

**FIITJEE - INTERNAL PHASE TEST****PHYSICS, CHEMISTRY & MATHEMATICS****CODE: 100692****Time Allotted: 3 Hours****Maximum Marks: 255**

- 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.

**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 **Section** is further divided into **Two Parts: Part-A & B** in the OMR.
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 **Blue/Black Ball Point Pen** 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 Two Parts.**

- (i) **PART-A (01-07)** contains 7 Multiple Choice Questions which have **One or More Correct** answer. For each question in the group **Q. 01 – 07** of **PART – A** you will be awarded  
*Full Marks: +4* If only the bubble(s) corresponding to all the correct options(s) is (are) darkened.  
*Partial Marks: +1* For darkening a bubble corresponding to **each correct option**, provided NO incorrect option is darkened.  
*Zero Marks: 0* If none of the bubbles is darkened.  
**Negative Marks: -1 In all other cases.**  
 For example, if **(A), (C) and (D)** are all the correct options for a question, darkening all these three will result in **+4 marks**; darkening only **(A) and (D)** will result in **+2 marks**; and darkening **(A) and (B)** will result in **-1 mark**, as a wrong option is also darkened.
- (ii) **Part-A (08-14)** – Contains seven (07) multiple choice questions which have **ONLY ONE CORRECT** answer Each question carries **+3 marks** for correct answer and **-1 marks** for wrong answer
- (iii) **Part-A (15-18)** - This section contains Two paragraphs. Based on each table, there are Two multiple choice questions. Each question has **only one correct** answer and carries **+3 marks** for the correct answer. **There is no negative marking.**
- (iv) **Part-A (19-20)** – This section contains Two (02) List-Match Sets, each List-Match set has One (01) Multiple Choice Questions. Each List-Match set has two lists: List-I and List-II. FOUR options are given in each Multiple Choice Question based On List-I and List-II and **ONLY ONE** of these four options satisfies the condition asked in the Multiple Choice Question. Each question carries **+3 Marks** for correct combination chosen and **-1 mark** for wrong options chosen.
- (v) **Part-B (01-06)** contains six (06) Numerical based questions, the answer of which maybe positive or negative numbers or decimals to **Two decimal places** (e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30) and each question carries **+3 marks** for correct answer. **There is no negative marking.**

Name of the Candidate : \_\_\_\_\_

Batch : \_\_\_\_\_ Date of Examination : \_\_\_\_\_

Enrolment Number : \_\_\_\_\_

BATCHES – Three Yr CRP427(R&amp;W) &amp; Four Yr CRP327(R&amp;W)\_PT-1&amp;5

## SECTION – I (PHYSICS)

### PART – A

#### Multiple Correct Choice Type

This section contains 7 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE or MORE THAN ONE are correct.

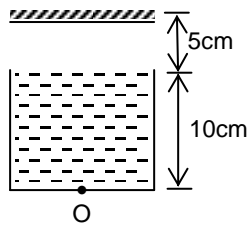
---

- A convex mirror is used to form an image of a real object, the image is  
(A) always lies between the pole and the focus  
(B) is diminished in size  
(C) is erect  
(D) is real
  - A converging lens is used to form an image on a screen. When upper half of the lens is covered by an opaque material :  
(A) half the image will disappear  
(B) complete image will be formed  
(C) intensity of the image will increase  
(D) intensity of the image will decrease
  - Which of the following form(s) a virtual and erect image for all positions of the object?  
(A) Convex lens  
(B) Concave lens  
(C) Convex mirror  
(D) Concave mirror
  - A concave mirror has focal length 15 cm. Where should an object be placed in front of the mirror so that the image formed is three times the size of the object?  
(A) 7.5 cm  
(B) 10 cm  
(C) 17.5 cm  
(D) 20 cm
  - Radius of curvature of convex mirror is 40 cm and the size of object is twice as that of image, then the image distance is  
(A) 10 cm  
(B) 20 cm  
(C) 40 cm  
(D) 30 cm
  - A virtual image is formed for a real object kept in front of a concave mirror we can say that :  
(A) Image is erect  
(B) magnification is positive  
(C) object is kept between C and F  
(D) object distance > image distance
  - A double convex lens of refractive index  $\mu_1$  is immersed in a liquid of refractive index  $\mu_2$ . The lens will act as  
(A) diverging lens, if  $\mu_1 > \mu_2$   
(B) diverging lens, if  $\mu_1 < \mu_2$   
(C) converging lens, if  $\mu_1 > \mu_2$   
(D) converging lens, if  $\mu_1 < \mu_2$
- 

*Space For Rough Work*

**Single Correct Choice Type**

This section contains 7 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE option is correct.

8. A person 1.6 m tall is standing at the center between two walls 4.5 m high. What is the minimum size of a plane mirror fixed on the wall in front of him so that he can see full height of the wall behind him?  
 (A) 1 m                      (B) 1.125 m                      (C) 1.5 m                      (D) 2.25 m
9. A convex mirror of focal length 'f' forms an image which is  $\frac{1}{n}$  times the object. The distance of the object from the mirror is:  
 (A)  $(1-n)f$                       (B)  $\left(\frac{n-1}{n}\right)f$                       (C)  $\left(\frac{n+1}{n}\right)f$                       (D)  $(n+1)f$
10. Consider the situation shown in figure. Water  $\left(\mu_w = \frac{4}{3}\right)$  is filled in a beaker upto a height of 10 cm. A plane mirror is fixed at a height of 5 cm from the surface of water. Distance of image from the mirror after reflection from it of an object O at the bottom of the beaker is  
 (A) 15 cm                      (B) 12.5 cm  
 (C) 7.5 cm                      (D) 10 cm
- 
11. In a concave mirror, an object is placed at a distance  $x_1$  from focus and image at a distance  $x_2$  from focus. Then the focal length of the mirror is  
 (A)  $\sqrt{x_1 x_2}$                       (B)  $\frac{x_1 + x_2}{2}$                       (C)  $\frac{x_1 - x_2}{2}$                       (D)  $\sqrt{\frac{x_1}{x_2}}$
12. A lens of power +2 diopter is placed in contact with a lens of power -1 diopter. The combination will behave like :  
 (A) a convergent lens of focal length 50 cm  
 (B) a convergent lens of focal length 100 cm  
 (C) a convergent lens of focal length 200 cm  
 (D) a divergent lens of focal length 100 cm

Space For Rough Work

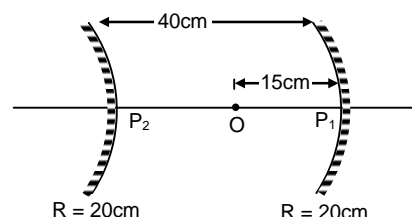
13. A biconvex lens of focal length 15 cm is in front of a plane mirror. The distance between the lens and the mirror is 10 cm. A small object is kept at a distance of 30 cm from the lens. The final image is  
 (A) virtual and a distance of 16 cm from the mirror  
 (B) real and at a distance of 16 cm from the mirror  
 (C) virtual and at a distance of 20 cm from the mirror  
 (D) real and at a distance of 20 cm from the mirror
14. A person is in a room whose ceiling and two adjacent walls are mirror. How many images are formed?  
 (A) 5 (B) 6 (C) 7 (D) 8

**Comprehension Type**

This section contains 2 Paragraphs which has two multiple choice questions each. Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE option is correct.

