FIITJEE Monthly Test – III

PHYSICS, CHEMISTRY & MATHEMATICS

Pattern–1 | **CODE: 000000.1** | **PAPER–1**

Time Allotted: 3 Hours **Maximum Marks: 183**

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.
- You are not allowed to leave the Examination Hall before the end of the test.

BATCHES – 2022

INSTRUCTIONS

Caution: Question Paper CODE as given above MUST be correctly marked in the answer OMR sheet before attempting the paper. Wrong CODE or no CODE will give wrong results.

A. General Instructions

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains Three Parts.
3. **SECTION–I** is Physics, **SECTION–II** is Chemistry and **SECTION–III** is Mathematics.
4. Each part is further divided into **one part**: **Part – A**
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

B. Filling of OMR Sheet

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with HB pencil for each character of your Enrolment No. and write in ink your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.

C. Marking Scheme For All One Part.

Part–A (01 – 07) contains 07 multiple choice questions which have one or more than one correct answer. Each question will be evaluated according to the following marking scheme.

Full Marks	:	**+4**	If only (all) the correct option(s) is (are) chosen;
Partial Marks	:	**+3**	If all the four options are correct but ONLY three options are chosen;
Partial Marks	:	**+2**	If three or more options are correct but ONLY two options are chosen and both of which are correct;
Partial Marks	:	**+1**	If two or more options are correct but ONLY one option is chosen and it is a correct option;
Zero Marks	:	**0**	If none of the options is chosen (i.e. the question is unanswered);
Negative Marks	:	**–1**	In all other cases.

Part–A (08 – 14) contains 07 Multiple Choice Questions which have Only One Correct answer. Each question will be evaluated according to the following marking scheme.

Full Marks	:	**+3**	If only (all) the correct option(s) is (are) chosen;
Zero Marks	:	**0**	If none of the options is chosen (i.e. the question is unanswered);
Negative Marks	:	**–1**	In all other cases.

Part–A (15 – 18) contains 2 Paragraphs. Based upon each paragraph, 2 Multiple Choice Questions have to be answered. Each question has Only One Correct answer and carries **+3 marks** for the correct answer and **– 1 mark** for a wrong answer.

Name of the Candidate :_____

Batch :_____ **Date of Examination :**_____

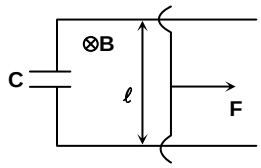
Enrolment Number :_____

SECTION – I : PHYSICS

PART – A: (Multi Correct Answer Type)

*This section contains **07 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.*

1. A conducting wire of length ℓ and mass m can slide without friction on two parallel rails and is connected to capacitance C. Whole system lies in a magnetic field B and a constant force F is applied to the rod. Then



(A) the rod moves with constant velocity

(B) the rod moves with an acceleration of $\frac{F}{m+B^2\ell^2c}$

(C) there is constant charge on the capacitor.

(D) charge on the capacitor increases with time

2. In the YDSE, initially light of equal intensity were coming out of the two slits S_1 and S_2. Now if in front of one slit, a glass sheet which absorbs half of the intensity is placed, then:

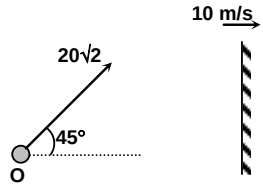
(A) The bright fringes will become comparatively darker

(B) The darker fringes will become comparatively brighter.

(C) The central fringe will shift on the side of the glass plate.

(D) None of these

3. A point object O is moving with velocity $20\sqrt{2}$ m/s and a plane mirror is also moving with a velocity 10 m/s as shown in the figure. Then



(A) the separation between the image and the mirror increases

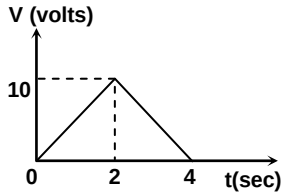
(B) the separation between the image and the mirror decreases

(C) the velocity of image with respect to ground is 20 m/s and parallel to the mirror.

(D) the velocity of image with respect to ground is 40 m/s and parallel to the mirror.

Space for rough work

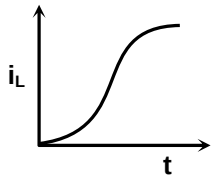
4. The potential difference across a 2H inductor as a function of time is shown in the figure. At time t = 0, current is zero. Choose the correct statement



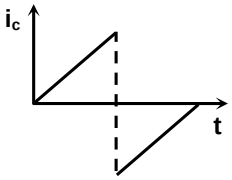
(A) Current at t = 2 sec is 5A

(B) Current at t = 2 sec is 10A

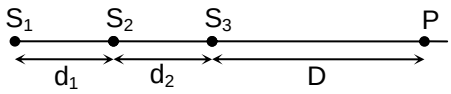
(C) Current vs time graph across inductor will be



(D) Current vs time graph across inductor will be



5. Three coherent sources producing plane wave fronts towards right of same amplitude and wavelength (3λ) are situated on a line as shown in the diagram. If an observer P also lies on the same line and observes no light when sources S_1, S_2 and S_3 are switched on simultaneously. Taking all suitable approximations and d_1 & d_2 <<< D,



(A) d_1 must be 3λ

(B) d_1 may be λ

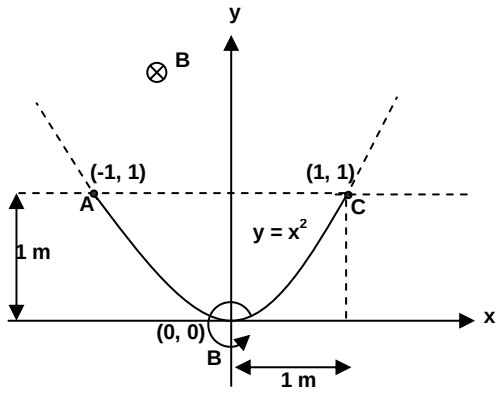
(C) d_2 may be 4λ

(D) d_1 must be λ

Space for rough work

6. The distance between an electric lamp and a screen is d = 1 m. A convergent lens of focal length of f = 21 cm is placed between the lamp and the screen such that a sharp image of the lamp filament is formed on the screen. Choose the correct option(s).
   (A) The positions of the lens from the lamp for which sharp images are formed on the screen are 35 cm and 65 cm.
   (B) The positions of the lens from the lamp for which sharp images are formed on the screen are 30 cm and 70 cm.
   (C) Magnitude of the difference in magnification is $\frac{40}{21}$
   (D) The size of the lamp filament, for which there are two sharp images of 4.5 cm and 2 cm, is 3 cm.

