M Prakash Institute **30 November 2025** **XI Entrance Test 1**
Each question carries five marks **10 am to 1 pm** **Paper Type AD**
Student Receipt number: **Student Name:**

Chemistry

Given : Atomic mass: $H = 1, Li = 7, B = 11, C = 12, N = 14, O = 16, F = 19, Na = 23, Mg = 24, Al = 27, S = 32, Cl = 35.5, K = 39, Ca = 40, Cu = 63.5, \mathrm{Zn} = 65, Ag = 108$
Avogadro's number $= 6 \times 10^{23}$ Particles per mole.

Key to Questions.

Q.	1	2	3	4	5	6	7	8	9	10
A.	81	69	85	6	53	52	7	7	31	69
Q.	11	12	13	14	15	16	17	18	19	20
A.	40	20	20	35	24	90	42	10	32	48
Q.	21	22	23	24	25	26	27	28	29	30
A.	85	2	53	65	76	14	63	66	18	14

Q.1 Silver metal reacts with nitric acid as following unbalanced reaction:

$$Ag + HNO_3 \rightarrow AgNO_{3(aq)} + NO_{(g)} + H_2O_{(l)}$$

The amount of silver required to produce 9.00 g of water is ____ g.

Solution:
$3Ag + 4HNO_3 \rightarrow 3AgNO_3 + NO_{(g)} + 2H_2O$

$\dfrac{\text{mole of } Ag}{\text{mole of } H_2O} = \dfrac{3}{2}$ **Ans. 81.**

$\dfrac{w_{Ag}}{108} \times \dfrac{18}{9} = \dfrac{3}{2} \Rightarrow w_{Ag} = 81\ g$

Q.2 A larger sized balloon contains 2.5 moles of NO_2 gas . If 6×10^{23} molecules of the same gas is leaked out due to a pin hole from the balloon than the amount of NO_2 gas left in the balloon is ____ g.

Solution: Amount of gas leaked out one mole.
Amount of gas left in the balloon $= 1.5\ mol$
Weight of 1.5 mole gas $= 1.5 \times 46 = 69\ g$ **Ans. 69.**

Q.3 Which of the following compound can lower down the temperature of solution, when is added to water. Identify from the following and write its molecular mass.
$H_2SO_4, NaNO_3, NaOH, CaO$

Solution: Sodium nitrate ($NaNO_3$). **Ans. 85.**

Q.4 How many are correct from the following:

(i) Melting Point: $NaBr > NaCl$; (vi)Boiling Point: $KCl > NaBr$
(ii)Melting Point: $NaCl > KCl$; (vii)BoilingPoint: $MgCl_2 > NaCl$
(iii)Melting Point: $KCl > MgCl_2$; (viii)Boiling Point: $ZnCl_2 > MgCl_2$
(iv)Melting Point: $MgCl_2 > ZnCl_2$; (ix)Boiling Point: $NaCl > KCl$
(v) Melting Point: $MgCl_2 > NaCl$; (x)Boiling Point: $MgCl_2 > NaBr$

Solution: ii,iii,iv,vi,ix, x. **Ans. 6.**

Q.5 The molar mass of monomer unit which is used to manufacture a polymer known as Polyacrylonitirle is ____ .

Solution: Molar mass of Acrylonitrile $CH_2 = CH - CN = 3 \times 12 + 3 \times 1 + 14 = 53\ g/mol$
Ans. 53.

Q.6 One of the Dobereiner triad belongs to 1^{st} group of modern periodic table having elements X, Y and Z , where Y is middle element. Other Dobereiner triad belongs to 17^{th} group of modern periodic table having elements P, Q and R , where Q is middle element. The difference in atomic number of elements Z and X is A , and difference in atomic number of elements R and P is B . The value of $(A+B)$ is

Solution: X, Y and $Z = {}_{3}^{7}Li, {}_{11}^{23}Na$ and ${}_{19}^{39}K \Rightarrow A = 19 - 3 = 16$

P, Q and $R = {}_{17}^{35.5}Cl, {}_{35}^{80}Br$ and ${}_{53}^{127}I \Rightarrow B = 53 - 19 = 36$

$A + B = 16 + 36 = 52$. **Ans. 52.**

Q.7 What is maximum valency of the element, which is kept at 20^{th} position in Newland's table of octaves?