**Paragraph - I (15-16)**

Two mirrors-one concave and the other convex are placed at separation of 40 cm as shown in the figure. The principal axis and radii of curvature of both mirrors are the same.

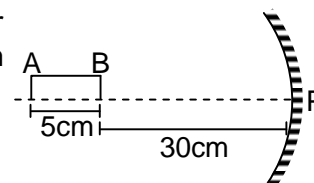


A point object is placed at a distance of 15 cm from concave mirror.

15. Find the location of image after reflection from concave mirror.  
 (A) 30 cm to left of  $P_1$  (B) 30 cm to left of  $P_2$   
 (C) 30 cm right to  $P_1$  (D) 30 cm right to  $P_2$
16. Find the location of 1st image formed by convex mirror.  
 (A)  $\frac{50}{7}$  cm left of  $P_1$  (B)  $\frac{50}{7}$  cm left of  $P_2$   
 (C)  $\frac{50}{7}$  cm right of  $P_1$  (D)  $\frac{50}{7}$  cm right of  $P_2$

**Paragraph -II (17-18)**

A thin rod of length 5 cm lies along the principal axis of the concave mirror of focal length 15 cm in such a way that the end closer to the pole is 30 cm away from it (as shown in figure).



17. Find the distance of image of 'A' from pole 'P'.  
 (A) 20.25 cm (B) 22.5 cm  
 (C) 35 cm (D) 26.25 cm
18. The length of image is  
 (A) 3.5 cm (B) 3.75 cm (C) 5 cm (D) none of these

Space For Rough Work

**Match Type**

This section contains Two (02) List-Match Sets, each List-Match set has One (01) Multiple Choice Questions. Each List-Match set has two lists: List-I and List-II. FOUR options are given in each Multiple Choice Question based On List-I and List-II and ONLY ONE of these four options satisfies the condition asked in the Multiple Choice Question.

19. Match the column.

Column-I		Column-II	
(A)	When light passes from a rarer medium to denser medium at non zero angle with normal	(P)	No change in speed of light
(B)	When light passes from a denser medium to rarer medium at non zero angle with normal	(Q)	light is deviated from its original path
(C)	When light falls normally on a plane mirror	(R)	speed of light changes
(D)	When a ray of light grazes a plane mirror	(S)	light goes undeviated

(A) A → QP; B → QR; C → RS; D → PS

(B) A → QR; B → QR; C → PQ; D → PS

(C) A → PS; B → QR; C → QR; D → PS

(D) A → QR; B → PR; C → QS; D → PS

20. Match the column.

Column-I		Column-II	
(A)	Real object placed between pole and focus of a concave mirror	(P)	Real image
(B)	Virtual image in mirror	(Q)	Enlarged image
(C)	Real object placed anywhere between infinity and pole of a convex mirror.	(R)	Erect image
(D)	Real object placed beyond centre of curvature in front of a concave mirror.	(S)	Diminished image

(A) A → QR; B → QRS; C → RS; D → PS

(B) A → QRS; B → RS; C → PS; D → QS

(C) A → PS; B → QR; C → QRS; D → RS

(D) A → QR; B → PS; C → RS; D → QRS

*Space For Rough Work*

**PART – B**

**Numerical Based**

**This section contains 6 questions. The answer of which maybe positive or negative numbers or decimals (e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30) and each question carries +3 marks for correct answer.**

---

1. An object placed in front of a concave mirror at a distance of  $x$  cm from the pole gives a 3 times magnified real image. If it is moved to a distance of  $(x + 5)$  cm, the magnification of the image becomes 2. The magnitude of focal length of the mirror is  $10 N$  cm. Find the value of  $N$ .
2. An air bubble in a glass slab with refractive index 1.5 (near normal incidence) is 3 cm deep when viewed from one surface and 1 cm deep when viewed from the opposite surface. The thickness (in cm) of the slab is \_\_\_\_\_.
3. A concave lens of focal length 20 cm is placed in contact with a convex lens of focal length 12.5 cm in such a way that they have the same principal axis. The power of the combination is \_\_\_\_\_ .
4. The magnification of an object placed in front of a convex lens is +2. The focal length of the lens is 2 m. Find the distance (in meter) by which object has to be moved to obtain a magnification of  $-2$ .
5. The distance between a convex lens and a plane mirror is 3.5 cm. The parallel rays incident on the convex lens reflection from the mirror form an image at the optical center of the lens. The focal length of the lens is \_\_\_\_\_ cm.
6. A point object is placed at a distance of 25 cm from a convex lens. Its focal length is 22 cm. A glass slab of refractive index 1.5 is inserted between the lens and the object. Then the image is formed at infinity. Find the thickness of the glass slab (in cm).

---

*Space For Rough Work*

**SECTION – II (CHEMISTRY)****PART – A****Multiple Correct Choice Type**

This section contains 7 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE or MORE THAN ONE are correct.

- Which of the following are exothermic processes?  
 (A) Reaction of water with quick lime (B) Dilution of an acid  
 (C) Evaporation of water (D) Sublimation of camphor (crystals)
- In which of the following species, the oxidation number of phosphorus is +3?  
 (A)  $\text{PH}_3$  (B)  $\text{H}_3\text{PO}_3$   
 (C)  $\text{H}_3\text{PO}_2$  (D)  $\text{PCl}_3$
- The correct statement regarding NaOH is/are  
 (A) It is an Arrhenius base (B) It is deliquescent in nature  
 (C) It is called an alkali (D) It can absorb  $\text{CO}_2$
- Which of the following is/are called Lewis acids?  
 (A)  $\text{BCl}_3$  (B)  $\text{Ag}^+$   
 (C)  $\text{NH}_3$  (D)  $\text{Br}^-$
- Which among the following is / are disproportionation reaction?  
 (A)  $\text{Cl}_2 + 2\text{OH}^- \longrightarrow \text{ClO}^- + \text{Cl}^- + \text{H}_2\text{O}$   
 (B)  $3\text{Cl}_2 + 6\text{OH}^- \longrightarrow 5\text{Cl}^- + \text{ClO}_3^- + 3\text{H}_2\text{O}$   
 (C)  $2\text{H}_2\text{O}_2 \longrightarrow 2\text{H}_2\text{O} + \text{O}_2$   
 (D)  $\text{S}_8 + 12\text{OH}^- \longrightarrow 4\text{S}^{2-} + 2\text{S}_2\text{O}_3^{2-} + 6\text{H}_2\text{O}$
- Let us consider the ionization of HCl in the aqueous solution of  $\text{CH}_3\text{COOH}$ .  

$$\text{CH}_3\text{COOH} + \text{HCl} \rightleftharpoons \text{CH}_3\text{COOH}_2^+ + \text{Cl}^-$$
 Select the correct statement(s) among the following  
 (A)  $\text{Cl}^-$  is the conjugate base of HCl  
 (B)  $\text{CH}_3\text{COOH}_2^+$  is conjugate acid of  $\text{CH}_3\text{COOH}$   
 (C)  $\text{CH}_3\text{COOH}_2^+$  is the conjugate base of  $\text{CH}_3\text{COOH}$   
 (D)  $\text{Cl}^-$  is the conjugate base of  $\text{CH}_3\text{COOH}$
- A 0.001 M NaOH solution will be having  
 (A)  $[\text{H}^+] = 10^{-11}$  (B)  $[\text{OH}^-] = 10^{-3}$  (C)  $\text{pH} = 11$  (D)  $[\text{Na}^+] = 10^{-3}$

*Space For Rough Work*

**Single Correct Choice Type**

This section contains 7 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE option is correct.

