PHYSICS

Single Correct Answer Type

1. Pick out the unmatched pair from the following

a) Moderator – Heavy water

b) Nuclear fuel - $_{92}U^{235}$

c) Pressurized water reactor – water as the heat exchange system

d) Safety rods – Carbon

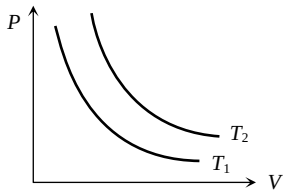
2. A long straight wire of resistance R, radius a and length l carries a constant current I. The Poynting vector for the wire will be

a) $\frac{IR}{2\pi al}$ b) $\frac{IR^2}{al}$ c) $\frac{I^2R}{al}$ d) $\frac{I^2R}{2\pi al}$

3. The length of a cube is 2.1×10^{-2}m. the volume in significant figures will be

a) $9.2 \times 10^{-6}\text{m}^3$ b) $9.3 \times 10^{-6}\text{m}^3$ c) $9.26 \times 10^{-6}\text{m}^3$ d) $9.261 \times 10^{-6}\text{m}^3$

4. The adjoining figure shows graph of pressure and volume of a gas at two temperatures T_1 and T_2. Which of the following inferences is correct



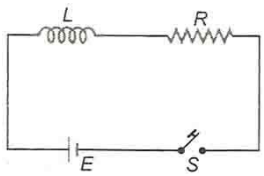
a) $T_1 > T_2$ b) $T_1 = T_2$

c) $T_1 < T_2$ d) No interference can be drawn

5. A body of mass M at rest explodes into three pieces, two of which of mass $M/4$ each are thrown off in perpendicular directions with velocities of 3 m/s and 4 m/srespectively. The third piece will be thrown off with a velocity of

a) 1.5 m/s b) 2.0 m/s c) 2.5 m/s d) 3.0 m/s

6. In the circuit shown in figure switch S is closed at time $t = 0$. The charge which passes through the battery in one time constant is



a) $\frac{EL}{e\,R^2}$ b) $\frac{eL}{ER}$

c) $\frac{eR^2E}{L}$ d) $E\left(\frac{L}{R}\right)$

7. A monoatomic ideal gas, initially at temperature T_1 is enclosed in a cylinder fitted with a frictionless piston. The gas is allowed to expand adiabatically to a temperature T_2 by releasing the piston suddenly. If L_1, L_2 are the lengths of the gas column before and after expansion respectively, then T_1/T_2 is given by

a) $\left(L_1/L_2\right)^{2/3}$ b) $\left(L_1/L_2\right)$ c) L_1/L_2 d) $\left(L_2/L_1\right)^{2/3}$

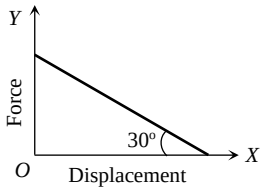
8. A spring of spring constant k is cut into two equal parts. A block of mass m is attached with one part of spring. What is the frequency of the system if α is frequency of block with original spring?

a) $\sqrt{2}\alpha$ b) $\alpha/2$ c) 2α d) α

9. If the earth did not have atmosphere, its surface temperature on a day time would be

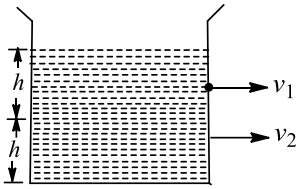
a) Higher b) Lower c) Same as now d) Not sure

10. The value of force constant between the applied elastic force F and displacement will be



a) $\sqrt{3}$ b) $\frac{1}{\sqrt{3}}$ c) $\frac{1}{2}$ d) $\frac{\sqrt{3}}{2}$

11. Equal volumes of two immiscible liquids of densities ρ and 2 ρ are filled in a vessel as shown in figure. Two small holes are made at depth $h/2$ and 3 $h/2$ from the surface of lighter liquid. If v_1 and v_2 are the velocities of efflux at these two holes, then v_1/v_2 is



