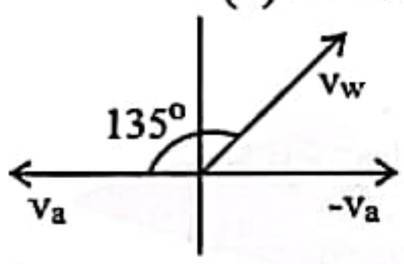
IUT Admission Test 2016-2017

Physics

01. A truck is stopped at a traffic signal. When the light turns green, it accelerates at 2.5 $m.s^{-2}$. At the same instant, a car passes the truck going 1.5 $m.s^{-1}$. Where does the truck catch up with the car?
(a) 220m (b) 180 m (c) 165 m (d) 195 m

Solution: (b); $\frac{1}{2} \times 2.5 \times t^2 = 15t \Rightarrow t = 12s;\ s = 15 \times 12 = 180m$ Ans.

02. An airplane flies due west at $185kmh^{-1}$ with respect to the air. There is a wind blowing at $85kmh^{-1}$ to the northeast relative to the ground. What is the plane's speed with respect to the ground?
(a) $139kmh^{-1}$ (b) $230kmh^{-1}$ (c) $239kmh^{-1}$ (d) $179kmh^{-1}$

Solution: (a); 

; $\sqrt{185^2 + 85^2 + 2 \times 85 \cos 135^\circ} = 138.6\ kmh^{-1} \approx 139kmh^{-1}$

03. A tennis ball is thrown straight up with an initial speed of 22.5 $m.s^{-1}$. It is caught at the same distance above the ground. How high does the ball rise?
(a) 24.72 m (b) 23.57m (c) 25.83 m (d) 26.53 m

Solution: (c); $H = \frac{V_0^2}{2g} = 25.83m$

04. Engineers are developing new types of guns that might someday be used to launch satellites as if they were bullets. One such gun can give a small object a velocity of 3.5 $km.s^{-1}$, moving it through only 2.0cm. Over what time interval does the acceleration take place?
(a) 11.43 μs (b) 13.43μs (c) 10.43μs (d) 12.43μs

Solution: (a); $v^2 = u^2 + 2as; a = 306.25 \times 10^6 ms^{-2}\ ; t = \frac{v-u}{a} = 11.43\ \mu s$

05. On a planet with an unknown value of g, the period of a 0.65 m long pendulum is 2.8 s. What is g for this planet?
(a) $2.27ms^{-2}$ (b) 2.95 ms^{-2} (c) $3.95ms^{-2}$ (d) $3.27ms^{-2}$

Solution: (d); $T = 2\pi\sqrt{\frac{L}{g}} \Rightarrow g = 3.27\ ms^{-2}$

06. A student stands on a bathroom scale in an elevator at rest on the 64^{th}floor of a building. The scale reads 836 N.As the elevator moves up, the scale reading increases to 936N, then decreases back to 836 N. What is the acceleration of the elevator?
(a) $1.17ms^{-2}$ (b) $1.27ms^{-2}$ (c) $1.21ms^{-2}$ (d) $1.57ms^{-2}$

Solution: (a); Weight $= \frac{836}{9.8} = 85.306$ kg; Second net acceleration $= 10.9722$
$\Delta a = 10.9722 - g = 1.17ms^{-2}$

07. As a baseball is being caught, its speed goes from 30.0 $m.s^{-1}$to 0.0 in about 0.0050 s. The mass of the baseball is 0.145 kg. What is the magnitude of the force acting on the player who caught it?
(a) 890N (b) 870N (c) 780N (d) 980N

Solution: (b); $F = \frac{\Delta P}{t} = \frac{30 \times 0.145}{0.005} = 870N$ (Ans.)

08. A player kicks a football from ground level with an initial velocity of 27.0 $m.s^{-1}, 30^\circ$ above the horizontal. Find the range of ball (assume negligible air resistance).
(a) 63.42m (b) 62.42m (c) 61.42m (d) 64.42m

Solution: (d); $R = \frac{v_0^2 \sin 2\theta}{g} = 64.42m$

09. A 5.00 g bullet is fired with a velocity of 100.0 ms^{-1} toward a 10.00 kg stationary solid block resting on a frictionless surface. What is the change in momentum of the bullet if it is embedded in the block?
(a) $-0.45 kg.m.s^{-1}$ (b) $-0.55 kg.m.s^{-1}$ (c) $-0.50 kg.m.s^{-1}$ (d) $-0.65 kg.m.s^{-1}$
Solution: (c); $\Delta P = 0 - 5 \times 10^{-3} \times 100 = -0.5\ Kgms^{-1}$

10. A 750kg car moving at 23 $m.s^{-1}$ brakes to a stop. The brakes contain about 15 kg of iron, which, absorbs the energy. What is the increase in temperature of the brakes? Specific heat of iron is 450J. $(kg^{\circ}C)^{-1}$
(a) 29.40°C (b) 39.40°C (c) 49.40°C (d) 19.40°C
Solution: (a); $\frac{1}{2}m_{car}V^2 = m_{iron}S\Delta\theta; \Delta\theta = 29.4^{\circ}C$

11. An electric motor develops 65kW of power as it lifts a loaded elevator to 17.5 m in 35 s. How much force does the motor exert?
(a) $1.75 \times 10^5 N$ (b) $1.30 \times 10^5 N$ (c) $1.45 \times 10^5 N$ (d) $1.95 \times 10^5 N$
Solution: (b); $P = \frac{F.X}{t} \therefore F = 1.3 \times 10^5 N$

12. The Earth is revolving around the Sun on an orbit of radius $1.5 \times 10^8 km$. If the time of one revolution is $3.156 \times 10^7 s$, what is the mass of the Sun? ($G = 6.67 \times 10^{11} Nm^2 kg^{-2}$).
(a) $3.0 \times 10^{30} kg$ (b) $1.5 \times 10^{10} kg$ (c) $2.0 \times 10^{30} kg$ (d) $2.5 \times 10^{30} kg$
Solution: (c); $\frac{mv^2}{r} = \frac{GMm}{r^2} \Rightarrow M = \frac{V^2 r}{G} = \frac{w^2 r^3}{G} = \frac{4\pi^2 r^3}{GT^2} = 2 \times 10^{30} kg$

13. The intensity level of sound produced by one lathe machine is 90.0 dB. If two such machines start operating at the same location, what is the intensity level of the sound produced by the machines?
(a) 95.0 dB (b) 93.0dB (c) 96.0dB (d) 99.0dB
Solution: (b); $\Delta B = 10 \log\frac{I}{I_o}; I = 1 \times 10^{-3}, I_{new} = 2 \times 10^{-3} \therefore \Delta B_{new} = 10 \log\frac{2\times10^{-3}}{1\times10^{-12}} = 93dB$

