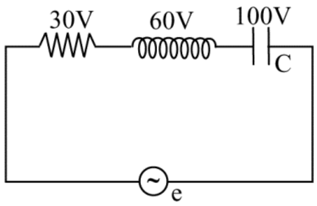
Max. Marks: 60 **Date: 03.09.2022**

ARJUNA BATCH
PHYSICS : DCT
Topics: EMI and AC

1. In an L – C – R series circuit $R = 10\ \Omega$, $X_L = 8\ \Omega$ and $X_C = 6\ \Omega$ the total impedance of the circuit is

   (a) $10.2\ \Omega$ (b) $17.2\ \Omega$ (c) $10\ \Omega$ (d) None of the above

2. In the given figure, the potential difference is shown on R, L and C. The e.m.f. of source in volt is

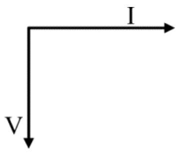


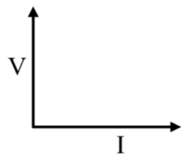
   (a) 190 (b) 70 (c) 50 (d) 40

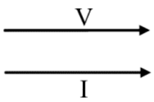
3. In an L.C.R. series circuit $R = 1\ \Omega$, $X_L = 1000\ \Omega$ and $X_C = 1000\ \Omega$. A source of 100 m. volt is connected in the circuit the current in the circuit is

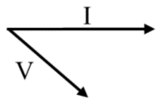
   (a) 100 m Amp (b) 1 μ Amp (c) 0.1 μ Amp (d) 10 μ Amp

4. Which of the following figure showing the phase relationship is correct phase diagram for an R – C circuit

(a) 

(b) 

(c) 

(d) 

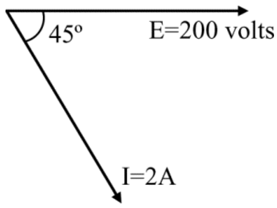
Space for Rough Work

5. A coil of inductance 0.1 H is connected to an alternating voltage generator of voltage E = 100 sin (100t) volt. The current flowing through the coil will be

(a) $I = 10\sqrt{2}\sin(100t)A$ (b) $I = 10\sqrt{2}\cos(100t)A$

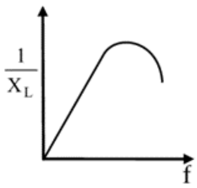
(c) $I = -10\sin(100t)$ A (d) $I = -10\cos(100t)$ A

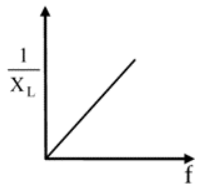
6. The vector diagram of the current and voltage in a given circuit is shown in the figure. The components of the circuit will be

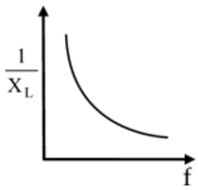


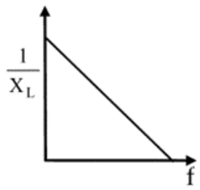
(a) L – C – R (b) L – R (c) L – C – R or L – R (d) C – R

7. In pure inductive circuit, the curves between frequency f and inductive reactance $1/X_L$ is:

(a) 

(b) 

(c) 

(d) 

8. The resistance of 50 Ω, an inductance of $20/\pi$. Henry and a capacitor of $5/\pi$ μF are connected in series with an A.C. source of 230 volt and 50 Hz. The impedance of circuit is

(a) 5 Ω (b) 50 Ω (c) 5 kΩ (d) 500 Ω

Space for Rough Work

9. In an L – C – R series circuit R = $\sqrt{5}\,\Omega$, $X_L = 9\ \Omega$ and $X_C = 7\ \Omega$. If applied voltage in the circuit is 50 volt then impedance of the circuit in ohm then impedance of the circuit in ohm will be

(a) 2 (b) 3 (c) $2\sqrt{5}$ (d) $3\sqrt{5}$

10. The potential difference between the ends of a resistance R is V_R between the ends of capacitor is $V_C = 2V_R$ and between the ends of inductance is $V_L = 3V_R$, then the alternating potential of the source in terms of V_R will be

(a) $\sqrt{2}V_R$ (b) V_R (c) $V_R / \sqrt{2}$ (d) $5V_R$

11. In an A.C. circuit the impedance is $Z = 100\angle 30°\,\Omega$, then the resistance of the circuit in ohm will be

(a) 50 (b) 100 (c) $50\sqrt{3}$ (d) $100\sqrt{3}$

12. In an LCR circuit, the voltages across the components are V_L, V_C and V_R respectively. The voltage of source wil be