Solution: Manganese. **Ans. 7.**

Newlands' Octaves

Notes of Music						
sa (do)	*re (re)*	*ga (mi)*	*ma (fa)*	*pa (so)*	*da (la)*	*ni (ti)*
H	Li	Be	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe
Co and Ni	Cu	Zn	Y	In	As	Se
Br	Rb	Sr	Ce and La	Zr	–	–

Q.8 The number of water molecules present in 22.41 ml of liquid water is A.BC $\times 10^{23}$ molecules . Given density of water is 1 g/ml. What is the value of A ?

Solution: $22.41 ml H_2O = 22.41\ g H_2O = \frac{22.41}{18} = 1.245\ mol H_2O$

$1.245\ mol H_2O = 1.245 \times 6 \times 10^{23} = 7.47 \times 10^{23}$ molecules of H_2O. **Ans. 7.**

Q.9 To get $3 \times 10^{23} H^{+}$or $H_3 \overset{+}{O}$ ions , the amount of H_3BO_3 added to water is = ____ g.

Solution: $\underset{\substack{62g \\ 31g}}{H_3BO_3} + H_2O\square \quad B(OH)_4^- + \underset{\substack{6\times10^{23} \\ 3\times10^{23}}}{H^+}.$

0.5 mole of H_3BO_3 is required. **Ans. 31.**

Q.10 Elements X, Y and Z belong to modern periodic table as given

Elements	Group number	Period number
X	11	5
Y	14	2
Z	16	2

The 0.25 mole of compound formed by elements X, Y and Z = ____ gram.

Solution: X = Ag (Silver), Y = C (Carbon) and Z = O (Oxygen)
The compound is silver carbonate Ag_2CO_3; Molar mass = 276 g/mol. **Ans. 69.**

Physics

Use $g = 10\ m/s^2$ wherever required.

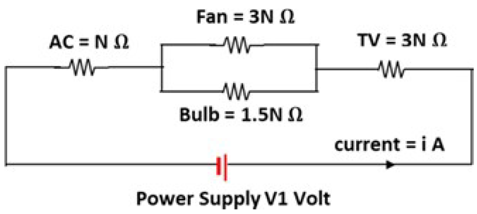
Q.11 At the initial moment, a mouse is 35 m ahead of a cat and a hole in the ground is 25 m further away from the mouse. At that moment the cat's velocity is 2 m/s towards the mouse and it accelerates at (a_1) m/s^2. At that moment, mouse is stationary and it starts moving at acceleration of 2 m/s^2 towards the hole. The cat just misses catching the mouse as it slips into the hole just when cat is about to catch it. The whole motion happens in a straight line. Find value of (a_1), multiply it by 10 and then write that as your answer.

Solution: Time taken by mouse to reach the hole is given by $25 = \frac{1}{2} \times 2 \times t^2 \Rightarrow t = 5$. Cat travels 60m in the same time giving $60 = 2 \times 5 + \frac{1}{2}a_1 \times 25 \Rightarrow a_1 = 4$. **Ans. 40.**

Q.12 Mass of ice is 0.6 kg and its temperature is minus T°C. (i.e. $-T$°C). In an insulated container, the ice is mixed with 1.2 kg water at 60°C. The final equilibrium temperature of the mixture is 10°C. Specific heat capacity (in cal / g °C) of ice and water is 0.5 and 1 respectively. Latent heat of melting of ice is 80 cal/g. Find T and write that as your answer.

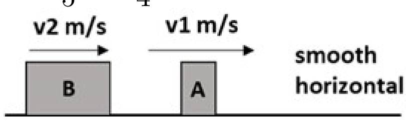
Solution: Heat given away by water $= 1200 \times (60 - 10) = 60000$ cal. Equating it with heat absorbed by ice, we get $60000 = 600(0.5 \times T + 80 + 10) \Rightarrow T = 20$.
Ans. 20.

