IIT – JEE: 2025 **TW TEST (MAIN)** **DATE: 14/01/23**

TOPIC: HEAT & THERMODYNAMICS

SOLUTIONS

1. (A)
As the two bodies are of same mass and dropped from same height, the final Kinetic energy is also same for both the bodies. When they hit the ground and this is converted to heat, the body with lower specific heat capacity will have higher rise in temperature
$Q = ms\Delta T$
As copper has lower specific heat capacity, its temperature will be higher

2. (D)
Thermal capacity $=$ mass $\times$ specific heat
Mass= volume $\times$density
For a sphere, volume is directly proportional to its cube of radius
$\therefore TC \propto r^3.\rho.C$
$\Rightarrow \frac{TC_1}{TC_2} = \frac{r_1^3.\rho_1.C_1}{r_2^3.\rho_2.C_2}$
$\frac{TC_1}{TC_2} = \left(\frac{1}{2}\right)^3 . \left(\frac{2}{3}\right) . \left(\frac{3}{4}\right)$
$\frac{TC_1}{TC_2} = \left(\frac{1}{2}\right)^3 . \left(\frac{2}{3}\right) . \left(\frac{3}{4}\right)$
$\frac{TC_1}{TC_2} = \frac{1}{16}$

3. (C)
Loss in temperature of one liquid is equal to the gain in temperature of another liquid.
$m_1.c_1.\Delta T_1 = m_2.c_2.\Delta T_2$
Given the masses are same
$c_1.(30-26) = c_2.(26-20)$
$\frac{c_1}{c_2} = \frac{6}{4} = 3/2$

4. (A)
Density of water is maximum at 4°C, this is because of anomalous expansion of water.
Let volume of the sphere be V and ρ be its density, then buoyant force,
$F = V\rho G$ (g = acceleration due to gravity)
$\Rightarrow F \propto \rho$ ($\because$ V and g are almost constant)
$\Rightarrow \frac{F_{4^\circ C}}{F_{0^\circ C}} = \frac{\rho_{4^\circ C}}{\rho_{0^\circ C}} > 1$ $\left(\because \rho_{4^\circ C} > \rho_{0^\circ C}\right)$

$\Rightarrow \quad F_{4^\circ C} > F_{0^\circ C}$

Hence, buoyancy will be less in water at 0°C than that in water at 4°C.

5. (C)

The scale is calibrated at $20^\circ C$

At $40^\circ C$, the measuring gaps will be more. So, it will measure lesser than actual.

Using , $l_2 = l_1(1+\alpha dt)$ where $\alpha = 10^{-5}, dt =$

20 and $l_1 = 5$, we get $l_2 = 5.001m$

6. (B)

When length of the liquid column remains constant, then the level of liquid moves down with respect to the container, thus γ must be less than 3α.

Now, we can write $V = V_0(1+\gamma\Delta T)$

Since, $V = Al_0 = \left[A_0(1+2\alpha\Delta T)\right]l_0 = V_0(1+2\alpha\Delta T)$

Hence, $V_0(1+\gamma\Delta T) = V_0(1+2\alpha\Delta T) \Rightarrow \gamma = 2\alpha$.

7. (C)

Since in the region AB, temperature is constant, at this temperature, phase of the material changes from solid to liquid and ($H_2 - H_1$) heat will be absorbed by the material. This heat is known as the heat of melting of the solid.

Similarly in the region CD, temperature is constant. Therefore at this temperature, phase of the material changes from liquid to gas and ($H_4 - H_3$) heat will be absorbed by the material. This heat is known as the heat of vaporisation of the liquid.

8. (C)

Energy $= \frac{1}{2}mv^2 = mc\Delta\theta$

$\Rightarrow \quad \Delta\theta \propto v^2$

Temperature does not depend upon the mass of the balls.