14. A man whose weight is 0.80kN is standing upright. How much his thighbone shortened compared to when he is lying down. The length of his thighbone when lying is 43.0 cm and the area of the thighbone is 8.0 cm. [Young's modulus of the thighbone $Y = 9.4 \times 10^9$ Pa]
(a) $2.29 \times 10^{-3} cm$ (b) $3.29 \times 10^{-3} cm$ (c) $1.29 \times 10^{-3} cm$ (d) $4.57 \times 10^{-3} cm$
Solution: (a); $L = \frac{43}{2} = 21.5cm; l = \frac{FL}{YA} = 2.29 \times 10^{-3} cm$

15. The equation of motion of particle experiencing simple harmonic motion is $x = 10 \sin\left(10t - \frac{\pi}{6}\right) m$. What is the velocity of the particle at $t = 1\ s$?
(a) $88.17 ms^{-1}$ (b) $78.57 ms^{-1}$ (c) $98.87 ms^{-1}$ (d) $88.87 ms^{-1}$
Solution: (d); $V = \frac{dx}{dt} 100 \cos\left(10\,t - \frac{\pi}{6}\right) = 100 \cos\left[\left(10 \times 0.1 - \frac{\pi}{6}\right) \times \frac{180}{\pi}\right] = 88.87\ ms^{-1}$

16. Two sources are producing sound in a medium with frequencies 480 Hz and 360Hz, respectively. The difference in wavelength corresponding to those two frequencies is 2 m. What is the velocity of sound in that medium?
(a) $2880 ms^{-1}$ (b) $2980 ms^{-1}$ (c) $2860 ms^{-1}$ (d) $2580 ms^{-1}$
Solution: (a); $\Delta\lambda = V\left(\frac{1}{f_1} - \frac{1}{f_2}\right) \therefore V = 2880\ ms^{-1}$

17. A bubble rises from the bottom of a lake of depth 80.0 m where the temperature is 4°C. The water temperature at the surface is 18 °C. If the bubble's initial diameter is 1.0mm, what is diameter when it reaches the surface? [Ans: b]
(a) 2.35mm (b) 2.10mm (c) 2.50mm (d) 2.40mm
Solution: (b); $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \Rightarrow \frac{P_1 d_1^3}{T_1} = \frac{P_2 d_2^3}{T_2}$
$P_1 = 101.325 \times 10^3 + 80 \times 1000 \times 9.8\ ; P_2 = 101.325 \times 10^3 \therefore d_2 = 2.10mm$

18. An astronaut wears a new watch when in a journey at a speed of 2×10^8 m.s^{-1} with respect to the earth. According to the mission control the trip lasts 12.0h. How long is the trip as measured on the watch? [Ans: c]
(a) 8.34h (b) 8.15h (c) 8.94h (d) 8.39h

Solution: (c); $t_0 = t_0\sqrt{1-\frac{v^2}{c_2}} = 8.94h$

19. A flash light is powered by two 1.5V batteries in series with internal resistance of 0.1Ω. The wire connecting the batteries with the lamp has a total resistance of 0.4Ω and the lamp filament has a resistance of 9.70Ω at normal operating temperature. What is the power absorbed by the lamp?
(a) 815mW (b) 823mW (c) 875mW (d) 865mW

Solution: (c); $p = \frac{V^2}{R} = \frac{3^2}{9.7+0.4+0.1\times2} = 873mW$ (Near to 875 mW)

20. A small fish is at a depth of 2.0 m below the surface of a still pond. What is the apparent depth of the fish as viewed by a kingfisher near surface of the pond?
(a) 1.75m (b) 1.45m (c) 1.50m (d) 1.65m

Solution: (c); $_a\mu_g = \frac{u}{v} \Rightarrow v = 1.5m$ (Ans.)

21. A wild rose 1.2 cm in diameter is 90.0 cm from a camera's zoom lens. The focal length of the lens has a magnitude of 150.0 mm. What is the distance between the lens and the camera film where the image of the rose is formed? [Ans: b]
(a) 17.5cm (b) 18.0cm (c) 19.5cm (d) 18.5cm

Solution: (b); $\frac{1}{u}+\frac{1}{v}=\frac{1}{f}$ ∴ V = 18.0 cm (Ans.)

22. The half life of ^{13}N is 9.965 min. If a sample contains 3.20×10^{12} ^{13}N atoms at t=0, how many ^{13}N nuclei are present 40.6 min later? [Ans: c]
(a) 2.65×10^{11} (b) 2.55×10^{11} (c) 2.00×10^{11} (d) 2.35×10^{11}

Solution: (c); $\lambda = \frac{\ln 2}{T_{\frac{1}{2}}} = 0.06956\,min^{-1}$; $N = N_0e^{-\lambda t} = 1.9 \times 10^{11} \approx 2 \times 10^{11}$

23. A door bell has a transformer to deliver 8.5 V to it when connected to a 220 V mains. If there are 50 turns on the secondary of the transformer, how many turns does the primary have?
(a) 1350 (b) 1222 (c) 1322 (d) 1250

Solution: (No correct answer); $n_1 = n_2 \times \frac{V_1}{V_2} = 1294.117$ turns ≈ 1295 turns

24. An ideal transformer has 500 turns in the primary and 250 turns in the secondary. If the average power input to the primary is 100W, what is the average output power?
(a) 95 W (b) 87 W (c) 59 W (d) 100 W

Solution: (d); W [Power remains constant]

25. The nichrome heating element of a toaster has a resistance of 12.0Ω when it is red hot (1200 °C). What is the resistance of the element at room temperature (27 °C)? (Temperature coefficient of resistance of nichrome is 0.4×10^{-3} °C^{-1}).
(a) 8.167Ω (b) 10.167Ω (c) 9.167Ω (d) 7.167Ω

Solution: (a); $\frac{R}{12} = \frac{R_0(1+\alpha 27)}{R_0(1+\alpha 1200)} = R = 8.167\Omega$

26. A proton enters in a magnetic field of 6.0μT with a velocity of 6.0×10^7 m.s^{-1}. What is the magnetic force on the proton?
(a) 5.76×10^{-7} (b) 5.76×10^{-8} (c) 4.76×10^{-17} (d) 3.76×10^{-17}

Solution: (a) ; $F = qvB = 5.76 \times 10^{-17}N$

27. A 125m long power line is horizontal and carries a current of 2500 A. The earth's magnetic field at the location is 0.52 mT directed downward. What is magnetic force on the line?

(a) 168.5N (b) 162.5N (c) 160.5N (d) 167.5N

Solution: (b); $F = IlB = 162.5\ N$

28. Three resistances, $R_A = 10\Omega, R_B = 20\ \Omega$ and $R_c = 30\Omega$ are connected in series across a 60 V source. How much power is consumed by R_B?

(a) 25 W (b) 30 W (c) 20W (d) 22W

Solution: (c); $R_s = 60A \Rightarrow I = \frac{E}{R_s} = 1A$

As connection is an series. $\therefore P_B = I^2R_B = 20W$

29. How high does a mercury barometer stand on a day when atmospheric pressure is 98.6 kPa?

(a) 740 mm (b) 760mm (c) 755mm (d) 725mm

Solution: (a); $P = \frac{98.6}{101.325} \times 760 = 739.56 \approx 740$

30. An old wooden tool is found to contain only 6.0% of $^{14}_{4}C$ that a sample of fresh wood contains . How old is the tool? (Half life of carbon is 5730 years).