Q.13
N is a positive number. A circuit as shown below draws current i A from the power source. Later, TV and bulb positions are interchanged and power source is replaced with a V_2 volt source. In modified circuit also, the current drawn from the power source remains same. Find the % change in the supply voltage and write that as your answer.



Solution: Case I: Effective resistance$= 1 + \dfrac{1}{\frac{1}{3} + \frac{1}{1.5}} + 3 = 5$ N.
Case II: Effective resistance$= 1 + 1.5 + 1.5 = 4$ N.
So, we have $\dfrac{V_1}{5} = \dfrac{V_2}{4} \Rightarrow V_2 = 0.8\ V_1$. **Ans. 20.**

Q.14



A smaller block A (2 kg) was moving to right on a smooth horizontal table at a constant velocity of 1 m/s. Another block B (4 kg) behind it and moving at constant velocity 2 m/s towards right collided with A. After collision they separate and move at constant velocities V_1 m/s and V_2 m/s as shown in the diagram below. Total of kinetic energy of both the blocks after collision is 8.5 J. Find V_1 and V_2. Then mark value of N as your answer where $N = 10(V_1 + V_2)$.

Solution: Law of conservation of momentum gives the first equation as
$2 \times 1 + 4 \times 2 = 2V_1 + 4V_2 \Rightarrow V_1 + 2V_2 = 5$.
Total kinetic energy condition gives
$\frac{1}{2} \times 2 \times V_1^2 + \frac{1}{2} \times 4 \times V_2^2 = 8.5 \Rightarrow (5 - 2V_2)^2 + 2V_2^2 = 8.5 \Rightarrow V_2 = \frac{3}{2}$ or $\frac{11}{6}$ and the corresponding values of V_1 are 2, $\frac{4}{3}$. Out of these, $V_1 = 2$ and $V_2 = \frac{3}{2}$ gives $10(V_1 + V_2) = 35$ as integer answer.
Ans. 35.

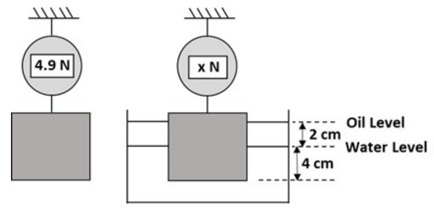
Q.15 A ball is thrown vertically upwards from ground at 80 m/s. point A is 5 m below the highest level the ball reaches. Point B is 275 m above the ground. Find time t (in seconds) taken by the ball to travel downwards from level A to level B. Multiply t by 12 and write that number as your answer.

Solution: Using $v^2 = u^2 + 2as$, we get the maximum height reached= 320m. So, distance from top position to B is 45m. Time taken to reach A and B respectively given by $5 = 5t_1^2$ and $45 = 5t_2^2$ giving $t_1 = 1,\ t_2 = 3 \Rightarrow t_2 - t_1 = 2$. **Ans. 24.**

Q.16 A bus and all people inside has mass 3000 kg. It starts from bus depot A. The first stop B is 1275 m away. The bus engine can safely produce a net drive force on bus of 3000 N or 7500 N depending on how the driver drives. The maximum safe braking force on bus is 11250 N. The greatest speed at which the bus can safely travel is 54 km/h. T seconds is the least possible time taken by a good driver to travel the path AB without any risk or damage to anyone. Find T.

Solution: Suppose the bus starts from rest and with maximum force, reaches top safe speed of 54, then travels at this constant speed and breaks with maximum decelration and stops at B.
54 km/h=15 m/s.
Stage 1: Acceleration $= \frac{7500}{3000} = 2.5$. Time taken to reach 15m/s = 6 seconds. Distance travelled in this time$= \frac{1}{2}(2.5)(6^2) = 45$ meters.
Stage 3: Deceleration$= \frac{11250}{3000} = 3.75$, time taken to reduce speed from 15 m/s to zero is 4 seconds. Distance travelled in 4 seconds with this deceleration$= \frac{1}{2}(3.75)(4^2) = 30$ meters.
So, distance travelled with constant speed $= 1275 - 45 - 30 = 1200$ meters. Constant speed= 15, so time taken= 80 seconds. Total time$= 80 + 4 + 6 = 90$ seconds.
Ans. 90.

