

FIITJEE RET – 7

(2017 – 2019)(2ND YEAR_CHAMPIONS)

IIT-2017 (P2)
DATE: 20.08.2018

Time: 3 hours

Maximum Marks: 183

INSTRUCTIONS:**A. General**

1. This booklet is your Question Paper containing 54 questions.
2. Blank papers, clipboards, log tables, slide rules, calculators, cellular phones, pagers and electronic gadgets in any form are not allowed to be carried inside the examination hall.
3. Fill in the boxes provided for Name and Enrolment No.
4. The answer sheet, a machine-readable Objective Response (ORS), is provided separately.
5. DO NOT TAMPER WITH / MULTILATE THE ORS OR THE BOOKLET.

B. Filling in the OMR:

6. The instructions for the OMR sheet are given on the OMR itself.

C. Question paper format & Marking Scheme

7. Each part has three sections as detailed in the following table:

Section	Question Type	Number of Questions	Category wise Marks Each Question				Maximum marks of the section
			Full Marks	Partial Marks	Zero Marks	Negative Marks	
1	Single Correct Option	7	+3 If only the bubble corresponding to the correct option is darkened	—	0 If none of the bubbles is darkened	-1 In all other cases	21
2	One or more correct option(s)	7	+4 If only the bubble(s) corresponding to all the correct option(s) is (are) darkened.	+1 For darkening a bubble corresponding to each correct option, provided NO incorrect option is darkened.	0 If none of the bubbles is darkened.	-2 In all other case.	28
3	Comprehension	4	+3 If only the bubble corresponding to the correct option is darkened	—	0 In all other case.	—	12

Don't write / mark your answers in this question booklet.

If you mark the answers in question booklet, you will not be allowed to continue the exam.

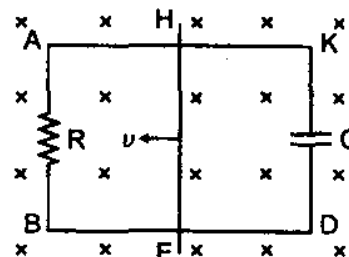
NAME:

ENROLLMENT NO.:

PAPER-II
PART I: PHYSICS
SECTION 1 (Maximum Marks: 28)

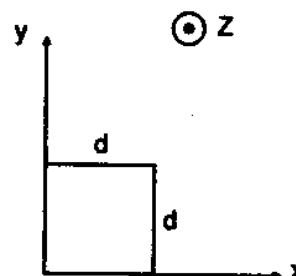
- * This section contains **SEVEN** questions.
* Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
* For each question, darken the bubble corresponding to all the correct option in the ORS.

1. In the circuit shown in figure, a conducting wire HE is moved with a constant speed v towards left. The complete circuit is placed in a uniform magnetic field \vec{B} perpendicular to the plane of circuit inwards. The current in HKDE is:



- (A) clockwise (B) anticlockwise (C) alternating (D) zero
2. Two circular coils can be arranged in any of the three situations shown in the figure. Their mutual inductance will be:
-
- (A) maximum in situation (a) (B) maximum in situation (b)
(C) maximum in situation (c) (D) the same in all situations

3. The magnetic field in a region is given by $\vec{B} = B_0 \left(\frac{x}{a} \right) \hat{k}$. A square loop of side d is placed with its edges along the x and y axis. The loop is moved with a constant velocity $\vec{v} = v_0 \hat{i}$. The emf induced in the loop is:



- (A) $B_0 v_0 d$ (B) $\frac{B_0 v_0 d^2}{2a}$ (C) $\frac{B_0 v_0 d^3}{a^2}$ (D) $\frac{B_0 v_0 d^2}{a}$
4. An inductor L is allowed to discharge through a capacitor C . The emf induced across the inductor, when the capacitor is fully charged is:
- (A) maximum (B) minimum (C) zero (D) infinite