7. A metallic wire ABC is placed along the curve $y = x^2$. Coordinates of point A, B and C are (-1, 1), (0, 0) and (1, 1) respectively. This wire is rotating with angular velocity ω = 4 rad/s about z-axis in anticlockwise sense. There exists a uniform magnetic field B = 2 Tesla directed towards negative z – axis. Then
   (A) emf between points B and C on the wire has magnitude 8 Volts.
   (B) emf between points A and B on the wire has magnitude 8 Volts.
   (C) emf between points A and C on the wire has magnitude 16 Volts.
   (D) none of these



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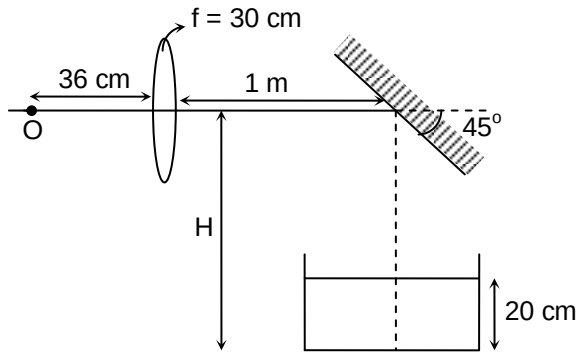
PART – A: (Single Correct Answer Type)

*This section contains **07 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.***

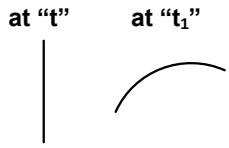
8. Focal length of a plano-convex lens is f cm. This is made of a material with $\mu_g = 2$. If it is placed in the liquid of refractive index $\mu = 4/3$, then focal length will be
(A) f/2 (B) 2f
(C) f (D) none of these

9. In the arrangement shown in figure, image of light source O is to be obtained at the bottom of beaker containing water $\left(\mu = \frac{4}{3}\right)$ upto height 20 cm. Find H.



(A) 80 cm (B) 85 cm
(C) 75 cm (D) 90 cm

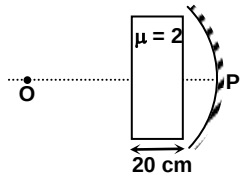
10. The figure shows a plane wavefront at a time 't' and at a time 't_1' In the time interval ($t_1 - t$) the wavefront must have passed through



(A) a prism (B) a prism and a convex lens
(C) a convex lens (D) a plane mirror and a concave lens

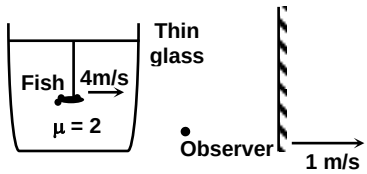
Space for rough work

11. Radius of curvature of the concave mirror is 60 cm. In front of this a glass slab is situated very close to the mirror as shown in the figure. A point object O lie at a distance of 100 cm from the pole, then the position of the image from the pole is

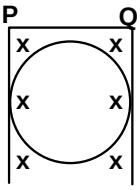


(A) 45 cm (B) 55 cm
(C) 40 cm (D) 60 cm

12. Velocity of image of fish in the mirror with respect to ground is
(A) zero
(B) 2 m/s towards mirror.
(C) 2 m/s away from mirror
(D) 4 m/s towards mirror.



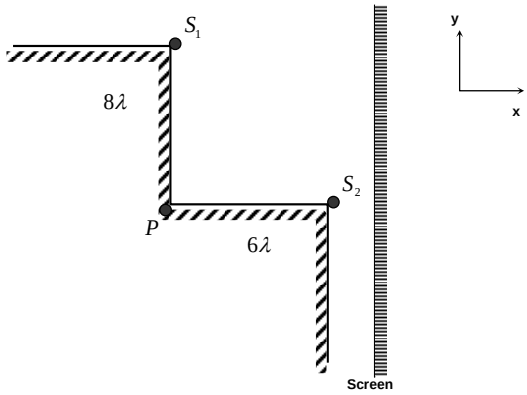
13. A vertical ring of radius r and resistance R falls vertically. It is in contact with two vertical rails which are joined at the top. The rails are without friction and resistance. There is a horizontal uniform magnetic field of magnitude B perpendicular to the plane of the ring and the rails. When the speed of the ring is v, the current in the section PQ is



(A) zero (B) $\frac{2Brv}{R}$

(C) $\frac{4Brv}{R}$ (D) $\frac{8Brv}{R}$

14. Two coherent sources S_1 and S_2 are kept on the edges of a step as shown in the figure. An infinitely long screen is placed on the right side of sources and lies along y - z plane. Calculate total no. of maximas observed on the screen. $PS_1 = 8\lambda$ and $PS_2 = 6\lambda$. Where λ is wavelength of light used. (There is no reflection from steps)



(A) 18
(B) 16
(C) 14
(D) 12

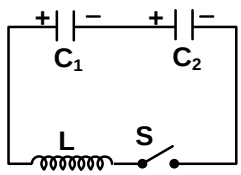
Space for rough work

PART – A: (Paragraph Type)

*This section contains **2 paragraphs.** Based upon the paragraphs **2 multiple choice questions** have to be answered. Each of these questions has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.*

Paragraph for Question Nos. 15 to 16

In the figure shown C_1 = 1F, C_2 = 2F and L = 5H. Initially C_1 is charged to 50 V and C_2 to 10 V. Switch S is closed at time t = 0. Suppose at some instant charge on C_1 is 20 C with the same polarities as shown in the figure.



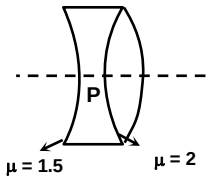
Then find the answer of following questions based on above paragraph.