(a) $[V_R + V_L + V_C]$ (b) $[V_R^2 + V_L^2 + V_C^2]^{1/2}$

(c) $[V_R^2 + (V_L + V_C)^2]^{1/2}$ (d) $[V_R^2 + (V_L - V_C)^2]^{1/2}$

13. In an electric circuit the applied alternating emf is given by E = 100 sin (314 t) volt, and current flowing I = sin (314t + π/3). Then the impedance of the circuit is (in ohm)

(a) $100/\sqrt{2}$ (b) 100 (c) $100\sqrt{2}$ (d) None of the above

14. The series combination of resistance R and inductance L is connected to an alternating source of e.m.f. e = 311 sin (100 π t). If the value of wattles current is 0.5 A and the impedance of the circuit is 311 Ω, the power factor will be

(a) $\frac{1}{2}$ (b) $\frac{1}{\sqrt{2}}$ (c) $\frac{1}{\sqrt{3}}$ (d) $\frac{1}{\sqrt{5}}$

15. In an A.C. circuit, a resistance of 3Ω, an inductance coil of 4Ω and a condenser of 8Ω are connected in series with an A.C. source of 50 volt (R.M.S.). The average power loss in the circuit will be

(a) 600 watt (b) 500 watt (c) 400 watt (d) 300 watt

Space for Rough Work

[SINGLE CORRECT CHOICE TYPE]

Q.1 to Q.15 has four choices (A), (B), (C), (D) out of which **ONLY ONE** is correct.

Q.1 $\int (x\,e^{\ln \sin x} - \cos x)\,dx$ is equal to :

(A) $x \cos x + c$ (B) $\sin x - x \cos x + c$
(C) $-e^{\ln x} \cos x + c$ (D) $\sin x + x \cos x + c$

Q.2 If $\int \frac{(2x+3)\,dx}{x(x+1)(x+2)(x+3)+1} = C - \frac{1}{f(x)}$ where f (x) is of the form of $ax^2 + bx + c$ then $(a + b + c)$ equals

(A) 4 (B) 5 (C) 6 (D) none

Q.3 Primitive of $\sqrt{1+2\cot x(\cot x+\operatorname{cosec} x)}$ w.r.t. x is :

(A) $2 \ln \cos\frac{x}{2} + c$ (B) $2 \ln \sin\frac{x}{2} + c$

(C) $\frac{1}{2} \ln \cos\frac{x}{2} + c$ (D) $\ln \sin x - \ln(\operatorname{cosec} x - \cot x) + c$

Q.4 Let $f:\left[0, \frac{\pi}{2}\right] \to R$ be continuous and satisfy $f'(x) = \frac{1}{1+\cos x}$ for all $x \in \left(0, \frac{\pi}{2}\right)$. If $f(0) = 3$ then $f\left(\frac{\pi}{2}\right)$ has the value equal to

(A) $\frac{13}{4}$ (B) 2 (C) 4 (D) None

Q.5 Let g (x) be an antiderivative for f (x). Then $\ln\left(1+(g(x))^2\right)$ is an antiderivative for

(A) $\frac{2f(x)g(x)}{1+(f(x))^2}$ (B) $\frac{2f(x)g(x)}{1+(g(x))^2}$ (C) $\frac{2f(x)}{1+(f(x))^2}$ (D) none

Q.6 Which one of the following is TRUE.

(A) $x.\int \frac{dx}{x} = x\,ln|x| + C$

(B) $x.\int \frac{dx}{x} = x\,ln|x| + Cx$

(C) $\frac{1}{\cos x}.\int \cos x \; dx = \tan x + C$

(D) $\frac{1}{\cos x}.\int \cos x \; dx = x + C$

Q.7 The evaluation of $\int \frac{p\,x^{p+2q-1} - q\,x^{q-1}}{x^{2p+2q} + 2x^{p+q} + 1}\; dx$ is

(A) $-\frac{x^p}{x^{p+q}+1} + C$ (B) $\frac{x^q}{x^{p+q}+1} + C$ (C) $-\frac{x^q}{x^{p+q}+1} + C$ (D) $\frac{x^p}{x^{p+q}+1} + C$

Q.8 If $I_n = \int (\sin x)^n\, dx \quad n \in N$, then $5I_4 - 6I_6$ is equal to