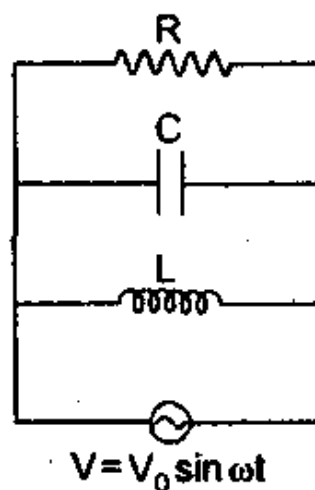
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5. An alternating current is given by $i = (3 \sin \omega t + 4 \cos \omega t)$ A
The rms current will be :
- (A) $\frac{7}{\sqrt{2}}$ A
(B) $\frac{1}{\sqrt{2}}$ A
(C) $\frac{5}{\sqrt{2}}$ A
(D) information is insufficient to find the rms current
6. A series circuit has an impedance of 50.0Ω and a power factor of 0.63 at 60 Hz. The voltage lags the current. To raise the power factor of the circuit:
- (A) an inductor should be placed in series
(B) a capacitor should be placed in series
(C) a resistance should be placed in series
(D) an inductor or a resistance should be placed in series

7. In the circuit shown in figure

$$X_L = \frac{X_C}{2} = R, \text{ the peak value current } i_0$$

is :



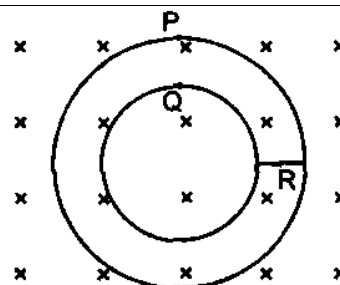
- (A) $\frac{\sqrt{5}V_0}{2R}$ (B) $\frac{V_0}{2\sqrt{2}R}$ (C) $\frac{V_0}{2R}$ (D) $\frac{V_0}{2\sqrt{3}R}$

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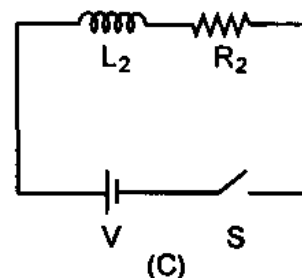
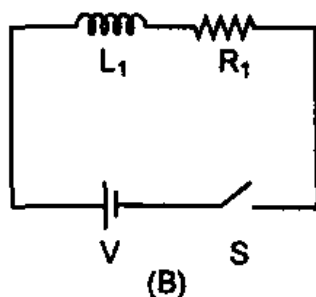
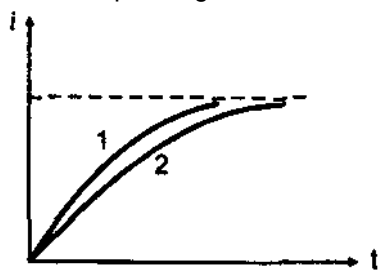
SECTION 2 (Maximum Marks: 15)

- * This section contains **SEVEN** questions.
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- * For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS.
- * For example, if (A), (C) and (D) are all the correct options for a question, darkening all these three will get +4 marks; darkening only (A) and (D) will get +2 marks; and darkening (A) and (B) will get -2 marks, as a wrong option is also darkened.

8. Figure shows a plane figure made of a conductor located in a magnetic field along the inward normal to the plane of the figure. The magnetic field starts diminishing. Then the induced current:



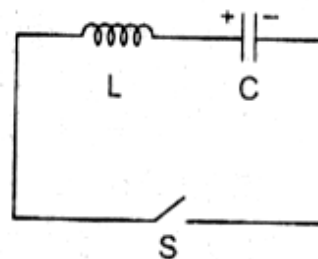
- (A) at point P is clockwise (B) at point Q is anticlockwise
 (C) at point Q is clockwise (D) at point R is zero
9. Current growth in two L-R circuits (B) and (C) is as shown in figure (A). Let L_1 , L_2 , R_1 and R_2 be the corresponding values in two circuits. Then:



- (A) $R_1 > R_2$ (B) $R_1 = R_2$ (C) $L_1 > L_2$ (D) $L_1 < L_2$
10. The magnetic field perpendicular to the plane of a conducting ring of radius 'a' changes at the rate of α , then:
- (A) all the points on the ring are at the same potential
 (B) the emf induced in the ring is $\pi a^2 \alpha$
 (C) electric field intensity E at any point on the ring is zero
 (D) $E = \frac{a\alpha}{2}$

Space for rough work

11. A capacitor is charged to a potential of V_0 . It is connected with an inductor through a switch S . The switch is closed at time $t = 0$. Which of the following statement(s) is/are correct?