$\therefore \quad \frac{mL}{t} = P$

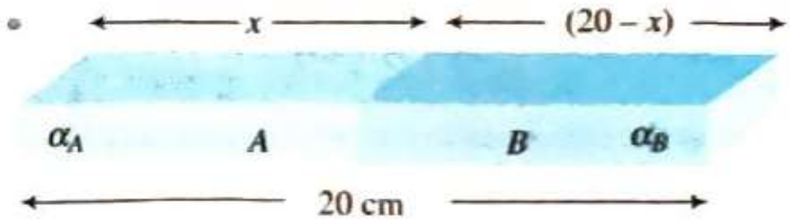
or $L = \frac{Pt}{m}$

9. (B)

$\Delta L = L_0\alpha\Delta\theta$

Rod A: $0.075 = 20\times\alpha_A\times100 \Rightarrow \alpha_A = \frac{75}{2}\times10^{-6} / {}^\circ C$

Rod B : $0.045 = 20\times\alpha_B\times100 \Rightarrow \alpha_B = \frac{45}{2}\times10^{-6} / {}^\circ C$



For composite rod : Taking *x* cm of A and (20 – *x*) cm of B, we have

$0.060 = x\alpha_A\times100 + (20-x)\alpha_B\times100$

$$= x\left[\frac{75}{2}\times10^{-6}\times100+(20-x)\times\frac{45}{2}\times10^{-6}\times100\right]$$

On solving, we get x = 10 cm

10. (D)

Coefficient of volume expansion

$$\gamma=\frac{\Delta\rho}{\rho\Delta T}=\frac{(\rho_1-\rho_2)}{\rho(\Delta\theta)}=\frac{(10-9.7)}{10\times(100-0)}=3\times10^{-4}$$

Hence, coefficient of linear expansion

$$\alpha=\frac{\gamma}{3}=10^{-4}\ /\ ^\circ\text{C}$$

11. (D)

Since tension in the two rods will be same,

$$A_1Y_1\alpha_1\Delta\theta=A_2Y_2\alpha_2\Delta\theta$$

$$A_1Y_1\alpha_1=A_2Y_2\alpha_2$$

12. (A)

Let m gram of steam get condensed into water (by heat loss).
This happens in following two steps:

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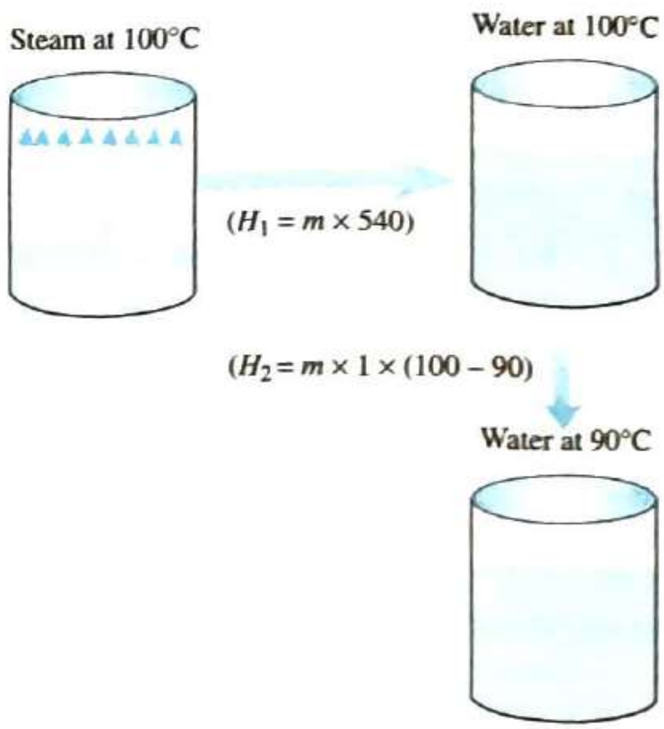

Heat gained by water (20°C) to raise its temperature upto 90° = 22 × 1 × (90 – 20)
Hence, in equilibrium, Heat lost = heat gain

$$\Rightarrow\ m\times540+m\times1\times(100-90)=22\times1\times(90-20)$$

$$\Rightarrow\ m=2.8\text{ g}$$

Net mass of the water present in the mixture = 22 +2.8 = 24.8 g

13. (C)

$$\text{Efficiency}=\frac{0.54\times746}{500}=0.80\ \text{ or } 80\%$$

(0.5 kW = 500 W and 0.54 hp = 0.54 × 746 W)

$\therefore$ 80% of the electrical energy is converted to mechanical energy and the rest 20% is converted to heat energy.

$\therefore$ $\frac{20}{100}\times 500 = 100\text{ W}$ of power is converted to heat

$\therefore$ Heat produced in 1 h (or 3600 s) = 100 × 3600 = 36 × 10^4 J

$= \frac{36\times 10^4}{4.18}\text{ cal} = 8.6\times 10^4\text{ cal}$

14. (D)

Since at 20 degree temperature steel tape measures correct measurement of wood. Now at 0 degree length is 25 cm therefore, when temperature is shifted the scale reading 25 cm will increase and therefore the length which is 25 cm at 0 degree will be less than 25 cm at 20 degree.

