iii) $Z = [R^2 + X_L^2]^{1/2}$ (1)

$= [5^2 + 12.6^2]^{1/2}$

$= [25 + 158.76]^{1/2}$

$Z = [183.76]^{1/2}$

$Z = 13.6\Omega$ (1)

(iv) $I = V/Z$ (1) $= \frac{10V}{13.6\Omega} = 0.735A$ (1)

$V_L = IX_L$ (1) $= 0.735 \times 12.6 = 9.3V$ (1)

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