- (A) The maximum current in the circuit is $V_0 \sqrt{\frac{C}{L}}$
- (B) Potential across capacitor becomes zero for the first time at $t = \pi \sqrt{LC}$
- (C) Energy stored in the inductor at time $t = \frac{\pi}{2} \sqrt{LC}$ is $\frac{1}{4} CV_0^2$
- (D) Maximum energy stored in the inductor is $\frac{1}{2} CV_0^2$
12. An LC circuit has capacitor $C_1 = C$ and inductance $L_1 = L$. A second circuit has $C_2 = C/2$ and $L_2 = 2L$ and a third circuit has $C_3 = 2C$ and $L_3 = \frac{L}{2}$. All the three capacitors are charged to the same potential V and then made to oscillate. Then
- (A) angular frequency of oscillation is same for all the three circuits
- (B) maximum current is greatest in first circuit
- (C) maximum current is greatest in second circuit
- (D) maximum current is greatest in third circuit
13. Which of the following statement(s) is/are correct regarding the electric field produced by the changing magnetic field?
- (A) It is nonelectrostatic in nature
- (B) It is non conservative in nature
- (C) Potential can be defined corresponding to this field
- (D) The lines of this field are closed curves

Space for rough work

14. Two different coils have self inductances $L_1 = 8 \text{ mH}$ and $L_2 = 2 \text{ mH}$. The current in one coil is increased at a constant rate. The current in the second coil is also increased at the same constant rate. At a certain instant of time, the power given to the two coils is the same. At this time the current, the induced voltage and the energy stored in the first coil are i_1 , V_1 and U_1 respectively. Corresponding values for the second coil at the same instant are i_2 , V_2 and U_2 respectively. Then:

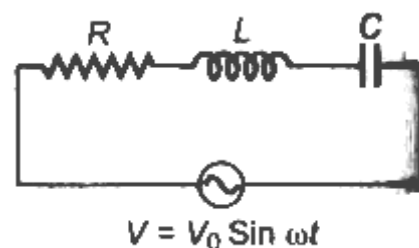
(A) $\frac{i_1}{i_2} = \frac{1}{4}$ (B) $\frac{i_1}{i_2} = 4$ (C) $\frac{U_2}{U_1} = 4$ (D) $\frac{V_2}{V_1} = \frac{1}{4}$

SECTION 3 (Maximum Marks: 18)

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Paragraph-1 (Series R-L-C and Resonance)

The impedance of R, L and C vary with applied frequency ω as ,
 $Z_R = R$, $Z_L = \omega L (= X_L)$ and $Z_C = \frac{1}{\omega C} (= X_C)$. Since the inductive and capacitive reactance are X_L and X_C respectively oppose each other and the net reactance $X = |X_C - X_L|$ is perpendicular to R, the net impedance of the circuit is $Z = \sqrt{R^2 + X^2}$. The phase between i and V is $\phi = \tan^{-1} \frac{X}{R} = \cos^{-1} \frac{R}{Z} = \sin^{-1} \frac{X}{Z}$



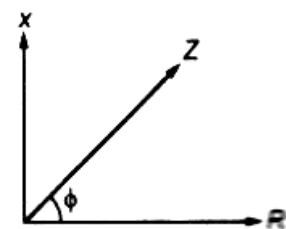
The average power dissipated in the circuit is

$$P = i_0 V_0 \cos \phi = \frac{V_0^2}{2R} = \frac{i_0^2 R}{2}$$

At resonance $X = 0$; X_L or then the resonant frequency is $\omega = \frac{1}{\sqrt{LC}}$. Using the above theories, answer the following questions.

A series R-L-C circuit has $R = 100 \text{ ohm}$, $L = 0.2 \text{ mH}$ and $C = \frac{1}{2} \mu\text{F}$.