15. (C)

Heat given by water, $Q_1 = 10\times 10 = 100\text{ cal}$

Heat taken by ice to melt, $Q_2 = 10\times 0.5\times\left[0-\left(-20\right)\right]+10\times 8 = 900\text{ cal}$

As $Q_1 < Q_2$, so ice will not completely melt and final temperature = 0^oC.

As heat given by water in cooling up to 0^oC is only just sufficient to increase the temperature of ice from -20^oC to 0^oC.

Hence mixture in equilibrium will consist of 10 g ice and 10 g water at 0^oC.

16. (C)

From given curve, Melting point for A = 60^oC and melting point for B = 20^oC

Time taken by A for fusion = (6 – 2) = 4 minutes

Time taken by B for fusion = (6.5 – 4) = 2.5 minutes

$\therefore$ $\frac{H_A}{H_B} = \frac{6\times 4\times 60}{6\times 2.5\times 60} = \frac{8}{5}$

17. (D)

It is clear that at desired temperature, T^oC, the densities of the wood and benzene must be equal for the wood to just sink.

i.e., $\rho_w(T) = \rho_B(T)$

If m is the mass of wood (which is assumed to be constant) then, if $(V_0)_w$ and $(V_0)_B$ are the respective volumes at 0^oC of mass m of wood and benzene,

$$\left(\rho_0\right)_w\left(V_0\right)_w = \left(\rho_0\right)_B\left(V_0\right)_B = m$$

$$\left(\rho_0\right)_w = 880\text{ kg/m}^3 \text{ and } \left(\rho_0\right)_B = 900\text{ kg/m}^3$$

Hence, $\left(V_0\right)_w = \frac{m}{880}\left(m^3\right)$

End, $\left(V_0\right)_B = \frac{m}{900}\left(m^3\right)$

We then have, $\left(V_T\right)_W = \left(V_0\right)_W\left(1+1.2\times 10^{-3}\,T\right)$

$$\left(V_T\right)_B = \left(V_0\right)_B\left(1+1.5\times 10^{-3}\,T\right)$$

Thus $\frac{\left(V_T\right)_W}{\left(V_T\right)_B} = \frac{\left(\rho_B\right)_T}{\left(\rho_W\right)_T} = 1 = \frac{\left(V_0\right)_W 1+1.2\times 10^{-3}\,T}{\left(V_0\right)_B 1+1.5\times 10^{-3}\,T}$

Solving for T, we have T = 83.2^oC.

18. (A)

$$m_1 \times 1 \times (50-30) = m_1 \times 1 \times (80-50)$$

$$m_1 \times 20 = m_1 \times 30 \text{ or } \frac{m_1}{m_2} = \frac{3}{2}$$

Mass of water from tank $A = \frac{3}{5} \times 40 = 24\text{ kg}$

Mass of water from tank $B = \frac{2}{5} \times 40 = 16\text{ kg}$

19. (D)

$$V = V_0(1+\gamma\Delta\theta)$$

$\Rightarrow$ Change in volume, $V - V_0 = \Delta V = A.\Delta l = V_0\gamma\Delta\theta$

$$\Rightarrow \Delta l = \frac{V_0\gamma\Delta\theta}{A} = \frac{10^{-6} \times 18 \times 10^{-5} \times (100-\theta)}{0.004 \times 10^{-4}}$$

$$= 45 \times 10^{-3}\text{m} = 4.5\text{cm}$$

20. (C)

Heat supplied is $L_{fusion} + Mc\Delta T + ML_{\upsilon ap}$

$$Q_1 = 10 \times 336 + 10 \times 4.2 \times 100 + 10 \times 2260$$

$Q_1 = 30160\text{J}$ or 7200 cal

Heat for calorimeter

$$Q_2 = 10 \times 1 \times 100 = 1000\text{cal}$$

$$Q = Q_1 + Q_2 = 8200\text{cal}$$

21. (150)

Since specific heat of lead is given in Joules, hence use W = Q instead of W = JQ.