8. The set with correct order of acidity is  
 (A)  $\text{HClO} < \text{HClO}_2 < \text{HClO}_3 < \text{HClO}_4$  (B)  $\text{HClO}_4 < \text{HClO}_3 < \text{HClO}_2 < \text{HClO}$   
 (C)  $\text{HClO} < \text{HClO}_4 < \text{HClO}_3 < \text{HClO}_2$  (D)  $\text{HClO}_4 < \text{HClO}_2 < \text{HClO}_3 < \text{HClO}$
9. Three beakers labelled as A, B and C each containing 25 mL of water were taken. A small amount of NaOH, anhydrous  $\text{CuSO}_4$  and NaCl were added to the beaker A, B and C respectively. It was observed that there was an increase in the temperature of the solutions contained in beakers A and B, whereas in case of beaker C, the temperature of the solution falls. Which one of the following statement(s) is(are) correct?  
 (i) In beaker A and B, exothermic process has occurred.  
 (ii) In beakers A and B, endothermic process has occurred.  
 (iii) In beaker C, endothermic process has occurred.  
 (A) (i) only (B) (ii) only  
 (C) (i) and (iii) (D) (ii) and (iii)
10. pH of solution is changed from 2 to 5. What has been done to solution?  
 (A) 3 times dilution (B) 3 times concentration  
 (C) 100 times concentration (D) 1000 times dilution
11. Which of the following is amphoteric in nature?  
 (A)  $\text{NH}_4^+$  (B)  $\text{HCO}_3^-$   
 (C) HCl (D)  $\text{H}_2\text{SO}_4$
12. Which among the following is (are) metathesis reaction (s)?  
 (i)  $\text{Pb} + \text{CuCl}_2 \longrightarrow \text{PbCl}_2 + \text{Cu}$   
 (ii)  $\text{Na}_2\text{SO}_4 + \text{BaCl}_2 \longrightarrow \text{BaSO}_4 + 2\text{NaCl}$   
 (iii)  $\text{C} + \text{O}_2 \longrightarrow \text{CO}_2$   
 (iv)  $\text{FeS} + \text{H}_2\text{SO}_4 \longrightarrow \text{FeSO}_4 + \text{H}_2\text{S}$   
 (A) (ii) and (iv) (B) (i) (ii) (iii)  
 (C) (iii) and (iv) (D) (i) (iv) (ii)
13. Which of the following is mixed salt?  
 (A)  $\text{KHCO}_3$  (B)  $\text{Pb}(\text{OH})\text{NO}_3$   
 (C)  $\text{Ca}(\text{OCl})\text{Cl}$  (D)  $\text{K}_4[\text{Fe}(\text{CN})_6]$
14. In which of the following change nitrogen atom is reduced?  
 (A)  $\text{N}_2 \longrightarrow \text{NF}_3$  (B)  $\text{NH}_3 \longrightarrow \text{N}_2\text{H}_4$  (C)  $\text{NO}_2 \longrightarrow \text{NO}$  (D)  $\text{N}_2\text{O}_4 \longrightarrow \text{N}_2\text{O}_5$

Space For Rough Work

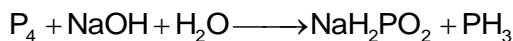


**Comprehension Type**

**This section contains 2 Paragraphs which has two multiple choice questions each. Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE option is correct.**

**Paragraph - I (15-16)**

Phosphorus ( $P_4$ ) reacts with sodium hydroxide (NaOH) and water ( $H_2O$ ) to form monosodium hypophosphite ( $NaH_2PO_2$ ) and phosphine ( $PH_3$ ). The chemical equation for the reaction is given below:



Answer the following questions on the basis of above write up.

15. If the stoichiometric coefficient of  $NaH_2PO_2$  in the balanced equation is 3, what will be the stoichiometric coefficient of NaOH in it?  
 (A) 4 (B) 2  
 (C) 3 (D) 6
16. Which of the following atom is oxidized in the reaction?  
 (A) P (B) Na  
 (C) H (D) O

**Paragraph –II (17-18)**

According to Lewis theory of acid and bases, 'an acid is a substance which can accept electron pairs and a base is a substance which can donate electron pairs'. This theory is called electronic theory because it deals only with the electron pairs and says nothing about the hydronium and hydroxide ions. Generally, cations or molecules having no lone pair of electrons acts as Lewis acids and anions or molecules with lone pair of electrons act as Lewis bases.

17. Which among the following will act as a Lewis acid?  
 (A)  $NH_3$  (B)  $BF_3$   
 (C)  $OH^-$  (D) Both (b) and (c)
18. Ammonia reacts with a proton to form a complex as follows  

$$H^+ + :NH_3 \longrightarrow [NH_4]^+$$
  
 In this reaction ammonia acts as a .....  
 (A) Lewis acid (B) Lewis base  
 (C) Bronsted acid (D) Arrhenius base

*Space For Rough Work*

**Match Type**

This section contains Two (02) List-Match Sets, each List-Match set has One (01) Multiple Choice Questions. Each List-Match set has two lists: List-I and List-II. FOUR options are given in each Multiple Choice Question based On List-I and List-II and ONLY ONE of these four options satisfies the condition asked in the Multiple Choice Question.

19. Match the following

Column – I (Redox Change)		Column – II (Number of electrons involved in change)	
A)	$\text{MnO}_2 \rightarrow \text{Mn}_2\text{O}_3$	p)	4
B)	$\text{MnO}_2 \rightarrow \text{MnSO}_4$	q)	2
C)	$\text{MnO}_2 \rightarrow \text{Mn}$	r)	3
D)	$\text{KMnO}_4 \rightarrow \text{MnO}_2$	s)	1

(A) A–s; B–q; C–p; D–r

(B) A–s; B–p; C–q; D–r

(C) A–r; B–q; C–p; D–s

(D) A–q; B–s; C–p; D–r

20. Match the reactions mentioned in column-I with their characteristics mentioned in column-II.

Column – I		Column – II	
(A)	$\text{Ca(OH)Cl}$	(P)	Acidic salt
(B)	$\text{KHSO}_4$	(Q)	Basic salt
(C)	$\text{NaNO}_3$	(R)	Neutral salt
(D)	$\text{KCl}$	(S)	Obtained by the reaction between a strong acid and a strong base

Choose the correct match out of all for the above list-match.

