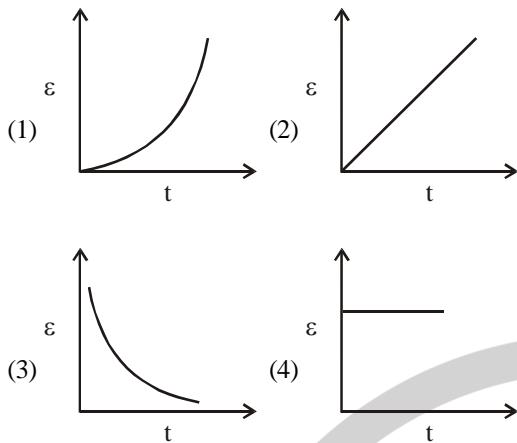


Q.9 A rectangular metallic loop is moving out of a uniform magnetic field region to a field free region with a constant speed. When the loop is partially inside the magnetic field, the plot of magnitude of induced emf (ϵ) with time (t) is given by



Q.10 A light source of wavelength λ illuminates a metal surface and electrons are ejected with maximum kinetic energy of 2 eV. If the same surface is illuminated by a

light source of wavelength $\frac{\lambda}{2}$, then the maximum kinetic energy of ejected electrons will be (The work function of metal is 1 eV)
 (1) 2 eV (2) 6 eV (3) 5 eV (4) 3 eV

Q.11 Given below are two statements. One is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A) : A simple pendulum is taken to a planet of mass and radius, 4 times and 2 times, respectively, than the Earth. The time period of the pendulum remains same on earth and the planet.

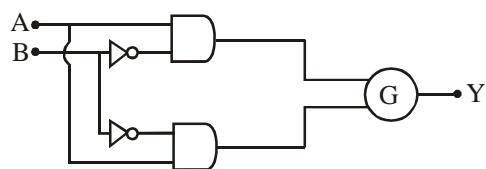
Reason (R) : The mass of the pendulum remains unchanged at Earth and the other planet. In the light of the above statements, choose the correct answer from the options given below :

- (1) Both (A) and (R) are true but (R) is NOT the correct explanation of (A)
- (2) (A) is true but (R) is false
- (3) (A) is false but (R) is true
- (4) Both (A) and (R) are true and (R) is the correct explanation of (A)

Q.12 The torque due to the force $(2\hat{i} + \hat{j} + 2\hat{k})$ about the origin, acting on a particle whose position vector is $(\hat{i} + \hat{j} + \hat{k})$, would be

- (1) $\hat{i} - \hat{j} + \hat{k}$
- (2) $\hat{i} + \hat{k}$
- (3) $\hat{i} - \hat{k}$
- (4) $\hat{j} - \hat{k}$

Q.13



A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1

To obtain the given truth table, following logic gate should be placed at G:

- (1) NOR Gate
- (2) AND Gate
- (3) NAND Gate
- (4) OR Gate

Q.14

A force $\vec{F} = 2\hat{i} + b\hat{j} + \hat{k}$ is applied on a particle and it undergoes a displacement $\hat{i} - 2\hat{j} - \hat{k}$. What will be the value of b, if work done on the particle is zero.

- (1) 0
- (2) $\frac{1}{2}$
- (3) $\frac{1}{3}$
- (4) 2

Q.15

Given below are two statements. One is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : In Young's double slit experiment, the fringes produced by red light are closer as compared to those produced by blue light.

Reason (R) : The fringe width is directly proportional to the wavelength of light.

In the light of above statements, choose the correct answer from the options given below :

- (1) Both (A) and (R) are true and (R) is the correct explanation of (A)
- (2) (A) is false but (R) is true.
- (3) Both (A) and (R) are true but (R) is NOT the correct explanation of (A).
- (4) (A) is true but (R) is false.

Q.16

A ball of mass 100 g is projected with velocity 20 m/s at 60° with horizontal. The decrease in kinetic energy of the ball during the motion from point of projection to highest point is :

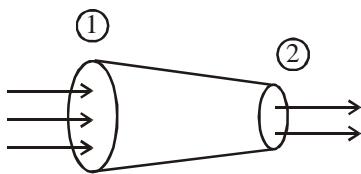
- (1) 20 J
- (2) 15 J
- (3) zero
- (4) 5 J

Q.17

A transparent film of refractive index, 2.0 is coated on a glass slab of refractive index, 1.45. What is the minimum thickness of transparent film to be coated for the maximum transmission of Green light of wavelength 550 nm. [Assume that the light is incident nearly perpendicular to the glass surface.]