15. Current in the circuit at this instant will be
(A) $10\sqrt{2}$ A (B) $15\sqrt{2}$ A
(C) 10 A (D) 20 A

16. Maximum current in the circuit will be
(A) $4\sqrt{30}$ A (B) $16\sqrt{2}$ A
(C) $20\sqrt{3}$ A (D) $12\sqrt{6}$ A

Paragraph for Question Nos. 17 to 18

One thin bi-convex lens (μ = 2) and on thin bi-concave lens (μ = 1.5) are joined to form an optical system a1 shown in the figure. Let the radii of curvature of each surface is R = 30 cm.



17. If object distance is equal to the image distance, then find object distance
(A) 16 cm (B) 60 cm
(C) 40 cm (D) none of these

18. Choose the correct statement.
(A) The system is converging (B) The system is diverging
(C) It can be converging or diverging (D) none of these

Space for rough work

PART II: CHEMISTRY

SECTION – 1 (One or More Than One Type)

This section contains **7 multiple choice type questions.** Each question has four choices (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct.

1. $NH_4NO_3(s) \xrightarrow{\Delta} A(gas) + H_2O(g)$

$2NaNH_2 + A \longrightarrow B + NaOH + NH_3$

Which of the following statement/s is/are correct about 'A' and 'B'?
(A) The anionic part of B and A are linear molecule and one of them have nonzero dipole moment
(B) B is used in automobile airbags
(C) A is colourless, non toxic gas and supporter of combustion
(D) A substantially contributes to global warming

2. The total pressure exerted in ideal binary solution is given by $P = P_A^o X_A + P_B^o X_B$ where P_A^o & P_B^o are the respective vapour pressure of pure components and X_A & X_B are their mole fraction in liquid phase. And composition of the vapour phase is determined with the help of Dalton's law of partial pressure:

$$Y_A = \frac{P_A^o X_A}{P}$$

If total pressure exerted in an ideal binary solution is given by $P = \frac{5400}{60 + 30Y_A}$ mm of Hg.

The correct option (s) is/are
(A) If the value of $Y_A = 0.4$ then the value of X_A is:0.5
(B) The more volatile liquid is:liquid B
(C) The value of P_A^o is60 mm of Hg
(D) If the value of $Y_A = 0.4$ then the value of X_B is:0.5

Space for rough work

3. Pick up the CORRECT statement(s).
   (A) In the fluorite structure (CaF_2), the Ca^{2+} ions are located at the lattice points of ccp and F^- ions fill all the tetrahedral holes in the ccp lattice
   (B) In the structure (Rb_2S), the cations are located at the lattice points and anions fill the tetrahedral holes in ccp
   (C) The radius of a metal atom is taken as ½ the nearest metal-metal distance in metallic crystal
   (D) There are effectively four octahedral voids in fcc packing

4. A blue colouration is obtained when:
   (A) Ammonium hydroxide dissolves in copper sulphate
   (B) Copper sulphate solution reacts with $K_4[Fe(CN)_6]$
   (C) Ferric chloride reacts with sodium ferrocyanide
   (D) Anhydrous white $CuSO_4$ is dissolved in water

5. Which of the following combination in an aqueous medium will give a red colour or precipitate?
   (A) $Fe^{3+} + SCN^-$ (B) $Fe^{2+} + [Fe(CN)_6]^{3-}$
   (C) Ni^{2+} + dimethyl glyoxime + NH_3 (D) $Co^{2+} + SCN^-$

6. What products are obtained by the action of aqueous ammonia on $HgCl_2$?
   (A) $[Hg(NH_3)_2]Cl_2$ (B) $[Hg(NH_2)(Cl)]$
   (C) $[Hg_2NCl(H_2O)]$ (D) Hg_2Cl_2

7. Which one of the following will react with the other three to form a white precipitate:
   (A) $CuSO_4$ (aq.) (B) KCl (aq.)
   (C) $Pb(NO_3)_2$ (aq.) (D) K_2CO_3(aq.)

Space for rough work

SECTION – 2 (Single Correct Type)

This section contains **7 multiple choice type questions.** Each question has four choices (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.

8. 0.1 m solution of an acid HA freezes at –0.0205°C. If k_f for water is 1.860 K kg mol^{-1}, the ionization constant of the conjugate base of the acid will be
   (A) 1.1×10^{-4} (B) 1.1×10^{-3}
   (C) 9×10^{-11} (D) 9×10^{-12}

9. White phosphorus when dissolves in boiling NaOH solution in an inert atmosphere, moles of salt of an inorganic salt formed if 24.8 gm of white phosphorus is taken:
   (A) 0.2 (B) 0.3
   (C) 0.4 (D) 0.6

10. Which of the following compound will produce more than one acid in aq. solution:
   (A) P_4O_8 (B) N_2O_4
   (C) $SOCl_2$ (D) All of the above

11. When $Na_2S_2O_3$ is allowed to react with mercuric chloride solution it produce thermally unstable white precipitate which on heating produce a precipitate insoluble in hot HNO_3 but soluble in aqua regia and it was found that 1 mole aqua regia is used for complete reaction. Find out mole of Hg_2Cl_2 produced on reaction of $SnCl_2$ in the mercuric chloride present in original solution.
   (A) 1.25 mole (B) 2 mole
   (C) 0.0625 mole (D) 0.03125 mole

12. If spheres of radius 'r' are arranged in a ccp fashion (ABCABC…), the vertical distance between any two consecutive A layers is:
   (A) $4r\sqrt{\frac{2}{3}}$ (B) $4r\sqrt{\frac{3}{2}}$
   (C) 6r (D) $r\sqrt{6}$

Space for rough work

13. When 66.83 g of VCl_4 is dissolved in 1Kg of CCl_4 the freezing point of CCl_4 was lowered by 5.97°. If the equilibrium constant for the reaction is Y . Then find the value of Y.