So, $\frac{1}{2} \times \left(\frac{1}{2}mv^2\right) = m.c.\Delta\theta \Rightarrow \delta\theta = \frac{v^2}{4c} = \frac{(300)^2}{4 \times 150} = 150\ ^{o}\text{C}$

22. (5)

$$\Delta L = \Delta L \Delta T$$

$$\Delta(2L) = 2\alpha(2L)\Delta T$$

$$\Delta(3L) = \alpha_{composite}(3L)\Delta T$$

$$\therefore \Delta L\Delta T + 2\alpha(2L)\Delta T = \alpha_{composite}(3L)\Delta T$$

$$\Rightarrow \alpha_{composite} = \frac{5}{3}\alpha$$

Comparing with $\frac{5x}{3}, x = 5$

23. (2)

Area expansion $= 2\times$ linear expansion

Therefore surface area will increase by 2% .

24. (8)

Let power lost to surrounding be Q.

$$16 - Q = \left(\frac{dm}{dt}\right)S(10)$$

and $32 - Q = 3\left[\left(\frac{dm}{dt}\right)S(10)\right]$

$\Rightarrow \quad \frac{32-Q}{16-Q} = 3 \Rightarrow Q = 8\text{ W}$

25. (3)

Energy released by water from 25°C to 0°C

= 2500 × 1 × 25 = 62500 cal

Energy to bring ice to 0°C = $2000 \times \frac{1}{2} \times 15 = 15000$ cal 2

Energy used to melt ice of m gram = m80 cal

$\therefore$ Ice melt $m = \left(\frac{62500 - 15000}{80}\right) = 593.75\text{ g}$

So, mass of water = (2500 + 593.75) g = 3093.75 g = 3 kg

26. (6)

Energy with 5 kg of H_2O at 20°C to become water at 0°C,

$E_1 = 5000 \times 1 \times 20 = 1000000$ cal

Energy to raise the temperature of 2 kg ice form –20°C to 0°C,

$E_2 = 2000 \times 0.5 \times 20 = 20000$ cal

$(E_1 - E_2)$ = 8000 cal is available to melt ice at 0°C.

So only 1000 g or 1 kg of ice would have melt.

So, the amount of water available 1 + 5 = 6 kg

27. (4)

$$(OR)^2 = (PR)^2 - (PO)^2 = l^2 - \left(\frac{l}{2}\right)^2$$

$$\Rightarrow (OR)^2 = \left[l(1+\alpha_2 t)\right]^2 - \left[\frac{l}{2}(1+\alpha_1 t)\right]^2$$

$$\Rightarrow l^2 - \frac{l^2}{4} = l^2\left(1+\alpha_2^2 t^2 + 2\alpha_2 t\right) - \frac{l^2}{4}\left(1+\alpha_1^2 t^2 + 2\alpha_1 t\right)$$

Neglecing $\alpha_2^2 t^2$ and $\alpha_1^2 t^2$, we get

$$0 = l^2(\alpha_2 t) - \frac{l^2}{4}(2\alpha_1 t) \Rightarrow 2\alpha_2 \Rightarrow \alpha_1 = 4\alpha_2$$

28. (8)

Suppose m gram ice melts, then heat required for its melting

= mL = m × 80 cal

Heat available with stem for being condensed and then brought to 0°C

= 1 × 540 + 1 × 1 × (100 – 0) = 640 cal

Now, heat lost = heat taken

$\Rightarrow 604 = m \times 80 \Rightarrow m = 8\text{ g}$

29. (3)

$$\gamma_{mercury} = 20\alpha_{glass} = \frac{20}{3}\gamma_{glass}$$

Let the volume of mercury is $V_{mercury}$

Since the volume above mercury remains same,

$$\gamma_{mercury} V_{mercury} = \gamma_{glass} V_{glass}$$

$$\Rightarrow \frac{20}{3} \gamma_{glass} V_{mercury} = \gamma_{glass} V$$

$$\Rightarrow V_{mercury} = \frac{3V}{20}$$

$$\Rightarrow x = 3$$

30. (0.02)

$$V = V_0 \left(1 + \gamma \Delta T\right)$$

$$V = V_0 + V_0 \gamma \Delta T$$

$$\frac{V - V_0}{V_0} = \gamma \Delta T$$

Now since mass M is constant

$$\frac{\frac{M}{\rho} - \frac{M}{\rho_0}}{\frac{M}{\rho_0}} = \gamma \Delta T$$

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TOPIC: GOC

Solutions

31. (C)
It is more contributing to resonance hybrid (Explains aromatic character).