(a) 2.3×10^3 (b) 2.3×10^4 (c) 2.75×10^4 (d) 3.25×10^4

Solution: (B); $R = R_oe^{-\lambda t}; \ln\left(\frac{R_o}{R}\right) = \lambda t \Rightarrow t = 2.3 \times 10^4 year \mid \lambda = \frac{\ln 2}{T_{\frac{1}{2}}} = 1.21 \times 10^{-4}\ year^{-1}$

31. A power station contains a heat engine operating between two heat reservoirs, one containing steam at 10°C and other containing water at 20°C What is the maximum amount of electrical energy which can be generated for each Joule of the heat extracted from the steam?

(a) 0.263J (b) 0.235J (c) 0.214J (d) 0.278J

Solution: (c); $\eta = 1 - \frac{T_2}{T_1} = 0.214\%\ ; W = \eta Q = 0.214J$

32. Two parallel circular plates of radius 0.08m are placed in air. The distance between the plates is 0.002 m and are kept at a potential difference of 100V. What is electrical energy stored in the system?

(a) 0.263J (b) 0.235J (c) 0.214J (d) 0.278J

Solution: (No correct answer); $c = \frac{\epsilon_o A}{d} = 8.9 \times 10^{-11}F; w = \frac{1}{2}CV^2 = 4.45 \times 10^{-7} = 0.445\ \mu J$

33. A heater of resistance 110Ω is immersed in a bucket containing 5 liter of water at 0°C. What is the temperature of water if the heater is kept on for 20 min using a 220 V mains? (Specific heat of water is $4.2\ J.g\,°C^{-1}$) .

(a) 26°C (b) 25°C (c) 27°C (d) 29°C

Solution: (b); $\frac{v^2t}{R} = ms\,\Delta\theta; \Delta\theta = 25.14°C$

34. The emitter and base current of a common emitter transistor circuit are respectively, 0.85 mA and 0.05 mA. What is β of the transistor?

(a) 16 (b) 18 (c) 20 (d) 10

Solution: (a); $I_c = 0.8\ ; \beta = \frac{Ic}{I_B} = \frac{0.8}{0.5} = 16$

35. A centrifuge in a medical laboratory rotates at an angular speed of 3,600 rpm. When the switch is off it rotates through 50 revolutions before coming to rest. What is the acceleration of the centrifuge.

(a) $235\ rad.s^{-2}$ (b) $226\ rad.s^{-2}$ (c) $247\ rad.s^{-2}$ (d) $210\ rad.s^{-2}$

Solution: (b); $\omega_o = \frac{2\pi \times 3600}{60} = 120\pi; \omega^2 = \omega_o^2 + 2\alpha\theta; \alpha = \frac{(120\pi)^2}{2 \times 50 \times 2\pi} = 226.195$

Chemistry

36. Solubility product of Al $(OH)_3$ is 3.7×10^{-15}. What will be the solubility of $Al(OH)_3$ in g/L unit?
(a) 8.424×10^{-3} (b) 8.424×10^{-2} (c) 7.424×10^{-3} (d) 7.424×10^{-2}
Solution: (a); $27S^4 = 3.7 \times 10^{-5}; S = 1.082 \times 10^{-4} molL^{-1} = 8.44 \times 10^{-3} g/L$

37. Find the value of X_4 from the following nuclear reaction.
$^{238}_{88}U \xrightarrow{-\alpha} X_1 \xrightarrow{-\beta} X_2 \xrightarrow{-\beta} X_3 \xrightarrow{-\alpha} X_4$
(a) $^{226}_{88}Ra$ (b) $^{234}_{92}U$ (c) $^{230}_{90}Th$ (d) $^{234}_{91}Pa$
Solution: (c); $^{238}_{88}U \xrightarrow{-\alpha} {}^{234}_{90}X_1 \xrightarrow{-\beta} {}^{234}_{91}X_2 \xrightarrow{-\beta} {}^{234}_{92}X_3 \xrightarrow{-\beta} {}^{230}_{90}Th$

38. Which one of the following properties is not the general property of d-block element? [Ans: d]
(a) All the d- block elements are heavy metals.
(b) d-block metals have high melting point and high boiling point.
(c) The ionization energy of d- block element is higher than that of s- block element.
(d) d-block metals are more electropositive than s- block metals.

39. If 4.25 mol H_2 and 4.75 mol I_2 is kept at a 1 L flask and heated to 300 °K then 6.7 mol HI is produced. Find equilibrium constant K_c and K_p.
(a) 3.563, 3.563 (b) 35.63, 35.63 (c) 35.63, 35.63 (d) 3.563, 87.65
Solution: (b);
$$\underset{(4.25-3.35)}{\overset{4.25}{H_2}} + \underset{(4.75-3.35)}{\overset{4.75}{I_2}} \rightleftharpoons \underset{6.7}{\overset{0}{2HI}}$$
$K_p = K_c\ [\Delta n = o] \therefore K_p = K_c = \frac{6.7^2}{(4.25-3.35)(4.75-3.35)} = 35.327$

40. What ratio of $\left[\frac{NH_3}{NH_4^+}\right]$ is required for a buffer solution that has pH = 7.0? K_a Value of NH_4^+ ion = 5.6×10^{-10}.
(a) 5.6×10^{-10} (b) 6.5×10^{-3} (c) 177.83 (d) 17.783
Solution: (a); $pH = pK_a + \log\frac{[NH_3]}{[NH_4^+]}; \frac{[NH_3]}{[NH_4^+]} = 5.6 \times 10^{-3}$

41. During the manufacturing process of a Sulphuric acid, As_2O_3 acts as a- [Ans: a]
(a) Catalyst poison (b) Positive catalyst (c) Catalyst promoter (d) Negative catalyst

42. According to Acid's strength, which one of the following statement is not true? [Ans: b]
(a) $HCl > H_2SO_3 > HNO_2$ (b) $H_3PO_3 > H_3PO_4 > HCO_2H$
(c) $HF > HNO_2 > CH_3CO_2H$ (d) $H_3PO_3 > HNO_2 > HCO_2H$

43. If acid rain happens at IUT, what will you use to make the soil normal?
(a) TSP (b) $(NH_4)_2CO_3$ (c) Dolomite (d) KNO_3
Solution: (c); Dolomite: $CaCo_3.MgCo_3$ Which is a basic compound.