$V_2Cl_8 \rightleftharpoons 2VCl_4$

Assuming that only these two molecular species remain in the solution. The melting point of pure CCl_4 is – 22.9°C and its heat of fusion is 4.2 cal gm^{-1}. [Mol. wt. of VCl_4 = 193]

(A) 0.02 (B) 0.05
(C) 0.04 (D) 0.08

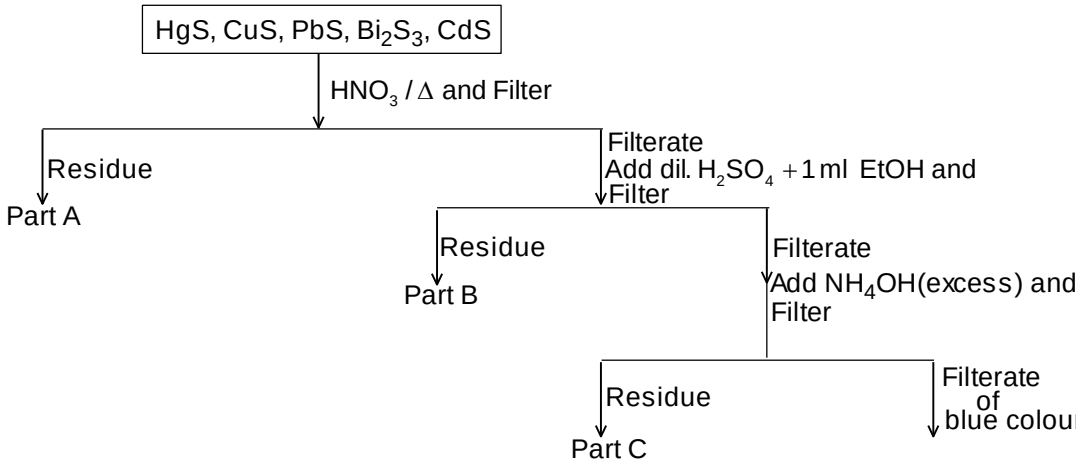
14. A solid cube of edge length = 25.32 mm of an ionic compound which has NaCl type lattice is added to 1 kg of water. The boiling point of this solution is found to be 100.52°C. Assume 100% ionization of ionic compound. If radius of anion of ionic solid is 200 pm then radius of cation in solid is (x pm) [K_b for H_2O = 0.52 K kg/mole, $N_A = 6 \times 10^{23}$, $\sqrt[3]{75} = 4.22$]. Find x.

(A) 100 (B) 200
(C) 10 (D) 600

SECTION – 3 (Paragraph Type)

This section contains **2 questions.** Based on each paragraph, there will be **TWO** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct

Paragraph for Question Nos. 15 and 16



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15. Residue in Part A and Residue in Part C are respectively
(A) CuS& $Cd(OH)_2$ (B) Bi_2S_3& $Bi(OH)_3$
(C) $Bi(OH)_3$ &HgS (D) HgS& $Bi(OH)_3$

16. Residue of part $B + CH_3COO^-NH_4^+ \rightarrow P + SO_4^{2-}$
$P + 2KI \rightarrow Q\downarrow + CH_3COO^-$
Q will be
(A) HgI_2 (B) PbI_2
(C) CdI_2 (D) CuI_2

Paragraph for Questions 17 and 18

(i) A inorganic iodide (A) on heating with a solution of KOH gives a gas (B) and solution of compound (C).
(ii) Gas (B) on ignition gives compound (D) and water.
(iii) $CuSO_4$ is finally reduced to the metal on passing (B) through its solution.
(iv) A ppt. of compound (E) is formed when (C) reacts with $CuSO_4$ solution.
On the basis of above information answer the following questions….

17. Compound (D) on hydrolysis produced…..
(A) Ortho Phosphoric acid (B) Meta Phosphoric acid
(C) Nitrous acid (D) Phosphorous acid

18. When $CuSO_4$ is finally reduced to the metal on passing (B) through its solution, what is the total sum of stoichiometric coefficient of all the reactants and products in the balance chemical equation?
(A) 25 (B) 18
(C) 20 (D) 12

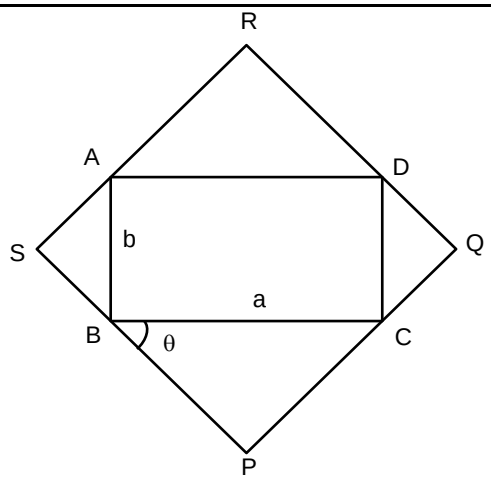
Space for rough work

SECTION – III : MATHEMATICS

PART – A: (Multi Correct Answer Type)

*This section contains **07 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.*

1. Let ABCD is a rectangle whose sides given are a and b. A rectangle PQRS whose area is A is shown in figure, then



(A) area A is maximum when $\theta = \frac{\pi}{3}$

(B) area A is maximum when $\theta = \frac{\pi}{4}$

(C) maximum value of area A = $\frac{1}{4}(a+b)^2$

(D) maximum value of area A = $\frac{1}{2}(a+b)^2$

2. If $f(x) = \begin{vmatrix} 1 & x & x+1 \\ 2x & x(x-1) & (x+1)x \\ 3x(x-1) & x(x-1)(x-2) & (x+1)x(x-1) \end{vmatrix}$, then

(A) f(50) = 50 (B) f(x) = x

(C) f(100) = 0 (D) f(0) = 0

3. In a set, A = {3^3, 7^3, 11^3, 15^3, ….. } if 9 elements are selected from set A and a matrix B of order 3 × 3 is made then, Det(B) must be divisible by

(A) 2 (B) 4

(C) 8 (D) 16

4. If p + q + r = 0 = a + b + c, then the value of the determinant $\begin{vmatrix} pa & qb & rc \\ qc & ra & pb \\ rb & pc & qa \end{vmatrix}$ is

(A) $abc\begin{vmatrix} p & q & r \\ r & p & q \\ q & r & p \end{vmatrix}$ (B) $pqr\begin{vmatrix} a & b & c \\ c & a & b \\ b & c & a \end{vmatrix}$

(C) $(a^3 + b^3 + c^3)(p^3 + q^3 + r^3)$ (D) 0

Space for rough work

5. Let A, B, C be n×n real matrices and product is pair wise commutative also ABC = O_n, if $\lambda = \det(A^3 + B^3 + C^3)$. det (A + B + C) then
(A) $\lambda > 0$ (B) $\lambda < 0$
(C) $\lambda = 0$ (D) $\lambda \in (-\infty, \infty) - \{0\}$