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

12. The number of waves contained in unit length of the medium is called

a) Elastic wave b) Wave number
c) Wave pulse d) Electromagnetic wave

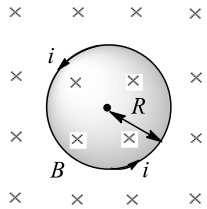
13. Two wires $'A'$ and $'B'$ of the same material have their lengths in the ratio 1 : 2 and radii in the ratio 2 : 1. The two wires are connected in parallel across a battery. The ratio of the heat produced in $'A'$ to the heat produced in $'B'$ for the same time is

a) 1 :2 b) 2 :1 c) 1 :8 d) 8 :1

14. In an amplifier the load resistance R_L is equal to the plane resistance (r_p). The voltage amplification is equal to

a) μ b) 2μc) $\frac{\mu}{2}$ d) $\frac{\mu}{4}$

15. A current (i) carrying circular wire of radius R is placed in a magnetic field B perpendicular to its plane. The tension T along the circumference of wire is



a) BiR b) $2\pi BiR$ c) πBiR d) $2BiR$

16. Three photons coming from excited atomic hydrogen sample are observed, their energies are 12.1 eV, 10.2 eV and 1.9 eV. These photons must come from

a) Single atom b) Two atoms
c) Three atoms d) Either two or three atom

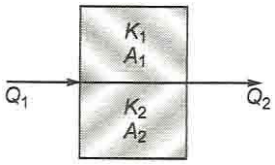
17. A 150 m long train is moving with a uniform velocity of 45 km/h. The time taken by the train to cross a bridge of length 850 m is

a) 56 sec b) 68 sec c) 80 sec d) 92 sec

18. Permanent magnet has properties retentivity and coercivity respectively

a) High-high b) Low-low c) Low-high d) High-low

19. Two plates of same thickness, of coefficients of thermal conductivity K_1 and K_2 and areas of cross section A_1 *and* A_2 are connected as shown in figure. The common coefficient of thermal conductivity K will be



a) $K_1A_1 + K_2A_2$ b) $\frac{K_1A_1}{K_2A_2}$ c) $\frac{K_1A_1+K_2A_2}{A_1+A_2}$ d) $\frac{K_1A_2+K_2A_1}{K_1+K_2}$

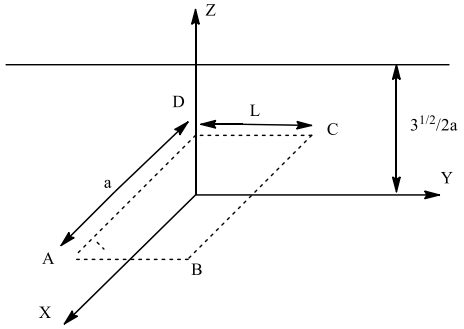
20. A capacitor of capacity C is connected with a battery of potential V inparallel. The distance between its plates is reduced to half at once, assuming that the charge remains the same. Then to charge the capacitance upto the potential V again, the energy given by the battery will be

a) $CV^2/4$ b) $CV^2/2$ c) $3CV^2/4$ d) CV^2

Integer Answer Type

21. A silver ball of radius 4.8 cm is suspended by a thread in a vacuum chamber. Ultraviolet light of wavelength 200 nm is incident on the ball for some time during which a total light energy of 1.0×10^{-7} J falls on the surface. Assuming that on the average, one photon out of ten thousand photons is able to eject a photoelectron, find the electric potential (in $\times 10^1$ V) at the surface of the ball assuming zero potential at infinity

22. An infinitely long uniform line charge distribution of charge per unit length λ lies parallel to the y-axis in the y-z plane at $z = \frac{\sqrt{3}}{2}a$ (see figure). If the magnitude of the flux of the electric field through the rectangular surface $ABCD$ lying in the x-y plane with its centre at the origin is $\frac{\lambda L}{n\varepsilon_0}$ (ε_0 = permittivity of free space), then the value of n is

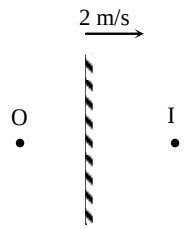


23. A stone of mass m, tied to the end of a string, is whirled around in a horizontal circle (neglect the force due to gravity). The length of the string is reduced gradually keeping the angular momentum of the stone about the centre of the circle constant.Then the tension in the string is given by $T = A/r^n$, where A is a constant, r is the instantaneous radius of the circle and n is

24. A long solenoid of diameter 0.1 m has 2×10^4 turns per metre. At the centre of the solenoid a 100 turn coil of radius 0.01 m is placed with its axis coinciding with the solenoid axis. The current in the solenoid is decreased at a constant rate from $+2$ A to -2 A in 0.05 s. Find the total charge (in μC) flowing through the coil during this time when the resistance of the coil is $40\pi^2\,\Omega$

