Assessment Schedule – 2019

Physics: Demonstrate understanding of electrical systems (91526)

Evidence Statement

Q	Evidence	Achievement	Merit	Excellence
ONE (a)	$V_{\text{terminal}} = emf - IR$ $8.60\text{ V} = 9.00\text{ V} - 0.333\text{ A} \times R$ $R = \frac{0.400}{0.333} = 1.20\ \Omega$	• $R = 1.20\ \Omega$ (Must show understanding of r, V & emf) **SHOW QUESTION**		
(b)	Outside Voltage Loop: $+9.00\text{ V} - 1.20\ \Omega \times 0.333\text{ A} - 25.0\ \Omega \times I_3 - 18.0\ \Omega \times I_3 = 0$ $I_3 = 0.200\text{ A}$ Equation at Junction A: $I_1 = I_2 + I_3$ $0.333\text{ A} = I_2 + 0.200\text{ A}$ $I_2 = 0.133\text{A}$ Left Hand Loop: $+9.00\text{ V} - 1.20\ \Omega \times 0.333\text{ A} - 9.80\ \Omega \times 0.133\text{ A} - emf = 0$ $emf = 7.30\text{ V}$	• $I_1 = I_2 + I_3$ • Correct loop equation with 2 unknowns • $I_3 = 0.20\text{ A}$ **SHOW QUESTION for I_3**	• $I_1 = I_2 + I_3$ AND $I_3 = 0.20\text{ A}$ • $I_2 = 0.133\text{A}$ AND $I_3 = 0.20\text{ A}$ • Correct Voltage loops shown using incorrect *I* values .	• $emf = 7.30\text{ V}$ AND • $I_3 = 0.20\text{ A}$ AND • $I_2 = 0.133\text{A}$ OR $I_1 = I_2 + I_3$
(c)	Alternating current in the reader induces a changing magnetic field in the payment machine coil. When the coil in the card is near enough the changing magnetic field of the payment machine coil creates a change flux inside the card coil, which then induces a voltage in the coil.	• Changing current / voltage in payment machine coil produces a changing magnetic field / flux • Change in flux in card induces voltage	• Full response **Do NOT accept induced current induces a voltage.**	
(d)	Resonanace under the condition ($X_L = X_C$) $X_L = \frac{1}{2\pi f C}$ $427\ \Omega = \frac{1}{2\pi \times 13.6 \times 10^6 \times C}$ $C = 2.74 \times 10^{-11}\text{ F}$	• $X_L = X_C$ • $X_C = 427\Omega$ • $C = 2.74 \times 10^{-11}\text{ F}$	• $X_L = X_C$ AND $C = 2.74 \times 10^{-11}\text{ F}$	?

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TWO (a)	$V_{peak} = \sqrt{2} \times 24.0\ V_{RMS} = 33.9\ V$	• 33.9 V		
(b)	Area = 1.60 m × 0.600 m = 0.960 m^2 Max B flux = $B \times A$ = 0.0413 T × 0.960 m^2 = 0.0396 Wb	• Correct method of calculating magnetic flux, but incorrect values used.	• 0.0396 Wb	
(c)	Reducing the inductance of the inductive loop would reduce the reactance of the circuit. The resistance remains unchanged, thus the overall impedance would be reduced, and so current would rise.	• ↓ *L* therefore ↑ *I* • ↓ *L*, ↓ X_L / Z • Idea of changing magnetic flux inducing an **opposing** voltage.	• ↓ *L*, results in ↓ X_L and ↓ *Z* & *I* ↑. • Links changing magnetic flux with induced voltage and current, which in turn produces an opposing magnetic field, reducing the overall magnetic field, which then reduces the inductance.	
(d)	$f = 1.20 \times 10^2$ Hz, $L = 5.00 \times 10^{-3}$ H $X_L = 2\pi \times 120\ \text{Hz} \times 0.005 = 3.77\ \Omega$ $R = 4.00\ \Omega$ $Z = \sqrt{R^2 + X_L{}^2}$ $= \sqrt{4.00^2 + 3.77^2}$ $Z = 5.496626\ \Omega$ $I = \frac{24.0\ \text{V}}{4.496626\ \Omega} = 4.36631\ \text{A} = 4.37\ \text{A}$	• X_L = 3.77 Ω • *Z* calculated with incorrect X_L value.	• *Z* = 5.5 Ω • *I* calculation with incorrect Z value.	• *I* = 4.37 A