32. (D)
Due to loss of planarity.

33. (B)
Maximum +M effect.

34. (B)
Due to resonance

35. (B)
Resonance and Hyperconjugation.

36. (C)
More branching

37. (C)
No empty orbital in N.

38. (D)
$–CH_3$ is a positive inductive effect group.

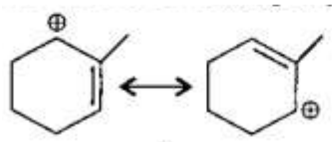
39. (C)
$–NH_2$ is a negative inductive effect group.

40. (B)
FCH_2COOH

41. (B)
–CN is electron withdrawing group via resonance.

42. (C)
–OH is electron releasing group via resonance.

43. (A)



44. (C)
–NO can show both +M and –M effect.

45. (B)
Octet complete.

46. (A)

$$CH_2 = CH - \overset{\oplus}{C}H - \overset{\ominus}{C}H - O - CH_3$$

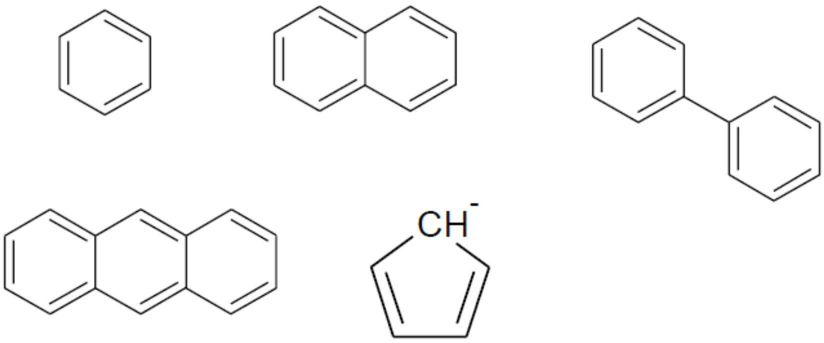
47. (D)
On the basis of hyperconjugation.

48. (D)
I effect is distance dependent.

49. (A)
$–NO_2$ > –Cl > –Br > –I

50. (A)
Only electrons are allowed to move, positions of nuclei don't change.

51. (5)



52. (5)
–SH, $–NH_2$, $–NO_2$, –CN, –CHO

53. (5)

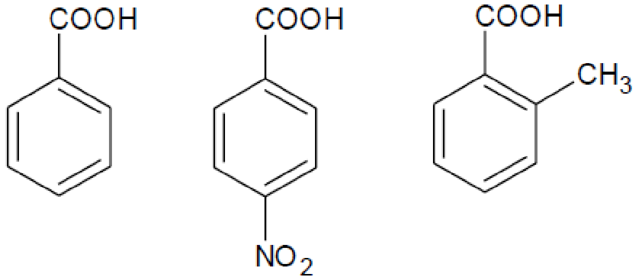
54. (3)
$–CH_3$, $–CH_2CH_3$, $–COO^-$

55. (7)

56. (6)

$-O^-$, $-OH$, $-NH_2$, $-NHCOCH_3$, $-OCOCH_3$, $-NHCOC_2H_5$

57. (3)

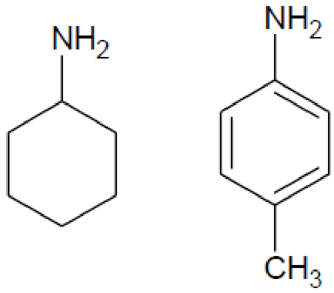


58. (4)

59. (2)

$-CH_2-\overset{\oplus}{C}H_2$, $-CH_2-\bar{C}H_2$

60. (2)



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TOPIC: PROBABILITY

SOLUTIONS

61. (D)

Let C, S, B, T be the events of the person going by car, scooter, bus or train respectively.

Then as per the given information P(C) = $\frac{1}{7}$, P(S) = $\frac{3}{7}$, P(B) = $\frac{2}{7}$, and P(T) = $\frac{1}{7}$.

Let O be the event of the person reaching the office in time.