25. In a square cut, the speed of the cricket ball changes from 30 m/s to 40 m/s during the time of its contact $\Delta t = 0.01$ s with the bat. If the ball is deflected by the bat through an angle of $\theta = 90°$, find the magnitude of the average acceleration (in $\times 10^2 \text{m/s}^2$) of the ball during the square cut

26. If in the given figure, image I is not moving. Find the velocity of object for this.



27. Magnitude of resultant of two vector $\vec{A}$ and $\vec{B}$ is equal to 2. Angle between two vectors is 180º. If $|\vec{A}| = 3$ then find $|\vec{B}|$ ($|\vec{B}|$ must be less then 2)

28. A cubical block of mass 6 kg and side 16.1 cm is placed on frictionless horizontal surface. It is hit by a cue at the top as to impart impulse in horizontal direction. Minimum impulse imparted to topple the block must be greater than –

29. A non-isotropic solid metal cube has coefficients of linear expansion as : 5×10^{-5} /°C along the x-axis and 5×10^{-6} /°C along the y and the z-axis. If the coefficient of volume expansion of the solid is $C \times 10^{-6}$ /°C then the value of C is …….. .

30. Two particles are moving with velocity $\vec{v}_1 = \hat{i} - 2t\,\hat{j}\,m/s$ and $\vec{v}_2 = 4\hat{i} + \hat{j}\ m/s$ respectively Time at which they are moving perpendicular to each other is.

CHEMISTRY

Single Correct Answer Type

1. A chain transfer agent is
   a) C_6H_5OH b) $NH(C_6H_5)_2$
   c) CCI_4 d) CH_3O

2. A mixture of CH_4, N_2 and O_2 is enclosed in a vessel of one litre capacity at $0°C$. The ratio of particle pressures of gases is 1 : 4 : 2. Total pressure of the gaseous mixture is 2660 mm. the number of molecules of oxygen present in the vessel is
   a) $\frac{6.02\times10^{23}}{22.4}$ b) 6.02×10^{23} c) 22.4×10^{22} d) 1000

3. In Langmuir's model of adsorption of a gas on a solid surface
   a) The rate of dissociation of adsorbed molecules from the surface does not depend on the surface covered
   b) The adsorption at a single site on the surface may involve multiple molecules at the same time
   c) The mass of gas striking a given area of surface is proportional to the pressure of the gas
   d) The mass of gas striking a given area of surface is independent of the pressure of the gas

4. Iodoform test is not given by
   a) HCHOb) CH_3CHOc) CH_3COCH_3d) C_2H_5OH

5. Black HgS:
   a) Dissolves in conc. HCl on boiling
   b) Dissolves in boiling HCl + a crystal of $KClO_3$
   c) Dissolves in NaOH
   d) None of the above

6. The product of acid catalysed hydration of 2-phenyl propene is:
   a) 3-phenyl-2-propanol b) 1-phenyl-2-propanol c) 2-phenyl-2-propanol d) 2-phenyl-1-propanol

7. Of the elements Sr, Zr, Mo, Cd and Sb, all of which are in V period, the paramagnetics are:
   a) Se, Cd and Sb b) Zr, Mo and Cd c) Sr, Zr and Cd d) Zr, Mo and Sb

8. A white solid reacts with dil. HCl to give colourless gas that decolourises aqueous bromine. The solid is most likely to be:
   a) Sodium carbonate b) Sodium chloride c) Sodium acetate d) Sodium thiosulphate

9. The electrons in an incomplete outershell are known as:
   a) Kernel electrons b) Valency electrons c) Shell electrons d) None of the above

10. Reaction of aniline with benzaldehyde is
    a) Substitution b) Addition c) Condensation d) Polymerisation

11. On shaking 10 mL of 0.1 molar solution of an organic compound in water with 10 mL of CCl_4 til equilibrium is attained, concentration of the organic compound in water would be $(K = 9)$ in molar units :
    a) 0.01 b) 0.09 c) 0.001 d) 0.009

12. Pencillin was first discovered by
    a) Alexander Fleming b) Tence and Salke c) S.A. Waksman d) Louis Pasteur

13. Among the following substituted silanes the one which will give rise to cross linked silicone polymer on hydrolysis is
    a) R_4Si b) $RSiCl_3$ c) R_2SiCl_2 d) R_3SiCl