(A) A – Q; B – P; C – S; D – R

(B) A – Q; B – P; C – RS; D – RS

(C) A – S; B – P; C – RS; D – R

(D) A – S; B – S; C – R; D – Q

*Space For Rough Work*

**PART – B**

**Numerical Based**

**This section contains 6 questions. The answer of which maybe positive or negative numbers or decimals (e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30) and each question carries +3 marks for correct answer.**

---

1. A solution has pH equal to 4. The concentration of  $H^+$  ions in the solution is  $1 \times 10^{-x} M$ . Calculate the value of x.
  2. The concentration of  $OH^-$  ions, for a solution having pH = 13 is  $10^{-x} M$ . Calculate the value of x.
  3. Oxidation number of O in  $BaO_2$  is x and in  $OF_2$  is y; then value of x+y is
  4. The oxidation number of Fe in  $K_4[Fe(CN)_6]$  is
  5. Calculate pH of solution obtained by mixing 50 ml of 0.2 N HCl with 50 ml of 0.1 N NaOH? (Take  $\log 5 = 0.7$ )
  6. Calculate the number of moles of carbon-dioxide formed upon complete oxidation of glucose.
- 

*Space For Rough Work*

**SECTION – III (MATHEMATICS)****PART – A****Multiple Correct Choice Type**

This section contains 7 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE or MORE THAN ONE are correct.

- One root of the quadratic equations  $x^2 - bx + 6 = 0$  and  $x^2 - 6x + c = 0$  is common. The ratio of the remaining roots is 3 : 4. If all the roots are positive integers then which of the following is/are true?  
 (A)  $b = 3$  (B)  $b = 5$   
 (C)  $c = 4$  (D)  $c = 8$
- If the lines given by  $2x + ky = 1$  and  $3x - 5y = 7$  has unique solution, then the value(s) of  $k$  can be equal to  
 (A)  $\frac{-10}{3}$  (B)  $\frac{-5}{3}$   
 (C)  $\frac{2}{3}$  (D)  $\frac{-1}{3}$
- The difference between the two roots of a quadratic equation is 2 and the difference between the cubes of the roots is 98, then which of the following is/are that quadratic equation?  
 (A)  $x^2 - 8x + 15 = 0$  (B)  $x^2 + 8x - 15 = 0$   
 (C)  $x^2 + 8x + 15 = 0$  (D)  $x^2 - 5x - 15 = 0$
- $49^{16} - 1$  is divisible by which of the following?  
 (A) 15 (B) 12  
 (C) 20 (D) 50
- If  $p(x)$  is a polynomial having real coefficients and graph of  $y = p(x)$  cuts  $x - axis$  at exactly 4 different points then which of the following can be the degree of  $p(x)$ ?  
 (A) 6 (B) 5  
 (C) 4 (D) 3
- $P(x)$  is a cubic polynomial such that  $P(1) = 1$ ,  $P(2) = 2$ ,  $P(3) = 3$  and  $P(4) = 16$ , then which of the following is/are true?  
 (A)  $P(0) = -12$  (B)  $P(5) = 53$   
 (C)  $P(0) = 12$  (D)  $P(-1) = -49$

*Space For Rough Work*

7. If N is the greatest number that will divide 445, 572 and 699 leaving remainders 4, 5 and 6 respectively then sum of digits of N is \_\_\_\_\_
- (A) 6 (B) 7  
(C) 8 (D) 9

**Single Correct Choice Type**

This section contains 7 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE option is correct.

8. Find the quadratic equation having rational coefficients and whose one root is  $2 + \sqrt{5}$
- (A)  $x^2 - 4x + 1 = 0$  (B)  $x^2 - 4x - 1 = 0$   
(C)  $x^2 - 4x + 3 = 0$  (D)  $x^2 - 4x - 3 = 0$
9. Ganesh has to pay Rs. 482 for 19 apples and 11 guavas. If he would have exchanged the number of apples and guavas purchased, then he would have paid Rs. 64 less. Find how much more amount he has to pay to purchase 1 apple than 1 guava?
- (A) Rs. 19 (B) Rs. 8  
(C) Rs. 11 (D) Rs. 7
10. The minimum value of the polynomial  $p(x) = 3x^2 - 5x + 2$  is
- (A)  $-\frac{1}{6}$  (B)  $\frac{1}{6}$   
(C)  $\frac{1}{12}$  (D)  $-\frac{1}{12}$
11. Find the remainder when  $x^{51}$  is divided by  $x^2 - 3x + 2$
- (A) x (B)  $(2^{51} - 2)x + 2 - 2^{51}$   
(C)  $(2^{51} - 1)x + 2 - 2^{51}$  (D) 0
12. Let a, b and c are the roots of the polynomial equation  $x^3 - 597x - 5236 = 0$  then the value of  $(a^3 + b^3 + c^3)$  is
- (A) 597 (B) 15708  
(C) 5236 (D) 10472
13. The product of two 2 digits numbers is 2160 and their H.C. F is 12. Then sum of the number is
- (A) 72 (B) 84  
(C) 96 (D) 60

*Space For Rough Work*

14. LCM of two numbers is 5775. Which of the following cannot be their HCF?  
(A) 175 (B) 231  
(C) 385 (D) 455

**Comprehension Type**

**This section contains 2 Paragraphs which has two multiple choice questions each. Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE option is correct.**

---

**Paragraph - I (15-16)**

A boat takes 7 hours to travel 30 km upstream and 28 km downstream. It takes 5 hours to travel 21 km upstream and to return back. Find

15. The speed of the boat in still water.  
(A) 10 km/hr (B) 20 km/hr  
(C) 14 km/hr (D) 6 km/hr
16. The speed of the stream  
(A) 2 km/hr (B) 3 km/hr  
(C) 4 km/hr (D) 6 km/hr

**Paragraph –II (17-18)**

If  $\alpha, \beta$  and  $\gamma$  are roots of  $3x^3 - x^2 = kx - 9$ , where  $\alpha > \beta > \gamma$ ,  $\alpha + \gamma = 0$  then

17. The value of k is equal to  
(A) 27 (B) 0  
(C) -9 (D) 3
18. The minimum value of  $x^2 + \alpha x + \beta$  is equal to  
(A)  $-\frac{23}{3}$  (B)  $\frac{23}{12}$   
(C)  $-\frac{23}{12}$  (D)  $\frac{23}{3}$

---

*Space For Rough Work*

**Match Type**

This section contains Two (02) List-Match Sets, each List-Match set has One (01) Multiple Choice Questions. Each List-Match set has two lists: List-I and List-II. FOUR options are given in each Multiple Choice Question based On List-I and List-II and ONLY ONE of these four options satisfies the condition asked in the Multiple Choice Question.