Then from the given information $P\left(\frac{O}{C}\right)=\frac{7}{9}, P\left(\frac{O}{S}\right)=\frac{8}{9}, P\left(\frac{O}{B}\right)=\frac{5}{9}$ and $P\left(\frac{O}{T}\right)=\frac{8}{9}$

Probability that he will reach office on time $P(O)=\left(\frac{1}{7}\times\frac{7}{9}\right)+\left(\frac{3}{7}\times\frac{8}{9}\right)+\left(\frac{2}{7}\times\frac{5}{9}\right)+\left(\frac{8}{9}\times\frac{1}{7}\right)$

Probability that he will reach office on time if he travel by car $\left(\frac{1}{7}\times\frac{7}{9}\right)$

Here we need to find probability of

$$P\left(\frac{C}{O}\right)=\frac{\left\{P\left(\frac{O}{C}\right)\times P(C)\right\}}{P(O)}=\frac{\left\{\left(\frac{1}{7}\times\frac{7}{9}\right)\right\}}{\left\{\left(\frac{1}{7}\times\frac{7}{9}\right)+\left(\frac{3}{7}\times\frac{8}{9}\right)+\left(\frac{2}{7}\times\frac{5}{9}\right)+\left(\frac{8}{9}\times\frac{1}{7}\right)\right\}}=\frac{1}{7}$$

62. (B)

Out of every 16 events 3 are favorable and events not favorable is 13 hence odd against the event is $\frac{13}{3}$.

In other words here sample space n(S) = 16, favorable event n(E) = 3 and n(E') = 13 hence odd against that event is n(E')/n(E) = 13/3

63. (A)

Sample space in this case is $6 \times 6 = 36$

Sum of two result is a prime number we have following cases-

Case (i) if sum is 2 then we have only one option (1, 1)

Case (ii) If sum is 3 then we have following 2 cases (1, 2) and (2, 1)

Case (iii) If sum is 5 then we have following 4 cases (1, 4), (2, 3), (3, 2) and (4, 1)

Case (iv) If sum is 7 then we have following 6 cases (1, 6), (2, 5), (3, 4), (4, 3), (5, 2) and (6, 1)

Case (v) If sum is 11 then we have following 2 cases (5, 6), and (6, 5)

So total number of ways is 1 + 2 + 4 + 6 + 2 = 15

So required probability is $\frac{15}{36}=\frac{5}{12}$

64. (B)

Probability of getting a head in a single throw is $\frac{1}{2}$.

Hence required probability is $\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}=\frac{1}{8}$

65. (A)

Probability that none of them will appear tail is $\left(\frac{1}{2}\right)^5=\frac{1}{32}$

So, required probability that at least one tail will appear is $1-\frac{1}{32}=\frac{31}{32}$

66. (A)

From the definition odds in favor of an event is $\frac{n(E)}{n(E')}$ and odds against an event is $\frac{n(E')}{n(E)}$ and from the given information is $\frac{\left\{\frac{n(E)}{n(E')}\right\}}{\left\{\frac{n(E')}{n(E)}\right\}}=\frac{9}{25}$ or $\frac{n(E)}{n(E')}=\frac{3}{5}$

Hence, required probability is $\frac{3}{8}$

67. (D)

Sum is multiple of 3 so we have following cases-

Case (i) sum is 3 then cases are (1, 2), (2, 1)

Case (ii) sum is 6 then cases are (1, 5), (2, 4), (3, 3), (4, 2) and (5, 1)

Case (iii) sum is 9 then cases are (3, 6), (4, 5), (5, 4), and (6, 3)

Case (iv) sum is 12 then only case is (6, 6)

So total number of elements in sample space is n(S) = 12

Number of favorable cases are 4

So required probability $=\frac{4}{12}=\frac{1}{3}$

68. (C)

Since A & B are mutually exclusive so P(A ∩ B) = 0

Now P(A U B) = P(A) + P(B) – P(A ∩ B) $=\frac{1}{8}+\frac{2}{5}=\frac{5+16}{40}=\frac{21}{40}$

69. (C)

Here P(A) = 1 – 0.6 = 0.4 and P(B) = 1 – 0.4 = 0.6

Since $P(A\cup B)$ = P(A) + P(B) – P(A ∩ B) = 0.6 + 0.4 – (0.6) × (0.4) = 1 – 0.24 = 0.76

70. (C)

Since $P(A')=\frac{9}{11}$ then P(A) = $\frac{2}{11}$ similarly P(B) = $\frac{2}{5}$

From the formula P(A ∪ B) = P(A) + P(B) – P(A ∩ B) $= \frac{2}{11} + \frac{2}{5} - \frac{1}{5} = \frac{10+22-11}{55} = \frac{21}{55}$