Q.17



A cylinder in air is suspended from the ceiling. Its axis is vertical and horizontal cross-section area is 80 cm^2. A weight meter reads 4.9 Newton as shown in the diagram below. Later it is suspended again keeping partially 4 cm in water (density 1 g/cc), partially 2 cm in oil (density 0.8 g/cc) and a small part out in air. Now, the reading is x Newton. As your answer, write the number $(100x)$.

Solution: Total buoyant force equals the weight of displaced oil and displaced water.
Volume of displaced water= 80×4 cc= 320 cc, so mass of displaced water= 320 gm = 0.32kg, so weight= 3.2N.
Volume of displaced oil= 80×2 cc= 160 cc, so mass of displaced oil= 160×0.8 = 128 gm = 0.128 kg, so weight= 1.28N.
So, reading on the meter= $4.9 - 3.2 - 1.28 = 0.42$N. **Ans. 42.**

Q.18 A concave mirror A of radius of curvature 20 and another concave mirror B of focal length 40 cm are kept with their axes coinciding and reflective sides facing each other. Distance between the two mirrors is 50 cm. A tiny object is kept on the axis so that its distance from the mirror B is four times its distance from the mirror A. Consider reflection of the object first due to mirror A and then due to the mirror B. Find the distance (in cm) between the mirror A and the 2^{nd} image formed.

Solution: Observe that the mirrors are placed such that their focus points coincide and the object is at the focus. So, rays from it will be reflected from mirror A and reflected rays will travel parallel to the axis. They will be reflected by mirror B and reflected rays will converge at the focus, tha is, at the object itself. The object is 10 cm from mirror A. **Ans. 10.**

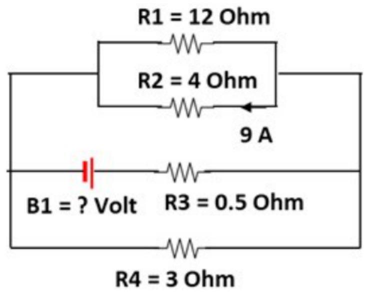
Q.19 A small fish inside a lake is 4 cm below the water surface. Almost vertically (at a small angle), above his head a small insect is hovering (that is, remaining steady in air) at a distance of 12 cm above the water surface. As seen by the fish, the insect is N cm above the water surface. Refractive index of water is 4/3 and that of air is 1. As your answer mark the number $2N$.

Solution: Actual height of the insect above the water surface $(h) = 12\ cm$
Refractive index of air $(\mu_1) = 1$
Refractive index of water $(\mu_2) = \frac{4}{3}$
When an observer in a denser medium looks at an object in a rarer medium at a near-vertical angle, the apparent height (h') above the surface is given by:

$$h' = \left(\frac{\mu_{\text{observer}}}{\mu_{\text{object}}}\right) \cdot h = \left(\frac{\mu_2}{\mu_1}\right) \cdot h$$

$N = \frac{4}{3} \times 12 = 16\ cm$. **Ans. 32.**

Q.20 Observe the diagram and find (in Volt) the potential difference of the battery.