44. Which of the following lights has the highest wavelength range? [Ans: d]
(a) Indigo (b) Green (c) Blue (d) Orange

45. Which of the following salts is soluble in water? [Ans: b]
(a) $CaSO_4$ (b) $ZnSO_4$ (c) $CaCO_3$ (d) $ZnCO_3$

46. Which one of the following groups is not true in the case of electro negativity order? [Ans: c]
(a) F > Cl > Br > I (b) Br > Te > Sb > Sn (c) Ga > Pb > In > Cd (d) O > N > C > B

47. At 27°C temperture I molecule of a gas has an average kinetic energy of 5.621×10^{-14}erg. How many molecules are there in 2 mols of that gas?
(a) 2.65×10^{23} (b) 5.31×10^{23} (c) 2.41×10^{23} (d) 4.82×10^{23}
Solution: (No correct answer)

48. Following equation is a part of preparing: $2CHClF_2 \xrightarrow{900°C} CF_2 = CF_2 + 2HCl$ [Ans: b]
(a) Polythene (b) Teflon (c) Ploystyrene (d) PVC

49. Which one of the following is not a way to increase Octane Number? [Ans: d]
(a) Using Pyrolysis (b) Alkylation
(c) To mix a fixed amount of TEL or TML (d) Adding Gasoline

50. Which is not an advantage of Lithium Ion Battery? [Ans: d]
(a) Portability (b) Voltage energy density
(c) Light weight (d) Low internal resistance

Mathematics

51. Find the vector equation of the line that passes through the points $A(3,4,1)$, and $B(2,-3,5)$ crosses xy plane.
(a) $\vec{r} = \frac{7}{3}\hat{i} + \frac{17}{3}\hat{j}$ (b) $\vec{r} = \frac{23}{5}\hat{i} + \frac{13}{5}\hat{j}$ (c) $\vec{r} = \frac{13}{5}\hat{j} + \frac{23}{5}\hat{j}$ (d) $\vec{r} = \frac{17}{3}\hat{j} + \frac{7}{3}\hat{j}$
Solution: (c); $r = a + \lambda b = (3\hat{i} + 4\hat{j} + \hat{k}) + \lambda(2\hat{i} - 3\hat{j} + 5\hat{k})$
$= (3 + 2\lambda)\hat{i} + (4 - 3\lambda)\hat{j} + (1 + 5\lambda)\hat{k}$ $\because$ crosses xy plane $\Rightarrow 1 + 5\lambda = 0 \Rightarrow \lambda = -\frac{1}{5} \therefore \vec{r} = \frac{13}{5}\hat{i} + \frac{23}{5}\hat{j}$

52. If $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}, B = \begin{bmatrix} 4 & 7 \\ 3 & 5 \end{bmatrix}$ and $AB^{-1} = \begin{bmatrix} 1 & a \\ 3 & 5 \end{bmatrix}$, then a =?
(a) 1 (b) -1 (c) Cannot be found (d) None of these
Solution: (b); $AB^{-1} = \begin{bmatrix} 1 & -1 \\ -3 & 5 \end{bmatrix} = a = -1$

53. If $A = \begin{bmatrix} 1 & 2 \\ a & b \end{bmatrix}$ and $A^2 = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$, then the values of a and b are:
(a) 2 and 1 (b) -2 and -1 (c) $-\frac{1}{2}$ and -1 (d) $\frac{1}{2}$ and 1
Solution: (c); $A^2 = \begin{bmatrix} 1+2a & 2+2b \\ a+ab & 2a+b^2 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$; $\begin{matrix} 1+2a & 2+2b=0 \\ a=-\frac{1}{2} & b=-1 \end{matrix}$

54. A ray of light coming from the point (1,2) is reflected at a point A on the x- axis and then passes through the point (5,3). Find the coordinates of the point A.
(a) (13, 0) (b) $(\frac{13}{5}, 0)$ (c) $\left(\frac{11}{5}, 0\right)$ (d) $\left(\frac{9}{5}, 0\right)$
Solution: (b); Co − ordinate $(x, 0)$ $\therefore \frac{2-0}{1-x} = -\frac{3-o}{5-x}$; $x = \frac{13}{5}$

55. Find the equation of the line passing through the point of intersection of the lines $4x + 7y - 3 = 0$ and $2x - 3y + 1 = 0$ that has the equal intercepts on the axes.
(a) $13x + 13y = 6$ (b) $13x + 13y = 1$ (c) $6x + 6y = 13$ (d) $6x + 6y = 1$
Solution: (a); Passing point $= \left(\frac{1}{13}, \frac{5}{13}\right)$; $\frac{x}{a} + \frac{y}{a} = 1 \Rightarrow \frac{1}{13a} + \frac{5}{13a} = 1 \Rightarrow a = \frac{6}{13}$
$\therefore$ line $\rightarrow 13x + 13y = 6$

56. A circle passes through the origin and the point (4,2); and its centre is one the line $x + y = 1$. The equation of the circle is-
(a) $x^2 + y^2 - 6x + 2y = 0$ (b) $x^2 + y^2 - x - 8y = 0$
(c) $x^2 + y^2 - 8x + 6y = 0$ (d) $x^2 + y^2 - 2x - 6y = 0$
Solution: (c); $x^2 + y^2 + 2gx + 2fy = 0$
That passes through point $(4,2) \therefore 20 + 8g + 4f = 0$
Again, centre $(-g, -f)$; $g + f + 1 = 0 \therefore g = -4$ $f = 3$
Ans. $x^2 + y^2 - 8x + 6y = 0$

57. Find the equation (s) of the tangent (s) from the origin to the circle $x^2 + y^2 - 5x - 5y + 10 = 0$.
(a) $3x - y = 0$ (b) $x - 3y = 0$ (c) None of these (d) Both (A) and (B)
Solution: (d); tangent from origin: $y = mx \Rightarrow mx - y = o$
Radius: $\frac{\sqrt{10}}{2} = \frac{\frac{5m}{2}\frac{5}{2}}{\sqrt{m^2+1}} \Rightarrow \frac{10}{4} = \frac{25}{4} \times \frac{(m-1)^2}{m^2+1} \Rightarrow 5m^2 - 10m + 5 = 2m^2 + 2 \Rightarrow m = 3, \frac{1}{3}$; $y = 3x; x - 3y = o$

58. There are 6 boys who enter a boat with 8 seats of which 4 seats on each side. In how many ways can they sit, if two boys A and B sit on the port side and another boy W sits on the starboard side?
(a) 56 (b) 240 (c) 2880 (d) 2200
Solution: (c);

Starboard side			
	W		

Port side			
A	B		

Existing = 3 more
2 of 3 in Port side : ${}^3c_2 \times 4! \times {}^4p_2$
1 of 3 in Port side : ${}^3c_1 \times {}^4p_3 \times {}^4p_3$
0 of 3 in Port side : ${}^3c_0 \times {}^4p_2 \times 4!$
2880

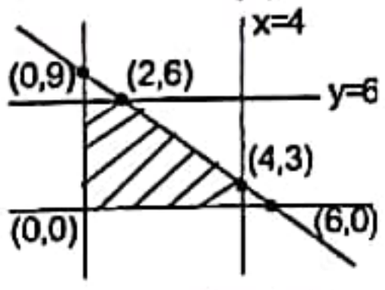
59. How many triangles can be formed by 12 points, 7 of which lie on one line and other 5 on another parallel line?
(a) 175 (b) 31 (c) 105 (d) 70
Solution: (a); $12_{C_3} - 7_{C_3} - 5_{C_3} = 175$