71. (C)

There are two cases when they will contradict-

Case (i) A speak truth and B speak lie then probability is $\frac{4}{5} \times \frac{1}{4} = \frac{1}{5}$

Case (ii) A speak lie and B speak truth then probability is $\frac{1}{5} \times \frac{3}{4} = \frac{3}{20}$

Hence, required probability is $\frac{1}{5} + \frac{3}{20} = \frac{7}{20}$

72. (C)

Let probability that A, B and C will pass the exam is P(A), P(B) and P(C) respectively then from the given information P(A) = $\frac{1}{2}$, P(B) = $\frac{1}{3}$ and P(C) = $\frac{1}{4}$ and also $P(A') = 1 - \frac{1}{2} = \frac{1}{2}$, $P(B') = 1 - \frac{1}{3} = \frac{2}{3}$ and $P(C') = 1 - \frac{1}{4} = \frac{3}{4}$

Now we have three cases-

Case (i) A and B will pass the exam and C fails that exam then probability is

$P(A) \times P(B) \times P(C') = \frac{1}{2} \times \frac{1}{3} \times \frac{3}{4} = \frac{1}{8}$

Case (ii) A and C will pass the exam and B fails that exam then probability is

$P(A) \times P(B') \times P(C) = \frac{1}{2} \times \frac{2}{3} \times \frac{1}{4} = \frac{1}{12}$

Case (iii) B and C will pass the exam and A fails that exam then probability is

$P(A') \times P(B) \times P(C) = \frac{1}{2} \times \frac{1}{3} \times \frac{1}{4} = \frac{1}{24}$

Total probability is $\frac{1}{8} + \frac{1}{12} + \frac{1}{24} = \frac{1}{4}$

73. (B)

Probability of getting a six is $\frac{1}{6}$

If Sanchita starts the game then the probability that she wins is

$$\left(\frac{1}{6}\right) + \left(\frac{5}{6}\right)\left(\frac{5}{6}\right)\left(\frac{1}{6}\right) + \ldots\ldots\infty = \frac{\frac{1}{6}}{1 - \frac{25}{56}} = \frac{6}{11}$$

And if Raj starts the game then probability that Sanchita wins the game is $1 - \frac{6}{11} = \frac{5}{11}$

74. (C)

Probability that none of them hit the plane is

$(1-0.4)(1-0.3)(1-0.2)(1-0.1) = 0.6 \times 0.7 \times 0.8 \times 0.9 = 0.3024$

So required probability is 1 – 0.3024 = 0.6976

75. (C)

Let P(A) = probability that a randomly selected student likes tea = 0.3

Let P(B) = probability that a randomly selected student likes coffee = 0.2

Then $P(A \cap B) = 0.1$

Now we have to find $P\left(\frac{A}{B}\right) = \frac{P(A \cap B)}{P(B)} = \frac{0.1}{0.2} = \frac{1}{2}$

76. (C)

There are two cases when Abhay will say 'Yes'-

Case (i) The number that came out is a prime and Abhay is speaking truth, probability for this case is

$$P(P) \times P(T)$$

Here, P(P) = probability of getting a prime = $\frac{3}{6} = \frac{1}{2} = 0.5$

P(T) is probability that Abhay is speaking truth and P(T) = 0.6

So, probability for this case is 0.5 × 0.6 = 0.3

Case (ii) The number that came out is not a prime and Abhay is not speaking truth, probability for this case is

$$P(P') \times P(T') = 0.5 \times 0.4 = 0.2$$

So total probability for the given case is 0.3 + 0.2 = 0.5

New sample space is 0.5 and we have to find the probability of case (i) which is $\frac{0.3}{0.5} = 0.6$

77. (A)

Total number of experiments = n = 5

Number of favorable cases = r = 3

Probability of getting favorable case = P(F) = (1/2)

Probability of not getting favorable case = $P(F') = \frac{1}{2}$

Required probability is $({}^5C_3)(F)^3(F')^2 = ({}^5C_3)\left(\frac{1}{2}\right)^3\left(\frac{1}{2}\right)^2 = \frac{10}{32} = \frac{5}{16}$

78. (B)

Total number of experiments = n = 5

Number of favorable cases = r = 0 (means he will not hit the target)

Probability of getting favorable case = P(F) = 0.8

Probability of not getting favorable case = $P(F')$ = 0.2

Required probability is $({}^5C_0)(0.8)^0(0.2)^5 = \frac{1}{3125}$

So, probability that the target is hit at least once is $1 - \frac{1}{3125} = \frac{3124}{3125}$