The applied voltage $V = 20 \sin \omega t$. Then



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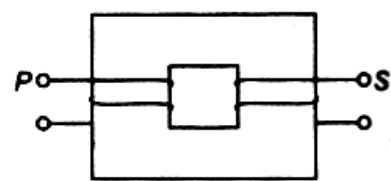
15. At resonant frequency ω_0 , $\frac{(V_R)_{\max}}{(V_L)_{\max}} =$
- (A) 2 (B) 5 (C) 3 (D) None of these
16. When the current lags the applied voltage by 45° , the value of ω is approximately
- (A) 8×10^{10} rad/s (B) 3×10^5 rad/s
- (C) 4×10^5 rad/s (D) None of these

Paragraph-2(Transformer)

Transformer is a device of stepping up or stepping down the voltage in A.C circuit according to the requirement. It works in accordance with the principle of mutual induction.

17. If N_p, i_p and V_p are the number of turns in the primary, current in the primary and voltage across the primary coil, and N_s and V_s are the corresponding parameters for the secondary coil, then

- (A) $\frac{V_s}{V_p} = \frac{i_s}{i_p}$ (B) $\frac{i_s}{i_p} = \frac{N_p}{N_s}$
- (C) $\frac{V_s}{V_p} = \frac{i_p}{i_s} = \frac{N_s}{N_p}$ (D) $\frac{V_s N_p}{V_p N_p} = \frac{i_p}{i_s}$



18. A step – down transformer has 5000 turns in the primary . If $(V_p)_{\max} = 20000$ volt and there are 200 turns in the secondary coil, the desired secondary current is 100 A. The maximum power that can be delivered from the primary to secondary coil (assuming negligible resistance) is
- (A) 88 MW (B) 8800 W (C) 8.8×10^5 W (D) 88 KW

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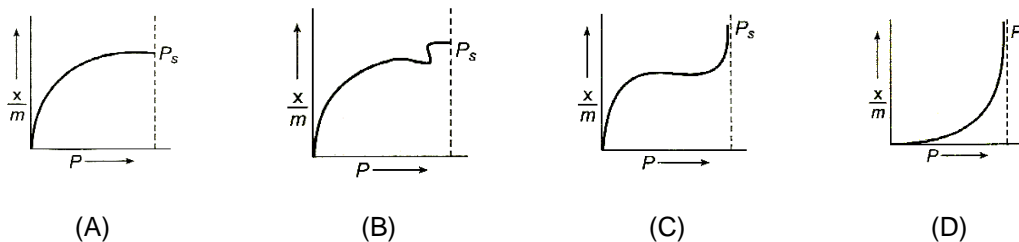
PART II: CHEMISTRY
SECTION 1 (Maximum Marks: 28)

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-

19. The colloidal sols are purified by
(A) peptization (B) coagulation (C) dialysis (D) flocculation
20. Which of the following is arranged in order of decreasing coagulating power ?
(A) $\text{NaCl} > \text{BaCl}_2 > \text{AlCl}_3$ (B) $\text{BaCl}_2 > \text{AlCl}_3 > \text{NaCl}$
(C) $\text{AlCl}_3 > \text{BaCl}_2 > \text{NaCl}$ (D) $\text{BaCl}_2 > \text{NaCl} > \text{AlCl}_3$
21. If the disperse phase and the dispersion medium both are liquid, the colloidal solution is classified as
(A) emulsion (B) foam (C) gel (D) supercooled liquid
22. Point out the false statement
(A) Brownian motion and Tyndall effect are shown by colloidal systems
(B) The colloidal solution of a liquid in liquid is called emulsion
(C) Hardy–Schulze law is related with coagulation of a sol
(D) Higher is the gold number, greater will be the protective power of a lyophilic colloid
23. Which of the following statements about starch is false?
(A) Starch is a polymer of α -D-glucose
(B) It consists of 20% amylose and 80% amylopectin
(C) Glycosidic linkages between glucose units are always formed only between C_1 and C_4
(D) Amylose is water soluble and amylopectin is insoluble.
24. Identify the correct statements among the following
(A) Cellulose has alpha 1, 4 – glycosidic linkage while amylose has beta 1, 4 – glycosidic linkage
(B) Cellulose has alpha 1, 6 – glycosidic linkage and amylose has alpha 1, 4 – linkage
(C) Cellulose has beta 1, 6 – glycosidic linkage and amylose has alpha 1, 6 – linkage
(D) Cellulose has beta 1, 4 – glycosidic linkage and amylose has alpha 1, 4 – glycosidic linkage
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Space for rough work