6. The differential equation for the family of curves y = c sinx can be given by
(A) $\left(\frac{dy}{dx}\right)^2 = y^2 \cot^2 x$ (B) $\left(\frac{dy}{dx}\right)^2 - \left(\sec x \frac{dy}{dx}\right)^2 + y^2 = 0$
(C) $\left(\frac{dy}{dx}\right)^2 = \tan^2 x$ (D) $\frac{dy}{dx} = y \cot x$

7. If equations $a^2x + b^2y + c^2 = 0$, $a^4x + b^4y + c^4 = 0$ and $x + y + 1 = 0$ are consistent then
(A) a = –b (B) |b| = |c|
(C) c = a (D) none of these

PART – A: (Single Correct Answer Type)

*This section contains **07 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.***

8. The region M consists of all the points (x, y) satisfying the inequalities $y \geq 0$, $y \leq x$ and $y \leq 2 - x$. The region N which varies with the parameter t consists of all points which satisfy $t \leq x \leq t + 1 \ \forall \ t \in [0, 1]$, then max(ar(M ∩ N)) is
(A) $\frac{1}{2}$ sq. units (B) $\frac{3}{4}$ sq. units
(C) $\frac{7}{8}$ sq. units (D) $\frac{16}{3}$ sq. units

9. The area enclosed by $\left[\frac{|3x+4y|}{5}\right] + \left[\frac{|4x-3y|}{5}\right] = 3$ is (where [.] denotes the greatest integer function)
(A) 2 (B) 4
(C) 8 (D) 16

Space for rough work

10. Let a, b, c be real numbers not all equal and $\Delta_1 = \begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$ and $\Delta_2 = \begin{vmatrix} a+2b & b+3c & c+4a \\ b+2c & c+3a & a+4b \\ c+2a & a+3b & b+4c \end{vmatrix}$ then $\frac{\Delta_2}{\Delta_1}$ is

(A) 24 (B) 25
(C) -24 (D) 23

11. If $\begin{vmatrix} x+3 & x+4 & x+\lambda \\ x+4 & x+5 & x+\mu \\ x+5 & x+6 & x+\nu \end{vmatrix} = 0$, where λ, μ, ν are in A.P. , is

(A) an identity in x (B) an equation whose all roots are real
(C) an equation with only one real root (D) None of these

12. Let A be a 2 X 2 matrix with real entries and $\det(A) = d \neq 0$ such that $\det(A + d(\text{adj}A)) = 0$. Find the value of $\det(A - d(\text{adj}A))$

(A) 8 (B) 7
(C) 4 (D) none of these

13. Solution of the differential equation $(x\cos y - y\sin y)dy + (x\sin y + y\cos y)dx = 0$ is equal to

(A) $x\sin y + y\cos y - \sin y = ce^{-x^3}$ (B) $y\cos x + x\sin y - 2\cos y = 2\ln(x)$
(C) $x^2\cos(xy) + x\sin y - y\cos x = 3e^{cx^2}$ (D) none of these.

14. $ydx - dy = e^{-x}y^4dy$ and $y = 1$ at $x = -\ln 3$, then at $y = 3$, $x = \ln k$, k is

(A) 21 (B) 24
(C) 27 (D) 81

Space for rough work

PART – A: (Paragraph Type)

*This section contains **2 paragraphs.** Based upon the paragraphs **2 multiple choice questions** have to be answered. Each of these questions has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.*

Paragraph for Question Nos. 15 to 16

Let $h(x) = f(x) - g(x)$ where $f(x) = \sin^2\pi x$ and $g(x) = \ln x$. Let $x_0, x_1, x_2, \ldots, x_{n+1}$ be the roots of $f(x) = g(x)$ in increasing order.

15. Then the absolute area enclosed by $y = f(x)$ and $y = g(x)$ is given by

(A) $\sum_{r=0}^{n} \int_{x_r}^{x_{r+1}} (-1)^r h(x)dx$ (B) $\sum_{r=0}^{n} \int_{x_r}^{x_{r+1}} (-1)^{r+1} h(x)dx$

(C) $2\sum_{r=0}^{n} \int_{x_r}^{x_{r+1}} (-1)^r h(x)dx$ (D) $\frac{1}{2}\sum_{r=0}^{n} \int_{x_r}^{x_{r+1}} (-1)^{r+1} h(x)dx$

16. The whole area bounded by $y = f(x)$, $y = g(x)$ and $x = 0$ is

(A) 3/2 (B) 3/4

(C) 2 (D) 1/2

Paragraph for Question Nos. 17 to 18

Let A & B are $n \times n$ matrices with real entries and $|B| \neq 0$ then

17. Det $(A^2 + I_n)$ can not be

(A) –1 (B) 1

(C) 2 (D) 0

18. Det $(I_n - AB) - \det(I_n - BA)$ is equal to

(A) 0 (B) 1

(C) 2 (D) 5

Space for rough work

FIITJEE Monthly Test – III

PHYSICS, CHEMISTRY & MATHEMATICS

CODE: 000000.1 **PAPER–1**

ANSWERS

PHYSICS (SECTION –I)

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

CHEMISTRY (SECTION –II)

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

MATHEMATICS (SECTION –III)

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

HINTS & SOLUITONS

PHYSICS (SECTION –I)

4. Area in (v_L-t)graph = $L\Delta I$

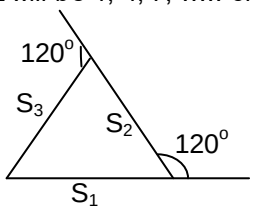
$\Rightarrow \quad 2(i_f - 0) = \frac{1}{2}\times 10\times 2$

$\Rightarrow \quad i_f = 5A$

5. Making phase diagram

d_1 will be 1, 4, 7, ... cm

d_2 will be 1, 4, 7, ... cm



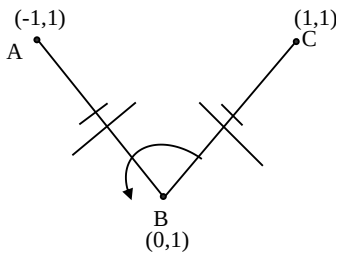
6. $\frac{1}{100-x}=\frac{1}{-x}=\frac{1}{21}$

$\Rightarrow$ x, the distance of object from the lens = 30 cm, 70 cm

$m_1=\frac{70}{-30}, m_2=\frac{30}{-70}$

$\therefore \quad |m_1-m_2|=\frac{40}{21}.$

7.