- (1) 94.8 nm
- (2) 68.7 nm
- (3) 137.5 nm
- (4) 275 nm

Q.18



The tube of length L is shown in the figure. The radius of cross section at the point (1) is 2 cm and at the point (2) is 1 cm, respectively. If the velocity of water entering at point (1) is 2 m/s, then velocity of water leaving the point (2) will be :

(1) 2 m/s (2) 4 m/s (3) 6 m/s (4) 8 m/s

Q.19

Given are statements for certain thermodynamic variables,

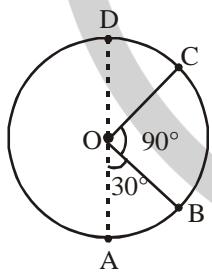
(A) Internal energy, volume (V) and mass (M) are extensive variables.
 (B) Pressure (P), temperature (T) and density (ρ) are intensive variables.
 (C) Volume (V), temperature (T) and density (ρ) are intensive variables.
 (D) Mass (M), temperature (T) and internal energy are extensive variables.

Choose the correct answer from the points given below :

(1) (C) and (D) only (2) (D) and (A) only
 (3) (A) and (B) only (4) (B) and (C) only

Q.20

A body of mass 100 g is moving in circular path of radius 2 m on vertical plane as shown in figure. The velocity of the body at point A is 10 m/s. The ratio of its kinetic energies at point B and C is :



(Take acceleration due to gravity as 10 m/s²)

(1) $\frac{2+\sqrt{3}}{3}$ (2) $\frac{2+\sqrt{2}}{3}$
 (3) $\frac{3+\sqrt{3}}{2}$ (4) $\frac{3-\sqrt{2}}{2}$

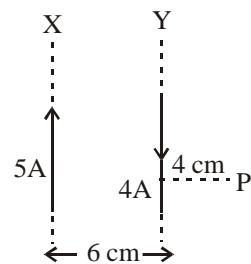
SECTION-B

Q.21

A proton is moving undeflected in a region of crossed electric and magnetic fields at a constant speed of 2×10^5 ms⁻¹. When the electric field is switched off, the proton moves along a circular path of radius 2 cm. The magnitude of electric field is $x \times 10^4$ N/C. the value of x is _____.
 Take the mass of the proton = 1.6×10^{-27} kg.

Q.22

Two long parallel wires X and Y, separated by a distance of 6 cm, carry currents of 5 A and 4 A, respectively, in opposite directions as shown in the figure. Magnitude of the resultant magnetic field at point P at a distance of 4 cm from wire Y is $x \times 10^{-5}$ T. The value of x is _____.
 Take permeability of free space as $\mu_0 = 4\pi \times 10^{-7}$ SI units.



Q.23

A parallel plate capacitor of area $A = 16 \text{ cm}^2$ and separation between the plates 10 cm, is charged by a DC current. Consider a hypothetical plane surface of area $A = 3.2 \text{ cm}^2$ inside the capacitor and parallel to the plates. At an instant, the current through the circuit is 6 A. At the same instant the displacement current through A_0 is ____ mA.

Q.24

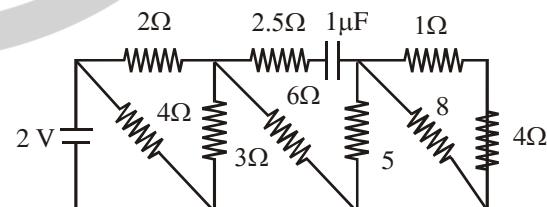
A tube of length 1 m is filled completely with an ideal liquid of mass 2 M, and closed at both ends.

The tube is rotated uniformly in horizontal plane about one of its ends. If the force exerted by the liquid at the other end is F then angular velocity of the tube is

$\sqrt{\frac{F}{\alpha M}}$ in SI unit. The value of α is

Q.25

The net current flowing in the given circuit is _____.
 A.

