

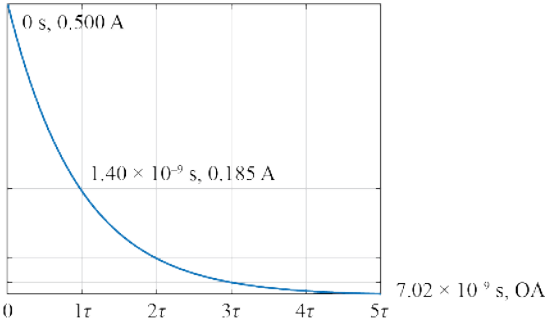
Assessment Schedule – 2019

Physics: Demonstrate understanding of electrical systems (91526)

Evidence Statement

Q	Evidence	Achievement	Merit	Excellence
ONE (a)	$V_{\text{terminal}} = emf - IR$ $8.60 \text{ V} = 9.00 \text{ V} - 0.333 \text{ A} \times R$ $R = \frac{0.400}{0.333} = 1.20 \Omega$	<ul style="list-style-type: none"> $R = 1.20 \Omega$ (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: $+9.00 \text{ V} - 1.20 \Omega \times 0.333 \text{ A} - 9.80 \Omega \times 0.133 \text{ A} - emf = 0$ $emf = 7.30 \text{ V}$	<ul style="list-style-type: none"> $I_1 = I_2 + I_3$ Correct loop equation with 2 unknowns $I_3 = 0.20 \text{ A}$ SHOW QUESTION for I_3	<ul style="list-style-type: none"> $I_1 = I_2 + I_3$ 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 . 	<ul style="list-style-type: none"> $emf = 7.30 \text{ V}$ 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.	<ul style="list-style-type: none"> Changing current / voltage in payment machine coil produces a changing magnetic field / flux Change in flux in card induces voltage 	<ul style="list-style-type: none"> Full response Do NOT accept induced current induces a voltage.	
(d)	Resonance under the condition ($X_L = X_C$) $X_L = \frac{1}{2\pi f C}$ $427 \Omega = \frac{1}{2\pi \times 13.6 \times 10^6 \times C}$ $C = 2.74 \times 10^{-11} \text{ F}$	<ul style="list-style-type: none"> $X_L = X_C$ $X_C = 427 \Omega$ $C = 2.74 \times 10^{-11} \text{ F}$ 	<ul style="list-style-type: none"> $X_L = X_C$ AND $C = 2.74 \times 10^{-11} \text{ F}$?

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TWO (a)	$V_{\text{peak}} = \sqrt{2} \times 24.0 \text{ V}_{\text{RMS}} = 33.9 \text{ V}$	<ul style="list-style-type: none"> • 33.9 V 		
(b)	<p>Area = 1.60 m × 0.600 m = 0.960 m²</p> <p>Max B flux = $B \times A = 0.0413 \text{ T} \times 0.960 \text{ m}^2 = 0.0396 \text{ Wb}$</p>	<ul style="list-style-type: none"> • Correct method of calculating magnetic flux, but incorrect values used. 	<ul style="list-style-type: none"> • 0.0396 Wb 	
(c)	<p>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.</p>	<ul style="list-style-type: none"> • ↓ L therefore ↑ I • ↓ L, ↓ X_L / Z • Idea of changing magnetic flux inducing an opposing voltage. 	<ul style="list-style-type: none"> • ↓ 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)	<p>$f = 1.20 \times 10^2 \text{ Hz}$, $L = 5.00 \times 10^{-3} \text{ H}$</p> <p>$X_L = 2\pi \times 120 \text{ Hz} \times 0.005 = 3.77 \Omega$</p> <p>$R = 4.00 \Omega$</p> <p>$Z = \sqrt{R^2 + X_L^2}$</p> <p>$= \sqrt{4.00^2 + 3.77^2}$</p> <p>$Z = 5.496626 \Omega$</p> <p>$I = \frac{24.0 \text{ V}}{4.496626 \Omega} = 4.36631 \text{ A} = 4.37 \text{ A}$</p>	<ul style="list-style-type: none"> • $X_L = 3.77 \Omega$ • Z calculated with incorrect X_L value. 	<ul style="list-style-type: none"> • $Z = 5.5 \Omega$ • I calculation with incorrect Z value. 	<ul style="list-style-type: none"> • $I = 4.37 \text{ A}$