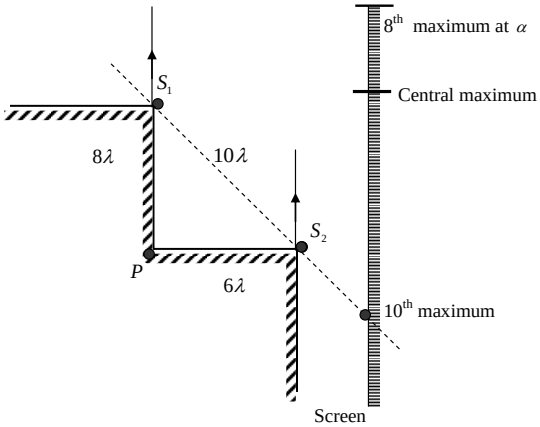


9. $\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$

v = 180 cm

$15\times\frac{4}{3}$ = 20 cm

14.



CHEMISTRY (SECTION –II)

1. **A, B, C, D**

$NH_4NO_3(s) \xrightarrow{\Delta} N_2O(A) + H_2O(g)$

$2NaNH_2 + N_2O \longrightarrow NaN_3(B) + NaOH + NH_3$

$O = N = N$ is linear but have some dipole moment

2. **A,B,C,D**

Y_A , Y_B are mole fractions of A, B in vapour phase

X_A, X_B are mole fractions of A, B in liquid phase

$$\frac{1}{P} = \frac{Y_A}{P_A^o} + \frac{Y_B}{P_B^o}$$

$$\frac{1}{P} = \frac{P_B^o Y_A + P_A^o Y_B}{P_A^o P_B^o}$$

$$\Rightarrow P = \frac{P_A^o + P_B^o}{P_A^o + Y_A\left(P_B^o - P_A^o\right)} = \frac{5400}{60 + 30Y_A}$$

$P_A^o = 60; P_B^o = 90$

'B' has more V.P. So, it is more volatile.

When $Y_A = 0.4$ $P = 75$

$$X_A = \frac{PY_A}{P_A^o} = \frac{(75)(0.4)}{60} = 0.5$$

$X_B = 1 - X_A = 0.5$

3. **A,C,D**

Rb_2S formula is not possible if cations are located at the lattice point and anions at tetrahedral holes.

4. **A,C,D**

$$2Cu^{2+} + \left[Fe(CN)_6\right]^{4-} \longrightarrow Cu_2\left[Fe(CN)_6\right]\downarrow$$
$$(\text{red brown})$$

5. **A, C**

6. **A, B, C**

$HgCl_2 + 2NH_3 \rightleftharpoons [Hg(NH_3)_2Cl_2]$

$[Hg(NH_3)_2Cl_2] \rightleftharpoons [Hg(NH_2)Cl] + NH_4Cl$

$2[Hg(NH_2)_2Cl] + H_2O \rightleftharpoons [Hg_2NCl(H_2O)] + NH_4Cl$

7. **C**

$Pb(NO_3)_2 + CuSO_4 \longrightarrow PbSO_4\downarrow + Cu(NO_3)_2$

$Pb(NO_3)_2 + 2KCl \longrightarrow PbCl_2\downarrow + 2KNO_3$

$Pb(NO_3)_2 + K_2CO_3 \longrightarrow PbCO_3\downarrow + 2KNO_3$

(All $\downarrow$ are white precipitates)

8. **C**

$\Delta T_{f(normal)} = k_f \times m = 1.860 \times 0.1 = 0.1860$

$i = \dfrac{\Delta T_{f(obs)}}{\Delta T_{f(nor)}} = \dfrac{0.0205}{0.0186} = 1.1$

$i = 1 + \alpha = 1.1$

$\alpha = 0.1$

$K_a = \dfrac{C\alpha^2}{1-\alpha}$

$K_b = \dfrac{K_w}{K_a} = 9 \times 10^{-11}$

9. **D**

$P_4 + 3NaOH + 3H_2O \longrightarrow PH_3 + 3NaH_2PO_2$

Mole of $NaH_2PO_2 = 0.6$

10. **D**

11. **D**

$Na_2S_2O_3 + HgCl_2 \rightarrow HgS_2O_3 \downarrow + 2NaCl$

$HgS_2O_3 + H_2O \rightarrow HgS \downarrow + H_2SO_4$

$\underbrace{HNO_3 + 3HCl}_{1\,mole} \rightarrow NOCl + 2H_2O + \underset{\frac{1}{2}\,mole}{2Cl}$

$4H_2O + HgS + \underset{\frac{1}{2}mole}{8Cl} \rightarrow HgCl_2 + H_2SO_4 + 6HCl$

HgS reacted $= \dfrac{1}{16}$ mole

So $HgCl_2$ present $= \dfrac{1}{16}$ mole

$\underset{\frac{1}{16}mole}{2HgCl_2} + SnCl_2 \rightarrow SnCl_4 + \underset{\frac{1}{32}\ mole}{Hg_2Cl_2}$

12. **B**

Because $a\sqrt{2} = 4r$

$\therefore a\sqrt{3} = 4r\sqrt{\dfrac{3}{2}}$

13. **A**

$K_f = \dfrac{RT_f^{0^2}M_2}{\Delta H_{molar}} = \dfrac{RT_f^{0^2}}{\Delta H_{molar}/M_2} = \dfrac{1.987 \times (250.1)^2}{4.2 \times 1000}\ kgmol^{-1} = 29.6$

	$2VCl_4 \rightleftharpoons V_2Cl_8$	
$t = 0$	0.346	0
	$-2x$	$+x$
t = t,	$(0.346 - 2x)$	x

$n_T = 0.346 - x$

$\Delta T_f = K_f \times M_{actual}$

on solving x = 0.146

$K_c = \dfrac{(0.346 - 2x)^2}{x} = 0.02 = 2 \times 10^{-2}$

14. **A**

No. of formula units in given cube = $0.5 \times 6 \times 10^{23}$

No. of unit cells along one edge of cube = $(75)^{1/3} \times 10^7$

$\therefore$ Edge length = a = $\frac{25.32\times10^{-3}}{4.22\times10^{7}} = 600$ pm

$2(r^+ + r^-) = a \Rightarrow r^+ = 100$ pm

15. **D**

Pb, Cu, Cd, Bi sulphides are solution in HNO_3.