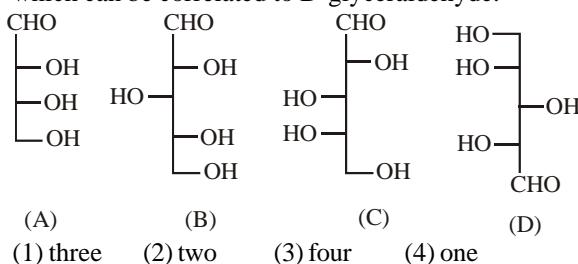


CHEMISTRY SECTION-A

Q.26

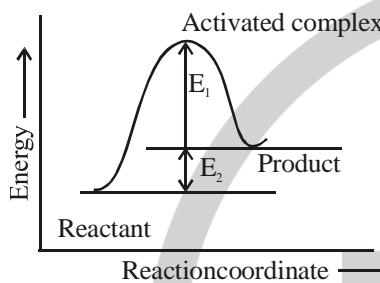
Arrange the following compounds in increasing order of their dipole moment :
 HBr, H₂S, NF₃ and CHCl₃
 (1) NF₃ < HBr < H₂S < CHCl₃
 (2) HBr < H₂S < NF₃ < CHCl₃
 (3) H₂S < HBr < NF₃ < CHCl₃
 (4) CHCl₃ < NF₃ < HBr < H₂S

Q.27 Identify the number of structure/s from the following which can be correlated to D-glyceraldehyde.



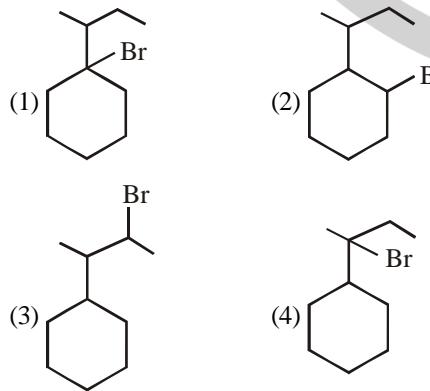
Q.28 The maximum covalency of a non-metallic group 15 element 'E' with weakest E-E bond is :
(1) 5 (2) 3 (3) 6 (4) 4

Q.29 Consider the given figure and choose the correct option :



(1) Activation energy of backward reaction is E_1 and product is more stable than reactant.
(2) Activation energy of forward reaction is $E_1 + E_2$ and product is more stable than reactant.
(3) Activation energy of forward reaction is $E_1 + E_2$ and product is less stable than reactant.
(4) Activation energy of both forward and backward reaction is $E_1 + E_2$ and reactant is more stable than product.

Q.30 When sec-butylcyclohexane reacts with bromine in the presence of sunlight, the major product is :



Q.31 The species which does not undergo disproportionation reaction is :

(1) ClO_2^- (2) ClO_4^-
(3) ClO^- (4) ClO_3^-

Q.32

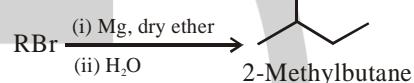
Match the Compounds (List-I) with the appropriate Catalyst/Reagents (List-II) for their reduction into corresponding amines.

List-I (Compounds)	List-II (Catalyst/Reagents)
(A) $\text{R}-\text{C}(=\text{O})-\text{NH}_2$	(I) NaOH (aqueous)
(B) 	(II) H_2/Ni
(C) $\text{R}-\text{C}\equiv\text{N}$	(III) $\text{LiAlH}_4, \text{H}_2\text{O}$
(D) 	(IV) Sn, HCl

Choose the correct answer from the options given below:

(1) (A)-(III), (B)-(II), (C)-(IV), (D)-(I)
(2) (A)-(II), (B)-(IV), (C)-(III), (D)-(I)
(3) (A)-(II), (B)-(I), (C)-(III), (D)-(IV)
(4) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)

Q.33



The maximum number of RBr producing 2-methylbutane by above sequence of reactions is _____. (Consider the structural isomers only)

(1) 4 (2) 5 (3) 3 (4) 1

Q.34

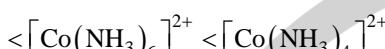
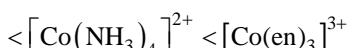
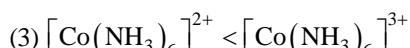
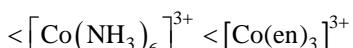
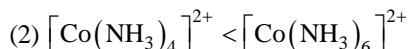
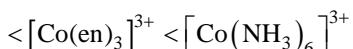
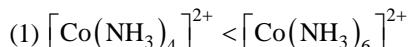
Match List-I with List-II.