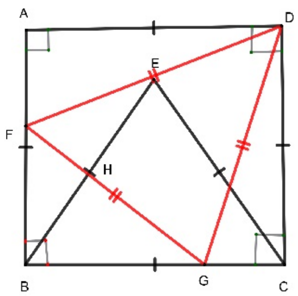
Solution: The top branch contains two resistors in parallel: $R_1 = 12\Omega$ and $R_2 = 4\Omega$. The current through R_2 is given as $I_2 = 9\ A$ flowing from right to left.
The potential difference (V_p) across this parallel group (between the right and left vertical rails) is: $V_p = I_2 \times R_2 = 9\ A \times 4\Omega = 36\ V$
Since R_1 is in parallel with R_2, it experiences the same voltage of 36 V :
$I_1 = \frac{V_p}{R_1} = \frac{36\ V}{12\Omega} = 3\ A$
The total current flowing from right to left through the top branch (I_{top}) is:
$I_{\text{top}} = I_1 + I_2 = 3\ A + 9\ A = 12\ A$
The bottom resistor $R_4 = 3\Omega$ is also connected in parallel across the same main left and right rails, so it has the same potential difference of 36 V : $I_4 = \frac{V_p}{R_4} = \frac{36\ V}{3\Omega} = 12\ A$
The total current returning through the middle branch (I_{total}) is the sum of the currents from the top and bottom branches: $I_{\text{total}} = I_{\text{top}} + I_4 = 12\ A + 12\ A = 24\ A$
The total potential difference between the rails (36 V) is maintained by the battery minus the internal drop across its series resistor $R_3 = 0.5\Omega$:
$V_p = B_1 - (I_{\text{total}} \times R_3)$
$36\ V = B_1 - (24\ A \times 0.5\Omega)$
$36 = B_1 - 12$
$B_1 = 36 + 12 = 48$ Volt. **Ans. 48.**

Maths

Q.21 A geometric series is the sequence of numbers like $a, ar, ar^2, ar^3, \cdots$ where the ratio of next term to previous is constant.
Consider a geometric series which contains terms less than 1 such that the sum of the first two terms is 2 and the sum of the first three terms is 3 . S be the sum of first 8 terms of this series. Report $32S$.

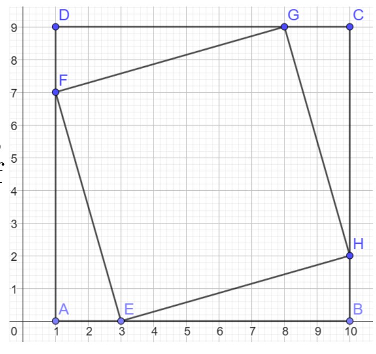
Solution:
$a + ar = 2$, $a + ar + ar^2 = 3$. $\therefore ar^2 = 1 \Rightarrow a = \frac{1}{r^2}$
$a(1+r) = 2 \Rightarrow \frac{1+r}{r^2} = 2 \Rightarrow 2r^2 - r - 1 = 0$
$\therefore r = -\frac{1}{2} a = 4$
Sum of 8 terms $= 4 - 2 + \frac{1}{2} + \frac{1}{4} - \frac{1}{8} + \frac{1}{16} - \frac{1}{32} = \frac{85}{32}$
$\therefore 32S = 85$

Q.22 Let $ABCD$ be a square with equilateral triangles BCE and DFG positioned inside it as shown. Find the ratio of the areas of HBG and EFH.



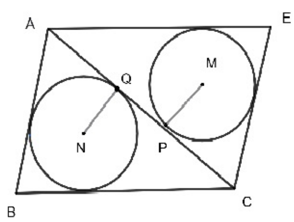
In $\triangle AFD, m\angle EAD = m\angle ADE = 15°$.
$\therefore E$ is the midpoint of hypotenuse $\Rightarrow EF = ED$.
Let $DF = FG = DG = 2a$. $\therefore EF = a$.
$\triangle BFG$ is $45-45-90$ $\therefore BG = \frac{2a}{\sqrt{2}} = \sqrt{2}a$
$\triangle HBG \sim \triangle HFE$ by AAA Theorem of Similarity
$\frac{HB}{HF} = \frac{BG}{FE} = \frac{\sqrt{2}a}{a} = \sqrt{2}$
$\frac{[HBG]}{[HFE]} = \left(\frac{BG}{FE}\right)^2 = (\sqrt{2})^2 = 2$

Q.23 The x-coordinates of the vertices of a square in the plane are 1,3 , 8 and 10 . Determine the area of the square.