16. **B**

. P = $Pb(CH_3COO)_2$, Q = PbI_2

17. **A**

18. **B**

A- PH_4I B-PH_3 C-KI D-P_2O_5 E-Cu_2I_2

$P_2O_5 + 3H_2O \rightarrow 2H_3PO_4$

$PH_3 + 4CuSO_4 + 4H_2O \rightarrow 4Cu + H_3PO_4 + 4H_2SO_4$

MATHEMATICS (SECTION –III)

1. **B, D**

Area A = area of PQRS

$= (b\sin\theta + a\cos\theta)(a\sin\theta + b\cos\theta)$

$= ab + (a^2 + b^2)\sin\theta\cos\theta$

$= ab + \frac{a^2+b^2}{2}\sin2\theta$

A is maximum when $\sin2\theta = 1 \Rightarrow \theta = \frac{\pi}{4}$

$A_{max} = ab + \frac{a^2+b^2}{2} = \frac{1}{2}(a+b)^2$.

2. **C, D**

$$f(x) = \begin{vmatrix} 1 & x & x+1 \\ 2x & x(x-1) & (x+1)x \\ 3x(x-1) & x(x-1)(x-2) & (x+1)x(x-1) \end{vmatrix}$$

$C_3 \rightarrow C_3 - C_2$

$$\Rightarrow f(x) = \begin{vmatrix} 1 & x & 1 \\ 2x & x(x-1) & 2x \\ 3x(x-1) & x(x-1)(x-2) & 3x(x-1) \end{vmatrix} = 0$$

$\Rightarrow f(50) = 0$

3. **A, B, C, D**

$a_n^3 = (4n-1)^3 = 64n^3 - 1 + 12n - 48n^2$

$ak_1^3 - ak_2^3 = 64\left(k_1^3 - k_2^3\right) + 12\left(k_1 - k_2\right) - 48\left(k_1^2 - k_2^2\right) = 4\lambda_1$ ..... (a)

The matrix formed is $\begin{bmatrix} ak_1^3 & ak_2^3 & ak_3^3 \\ ak_4^3 & ak_5^3 & ak_6^3 \\ ak_7^3 & ak_8^3 & ak_9^3 \end{bmatrix} = B$

$$\text{Det}(B) = \begin{vmatrix} ak_1^3 & ak_2^3 & ak_3^3 \\ ak_4^3 & ak_5^3 & ak_6^3 \\ ak_7^3 & ak_8^3 & ak_9^3 \end{vmatrix}$$

Now, $R_1 \to R_1 - R_3$ and $R_2 \to R_2 - R_3$

$$\text{Det}(B) = \begin{vmatrix} ak_1^3 - ak_7^3 & ak_2^3 - ak_8^3 & ak_3^3 - ak_9^3 \\ ak_4^3 - ak_7^3 & ak_5^3 - ak_8^3 & ak_6^3 - ak_9^3 \\ ak_7^3 & ak_8^3 & ak_9^3 \end{vmatrix}$$ using (a) we get

$$= \begin{vmatrix} 4\lambda_{17} & 4\lambda_{28} & 4\lambda_{39} \\ 4\lambda_{47} & 4\lambda_{58} & 4\lambda_{69} \\ ak_7^3 & ak_8^3 & ak_9^3 \end{vmatrix} = 16 \begin{vmatrix} \lambda_{17} & \lambda_{28} & \lambda_{39} \\ \lambda_{47} & \lambda_{58} & \lambda_{69} \\ ak_7^3 & ak_8^3 & ak_9^3 \end{vmatrix}$$

$\Rightarrow$ Divisible by 2, 4, 8, 16

4. **A, B, D**

We have $\Delta = \begin{vmatrix} pa & qb & rc \\ qc & ra & pb \\ rb & pc & qa \end{vmatrix}$

$= pqr(a^3 + b^3 + c^3) - abc(p^3 + q^3 + r^3)$ …(1) [on expanding]

Now $a + b + c = 0 \Rightarrow a^3 + b^3 + c^3 = 3abc$

and $p + q + r = 0 \Rightarrow p^3 + q^3 + r^3 = 3pqr$.

So from (1) $\Delta = 0$.

Again $a + b + c = 0 \Rightarrow \begin{vmatrix} a & b & c \\ c & a & b \\ b & c & a \end{vmatrix} = 0$

and $p + q + r = 0 \Rightarrow \begin{vmatrix} p & q & r \\ r & p & q \\ q & r & p \end{vmatrix} = 0$.

5. **A, C**

$A^3 + B^3 + C^3 = A^3 + B^3 + C^3 - 3ABC$

$= (A + B + C)(A^2 + B^2 + C^2 - AB - BC - CA)$

$= (A + B + C)(A + \omega B + \omega^2 C)(A + \omega^2 B + \omega C)$ [ω is complex cube root of unity]

$= (A + B + C)(A + \omega B + \omega^2 C)\overline{(A + \omega B + \omega^2 C)}$

thus $\det(A^3 + B^3 + C^3).\det(A + B + C)$

$\det(A + B + C)^2.\det(A + \omega B + \omega^2 C)\det\overline{(A + \omega B + \omega^2 C)}$

$= \left(\det(A + B + C)\right)^2 . \left|\det(A + \omega B + \omega^2 C)\right|^2 \geq 0$.

6. **A, B, D**

$y = c \sin x$ …(1)

$\frac{dy}{dx} = c \cos x$ …(2)

from (2)

$\left(\frac{dy}{dx}\right)^2 = c^2 \cos^2 x$ …(3)

Putting $c = \frac{y}{\sin x}$ from (1), $\left(\frac{dy}{dx}\right)^2 = y^2 \cot^2 x$

Eliminating c from (1) and (2),

$\frac{dy}{dx} = y \cot x$.