60. $\tan\frac{1}{2}\left(\tan^{-1}x + \tan^{-1}\frac{1}{x}\right) = ?$
(a) $\frac{x-1}{2x}$ (b) $\tan\frac{x-1}{2x}$ (c) 1 (d) $\sqrt{2}$
Solution: (c); $\tan\left(\frac{1}{2}\tan^{-1}\frac{x+\frac{1}{x}}{o}\right) = \tan\left(\frac{1}{2}.\tan\infty\right) = \tan\left(\frac{1}{2} \times \frac{\pi}{2}\right) = \tan\frac{\pi}{4} = 1$

61. If $\tan^{-1}\frac{2x}{1-x^2} = \sin^{-1}\frac{2a}{1+a^2} - \cos^{-1}\frac{1-b^2}{1+b^2}$, then $x = ?$
(a) $\frac{a-b}{1+ab}$ (b) $\frac{a+b}{1-ab}$ (c) $\frac{2a}{1+ab}$ (d) $\frac{2a}{1-ab}$
Solution: (a); $\tan^{-1}\frac{2x}{1-x^2} = \sin^{-1}\frac{2a}{1+a^2} - \cos^{-1}\frac{1-b^2}{1+b^2} \Rightarrow \tan^{-1}x = \tan^{-1}a - \tan^{-1}b \Rightarrow x = \frac{a-b}{1+ab}$

62. $\cot^{-1}(\tan 2x) + \cot^{-1}(-\tan 3x) = ?$
(a) $\frac{2}{3}x$ (b) x (c) $\frac{3}{2}x$ (d) $2x$
Solution: (b); $\tan^{-1}\frac{1}{\tan 2x} - \tan^{-1}\frac{1}{\tan 3x} \Rightarrow \tan^{-1}\frac{\frac{\tan 3x - \tan 2x}{\tan 2x \tan 3x}}{\frac{\tan 2x + \tan 3x + 1}{\tan 2x \tan 3x}} = x$

63. A company produces 2 types of product. It uses 3 plants for the production. The 1st product requires one hour in plant 1 and 3 hours in plant 3 for producing 1 item. The 2nd product requires 2 hours each in plant 2 and 3 for one production. Total available hours in plants 1,2 and 3 in a week are 4, 12 and 18 respectively. Profit for each item of product 1 is 3 thousand, and for product 2 is 5 thousand. The possible maximum weekly profit for the company is-
(a) 18 thousand (b) 33 thousand (c) 36 thousand (d) 3
Solution: (c);



$z_{max} = 3x + 5y; x \leq 4; 2y \leq 12; J \leq 6; 3x + 2y \leq 18;\ z_{max} = 36000$ at point $(2, 6)$

64. Evaluate $\lim_{x\to 0}\frac{e^x-1}{e^{2x}-1}$ =?

(a) $\frac{1}{4}$ (b) 0 (c) $\frac{1}{2}$ (d) 1

Solution: (c); $\left(\frac{0}{0}\text{ form}\right)\lim_{x\to 0}\frac{e^x}{2e^{2x}}=\frac{1}{2}$

65. $\frac{dy}{dx}\ln(\sec x+\tan x)$=?

(a) secx (b) tanx (c) cotx (d) cosx

Solution: (a); $\frac{\sec x(\sec x+\tan x)}{(\text{seex}+\tan x)}=\sec x$

66. $\frac{d}{dx}\tan^{-1}\sqrt{\frac{1-\cos x}{1-\sin x}}=?$

(a) $\frac{1}{2}$ (b) $\frac{1}{3}$ (c) $\sin\frac{x}{2}$ (d) $\cos\frac{x}{2}$

Solution: (a); $\frac{d}{dx}\tan^{-1}\sqrt{\frac{1-\cos x}{1+\cos x}}=\frac{d}{dx}\tan^{-1}\sqrt{\frac{2\sin^2\frac{x}{2}}{2\cos^2\frac{x}{2}}}=\frac{d}{dx}\tan^{-1}\left(\tan\frac{x}{2}\right)=\frac{d}{dx}\left(\frac{x}{2}\right)=\frac{1}{2}$

67. The total waste per mile in an electric conductor is $W=i^2R+\frac{K^2}{R}$. Where i is the current and R is the resistance. If the current is kept constant, then find the maximum value of W.

(a) 2ik (b) ik (c) $\frac{k}{i}$ (d) $\frac{2K}{i}$

Solution: (a); $\frac{dW}{dR}=i^2-\frac{k^2}{R^2}=0; R=\frac{k}{i}; W_{max}=2ki$

68. A cylinder is expanding is such a way that its height h and radius r are both increasing at the rate of 1% per hour. Find the rate the volume, $V=\pi r^2h$, is increasing per hour.

(a) 1% (b) 2% (c) 3% (d) 4%

Solution: (c); $\frac{dh}{dt}=1\%\times h;\ \frac{dr}{dt}=1\%\times r;\ V=\pi r^2h$

$$\Rightarrow\frac{dV}{dt}=\pi r^2\frac{dh}{dt}+2\pi rh\frac{dr}{dt}=\pi r^2\times 1\%\times h+2\pi rh\times 1\%\times r\ \therefore\frac{\frac{dV}{dt}}{V}=\frac{\pi r^2h\times 1\%+\pi r^2h\times 2\%}{\pi r^2h}=3\%$$

69. $\int\frac{x^2}{\sqrt{1-x^2}}dx=?$

(a) $\frac{1}{2}x\sqrt{1-x^2}+C$ (b) $\frac{1}{2}\cos^{-1}x+\frac{1}{2}x\sqrt{1-x^2}+C$ (c) $\frac{1}{2}x^2\sqrt{1-x^2}+C$ (d) $\frac{1}{2}\sin^{-1}x+\frac{1}{2}x\sqrt{1-x^2}+C$

Solution:(No correct answer); $\int\frac{x^2}{\sqrt{1-x^2}}dx=\text{left}, x=\sin\theta; dx=\cos\theta d\theta$

$$\therefore\int\frac{\sin^2\theta.\cos\theta d\theta}{\cos\theta}=\frac{1}{2}\left|2\sin^2\theta d\theta=\frac{1}{2}\right|(1-\cos 2\theta)d\theta$$

$$\frac{1}{2}\theta-\frac{1}{2}\frac{\sin 2\theta}{2}+2c=\frac{\theta}{2}-\frac{1}{2}\sin\theta\cos\theta+c.=\frac{1}{2}\sin^{-1}x-\frac{1}{2}x\sqrt{1-x^2}+c$$

70. $\int_0^{\frac{\pi}{2}}\cos^3 x\sin^2 x dx$ =?