19. Match the column I & column II.

List – I		List – II	
(A)	The x-coordinate of the point of intersection of linear equations $2x - y - 3 = 0$ and $4x + y - 3 = 0$ is _____	(P)	5
(B)	Find remainder when $51^{203}$ is divided by 7.	(Q)	4
(C)	If $5x - 3y = 1$ and $2x + 5y = 19$ , then find value of $x + y$	(R)	1
(D)	The decimal expansion of rational number $\frac{129}{2^2 \times 5^7}$ will terminate after how many places of decimal?	(S)	7

(A) A–Q; B–P; C–R; D–S

(B) A–R; B–Q; C–P; D–S

(C) A–R; B–S; C–P; D–Q

(D) A–S; B–R ; C–Q; D–P

20. Match the column I & column II.

Column I		Column II	
(A)	Unit digit of $17^{102}$ is	(P)	3
(B)	Unit digit of $24^{83}$ is	(Q)	4
(C)	Unit digit of $3^{65} \times 6^{59} \times 8^{71}$ is	(R)	9
(D)	Unit digit of $7^{95} - 3^{58}$ is	(S)	6

(A) A–Q; B–R; C–P; D–S

(B) A–S; B–P; C–Q; D–R

(C) A–R; B–Q; C–S; D–Q

(D) A–P; B–S; C–R; D–Q

*Space For Rough Work*

**PART – B**

**Numerical Based**

**This section contains 6 questions. The answer of which maybe positive or negative numbers or decimals (e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30) and each question carries +3 marks for correct answer.**

---

1. The number of integral solutions of the equation  $7\left(y + \frac{1}{y}\right) - 2\left(y^2 + \frac{1}{y^2}\right) = 9$  is \_\_\_\_\_
  2. Find the remainder when  $10^1 + 10^2 + 10^3 + 10^4 + 10^5 + \dots + 10^{99}$  is divided by 6.
  3. Let  $\alpha$  and  $\beta$  be the roots of  $x^2 - 5x + 3 = 0$  with  $\alpha > \beta$ . If  $a_n = \alpha^n - \beta^n$  for  $n \geq 1$  then find the value of  $\frac{3a_6 + a_8}{a_7}$
  4. If  $65x - 33y = 97$  and  $33x - 65y = 1$  then  $\frac{x}{y} = ?$
  5. A two digit number is obtained by either multiplying sum of its digits by 8 then adding 1 or by multiplying the difference of digits by 13 and adding 2. Find the product of its digit.
  6. Find the sum of the all real roots of the equation  $3^{2x^2} - 2\left(3^{x^2+x+6}\right) + 3^{2(x+6)} = 0$
- 

*Space For Rough Work*



## TEST CODE: 100692

### ANSWER KEYS

#### Physics

##### Part – A

- |        |       |       |       |
|--------|-------|-------|-------|
| 1. ABC | 2. BD | 3. BC | 4. BD |
| 5. A   | 6. AB | 7. BC | 8. C  |
| 9. A   | 10. B | 11. A | 12. B |
| 13. B  | 14. C | 15. A | 16. B |
| 17. D  | 18. B | 19. B | 20. A |

##### Part – B

- |      |      |      |      |
|------|------|------|------|
| 1. 3 | 2. 6 | 3. 3 | 4. 2 |
| 5. 7 | 6. 9 |      |      |

#### Chemistry

##### Part – A

- |         |       |         |       |
|---------|-------|---------|-------|
| 1. AB   | 2. BD | 3. ABCD | 4. AB |
| 5. ABCD | 6. AB | 7. ABCD | 8. A  |
| 9. C    | 10. D | 11. B   | 12. A |
| 13. C   | 14. C | 15. C   | 16. A |
| 17. B   | 18. B | 19. A   | 20. B |

##### Part – B

- |        |      |      |      |
|--------|------|------|------|
| 1. 4   | 2. 1 | 3. 1 | 4. 2 |
| 5. 1.3 | 6. 6 |      |      |

#### Mathematics

##### Part – A

- |       |        |       |         |
|-------|--------|-------|---------|
| 1. BD | 2. BCD | 3. AC | 4. ABCD |
| 5. AC | 6. ABD | 7. D  | 8. B    |
| 9. B  | 10. D  | 11. C | 12. B   |
| 13. C | 14. D  | 15. A | 16. C   |
| 17. A | 18. C  | 19. B | 20. C   |

##### Part – B

- |      |      |      |      |
|------|------|------|------|
| 1. 1 | 2. 0 | 3. 5 | 4. 2 |
| 5. 4 | 6. 1 |      |      |

# Answers & Solutions

## SECTION – I (PHYSICS)

### PART – A

1. ABC

Sol. Image formed by a convex mirror is always lies between pole and focus, diminished size and erect.

2. BD

Sol. Focal length does not change so image will completely visible but intensity will decrease.

3. BC

Sol. Concave lens and convex mirror form virtual and erect image.

4. BD

Sol.  $m = \pm 3 = \frac{f}{f - u} = \frac{-15}{-15 - 4}$   
 $u = -10 \text{ cm} ; u = -20 \text{ cm}$

5. A

Sol.  $f = +20 \text{ cm}$

$$\frac{h_i}{h_o} = \frac{1}{2} = -\frac{v}{u} \Rightarrow u = 2v$$

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u} \Rightarrow \frac{1}{20} = \frac{1}{v} - \frac{1}{2v} \Rightarrow u = 10 \text{ cm}$$

6. AB

Sol. Concave mirror magnification is positive and image is erect.

7. BC

Sol. If  $\mu_1 < \mu_2$ , the lens will become diverging and if  $\mu_1 > \mu_2$ , the lens will become converging.

8. C

Sol. Height of mirror =  $\frac{H}{3} = 1.5 \text{ m}$

9. A

Sol.  $m = \frac{f}{f - u} \Rightarrow \frac{1}{n} = \frac{f}{f - u} \Rightarrow u = (1 - n)f$

10. B

Sol.  $\frac{\text{Real depth}}{\text{Apparent depth}} = \mu_w = \text{App. depth} = \frac{10}{\frac{4}{3}} = \frac{30}{4}$

Total distance from mirror =  $\frac{30}{4} + 5 = \frac{50}{4} = 12.5$

11. A

Sol. Object distance  $f + x_1$

Image distance =  $f + x_2$

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u} \Rightarrow \frac{1}{f} = \frac{1}{(f + x_1)} + \frac{1}{(f + x_2)}$$

$$\frac{1}{f} = \frac{2f + x_1 + x_2}{f^2 + f(x_1 + x_2) + x_1x_2} \Rightarrow f = \sqrt{x_1x_2}$$