Finding value of c from (2) and eliminating with help of (3), we get

$\left(\frac{dy}{dx}\right)^2 - \left(\sec x \frac{dy}{dx}\right)^2 + y^2 = 0$.

7. **A, B, C**

$$\begin{vmatrix} a^2 & b^2 & c^2 \\ a^4 & b^4 & c^4 \\ 1 & 1 & 1 \end{vmatrix} = 0$$

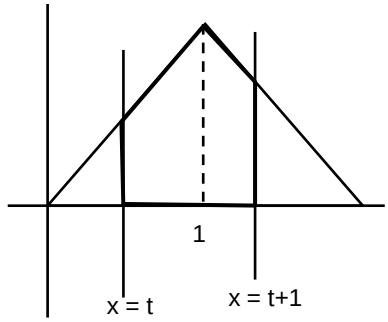
$(a^2 - b^2)(b^2 - c^2)(c^2 - a^2) = 0$

8. **B**

$$\text{ar}(M \cap N) = -t^2 + t + \frac{1}{2} \quad \forall\ t \in [0, 1]$$

$$\text{ar}(M \cap N) = -\left(t - \frac{1}{2}\right)^2 + \frac{3}{4}$$

$\Rightarrow \min(\text{ar}(M \cap N)) = \frac{3}{4}$ sq. units.



9. **D**

Let $|X| = PQ = \frac{|4x - 3y|}{5}$

$|Y| = PR = \frac{|3x + 4y|}{5}$

$\Rightarrow$ Given equation is $[|X|] + [|Y|] = 3$

symmetric about X-axis and Y-axis.

For $X, Y \geq 0$

$\Rightarrow$ area = 4 sq. units

$\Rightarrow$ total area enclosed = $4 \times 4 = 16$ sq. units.

10. **B**

$$\Delta_2 = \begin{vmatrix} a+2b & b+3c & c+4a \\ b+2c & c+3a & a+4b \\ c+2a & a+3b & b+4c \end{vmatrix} = 25 \begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix} = 25\ \Delta_1$$

$\frac{\Delta_2}{\Delta_1} = 25$

11. **A**

Since $\begin{vmatrix} x+3 & x+4 & x+\lambda \\ x+4 & x+5 & x+\mu \\ x+5 & x+6 & x+\nu \end{vmatrix} = 0$

$R_2 \to R_2 - \left(\frac{R_1 + R_3}{2}\right)$.

$$\Rightarrow \begin{vmatrix} x+3 & x+4 & x+\lambda \\ 0 & 0 & \mu - \left(\frac{\lambda+\nu}{2}\right) \\ x+5 & x+6 & x+\nu \end{vmatrix} = 0$$

But λ, μ, ν are in A.P. .

$\therefore \mu = \frac{\lambda+\nu}{2}$

$$\therefore \begin{vmatrix} x+3 & x+4 & x+\lambda \\ 0 & 0 & 0 \\ x+5 & x+6 & x+\nu \end{vmatrix} = 0 \ \forall \ x \in R$$

$\therefore$ An identity in x.

12. **C**

Let $A = \begin{bmatrix} x & y \\ z & w \end{bmatrix}$ then adj $A = \begin{bmatrix} w & -y \\ -z & x \end{bmatrix}$

$$A + d(adjA) = \begin{bmatrix} x+dw & y(1-d) \\ z(1-d) & w+dx \end{bmatrix}$$

$$|A + d(adjA)| = (x+dw)(w+dx) - yz(1-d)^2$$

$$= xw + (w^2 + x^2)d + d^2xw - yz + 2yzd - d^2yz$$

$$= d + (w+x)^2 d + d^3 - 2d^2 = 0$$

$\Rightarrow 1 + (w+x)^2 + d^2 - 2d = 0 \Rightarrow d = 1, w + x = 0$

$$|A - d \text{ adj } A| = d[1 + d^2 + 2d] = 4$$

13. **D**

14. **C**

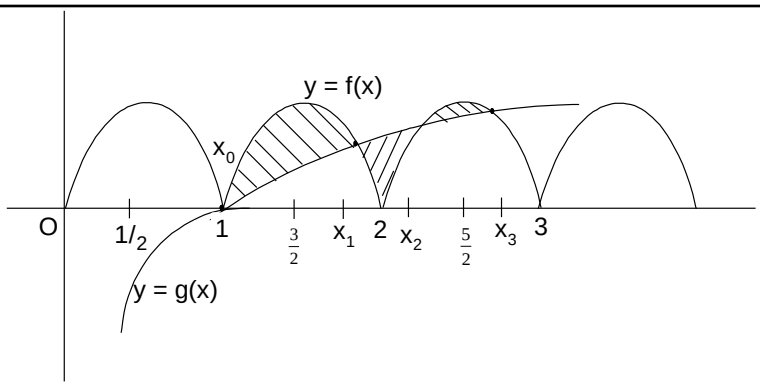
$$\frac{ye^x dx - e^x dy}{y^2} = y^2 dy \Rightarrow d\left(\frac{e^x}{y}\right) = y^2 dy$$

$$\Rightarrow \frac{e^x}{y} = \frac{y^3}{3} + c$$

put $y = 1$, $x = \ln\left(\frac{1}{3}\right)$, $c = 0$

put $y = 3$, $x = \ln 27$.

15. **A**



16. **A**

17. **A**

18. **A**

Question Numbers	Physics	Chemistry	Math
	MyPAT Code	MyPAT Code	MyPAT Code
1	P120404	C120803 C120806	M121001
2	P120511	C120601 C120602	M120201
3	P120502	C120303,C120304	M120201
4	P120407	C120208	M120201
5	P120512	C120208	M120101
6	P120504	C120208	M120902
7	P120403	C120201,C120202, C120203,C120208	M120203
8	P120504	C120606,C120608	M121001
9	P120504	C120810	M121001
10	P120510	C120810 C120806 C120809 C120904	M120201
11	P120503	C120203,C120208	M120201
12	P120503	C120303	M120103
13	P120403	C120608, C120307	M120905
14	P120512	C120608, C120306	M120905
15	P120407	C120203,C120204,C120208	M121001
16	P120407	C120203,C120204,C120208	M121001
17	P120505	C120803	M120104
18	P120505	C120803	M120101