(a) $\frac{2}{15}$ (b) $\frac{2}{13}$ (c) $\frac{\pi}{4}$ (d) $\frac{\pi}{2}$

Solution: (a); $\int_0^{\frac{\pi}{2}}\cos^3 x\sin^2 x dx$

x	o	x/2
z	o	1

Let, $\sin x=z$

$\therefore \cos x dx=dz$

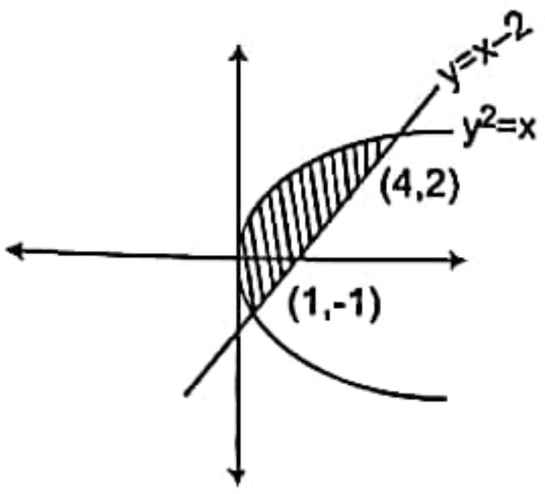
$$=\int_0^{\frac{\pi}{2}}(1-\sin^2 x)\sin^2 x.\cos x\,dx=\int_0^1(1-z^2)z^2dz$$

$$=\int_0^1(z^2-z^4)\,dz=\left[\frac{z^3}{3}-\frac{z^5}{5}\right]_0^1=\frac{1}{3}-\frac{1}{5}=\frac{5-3}{15}=\frac{2}{15}\text{ (Ans.)}$$

71. The area bounded by the curves $y^2 = x$ and $y = x - 2$ is-

(a) $\frac{7}{2}$ (b) $\frac{9}{2}$ (c) $\frac{11}{2}$ (d) $\frac{5}{2}$

Solution: (b);



$\therefore$ Area $= \int_{-1}^{2}(y + 2 - y^2)dy = \left[\frac{y^2}{2} + 2y - \frac{y^3}{3}\right]_{-1}^{2} = \frac{9}{2}$

72. Find the condition that one root of the quadratic equation $px^2 - qx + p = 0$ is 1 more than the other.

(a) $p^2 - 4q^2 = 0$ (b) $q^2 - 5p^2 = 0$ (c) $q^2 - 4p^2 = 0$ (d) $p^2 - 5q^2 = 0$

Solution: (b); Let, the roots are $\alpha, \alpha + 1 \therefore 2\alpha + 1 = \frac{q}{p}$ $\alpha = \frac{q-p}{2p}$

$\alpha^2 + \alpha = 1 \Rightarrow \frac{(q-p)^2}{4p^2} + \frac{q-p}{2p} = 1 \Rightarrow q^2 + p^2 - 2pq + 2pq - 6p^2 = 0 \Rightarrow q^2 - 5p^2 = 0$

73. The positive integers are bracketed as follows: (1), (2,3), (4, 5,6),...

Where there are r integers in the r^{th} bracket. The sum of all integers in the 20^{th} brackets is-

(a) 2010 (b) 4210 (c) 4010 (d) 2005

Solution: (c); Last number of 19th bracket

$\frac{19}{2}[2 \times 1 + 18 \times 1] = 190$

20th bracket: (191, ...)

sum $= \frac{20}{2}[2 \times 191 + 19 \times 1] = 4010$

74. In the expansion of $\left(1 + \frac{1}{x}\right)^{-1}$, when $-1 < x < 1$, the coefficient of x^7 is-

(a) 1 (b) -1 (c) $\frac{1}{2}$ (d) $-\frac{1}{2}$

Solution: (a); $\left(1 + \frac{1}{x}\right)^{-1} = x^{-1}(1 + x)^{-1} = (x^{-1} + 1 + x + x^2 + ..)$

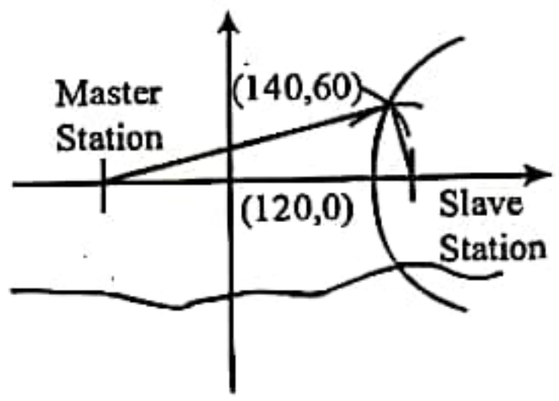
75. The point in a lunar orbit nearest the surface of the moon in called perilune and the point farthest from the surface is called apolune. The Apollo 11 spacecraft was placed in an elliptical lunar orbit with the perilune altitude 110 km and apolune altitude 314 km (above the moon). Find the equation of the ellipse if the radius of the moon is 1728 km and the centre of the moon is at one focus.

(a) $\frac{x^2}{37,63,600} + \frac{y^2}{41,69,764} = 1$ (b) $\frac{x^2}{37,63,600} + \frac{y^2}{37,53,196} = 1$

(c) $\frac{x^2}{33,78,244} + \frac{y^2}{37,53,196} = 1$ (d) $\frac{x^2}{33,78,2441} + \frac{y^2}{41,69,7644} = 1$

Solution: (d); $\frac{x^2}{(1728+110)^2} + \frac{y^2}{(1728+314)^2} = 1$

76. Long – range navigation (LORAN) is a radio navigation system developed during. World War II. The system enable a pilot to guide aircraft by maintaining a constant difference between the aircraft's distances from two fixed points: the master station and the slave station. Write an equation for the hyperbola depicted in the following figure.



(a) $\frac{x^2}{3600} - \frac{13y^2}{19600} = 1$ (b) $\frac{x^2}{19600} - \frac{y^2}{3600} = 1$ (c) $\frac{x^2}{14400} - \frac{y^2}{19600} = 1$ (d) $\frac{x^2}{14400} - \frac{13y^2}{129600} = 1$

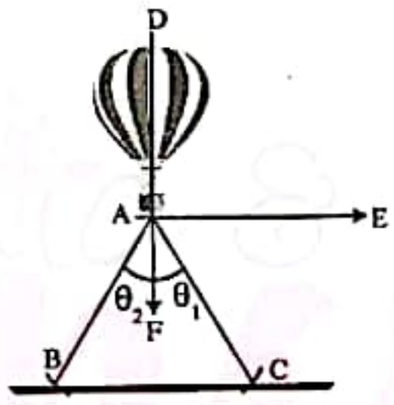
Solution: (d); $\frac{140^2}{14400} - \frac{1360^2}{129600} = 1$ [Check the options by plotting the point (140,60) in the equation.]

77. Suppose you decide to drop a melon from rest from the first observation platform of the Eiffel Tower which is 58.3m about the head of your friend who is standing just below you. Your friend shoots an straight up at the same time with an initial velocity of $25.1\ ms^{-1}$.What height above your friend's arrow head does the collision occur?