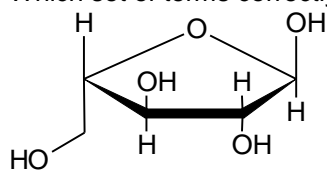
25. Which of the following adsorption isotherms represents the adsorption of a gas by a solid involving multilayers of layers? (P_s = saturation pressure)



SECTION 2 (Maximum Marks: 15)

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26. The term anomers of glucose does not refer to :
- (A) isomers of glucose that differ in configuration at carbons one and four C-(1) and C-(4)
 (B) a mixture of (D-) glucose and (L-) glucose
 (C) enantiomers of glucose
 (D) isomers of glucose that differ in configuration at carbon one C-(1)
27. Which of the following hexoses will form the same osazone when treated with excess of phenyl hydrazine ?
- (A) D-glucose (B) D-fructose
 (C) D-mannose (D) D-galactose
28. Which set of terms correctly identifies the carbohydrate shown ?



- (A) Pentose (B) Aldose (C) Ketose (D) Furanose

Space for rough work

29. If adsorption of a gas on a solid is limited to monolayer formation, then which of the following statements are true?
- (A) at low pressures, $\frac{x}{m}$ varies proportionately with p
- (B) at moderate pressures, $\frac{x}{m}$ varies less than proportionately with p
- (C) at high pressures, $\frac{x}{m}$ becomes independent of p
- (D) at high pressures, $\frac{x}{m}$ varies more than proportionately with p
30. Which of the following is/are correct for lyophilic sols?
- (A) its surface tension is lower than that of water
- (B) its viscosity is higher than that of water
- (C) its surface tension is higher than that of water
- (D) its viscosity is equal to that of water
31. Which of the following statement(s) is/are correct ?
- (A) Adsorption is a non-spontaneous process
- (B) Surface energy decreases during the process of adsorption
- (C) Adsorption takes place with decrease of entropy
- (D) Physical adsorption is exothermic process whereas chemisorption is endothermic
32. The pair of compounds that can be distinguished by Fehling's solution are
- (A) Glucose and Fructose
- (B) CH_3COCH_3 and Fructose
- (C) CH_3CHO and $\text{C}_6\text{H}_5\text{CHO}$
- (D) HCOOH and CH_3COOH

Space for rough work

SECTION 3 (Maximum Marks: 18)

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-

Paragraph-1

The change in specific rotation of an optically active compound due to the interconversion of one anomer to the other (like two forms of glucose), on standing is called mutarotation. On account of this glucose forms a six-membered ring by the interaction between the aldehyde group and the hydroxyl group at C-5.

33. Mutarotation involves
 (A) Conformational inversion (B) Racemisation
 (C) Diastereoisomerisation (D) Epimerization
34. Which of the following carbohydrates undergo mutarotation
 (A) Fructose (B) Cellulose (C) Maltose (D) Lactose

Paragraph-2

Coagulation is the process by which the dispersed phase of a colloid is made to aggregate and thereby separate from the continuous phase. The minimum concentration of an electrolyte in milli-moles per litre of the electrolyte solution which is required to cause the coagulation of colloidal sol is called coagulation value.

Therefore higher is the coagulating power of effective ion, smaller with the coagulation value of the electrolyte.

$$\text{Coagulation value} \propto \frac{1}{\text{coagulating power}}$$

The coagulation values of different electrolytes are different. This behaviour can be easily understood by Hardy-Schulze rule which states.

“The greater is the valency of the effective ion greater is its precipitating power.”