	List-I (Partial Derivatives)		List-II (Thermodynamic Quantity)
(A)	$\left(\frac{\partial G}{\partial T}\right)_P$	(I)	C_P
(B)	$\left(\frac{\partial H}{\partial T}\right)_P$	(II)	$-S$
(C)	$\left(\frac{\partial G}{\partial P}\right)_T$	(III)	C_V
(D)	$\left(\frac{\partial U}{\partial T}\right)_V$	(IV)	V

Choose the correct answer from the options given below:

(1) (A)-(II), (B)-(I), (C)-(III), (D)-(IV)
(2) (A)-(II), (B)-(I), (C)-(IV), (D)-(III)
(3) (A)-(I), (B)-(II), (C)-(IV), (D)-(III)
(4) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)

Q.35 The correct order of the following complexes in terms of their crystal field stabilization energies is :



Q.36 Density of 3 M NaCl solution is 1.25 g/mL. The molality of the solution is :

(1) 1.79 m (2) 2 m (3) 3 m (4) 2.79 m

Q.37 The molar solubility(s) of zirconium phosphate with molecular formula $(\text{Zr}^{4+})_3(\text{PO}_4)^{3-}_4$ is given by relation:

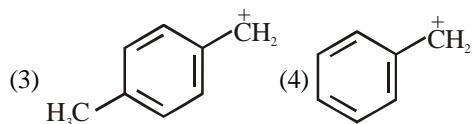
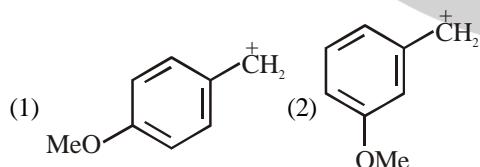
(1) $\left(\frac{K_{\text{sp}}}{6912}\right)^{\frac{1}{7}}$

(2) $\left(\frac{K_{\text{sp}}}{5348}\right)^{\frac{1}{6}}$

(3) $\left(\frac{K_{\text{sp}}}{8435}\right)^{\frac{1}{7}}$

(4) $\left(\frac{K_{\text{sp}}}{9612}\right)^{\frac{1}{3}}$

Q.38 The most stable carbocation from the following is :



Q.39 Given below are two statements :

Statement (I) : An element in the extreme left of the periodic table forms acidic oxides.

Statement (II) : Acid is formed during the reaction between water and oxide of a reactive element present in the extreme right of the periodic table.

In the light of the above statements, choose the correct answer from the options given below :

(1) Statement-I is false but Statement-II is true.
(2) Both Statement-I and Statement-II are false.
(3) Statement-I is true but Statement-II is false.
(4) Both Statement-I and Statement-II are true.

Given below are two statements :

Statement (I) : A spectral line will be observed for a $2p_x \rightarrow 2p_y$ transition.

Statement (II) : $2p_x$ and $2p_y$ are degenerate orbitals.

In the light of the above statements, choose the correct answer from the options given below :

(1) Both Statement-I and Statement-II are true.
(2) Both Statement-I and Statement-II are false.
(3) Statement-I is true but Statement-II is false.
(4) Statement-I is false but Statement-II is true.

Given below are two statements :

Statement (I) : Nitrogen, sulphur, halogen and phosphorus present in an organic compound are detected by Lassaigne's Test.

Statement (II) : The elements present in the compound are converted from covalent form into ionic form by fusing the compound with Magnesium in Lassaigne's test.

In the light of the above statements, choose the correct answer from the options given below :

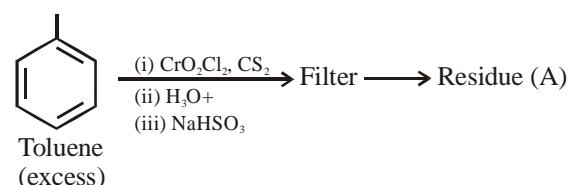
(1) Both Statement I and Statement II are true
(2) Both Statement I and Statement II are false
(3) Statement I is true but Statement II is false
(4) Statement I is false but Statement II is true

Identify the homoleptic complex(es) that is/are low spin.