(a) 31.92 m (b) 26.27 m (c) 46.93 m (d) 22.32 m

Solution: (a); $58.3 - (25.1t - 4.9t^2) = 4.9t^2; t = 2.323\ s\ ; s = 2.323\ s$

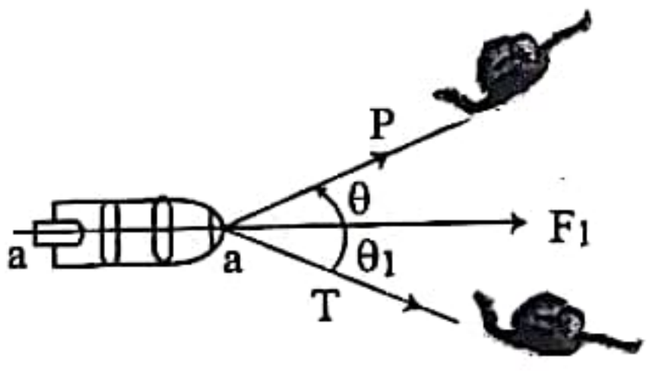
78. A resultant force F equal to 350 ℓb is necessary to hold the balloon in place. Assume that $\theta_1 = 30°$ and $\theta_2 = 40°$ The force is applied along the lines AB and AC as shown in the following figure. The magnitude of forces along the lines AB and AC are?



(a) 186 1b and 239 ℓb (b) 76 ℓb and 239 ℓb (c) 268 ℓb and 322 ℓb (d) 268 ℓb and 322 ℓb

Solution: (a); $AB = \frac{350\sin(30)}{\sin(70)}; AC = \frac{350\sin 40}{\sin 70}$

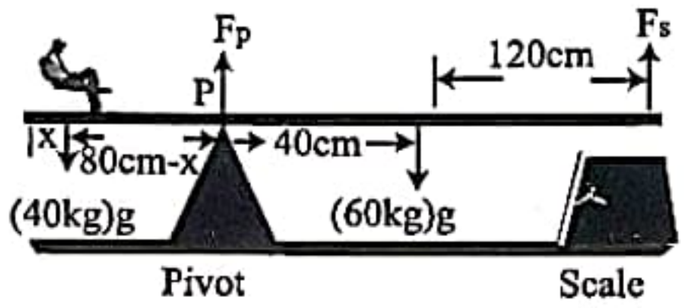
79. The boat shown in the following figure is to be pulled onto the shore using two ropes. If the resultant force is to be $F_1 = 80$ ℓb directed along the line aa, determine the magnitudes of the force P so that the magnitude of P is minimum. T acts at an angle $\theta_1 = 30°$ from the line aa. The force P will be minimum for a certain angle between P and T.



(a) 40ℓb (b) 56.56ℓb (c) 69.3ℓb (d) 77.27ℓb

Solution: (a) ; $= \frac{80\sin 30°}{\sin 90°} = 40$ℓb

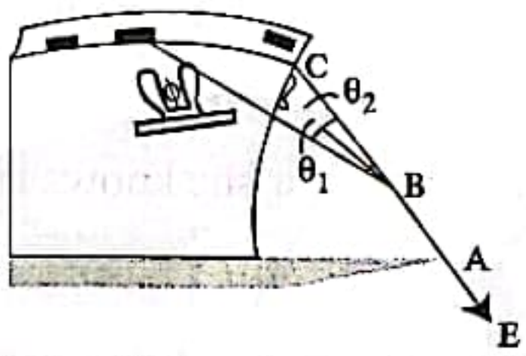
80. A 2.4m long 60 kg uniform tabletop is supported by a pivot 80 cm form the left end and by a scale at the right end as shown in the following figure. How far from the left end should a 40 kg child sit if the scale is to read zero?



(a) 70cm (b) 60cm (c) 20cm (d) 10cm

Solution: (c); $(80-x)40 = 60 \times 40 \Rightarrow x = 20\text{cm}$

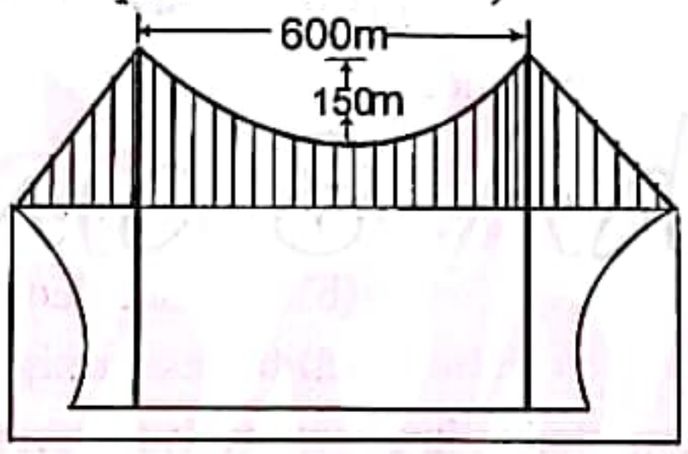
81. The ship shown in the following figure is moving at a constant velocity by a tugboat applying a force $F_1 = 50\text{kN}$. Determine the force in each of BC and BD assuming $\theta_1 = 20°$ and $\theta_2 = 30°$.



(a) 25.25 and 12.54kN (b) 22.32 and 32.64kN (c) 62.32 and 82.64kN (d) 102.32 and 32.64 kN

Solution: (b); $\frac{50\sin(20)}{\text{Sin}50} = 22.32\text{kN}$; $\frac{50\sin 30}{\sin 50} = 32.635\text{ kN}$

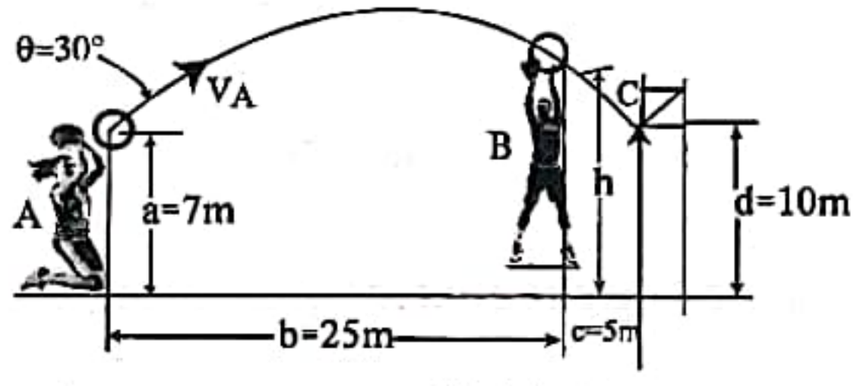
82. In a suspension bridge the shape of the suspension cables is parabolic. The bridge shown in the following figure has tower that are 600m apart, and the lowest point of the suspension cables is 150m below the top of the tower, Find the equation of the parabolic part of the cables, placing the origin of the coordinate system at the vertex (that is, the lowest point of the cables).