Solution: Refer to the diagram. The four triangles, namely, $\triangle AEF, \triangle BHE, \triangle HCG, \triangle GDF$ are congruent, giving the side of the $\square EFGH = \sqrt{53}$. **Ans. 53.**

Q.24 $ABCD$ is a parallelogram with $AB = 13, BC = 14, AC = 15$. M and N are the centers of incircles of ΔABC and ΔCDA. Find MN^2.

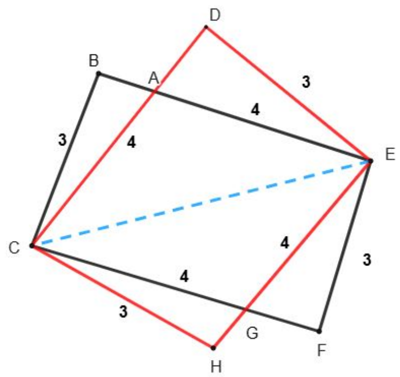


$\overline{MN}$, $\overline{AC}$ bisect each other. Let $\overline{MP} \perp \overline{AC}$, $MP =$ inradius of $\triangle ABC$
By heron's formula, Area of $\triangle ABC = \sqrt{21 \times 7 \times 8 \times 6} = 84$
Area of $\triangle ABC$ is also computed as $r.s$
$\therefore 84 = r \cdot s = MP \cdot 21$
$\therefore MP = 4$
$AP = s - 14 = 7, AQ = \frac{15}{2}$, $\therefore PQ = \frac{1}{2}$
By Pythagoras Theorem in $\triangle MPQ$
$MQ^2 = \sqrt{\left(\frac{1}{2}\right)^2 + 4^2} = \sqrt{\frac{1}{4} + 16} = \sqrt{\frac{65}{4}}$
$MN = 2\sqrt{\frac{65}{4}} = \sqrt{65} \therefore MN^2 = 65$

Q.25 A is the angle between $0 - 90$ degrees. If $\sec^4 A + \tan^4 A = 5101$ find the value of $\sec^2 A + \tan^2 A - 25$

$\sec^4 A + \tan^4 A = 5101$
$(1 + \tan^2 A)^2 + \tan^4 A = 5101$
$1 + 2\tan^4 A + 2\tan^2 A = 5101$
$2\tan^2 A(1 + \tan^2 A) = 5100$
$2\tan^2 A \sec^2 A = 5100$
Given $(\sec^2 A + \tan^2 A)^2 - 2\sec^2 A \tan^2 A = 5101$
$(\sec^2 A + \tan^2 A)^2 = 5101 + 5100 = 10201$
$\sec^2 A + \tan^2 A = 101$
$\therefore 101 - 25 = 76$

Q.26 Two rectangles each with width 3 and length 4 are placed so that they share a diagonal, as shown. The area of the octagon shaded in the diagram is $\frac{m}{n}$, where m and n are relatively prime positive integers.
Find the value of $\frac{m-5}{n}$.



$\triangle ABC \cong \triangle ADE \cong \triangle GFE \cong \triangle GHC$
Let $AC = AE = x. \therefore AB = 4 - x$
By Pythergoras Theorem in $\triangle ABC$
$(4-x)^2 + 3^2 = x^2 \Rightarrow x = \frac{25}{8} \Rightarrow AB = \frac{7}{8}$
Required Area $=$ Area of $\square CDEH + 2\times$ Area of $\triangle ABC$
$= 3(4) + 3\left(\frac{7}{8}\right) = \frac{117}{8}$
$\therefore \frac{m-5}{n} = \frac{117-5}{8} = 14$

Q.27 Find the positive real number x for which

$$2\sqrt[3]{1 + \frac{x}{2}} + \sqrt[3]{1 - x} = 3$$

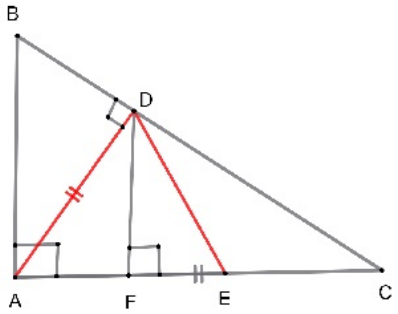
Report $x/2$ as answer.