Q	Evidence	Achievement	Merit	Excellence
THREE (a)	$C = \frac{8.85 \times 10^{-12} \text{ F} \times 0.687 \text{ m}^2}{0.0519 \text{ m}} = 1.17 \times 10^{-10} \text{ F}$	<ul style="list-style-type: none"> • $C = 1.17 \times 10^{-10} \text{ F}$ <p>SHOW QUESTION</p>		
(b)	$I_{\max} = \frac{V_{\text{source}}}{R} = 0.500 \text{ A at } t = 0.$ <p>reduces exponentially to zero at $t = 5RC = 7.02 \times 10^{-9} \text{ s}$</p> $I_{\tau} = 0.37 \times I_{\max} = 0.185 \text{ A at } t = RC = 1.40 \times 10^{-9} \text{ s}$ $I_{2\tau} = 0.37 \times 0.185 \text{ A} = 0.0685 \text{ A at } 2.808 \times 10^{-9} \text{ s}$ 	<ul style="list-style-type: none"> • Exponential decay shape • $\tau = 1.40 \times 10^{-9} \text{ s}$ • $I_1 = 0.185 \text{ A}$ 	<ul style="list-style-type: none"> • Correct shape with values shown $I_{\tau} = 0.5 \text{ A} \text{ \& } I_{\tau} = 0.185 \text{ A}$ <p>OR</p> $I_{\tau} = 0.185 \text{ A} \text{ \& } I_{2\tau} = 0.0685 \text{ A}$	
(c)	$C_{\text{new}} = 2.303011 \times 10^{-10} \text{ F}$ $C = \frac{Q}{V}$ $C_{\text{new}} \times V_{\text{cap new}} = Q = C_{\text{original}} \times V_{\text{cap original}}$ $V_{\text{cap new}} = \frac{C_{\text{original}} \times V_{\text{cap original}}}{C_{\text{new}}}$ $= \frac{1.17 \times 10^{-10} \times 6.00 \text{ V}}{2.303 \times 10^{-10} \text{ F}} = 3.05 \text{ V}$	<ul style="list-style-type: none"> • $C \uparrow$, therefore $V \downarrow$. • $Q = 7.03 \times 10^{-10} \text{ C}$ 	<ul style="list-style-type: none"> • $V_{\text{cap new}} = 3.05 \text{ V}$ <p>SHOW QUESTION</p>	

<p>(d)</p>	<p>When the plates are pushed together, Q is initially constant, but C is increased, therefore $V_{1(\text{cap})}$ 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).</p> $I = \frac{V_2}{R} = \frac{V_s - V_1}{R} = \frac{6.00 \text{ V} - 3.05 \text{ V}}{12 \Omega} = 0.246 \text{ A}$	<ul style="list-style-type: none"> • V_1 (cap) ↓ • V_2 (r) ↑ • I ↑ • $V_2 = 2.95 \text{ V}$ • pd between V_s and V_c therefore current flows. 	<ul style="list-style-type: none"> • $V_{\text{source}} = V_1 + V_2, V_1 \downarrow \& V_2 \uparrow$ • $V_{\text{source}} = V_1 + V_2, V_1 \& V_2$ change • Kirchoffs Law $\Sigma V = 0$, so $V_1 \downarrow$ and $V_2 \uparrow$ • $I = 0.246 \text{ A}$ • pd between V_s and V_c therefore $V_1 \downarrow V_2 \uparrow \& I \uparrow$ 	<ul style="list-style-type: none"> • $V_{\text{source}} = V_1(\text{cap}) + V_2(\text{r}), V_1 \downarrow$ and $V_2 \uparrow$ AND $I = 0.246 \text{ A}$ • pd between V_s and V_c therefore $V_1 \downarrow V_2 \uparrow \& I \uparrow$ AND $I = 0.246 \text{ A}$
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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