35. Which one has the highest coagulating power?
 (A) K^+ (B) Ca^{2+} (C) Al^{3+} (D) Sn^{4+}
36. As_2S_3 sol is negatively charged, capacity to precipitate it is highest in
 (A) K_2SO_4 (B) Na_3PO_4 (C) $AlCl_3$ (D) $CaCl_2$

Space for rough work

PART III: MATHEMATICS
SECTION 1 (Maximum Marks: 28)

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37. If $f(x) = \int_0^x \frac{dt}{\{f(t)\}^2}$ and $\int_0^2 \frac{dy}{\{f(t)\}^2} = \sqrt[3]{6}$, $f(9)$ equals
 (A) 0 (B) 1 (C) 2 (D) none of these
38. The value of $\lim_{n \rightarrow \infty} \frac{(\sum n^2)(\sum n^3)}{(\sum n^6)}$ is
 (A) 1 (B) $\frac{3}{2}$ (C) $\frac{5}{6}$ (D) $\frac{7}{12}$
39. The value of the constant $a > 0$ such that $\int_0^a [\tan^{-1} \sqrt{x}] dx = \int_0^a [\cot^{-1} \sqrt{x}] dx$, where $[.]$ denotes the greatest integer function, is
 (A) $\frac{3 + \cos 4}{1 - \cos 4}$ (B) $\frac{3 - \cos 4}{1 + \cos 4}$ (C) $\frac{2(3 + \cos 4)}{1 - \cos 4}$ (D) $\frac{2(3 - \cos 4)}{1 + \cos 4}$
40. The value of $\int_1^5 \left(\sqrt{x + 2\sqrt{x-1}} + \sqrt{x - 2\sqrt{x-1}} \right) dx$ is
 (A) $\frac{8}{3}$ (B) $\frac{16}{3}$ (C) $\frac{32}{3}$ (D) $\frac{64}{3}$
41. The value of the integral $\int_0^{n\pi+t} (|\cos x| + |\sin x|) dx$, where $0 < t < \frac{\pi}{2}$ is
 (A) n (B) $2n + \sin t + \cos t$ (C) $\cos t$ (D) $4n + \sin t - \cot t + 1$

Space for rough work

42. If $\int_{1/2}^2 \frac{1}{x} \operatorname{cosec}^{101} \left(x - \frac{1}{x} \right) dx = k$, then the value of k is
 (A) 1 (B) $\frac{1}{2}$ (C) 0 (D) $\frac{1}{101}$
43. The value of $\int_0^{2\pi} \frac{x \sin^{2n} x}{\sin^{2n} x + \cos^{2n} x} dx$ is
 (A) $\frac{\pi^2}{4}$ (B) $\frac{\pi^2}{2}$ (C) π^2 (D) $2\pi^2$

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44. The value of α in the interval $[-\pi, 0]$ satisfying $\sin \alpha + \int_{\alpha}^{2\alpha} \cos 2x dx = 0$ is
 (A) $-\frac{\pi}{2}$ (B) $-\pi$ (C) $-\frac{\pi}{3}$ (D) 0
45. The integral $\int_{\tan^{-1} x}^{\cot^{-1} x} \frac{\tan x}{\tan x + \cot x} dx$, $\forall \lambda \in \mathbb{R}$ can not take the value
 (A) $-\frac{\pi}{4}$ (B) $\frac{\pi}{4}$ (C) $-\frac{\pi}{2}$ (D) $\frac{3\pi}{4}$
46. If $f'(x) = f(x) + \int_0^1 f(x) dx$ and given $f(0) = 1$, then $f(x)$ is equal to
 (A) $\frac{e^x}{2-e} + \left(\frac{1+e}{1-e} \right)$ (B) $\frac{2e^x}{3-e} + \left(\frac{1-e}{3-e} \right)$ (C) $\frac{e^x}{2-e}$ (D) $\frac{2e^x}{3-e}$