(A) $[\text{Fe}(\text{CN})_5\text{NO}]^{2-}$ (B) $[\text{CoF}_6]^{3-}$
(C) $[\text{Fe}(\text{CN})_6]^{4-}$ (D) $[\text{Co}(\text{NH}_3)_6]^{3+}$
(E) $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$

Choose the correct answer from the options given below:

(1) (B) and (E) only (2) (A) and (C) only
(3) (C) and (D) only (4) (C) only



Residue (A) + HCl (dil.) \rightarrow Compound (B)
Structure of residue (A) and compound (B) formed respectively is :

Q.55 Suppose that the number of terms in an A.P. is $2k$, $k \in \mathbb{N}$. If the sum of all odd terms of the A.P. is 40, the sum of all even terms is 55 and the last term of the A.P. exceeds the first term by 27, then k is equal to
 (1) 5 (2) 8 (3) 6 (4) 4

Q.56 Let a line pass through two distinct points $P(-2, -1, 3)$ and Q , and be parallel to the vector $3\hat{i} + 2\hat{j} + 2\hat{k}$. If the distance of the point Q from the point $R(1, 3, 3)$ is 5, then the square of the area of ΔPQR is equal to:
 (1) 136 (2) 140 (3) 144 (4) 148

Q.57 If $\lim_{x \rightarrow \infty} \left(\left(\frac{e}{1-e} \right) \left(\frac{1}{e} - \frac{x}{1+x} \right) \right)^x = \alpha$, then the value of $\frac{\log_e \alpha}{1 + \log_e \alpha}$ equals :
 (1) e (2) e^{-2} (3) e^2 (4) e^{-1}

Q.58 Let $f(x) = \int_0^{x^2} \frac{t^2 - 8t + 15}{e^t} dt$, $x \in \mathbb{R}$. Then the numbers of local maximum and local minimum points of f , respectively, are :
 (1) 2 and 3 (2) 3 and 2 (3) 1 and 3 (4) 2 and 2

Q.59 The perpendicular distance, of the line $\frac{x-1}{2} = \frac{y+2}{-1} = \frac{z+3}{2}$ from the point $P(2, -10, 1)$, is:
 (1) 6 (2) $5\sqrt{2}$ (3) $3\sqrt{5}$ (4) $4\sqrt{3}$

Q.60 If $x = f(y)$ is the solution of the differential equation $(1+y^2) + (x - 2e^{\tan^{-1}y}) \frac{dy}{dx} = 0$, $y \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ with $f(0) = 1$, then $f\left(\frac{1}{\sqrt{3}}\right)$ is equal to :
 (1) $e^{\pi/4}$ (2) $e^{\pi/12}$ (3) $e^{\pi/3}$ (4) $e^{\pi/6}$

Q.61 If $\int e^x \left(\frac{x \sin^{-1} x}{\sqrt{1-x^2}} + \frac{\sin^{-1} x}{(1-x^2)^{3/2}} + \frac{x}{1-x^2} \right) dx = g(x) + C$, where C is the constant of integration, then $g\left(\frac{1}{2}\right)$ equals :
 (1) $\frac{\pi}{6}\sqrt{\frac{e}{2}}$ (2) $\frac{\pi}{4}\sqrt{\frac{e}{2}}$ (3) $\frac{\pi}{6}\sqrt{\frac{e}{3}}$ (4) $\frac{\pi}{4}\sqrt{\frac{e}{3}}$

Q.62 Let α_0 and β_0 be the distinct roots of $2x^2 + (\cos\theta)x - 1 = 0$, $\theta \in (0, 2\pi)$. If m and M are the minimum and the maximum values of $\alpha_0^4 + \beta_0^4$, then $16(M+m)$ equals :
 (1) 24 (2) 25 (3) 27 (4) 17