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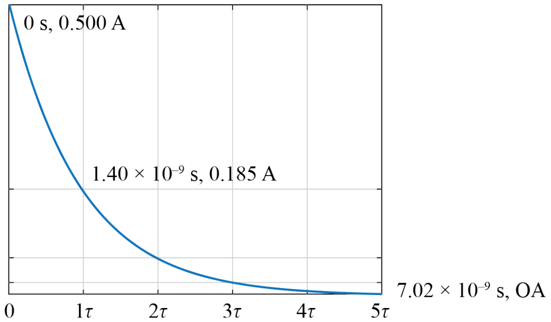
THREE (a)	$C = \dfrac{8.85 \times 10^{-12}\ \text{F} \times 0.687\ \text{m}^2}{0.0519\ \text{m}} = 1.17 \times 10^{-10}\ \text{F}$	• $C = 1.17 \times 10^{-10}$ F **SHOW QUESTION**		
(b)	$I_{max} = \dfrac{V_{source}}{R} = 0.500$ A at $t = 0$. reduces exponentially to zero at $t = 5\ RC = 7.02 \times 10^{-9}$ s $I_\tau = 0.37 \times I_{max} = 0.185$ A at $t = RC = 1.40 \times 10^{-9}$ s $I_{2\tau} = 0.37 \times 0.185$ A $= 0.0685$ A at 2.808×10^{-9} s 	• Exponential decay shape • $\tau = 1.40 \times 10^{-9}$ s • $I_1 = 0.185$ A	• Correct **shape** with values shown $I_T = 0.5$ A & $I_\tau = 0.185$ A OR $I_\tau = 0.185$ A & $I_{2\tau} = 0.0685$ A	
(c)	$C_{new} = 2.303011 \times 10^{-10}$ F $C = \dfrac{Q}{V}$ $C_{new} \times V_{cap\ new} = Q = C_{original} \times V_{cap\ original}$ $V_{cap\ new} = \dfrac{C_{original} \times V_{cap\ original}}{C_{new}}$ $= \dfrac{1.17 \times 10^{-10} \times 6.00\ \text{V}}{2.303 \times 10^{-10}\ \text{F}} = 3.05\ \text{V}$	• $C\uparrow$, therefore $V\downarrow$. • $Q = 7.03 \times 10^{-10}$ C	• $V_{cap\ new} = 3.05$ V **SHOW QUESTION**	

(d)	When the plates are pushed together, Q is initially constant, but C is increased, therefore $V_{1\,(cap)}$ will decrease, according to $C = \frac{Q}{V}$. Since the capacitor voltage is now less than the source voltage, a difference in voltage exists across the resistor and the current will flow from the source to the capacitor. So there will be a momentary current reading on the ammeter, and a momentary voltage reading on V_2 (across the resistor). $I = \frac{V_2}{R} = \frac{V_s - V_1}{R} = \frac{6.00\text{ V} - 3.05\text{ V}}{12\ \Omega} = 0.246\text{ A}$	• V_1 (cap) ↓ • V_2 (r) ↑ • I ↑ • $V_2 = 2.95$ V • pd between V_s and V_c therefore current flows.	• V_{source}, $= V_1 + V_2$, V_1 ↓ & V_2 ↑ • V_{source}, $= V_1 + V_2$, V_1 & V_2 change • Kirchoffs Law $\Sigma V = 0$, so V_1 ↓ and V_2 ↑ • $I = 0.246$ A • pd between V_s and V_c therefore V_1 ↓ V_2 ↑ & I ↑	• V_{source}, $= V_1$ (cap) $+ V_2$ (r), V_1 ↓ and V_2 ↑ AND I = 0.246 A • pd between V_s and V_c therefore V_1 ↓ V_2 ↑ & I ↑ AND $I = 0.246$ A

Marking convention:

a = 1 m = 2 e = 3 For E at least one e is required

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 6	7 – 13	14 – 18	19 – 24