(a) $x^2 = 600y$ (b) $x^2 = 300y$ (c) $x^2 = 150y$ (d) $y^2 = 300x$

Solution: (a); (300,150)point satifies eqn; $x^2 = 600y$

83. Measurements of a shot recorded on a vidcotape during a basketball game are shown in the following figure. The ball passed through the hoop even though it barely cleared the hands of the player B who attempted to block it. Neglecting the size of the ball, find the height of the ball when it passes over player B.

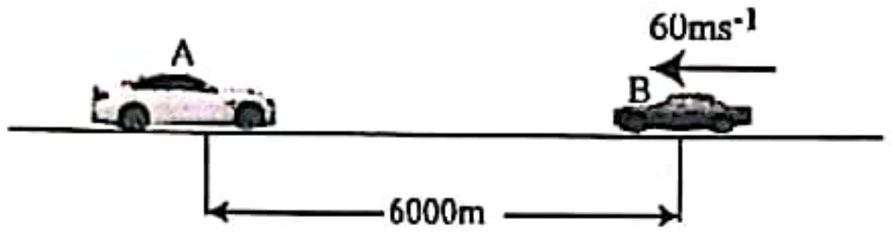


(a) 7.40m (b) 4.72m (c) 11.48m (d) 9.40m

Solution: (c); $B = 30\tan 30° - \frac{g.30^2}{2v_o^2\cos^2 30}$; $V_o = 20.2632$

$Y = 7 + 30\tan 30° - \frac{g.25^2}{2v_0^2\cos^2 30°} = 11.48\text{m}$

84. Car A starts from rest at t=0 and travels along a straight road with a constant acceleration of $6ms^{-2}$ until it reaches a speed of $80ms^{-1}$. Afterwards it maintains this speed. In contrast, at t =0, car B located 6000m down the road is traveling towards A at a constant speed of 60 ms^{-1}. Find the distance traveled by car A when they pass each other.



(a) 2400m (b) 3400m (c) 2800m (d) 3200m

Solution: (d); $t_1 = \frac{v_a}{a} = 13.33s$ $S_{A1} = 533.33m; S_B = 800m$

$80t_2 = 46667 - 60, t_2$; $t_2 = 33.33s$; $S_{A2} = 2666.4m$; $S_A = 3200m$

85. On a multiple- choice examination with four choices for each question, a student either knows the answer to a question or marks it randomly. The probability that he or she knows the answer is $\frac{2}{3}$. If a question was marked correctly, what is the probability that he or she knows the answer?

(a) $\frac{8}{9}$ (b) $\frac{1}{4}$ (c) $\frac{3}{4}$ (d) $\frac{7}{9}$

Solution: (a); $P\left(\frac{k}{c}\right) = \frac{P(K)P(C/K)}{P(K)P\left(\frac{C}{K}\right)+P(K')P\left(\frac{C}{K'}\right)} = \frac{\frac{2}{3}\cdot 1}{\frac{2}{3}\cdot 1+\frac{1}{3}\cdot\frac{1}{4}} = \frac{8}{9}$

English

Question 86-90:

Choose the appropriate word/Words for the blank space to complete the sentence.

86. Abdur Rahim and Liaqat went to the bank and..... made a deposit. [Ans: b]

(a) he (b) they (c) it (d) their

87. In 1980, the Nether lands agreed to limit fishing in certain Atlantic Ocean beds, but in 1981,..... [Ans: d]

(a) they terminated the agreement. (b) they decided to terminate the agreement.

(c) it terminated the agreement. (d) It was terminated.

88. While brokers, as a rule, are not permitted to know executive access codes, in many instances... [Ans: d]

(a) they are widely known (b) they are widely known to be

(c) they are widely known by many (d) the codes are widely known

89. The number of workers..... each year. [Ans: d]

(a) have in creased steadily (b) steadily have increased

(c) have been increasing steadily (d) has increased steadily

90. The commercial airliner flew too close to the military base, an act the army saw.....a violation of its air space. [Ans: b]

(a) as (b) as if it was (c) to be (d) that it was

Question 91-93:

The questions in the group are based on the content of a passage.

"In an effort to reduce the amount of fat and the number of calories that they consume, many citizens are making significant changes in their diets. For them staying in shape and looking fit now take precedence over eating foods are filling and that taste good. It is likely that if they maintain these new priorities with consistent regard for other health issues, the length and quality of their lives will increase significantly."

91. Which one of the following is an assumption upon which the argument is based? [Ans: c]
(a) Eating foods that are filling and tastes good is inconsistent with staying in shape and looking fit
(b) Controlling the quality of one's life requires more than mere dietary adjustments.
(c) A combination of diet and exercise is necessary if one wishes to stay in shape and look fit.
(d) Many citizens of the United States have only recently discovered the importance of diet to living a longer, healthier life.

92. "Singing in the Rain Umbrella Corporation plans to institute plans to institute a marketing campaign in which it sells umbrellas at the exits of subway stations during rainy weather. The umbrellas will be sold at a price that is slightly higher than normal. The company thinks the sales of these higher- priced umbrellas will be greater than normal sales of umbrellas, because the purchasers of these umbrellas will be forced to buy them if they do not want to get wet."
The author assumes which of the following about the purchasers of the umbrellas is predicting the sales of the umbrellas? [Ans: a]
(a) Customers who do not feel immediate pressure to purchase will not do so.
(b) Normally priced umbrellas are not profitable for singing in the Rain Umbrellas Corporation.
(c) very few people buy Singing in the Rain's normally priced umbrellas.
(d) Singing in the Rain Umbrellas Corporation will have to stop selling normally priced umbrellas when it starts selling higher priced umbrellas.

93. " A leading cement manufacturer has been having problems processing manufacturing and delivery records since it expanded its operations. To solve this problem it plans to install a new platform on its central computing system which will run its tracking program five times faster than the current system does." Which one of the following castes the most serious doubt on the manufacturer's plan? [Ans: a]
(a) Not all computer platforms can make the company's tracking programs run more quickly.
(b) The cost of the new computer platform will require the cement manufacture to raise prices for its products.
(c) The cement company' computer system does not have the capability to run the new platform and cannot be updated.
(d) The company has been increasing the sales of cement by 1.5 percent a month for the past 18 months.

Question 94-97:
Identify the correct synonym by looking for word rootes, prefixes, or suffixes, Choose the word that means the same or about the same as the italicized word.

94. An incoherent answer [Ans: a]
(a) Not understandable (b) not likely (c) undeniable (d) challenging

95. Covered with debr is [Ans: c]
(a) good excuses (b) transparent material (c) scattered rubble (d) protective material

96. Inadvertently left [Ans: a
(a) mistakently (b) purposely (c) cautiously (d) carefully

97. Compatible workers [Ans: c]
(a) gifted (b) competitive (c) harmonious (d) experienced

Question 98-100:
Choose the word that means the opposite of the italicized word.

98. Capable employee [Ans: a]
(a) unskilled (b) absurd (c) apt (d) able

99. Zealous pursuit [Ans: c]
(a) envious (b) eager (c) idle (d) comical

100. Exorbitant prices [Ans: c]
(a) expensive (b) unexpected (c) reasonable (d) outrageous