12. B

Sol.  $P = P_1 + P_2 = +2 - 1$

$$F = \frac{1}{P} = \frac{100}{1} = 100 \text{ cm (convergent)}$$

13. B

Sol.  $f = 15 \text{ cm} ; u = -30 \text{ cm}$

$$\frac{1}{v} = \frac{1}{f} + \frac{1}{u} \Rightarrow v = 30 \text{ cm}$$

Now the image will form inside the mirror that behaves as an object. Now object distance = +10 cm (ray of light coming from mirror),  $f = 15 \text{ cm}$

$$\frac{1}{v} = \frac{1}{f} + \frac{1}{u} = 6 \text{ cm}$$

So, image is real and at a distance of  $10 + 6 = 16 \text{ cm}$

14. C

Sol. Number of image  $\frac{360^\circ}{90^\circ} - 1 = 3$

Total number of image when calling is also mirror is  $3 + 4 = 7$

15. A

Sol.  $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$f = -10; u = -15$

So  $v = -30$

16. B

Sol.  $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$f = +10 \text{ cm}, u = -25 \text{ cm}$

So,  $v = +\frac{50}{7} \text{ cm}$

17. D

Sol.  $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

$u = -35 \text{ cm}; f = -15 \text{ cm}$

We get,  $v = -26.25$

18. B

Sol. For A

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

$u = -30 \text{ cm}; f = -15 \text{ cm}$

We get,  $v = -30$

Length of the image = 3.75 cm

19. B

Sol.  $A \rightarrow QR; B \rightarrow QR; C \rightarrow PQ; D \rightarrow PS$

20. A

Sol.  $A \rightarrow QR; B \rightarrow QRS; C \rightarrow RS; D \rightarrow PS$

**PART – B**

1. 3

Sol.  $m = -3 = \frac{-v}{u} \Rightarrow v = 3u$ ;  $u = -x$ , So  $v = -3x$

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u} \Rightarrow -\frac{1}{3x} - \frac{1}{x} \quad \dots(A)$$

$m = -2 = \frac{-v}{u} \Rightarrow v = 2u$ ;  $u = -(x+5)$  So  $v = -2(x+5)$

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u} \Rightarrow -\frac{1}{(x+5)} - \frac{1}{2(x+5)} \quad \dots(B)$$

From (A) and (B), we have  $f = 30$  cm, So  $N = 3$

2. 6

Sol.  $\frac{x}{\mu} = 1$ ;  $\frac{t-x}{\mu} = 3 \frac{x}{\mu} + \frac{t-x}{\mu} = 4$

$$\frac{t}{\mu} = 4 \Rightarrow t = 4 \times 1.5 = 6 \text{ cm}$$

3. 3

Sol.  $P = \frac{1}{f_1} + \frac{1}{f_2} = -\frac{100}{20} + \frac{100}{12.5} = -5 + 8 = +3$

4. 2

Sol.  $m = \frac{v}{u} \Rightarrow v = 2u$

Lens formula  $\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \Rightarrow u = -1$

When  $m = -2$  then  $v = -2u$

So  $\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \Rightarrow u = -3m$

So the object is moved by 2 m.

5. 7

Sol. Plane mirror reflects the ray on the optical center of lens. So the total distance of virtual image to lens is 7 cm. The focal length of lens is 7 cm.

6. 9

Sol. Object must be at focus of lens to form image at infinity

$$25 - 22 = 3 \text{ cm}$$

$$3 = t \left( \frac{1.5 - 1}{1.5} \right) = 3 = \frac{t}{3}$$

$$t = 9 \text{ cm}$$

## SECTION – II (CHEMISTRY)

### PART – A

1. AB

Sol. Option A and B are exothermic processes.

2. BD

Sol.  $H_3PO_3 \rightarrow P$  has +3;  $PCl_3 \rightarrow P$  has +3

3. ABCD

Sol. The correct statement regarding NaOH are – It is an Arrhenius base, it is deliquescent in nature, it is called an alkali and it can absorb  $CO_2$ .

4. AB

Sol.  $BCl_3$  and  $Ag^+$  are called Lewis acids.

5. ABCD

Sol. All options are disproportionation reaction.

6. AB

Sol.  $Cl^-$  is the conjugate base of HCl  
 $CH_3COOH_2^+$  is conjugate acid of  $CH_3COOH$

7. ABCD

Sol. A 0.001 M NaOH solution will be having  $[H^+] = 10^{-11}$ ,  $[OH^-] = 10^{-3}$ ,  $pH = 11$  and  $[Na^+] = 10^{-3}$ .

8. A

Sol. The set with correct order of acidity is  $HClO < HClO_2 < HClO_3 < HClO_4$ .

9. C

Sol. A rise in temperature indicates exothermic reaction whereas a fall in temperature indicates endothermic reaction.

Ans. D

Sol. Solution is 1000 times dilution.

11. B

Sol.  $HCO_3^-$  is amphoteric in nature.

12. A

Sol.  $Na_2SO_4 + BaCl_2 \longrightarrow BaSO_4 + 2NaCl$  and  $FeS + H_2SO_4 \longrightarrow FeSO_4 + H_2S$  are metathesis reactions.

13. C

Sol.  $Ca(OCl)Cl$  is mixed salt.

14. C

Sol. Nitrogen atom is reduced in  $NO_2 \longrightarrow NO$ .

15. C

Sol. The stoichiometric coefficient of NaOH will be 3.

16. A

Sol. P is oxidized in the reaction.

17. B

Sol.  $\text{BF}_3$  will act as a Lewis acid.

18. B

Sol. In this reaction ammonia acts as a Lewis base.

19. A

Sol. A-s; B-q; C-p; D-r

20. B

Sol. A - Q; B - P; C - RS; D - RS

### PART - B

1. 4

Sol.  $\text{pH} = 4$

$$[\text{H}^+] = 1 \times 10^{-4} \text{M}$$

2. 1

Sol.  $\text{pH} = 13$

$$[\text{H}^+] = 10^{-13} \text{M}$$

$$[\text{OH}]^- = 10^{-1} \text{M}$$

3. 1

Sol.  $X = -1; y = +2$

4. 2

Sol.  $4(+1) + x + 6(-1) = 0$

$$x = +2$$

5. 1.3

Sol.  $\text{meq}(\text{acid}) = 50 \times 0.2 = 10$

$\text{meq}(\text{base}) = 50 \times 0.1 = 5$

$$[\text{H}^+] = \frac{5}{100} = 5 \times 10^{-2}$$

$$\text{pH} = -\log[5 \times 10^{-2}]$$

$$= -0.7 + 2 = 1.3$$

6. 6

Sol.  $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \longrightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + \text{Energy}$

**SECTION – III (MATHEMATICS)****PART – A**

1. BD

Sol.  $x^2 - bx + 6 = 0$ , Roots are  $\alpha, \beta_1$  $x^2 - 6x + c = 0$ , Roots are  $\alpha, \beta_2$ 

Roots

$$\beta_1 = 3k, \beta_2 = 4k$$

$$3\alpha k = 6 \Rightarrow \alpha k = 2$$

$$4\alpha k = c \Rightarrow \alpha k = \frac{c}{4}$$

$$\Rightarrow c = 8$$

$$\therefore b = 5 \quad [\alpha = +2]$$

2. BCD

Sol. The given equations can be rewritten as  $2x + ky - 1 = 0$  and  $3x - 5y - 7 = 0$ .On comparing with  $a_1x + b_1y + c_1 = 0$  and  $a_2x + b_2y + c_2 = 0$ , we get

$$a_1 = 2, b_1 = k, c_1 = -1 \text{ and } a_2 = 3, b_2 = -5, c_2 = -7$$

$$\text{For unique solution, } \frac{a_1}{a_2} \neq \frac{b_1}{b_2} \Rightarrow \frac{2}{3} \neq \frac{k}{-5} \Rightarrow k \neq \frac{-10}{3}$$

Thus, given lines have a unique solution for all real values of  $k$ , except  $\frac{-10}{3}$ .