Solution:
Taking cube on both sides, we get
$8\left(1 + \frac{x}{2}\right) + (1 - x) + 3 \times 2 \cdot \sqrt[3]{\left(1 + \frac{x}{2}\right)(1 - x)}\left(2\sqrt[3]{1 + \frac{x}{2}} + \sqrt[3]{1 - x}\right) = 3^3$
$8\left(1 + \frac{x}{2}\right) + (1 - x) + 3 \times 2 \cdot \sqrt[3]{\left(1 + \frac{x}{2}\right)(1 - x)} \cdot (3) = 27$
$6 \cdot \sqrt[3]{\left(1 + \frac{x}{2}\right)(1 - x)} = 6 - x$
Taking the cube on the both sides, we get
$216\left(1 + \frac{x}{2}\right)(1 - x) = 216 - x^3 - 18x(6 - x)$
$x^3 - 126x^2 = 0 \quad \Rightarrow x = 126 \Rightarrow \frac{x}{2} = 63$

Q.28 There are positive integers m and n such that $m - n = 18$ and $\frac{1}{6} + \frac{1}{7} + \frac{1}{8} + \frac{1}{m} + \frac{1}{n} = \frac{1}{2}$.
Find $m + n$

Solution: $m - n = 18 \Rightarrow m = n + 18$. $\quad \frac{1}{6} + \frac{1}{7} + \frac{1}{8} = \frac{28+24+21}{24(7)} = \frac{73}{24(7)}$
$\therefore \frac{1}{m} + \frac{1}{n} = \frac{1}{2} - \frac{73}{24(7)} = \frac{11}{24(7)} \Rightarrow \frac{m+n}{mn} = \frac{n+18+n}{(n+18)n}$
$\therefore 11n^2 - 138n - 3024 = 0$
$\therefore (11n + 126)(n - 24) = 0$
$\therefore n = 24, m = 42 \rightarrow m + n = 66$

Q.29 Right triangle $\triangle ABC$ has sides $AB = 75, AC = 100$, and $BC = 125$. Point D lies on $\overline{BC}$ and point E lies on $\overline{AC}$ such that $\overline{AD} \perp \overline{BC}$ and $AD = DE$. Find the area of $\triangle ADE$. Report sum of the digits of area of triangle ADE.



Applying Complete Pythagoras Theorem in
$\triangle BAC : AC^2 = CD \cdot BC \Rightarrow CD = 80, BD = 45$
$AD^2 = BD \cdot CD \Rightarrow AD = 60$
$\triangle ADC : 80^2 = CF \cdot 100 \Rightarrow CF = 64$
$EF = 100 - 64 = 36, DF = \sqrt{36 \times 64} = 48$
Area of $\triangle EDA = \frac{1}{2} \times 72 \times 48 = 1728$
$\therefore 1 + 7 + 2 + 8 = 18$

Q.30 A polynomial $p(x)$ is defined, in terms of a constant a, by $p(x) = x^4 + 2x^3 + 9x + a$. When $p(x)$ is divided by $x^2 - x + 2$ the quotient is $x^2 + bx + 1$ and the remainder is $cx + 5$, where b and c are constants. Find $a + b + c$

Solution:
By Division Algorithm, we get:
$x^4 + 2x^3 + 9x + a = \left(x^2 - x + 2\right)\left(x^2 + bx + 1\right) + cx + 5$
Comparing coefficients of x^3 and x of the terms in LHS and RHS, we get
$2x^3 = x^2(bx) - x\left(x^2\right) \Rightarrow b = 3$
$9x = -x(1) + 2(3x) + c \Rightarrow c = 4$
$a = 2(1) + 5 = 7$
$\therefore a + b + c = 14$