(A) $\sin x \cdot (\cos x)^5 + C$

(B) $\sin 2x \cdot \cos 2x + C$

(C) $\frac{\sin 2x}{8}\,[\cos^2 2x + 1 - 2\cos 2x] + C$

(D) $\frac{\sin 2x}{8}\,[\cos^2 2x + 1 + 2\cos 2x] + C$

Q.9 If $\int x^2 \cdot e^{-2x}\, dx = e^{-2x}(ax^2 + bx + c) + d$, then

(A) $a = -\frac{1}{2}, b = -\frac{1}{2}, c = -\frac{1}{4}$

(B) $a = -\frac{1}{2}, b = -\frac{1}{2}, c = \frac{1}{4}$

(C) $a = -\frac{1}{2}, b = -1, c = -\frac{1}{2}$

(D) $a = 1, b = 1, c = -\frac{1}{2}$

Q.10 $\int \sec^2\theta\,(\sec\theta+\tan\theta)^2\,d\theta$

(A) $\frac{(\sec\theta+\tan\theta)}{2}[2+\tan\theta(\sec\theta+\tan\theta)]+C$

(B) $\frac{(\sec\theta+\tan\theta)}{3}[2+4\tan\theta(\sec\theta+\tan\theta)]+C$

(C) $\frac{(\sec\theta+\tan\theta)}{3}[2+\tan\theta(\sec\theta+\tan\theta)]+C$

(D) $\frac{3(\sec\theta+\tan\theta)}{2}[2+\tan\theta(\sec\theta+\tan\theta)]+C$

Q.11 The antiderivative of $f(x)=\frac{1}{3+5\sin x+3\cos x}$ whose graph passes through the point (0, 0) is

(A) $\frac{1}{5}\left(\log\left|1-\frac{5}{3}\tan\frac{x}{2}\right|\right)$

(B) $\frac{1}{5}\left(\log\left|1+\frac{5}{3}\tan\frac{x}{2}\right|\right)$

(C) $\frac{1}{5}\left(\log\left|1+\frac{5}{3}\cot\frac{x}{2}\right|\right)$

(D) None of these

Q.12 $\int\frac{1}{x^2(x^4+1)^{3/4}}dx$ is equal to

(A) $\left(1+\frac{1}{x^4}\right)^{1/4}+c$ (B) $(x^4+1)^{1/4}+c$ (C) $\left(1-\frac{1}{x^4}\right)^{1/4}+c$ (D) $-\left(1+\frac{1}{x^4}\right)^{1/4}+c$

Q.13 $\int e^{\tan\theta}(\sec\theta - \sin\theta)\,d\theta$ equals

(A) $-e^{\tan\theta}\sin\theta + c$ (B) $e^{\tan\theta}\sin\theta + c$ (C) $e^{\tan\theta}\sec\theta + c$ (D) $e^{\tan\theta}\cos\theta + c$

Q.14 Primitive of $\frac{3x^4 - 1}{(x^4 + x + 1)^2}$ w.r.t. x is

(A) $\frac{x}{x^4+x+1} + c$ (B) $-\frac{x}{x^4+x+1} + c$ (C) $\frac{x+1}{x^4+x+1} + c$ (D) $-\frac{x+1}{x^4+x+1} + c$

Q.15 $\int \frac{(2x+1)}{(x^2+4x+1)^{3/2}}\,dx$

(A) $\frac{x^3}{(x^2+4x+1)^{1/2}} + C$

(B) $\frac{x}{(x^2+4x+1)^{1/2}} + C$

(C) $\frac{x^2}{(x^2+4x+1)^{1/2}} + C$

(D) $\frac{1}{(x^2+4x+1)^{1/2}} + C$

Max. Marks: 60 **Date: 03.09.2022**

ARJUNA BATCH
PHYSICS : DCT ANSWER KEY
Topics: EMI and AC

1.	(a)	2.	(c)	3.	(a)	4.	(d)	5.	(d)
6.	(c)	7.	(c)	8.	(b)	9.	(b)	10.	(a)
11.	(c)	12.	(d)	13.	(b)	14.	(b)	15.	(d)

Max Marks: 60 **Date: 03.09.2022**

ARJUNA BATCH
MATHEMATICS : DCT ANSWER KEY
Topic: Indefinite Integration

16.	(c)	17.	(b)	18.	(b)	19.	(c)	20.	(b)
21.	(b)	22.	(c)	23.	(c)	24.	(a)	25.	(c)
26.	(b)	27.	(d)	28.	(d)	29.	(b)	30.	(b)