3. AC

Sol.  $\alpha - \beta = 2$ 

$$\alpha^3 - \beta^3 = 98$$

$$\Rightarrow (2 + \beta)^3 - \beta^3 = 98$$

$$\Rightarrow 8 + \beta^3 + 6\beta(\beta + 2) - \beta^3 = 98$$

$$\Rightarrow 6\beta(\beta + 2) = 90$$

$$\Rightarrow \beta^2 + 2\beta - 15 = 0$$

$$\Rightarrow \beta = \frac{-2 \pm \sqrt{4 - (-60)}}{2}$$

$$= \frac{-2 \pm \sqrt{64}}{2}$$

$$= \frac{-2 \pm 8}{2}$$

$$\beta = \frac{-2 + 8}{2} \text{ or } \beta = \frac{-2 - 8}{2}$$

$$\beta = 3 \text{ or } -5$$

$$\Rightarrow \beta = 3, \alpha = 3 + 2 = 5$$

$$\Rightarrow \beta = -5, \alpha = -5 + 2 = -3$$

Now QE whose roots are  $\alpha$  and  $\beta$  is given by  $x^2 - (\alpha + \beta)x + \alpha\beta = 0$ 

$$(3, 5) \Rightarrow x^2 - 8x + 15$$

$$(-3, -5) \Rightarrow x^2 - (\alpha + \beta)x + \alpha\beta = 0$$

$$\Rightarrow x^2 - (-8)x + 15 = 0$$

$$\Rightarrow x^2 + 8x + 15 = 0$$

4. ABCD

Sol. We know that  $a^n - b^n$  is divisible by  $a + b$  and  $a - b$  when  $n$  is even

$$\Rightarrow 49^{16} - 1^{16} \text{ is divisible by } 48 \text{ and } 50$$

$$\Rightarrow 49^{16} - 1^{16} \text{ is also divisible by } 12, 15 \text{ and } 20.$$

5. AC

Sol. Number of real roots = 4

So degree is 4 or more but degree can not be equal to 5 as imaginary roots always occur in conjugate pairs so degree can be 4 or 6.

6. ABD

Sol.  $P(x) = x + a(x-1)(x-2)(x-3)$

$$\because P(4) = 16 \Rightarrow a = 2$$

$$\Rightarrow P(x) = 2(x-1)(x-2)(x-3) + x$$

$$\Rightarrow P(0) = -12, P(5) = 53, P(-1) = -49$$

7. D

Sol.  $N = \text{HCF of } (441, 567, 693) = 63$

$$\text{Sum of digits of } N = 9$$

8. B

Sol. Given one root is  $2 + \sqrt{5}$

$$\therefore \text{Other root is } 2 - \sqrt{5}$$

Hence, requires equation

$$x^2 - \left\{ (2 + \sqrt{5}) + (2 - \sqrt{5}) \right\} x + (2 + \sqrt{5})(2 - \sqrt{5}) = 0$$

$$\Rightarrow x^2 - 4x - 1 = 0$$

9. B

Sol. Let  $x$  = price of one apple

$y$  = price of one guava

According to the question

$$19x + 11y - 482 = 0$$

$$11x + 19y - 418 = 0$$

By cross multiplication

$$\frac{x}{-4598 + 9158} = \frac{y}{-5302 + 7942} = \frac{1}{361 - 121}$$

$$\Rightarrow x = \frac{4560}{240} = 19 \text{ and } y = \frac{2640}{240} = 11$$

$$\text{Hence } x - y = 8$$

10. D

Sol. Min. of  $P(x) = \frac{4(3)(2) - (5)^2}{4(3)} = \frac{-1}{12}$

11. C



Sol. Let remainder be  $ax + b, f(x) = x^{51}$

$$x^{51} = (x^2 - 3x + 2)Q(x) + ax + b$$

$$\Rightarrow x^{51} = (x-1)(x-2)Q(x) + ax + b$$

$$f(1) = 1 = a + b$$

$$f(2) = 2^{51} = 2a + b$$

$$\Rightarrow a = 2^{51} - 1$$

$$\Rightarrow b = 2 - 2^{51}$$

$$\therefore \text{Remainder} = (2^{51} - 1)x + (2 - 2^{51})$$

12. B

Sol.  $x^3 - 597x - 5236 = 0$

$$\text{Sum of roots} = a + b + c = 0$$

$$\text{Also, } abc = 5236$$

$$\text{Since } a + b + c = 0$$

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

$$= 15708$$

13. C

Sol. Let numbers are  $12x$  and  $12y$ ,  $\text{HCF}(x, y) = 1$

$$\text{then } (12x)(12y) = 2160$$

$$\Rightarrow xy = 15 = 5 \times 3$$

$$\Rightarrow x = 5, y = 3$$

So, numbers are 60 and 36

$$\text{Sum} = 96$$

14. D

Sol. HCF is always a factor of LCM

$$5775 = 3 \times 5^2 \times 7 \times 11$$

$$175 = 7 \times 5^2$$

$$231 = 3 \times 7 \times 11$$

$$385 = 5 \times 7 \times 11$$

$$455 = 5 \times 7 \times 13$$

$\therefore$  455 cannot be the HCF as it is not a factor of 5775.

15. A

16. C

Sol. (15 – 16)

Let speed of boat in still water =  $x$  km/hr

Let speed of steam =  $y$  km/h

Net speed of Boat for upstream =  $(x - y)$  km/hr

Net speed of Boat for downstream =  $(x + y)$  km/hr

$$\frac{30}{x-y} + \frac{28}{x+y} = 7 \quad \dots\dots\dots(1)$$

$$\frac{21}{x-y} + \frac{21}{x+y} = 5 \quad \dots\dots\dots(2)$$

On solving both equations we get,  $x = 10$  and  $y = 4$

17. A

Sol. From given information we can say that  $\alpha, \beta$  and  $\gamma$  satisfy  $3x^3 - x^2 = kx - 9$  so  $\alpha, \beta$  and  $\gamma$  are roots of  $3x^3 - x^2 = kx - 9$

$\Rightarrow \alpha, \beta$  and  $\gamma$  are roots of  $3x^3 - x^2 - kx + 9 = 0$

$$\alpha + \beta + \gamma = \frac{1}{3} \Rightarrow \beta = \frac{1}{3} \text{ since } \alpha + \gamma = 0$$

Put  $\beta = \frac{1}{3}$  in given cubic equation we get  $k = 27$

$$\text{Now } \alpha\beta\gamma = -3 \Rightarrow \alpha\gamma = -9 \text{ since } \beta = \frac{1}{3}$$

On solving  $\alpha\gamma = -9$  and  $\alpha + \gamma = 0$  we get  $\alpha = 3, \gamma = -3$

18. C

Sol.  $y = x^2 + \alpha x + \beta \Rightarrow y = x^2 + 3x + \frac{1}{3}$

$$\text{Minimum} = \frac{-D}{4a} = \frac{-23}{12}$$

19. B

Sol.