79. (A)

Total number of experiments = n = 5

Number of favorable cases = r = 4

Probability of getting favorable case = P(F) = $\frac{2}{6} = \frac{1}{3}$

Probability of not getting favorable case = $P(F') = \frac{2}{3}$

Required probability is $\left({}^{5}C_{4}\right)\left(\frac{1}{3}\right)^{4}\left(\frac{2}{3}\right)^{1} = \frac{5\times 2}{3^{5}} = \frac{10}{243}$

80. (C)

Total number of experiments = n=12

Number of favorable cases = r = 10

Total sample space in one such trial is n(S) = 6 × 6 = 36

Favorable cases are (4, 6), (5, 5) and (6, 4)

Probability of getting favorable case = P(F) = $\frac{3}{36} = \frac{1}{12}$

Probability of not getting favorable case = $P(F') = \frac{11}{12}$

Required probability is $\left({}^{12}C_{10}\right)\left(\frac{1}{12}\right)^{10}\left(\frac{11}{12}\right)^{2}$

81. (20)

Event G = original signal is green

E_1 = A receives the signal correct

E_2 = B receives the signal correct

E = signal received by B is green

Now total probability such that signal received by B is green is

= $P(GE_1E_2) + P[G(E_1' E_2')] + P[E_1(G'E_2')] + P[E_2(G'E_1')]$

$P(E) = \frac{46}{80}$

$$P\left(\frac{G}{E}\right) = \frac{\left(\frac{40}{5}\times 16\right)}{\left(\frac{46}{5}\times 16\right)} = \frac{20}{23}$$

82. (38)

Required probability $= \frac{475}{90} = \frac{19}{36}$

83. (7)

$$P(A\cup B\cup C) = \Sigma P(A) - \Sigma P(A\cap B) + \Sigma P(A\cap B\cap C)$$

$$= \frac{7}{16}$$

84. (39)

As per the given condition P(A) = 0.25, P(B) = 0.50 and P(A∩B) = 0.14

And P(AUB) = P(A) + P(B) – P(A∩B) = 0.25 + 0.50 – 0.14 = 0.61

Hence required probability is $P(AUB)' = 1 - P(A \cup B) = 1 - 0.61 = 0.39$

85. (4)

$$P(A' \cap B') = 1 - P(A \cup B)$$

$$= 1 - P(A) - P(B) + P(A \cap B) = \frac{1}{18}$$

$$72P = 72\left(\frac{1}{18}\right) = 4$$

86. (2)

Here sample space is selecting 2 out of 10 i.e $^{10}C_2$ and 2 red balls can be selected in $^{4}C_2$ ways hence required probability is $\frac{^{4}C_2}{^{10}C_2} = \frac{4 \times 3}{10 \times 9} = \frac{2}{15}$

87. (31)

Probability that none of them will appear tail is $\left(\frac{1}{2}\right)^5 = \frac{1}{32}$

So required probability that at least one tail will appear is $1 - \frac{1}{32} = \frac{31}{32}$

88. (75)

Out of 12 students 5 can be selected in $^{12}C_5 = \frac{12 \times 11 \times 10 \times 9 \times 8}{120} = 792$ ways and the number of ways of selecting 3 girls and 2 boys is $^{6}C_3 \times {}^{6}C_2 = 20 \times 15 = 300$.

So required probability is $\frac{300}{792} = \frac{75}{198}$

89. (18)

We have the ratio of the ships A, B and C for arriving safely to be 2:5, 3:7 and 6:11, respectively.

The probability of ship A for arriving safely = $\frac{2}{2+5} = \frac{2}{7}$

Similarly, for B = $\frac{3}{3+7} = \frac{3}{10}$ and for C = $\frac{6}{6+11} = \frac{6}{17}$

Probability of all the ships for arriving safely = $\frac{2}{7} \times \frac{3}{10} \times \frac{6}{17} = \frac{18}{595}$.

90. (11)

Here, $P(X) = 0.3$; $P(Y) = 0.2$

Now $P(X \cup Y) = P(X) + P(Y) - P(X \cap Y)$

Since these are independent events, so $P(X \cap Y) = P(X) * P(Y)$

Thus required probability = $0.3 + 0.2 - 0.06 = 0.44$