Q.63 Let $A = \{1, 2, 3, 4\}$ and $B = \{1, 4, 9, 16\}$. Then the number of many-one functions $f : A \rightarrow B$ such that $1 \in f(A)$ is equal to :
 (1) 127 (2) 151 (3) 163 (4) 139

If the system of linear equations :
 $x + y + 2z = 6$,
 $2x + 3y + az = a + 1$,
 $-x - 3y + bz = 2b$, where $a, b \in \mathbb{R}$, has infinitely many solutions, then $7a + 3b$ is equal to :
 (1) 9 (2) 12 (3) 16 (4) 22

Q.65 Let \vec{a} and \vec{b} be two unit vectors such that the angle between them is $\frac{\pi}{3}$. If $\lambda\vec{a} + 2\vec{b}$ and $3\vec{a} - \lambda\vec{b}$ are perpendicular to each other, then the number of values of λ in $[-1, 3]$ is :
 (1) 3 (2) 2 (3) 1 (4) 0

Q.66 Let $E : \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, $a > b$ and $H : \frac{x^2}{A^2} - \frac{y^2}{B^2} = 1$. Let the distance between the foci of E and the foci of H be $2\sqrt{3}$. If $a - A = 2$, and the ratio of the eccentricities of E and H is $\frac{1}{3}$, then the sum of the lengths of their latus rectums is equal to :
 (1) 10 (2) 7 (3) 8 (4) 9

Q.67 If A and B are two events such that $P(A \cap B) = 0.1$, and $P(B|A)$ and $P(A|B)$ are the roots of the equation $12x^2 - 7x + 1 = 0$, then the value of $\frac{P(\bar{A} \cup \bar{B})}{P(\bar{A} \cap \bar{B})}$ is:
 (1) $\frac{5}{3}$ (2) $\frac{4}{3}$ (3) $\frac{9}{4}$ (4) $\frac{7}{4}$

Q.68 The sum of all values of $\theta \in [0, 2\pi]$ satisfying $2\sin^2\theta = \cos 2\theta$ and $2\cos^2\theta = 3\sin\theta$ is
 (1) $\frac{\pi}{2}$ (2) 4π (3) $\frac{5\pi}{6}$ (4) π

Q.69 Let the curve $z(1+i) + \bar{z}(1-i) = 4$, $z \in \mathbb{C}$, divide the region $|z - 3| \leq 1$ into two parts of areas α and β . Then $|\alpha - \beta|$ equals :

(1) $1 + \frac{\pi}{2}$ (2) $1 + \frac{\pi}{3}$ (3) $1 + \frac{\pi}{4}$ (4) $1 + \frac{\pi}{6}$

Q.70 The area of the region enclosed by the curves $y = x^2 - 4x + 4$ and $y^2 = 16 - 8x$ is :

(1) $\frac{8}{3}$ (2) $\frac{4}{3}$ (3) 5 (4) 8

SECTION-B

Q.71 Let $y = f(x)$ be the solution of the differential equation

$\frac{dy}{dx} + \frac{xy}{x^2 - 1} = \frac{x^6 + 4x}{\sqrt{1-x^2}}$, $-1 < x < 1$ such that $f(0) = 0$. If

$6 \int_{-1/2}^{1/2} f(x) dx = 2\pi - \alpha$ then α^2 is equal to _____.

Q.72 Let $A(6, 8)$, $B(10 \cos \alpha, -10 \sin \alpha)$ and $C(-10 \sin \alpha, 10 \cos \alpha)$, be the vertices of a triangle. If $L(a, 9)$ and $G(h, k)$ be its orthocenter and centroid respectively, then $(5a - 3h + 6k + 100 \sin 2\alpha)$ is equal to

Q.73 Let the distance between two parallel lines be 5 units and a point P lie between the lines at a unit distance from one of them. An equilateral triangle PQR is formed such that Q lies on one of the parallel lines, while R lies on the other. Then $(QR)^2$ is equal to _____.

Q.74 If $\sum_{r=1}^{30} \frac{r^2 \left({}^{30}C_r \right)^2}{{}^{30}C_{r-1}} = \alpha \times 2^{29}$, then α is equal to _____.

Q.75 Let $A = \{1, 2, 3\}$. The number of relations on A , containing $(1, 2)$ and $(2, 3)$, which are reflexive and transitive but not symmetric, is _____.