Space for rough work

47. The value of $\int_{1/e}^{\tan x} \frac{t \, dt}{1+t^2} + \int_{1/e}^{\cot x} \frac{dt}{t(1+t^2)}$ is
 (A) $\frac{1}{2 + \tan^2 x}$ (B) 1 (C) $\frac{\pi}{4}$ (D) $\frac{2}{\pi} \int_{-1}^1 \frac{dt}{1+t^2}$
48. Which of the following is/are true
 (A) $\int_0^1 2^{x^2} \, dx > \int_0^1 2^{x^5} \, dx$ (B) $\int_1^2 2^{x^3} \, dx > \int_1^2 2^{x^5} \, dx$
 (C) $\int_1^2 \ln x \, dx > \int_1^2 (\ln x)^2 \, dx$ (D) $\int_3^4 \ln x \, dx > \int_3^4 (\ln x)^2 \, dx$
49. The points of extremum of $\int_0^{x^2} \left(\frac{t^2 - 5t + 4}{2 + e^t} \right) dt$ are
 (A) $x = -2$ (B) $x = 1$ (C) $x = 0$ (D) $x = -1$
50. If $\int_{-1}^4 f(x) \, dx = 4$ and $\int_2^4 (3 - f(x)) \, dx = 7$, the value of $\int_2^{-1} f(x) \, dx$ is
 (A) 2 (B) -3 (C) -5 (D) none of these

SECTION 3 (Maximum Marks: 18)

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Paragraph-1

$$\int_a^b f(x) d\alpha(x) + \int_a^b \alpha(x) d f(x) = \alpha(b) f(b) - \alpha(a) f(a)$$

51. $\int_0^3 (x^2 + 1) d[x]$ (where $[.]$ denotes the greatest integer function) is equal to
 (A) 3 (B) $\frac{9}{2}$ (C) 17 (D) $\frac{27}{2}$
52. $\int_0^6 (x^2 + [x]) d|3 - x|$ (where $[.]$ denotes the greatest integer function) is equal to
 (A) 36 (B) 72 (C) 63 (D) 126

Space for rough work

Paragraph-2

If $f(x)$ and $g(x)$ be two functions, such that $f(a) = g(a) = 0$ and f and g are both differentiable at everywhere in some neighbourhood of point a except possibly 'a'.

Then $\lim_{x \rightarrow a} \frac{f(x)}{g(x)} = \lim_{x \rightarrow a} \frac{f'(x)}{g'(x)}$, provided $f'(a)$ and $g'(a)$ are not both zero.

53. The value of $\lim_{x \rightarrow \infty} \frac{\left\{ \int_0^x e^{t^2} dt \right\}^2}{\int_0^x e^{2t^2} dt}$ is

(A) $\frac{1}{3}$

(B) $\frac{2}{3}$

(C) 1

(D) none of these

54. The value of $\lim_{x \rightarrow 0} \frac{\int_0^{x^2} \cos t^2 dt}{x \sin x}$ is

(A) 1

(B) 2

(C) 3

(D) 0

Space for rough work

FITJEE RET – 7

(2017 – 2019)(2ND YEAR_CHAMPIONS)

IIT-2017 (P2)

DATE: 20.08.2018

ANSWERS

PHYSICS

- | | | | |
|-----------|-----------|---------|----------|
| 1. D | 2. A | 3. D | 4. A |
| 5. C | 6. D | 7. A | 8. A,C,D |
| 9. B,D | 10. A,B,D | 11. A,D | 12. A,D |
| 13. A,B,D | 14. A,C,D | 15. B | 16. D |
| 17. C | 18. D | | |

CHEMISTRY

- | | | | |
|-------------|-------------|-----------|-------------|
| 19. C | 20. C | 21. A | 22. D |
| 23. C | 24. D | 25. A | 26. A, B, C |
| 27. A, B, C | 28. A, B, D | 29. A,B,C | 30. A,B |
| 31. B, C | 32. B, C, D | 33. C | 34. A |
| 35. D | 36. C | | |

MATHEMATICS

- | | | | |
|----------|-------|--------|---------|
| 37. D | 38. D | 39. C | 40. C |
| 41. D | 42. C | 43. C | 44. BCD |
| 45. ACD | 46. B | 47. BD | 48. AC |
| 49. ABCD | 50. C | 51. C | 52. C |
| 53. D | 54. A | | |