(A)  $2x - y - 3 = 0 \Rightarrow y = 2x - 3 \quad \dots\dots(1)$

$4x + y - 3 = 0 \Rightarrow y = 3 - 4x \quad \dots\dots(2)$

From equation (1) and equation (2)

$$2x - 3 = 3 - 4x \Rightarrow x = 1$$

$$y = 2 \times 1 - 3 = -1$$

(B)  $R\left[\frac{51^{203}}{7}\right] = R\left[\frac{2^{203}}{7}\right] = 4$

(C) Step 1.  $5x - 3y = 1 \quad \Rightarrow \quad 5x = 1 + 3y, \text{ i.e. } x = \frac{1+3y}{5}$

Step 2 and 3  $2x + 5y = 19$

$$\Rightarrow 2\left(\frac{1+3y}{5}\right) + 5y = 19$$

$$\Rightarrow \frac{2+6y+25y}{5} = 19$$

$$\Rightarrow 31y = 93 \text{ i.e., } y = 3$$

Step 4.  $x = \frac{1+3y}{5} = \frac{1+3 \times 3}{5} = 2$

$\therefore$  Solution is  $x = 2$  and  $y = 3 \Rightarrow x + y = 5$

(D)  $\frac{129}{2^2 \times 5^7} = \frac{129 \times 2^5}{2^7 \times 5^7} = \frac{129 \times 2^5}{10^7}$  which will terminate after 7 places of decimals

20. C

Sol. Using Cyclicity unit digit of  $17^{102} = 9$

unit digit of  $24^{83} = 4$

unit digit of  $3^{65} \times 6^{59} \times 8^{71} = 6$

unit digit of  $7^{95} - 3^{58} = 4$

**PART – B**

1. 1

Sol. Let  $y + \frac{1}{y} = t \Rightarrow y^2 + \frac{1}{y^2} = t^2 - 2$

The given equation reduces to:

$$7t - 2(t^2 - 2) = 9$$

$$\Rightarrow 2t^2 - 7t + 5 = 0$$

$$t = 1,$$

$$y + \frac{1}{y} = 1$$

$$\Rightarrow y^2 - y + 1 = 0$$

This equation has no real solutions

$$t = \frac{5}{2}$$

$$y + \frac{1}{y} = \frac{5}{2}$$

$$\Rightarrow 2y^2 - 5y + 2 = 0$$

$$\Rightarrow y = \frac{1}{2}, y = 2$$

So number of integral solutions = 1

2. 0

Sol. The remainder when  $10^1$  is divided by 6 is 4

The remainder when  $10^2$  is divided by 6 is 4

The remainder when  $10^3$  is divided by 6 is 4

The remainder when  $10^4$  is divided by 6 is 4

The remainder when  $10^5$  is divided by 6 is 4

Thus the remainder is always 4.

$$\text{So, the required remainder} = \frac{4 + 4 + 4 + \dots + 99 \text{ times}}{6} = \frac{396}{6}$$

Thus, the remainder is zero.

3. 5

Sol.  $\alpha, \beta$  are roots of  $x^2 - 5x + 3 = 0$

$$\Rightarrow \alpha^2 - 5\alpha + 3 = 0 \text{ and } \beta^2 - 5\beta + 3 = 0$$

$$\Rightarrow \alpha^2 + 3 = 5\alpha \text{ and } \beta^2 + 3 = 5\beta$$

$$\text{Now, } \frac{3a_6 + a_8}{a_7} = \frac{3(\alpha^6 - \beta^6) + (\alpha^8 - \beta^8)}{\alpha^7 - \beta^7}$$

$$= \frac{\alpha^6(3 + \alpha^2) - \beta^6(3 + \beta^2)}{\alpha^7 - \beta^7}$$

$$= \frac{5\alpha^7 - 5\beta^7}{\alpha^7 - \beta^7} = 5$$

4. 2

Sol. Step 1.  $65x - 33y = 97$

$$33x - 65y = 1$$

$$\text{Add } \frac{98x - 98y = 98}{x - y = 1}$$

Step 2.  $x - y = 1$

Step 3.  $65x - 33y = 97$

$$33x - 65y = 1$$

$$\begin{array}{r} - \quad + \quad - \\ \hline \end{array}$$

$$\text{Subtract } 32x + 32y = 96$$

$$\text{Step 4. } x + y = 3$$

$$\text{Step 5. } x - y = 1$$

$$x + y = 3$$

$$\text{On adding } \quad \quad \quad \overline{2x = 4} \quad \Rightarrow \quad x = 2$$

$$\text{Step 6. } x - y = 1 \quad \Rightarrow \quad 2 - y = 1 \text{ i.e. } y = 1$$

$\therefore$  Solution is  $x = 2$  and  $y = 1$ . So,  $\frac{x}{y} = 2$

5. 4

Sol. Let the digit at ten's place =  $x$  and the digit at unit's place =  $y$

$$\therefore \text{ The number} = 10x + y$$

$$\text{The sum of digits} = x + y$$

$$\text{Also, the difference of digits} = x - y \text{ or } y - x$$

According to 1<sup>st</sup> statement,

$$10x + y = 8(x + y) + 1$$

$$\Rightarrow 10x + y = 8x + 8y + 1 \quad \text{or} \quad 2x - 7y = 1 \quad \dots(1)$$

According to 2<sup>nd</sup> statement,

$$10x + y = 13(x - y) + 2 \quad \text{or} \quad 10x + y = 13(y - x) + 2$$

$$\Rightarrow 10x + y = 13x - 13y + 2 \quad \text{or} \quad 10x + y = 13y - 13x + 2 \quad \dots(2)$$

On solving  $2x - 7y = 1$  and  $14y - 3x = 2$ , we get

$$x = 4 \text{ and } y = 1$$

Whereas on solving  $2x - 7y = 1$  and  $23x - 12y = 2$ , we get

$$x = \frac{2}{137} \text{ and } y = -\frac{19}{137}$$

Since,  $x$  and  $y$  are digits therefore,

$$x = 4 \text{ and } y = 1$$

Hence, the required number =  $10x + y = 10 \times 4 + 1 = 41$ . So product of digits = 4

6. 1

$$6. \quad 3^{2x^2} - 2 \cdot 3^{x^2+x+6} + 3^{2(x+6)} = 0$$

$$\Rightarrow (3^{x^2} - 3^{x+6})^2 = 0$$

$$\therefore 3^{x^2} = 3^{x+6}$$

$$\Rightarrow x^2 = x + 6 \quad \Rightarrow \quad x^2 - x - 6 = 0$$

$$x = 3 \text{ or } -2$$

$$\text{Sum} = 1$$