14. 380 mL of a gas at 27°C, 800 mm of Hg weighs 0.455 g. The molecular weight of gas is
a) 46 b) 38 c) 28 d) 24

15. Among CaH_2, NH_3, NaH and B_2H_6, which are covalent hydride?
a) NH_3 and B_2H_6 b) NaH and CaH_2 c) NaH and NH_3 d) CaH_2 and B_2H_6

16. The highest first ionisation potential is of
a) Carbon b) Boron c) Oxygen d) Nitrogen

17. When pressure is applied to the equilibrium system ice r water. Which of the following phenomenon will happen?
a) More ice will be formed b) Water will evaporate
c) More water will be formed d) Equilibrium will not be formed

18. Stannous chloride gives a white precipitate with a solution of mercuric chloride. In this process mercuric chloride is :
a) Oxidized
b) Reduced
c) Converted into a complex compound containing Sn and Hg
d) Converted into a chloro complex of Hg

19. Methylene chloride on hydrolysis yields:
a) HCHO b) CH_3CHO c) CH_3COCl d) None of these

20. Phosphorus is present in bones as:
a) $Ca_3(PO_4)_2$ b) $FePO_4$ c) Ca_3P_2 d) Cu_3P_2

Integer Answer Type

21. A certain number of moles of gas is allowed to heat from 300 K to 500 K at constant P. By doing so gas is expanded to do work on boundries equivalent to 9.9768 kJ. How many moles of gas were used?

22. In an atom, the total number of electrons having quantum numbers
$n = 4$, $|m_l| = 1$ and $m_s = -\frac{1}{2}$ is

23. The half-life period of a reaction, becomes 16 times when reactant concentration is halved. The order of reaction is ...

24. EDTA is a multidentate ligand. Its deniticity (multicity) is.....

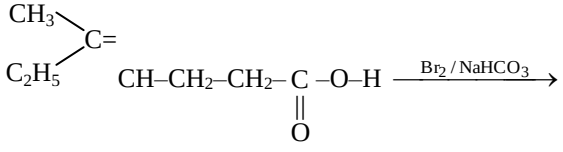
25. $E°$ (in volt) of cell $A + B^{+n} \longrightarrow A^{+n} + B$ if $E^{\circ}_{A^{2+}/A} = -2.5$ V and $E^{\circ}_{B^{n+}/B} = 0.5$ V.

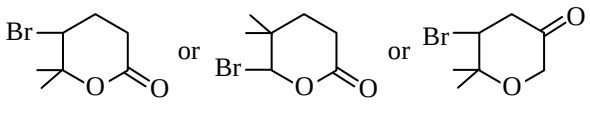
26. A photon of 300 nm is absorbed by a gas and then re-emitted two photons. One re-emitted photon has wavelength 500 nm. Calculate the energy of other photon re-emitted out.

27. What is total mole of NaOH present in 5 L of 0.2 M NaOH solution ?

28. In 100 ml sample of hard water, 100 ml of $\left(\frac{N}{50}\right)$ Na_2CO_3 solution was added and the mixture was boiled and filtered. The filtrate was neutralised with 60 ml of (N/50) HCl. If the density of hard water sample was 1 gm/ml, determine the permanent hardness of given hard water sample in ppm of $CaCO_3$ in nearest possible integers.

29. Which is final product of halolactonisation ?





(1) (2) (3)

30. To Produce 0.56 Kg polyethylene, $(C_2H_4)_n$ how many gm of CaC_2 is required in nearest possible integers?
At.wt. : Ca – 40 ; C – 12 ; H – 1

MATHEMATICS

Single Correct Answer Type

1. A and B are two square matrices of same order and A' denotes the transpose of A, then

a) $(AB) = B'A'$

b) $(AB)' = A'B'$

c) $AB = 0 \Rightarrow |A| = 0$ or $|B| = O$

d) $AB = 0 \Rightarrow A = 0$ or $B = 0$

2. The solution of the differential equation $x\frac{dy}{dx} = 2y + x^3e^x$, where $y = 0$ when $x = 1$, is

a) $y = x^3(e^x - e)$ b) $y = x^3(e - e^x)$ c) $y = x^2(e^x - e)$ d) $y = x^2(e - e^x)$

3. If θ and ϕ are eccentric angle of the ends of a pair of conjugate diameters of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, then θ − ϕ is equal to

a) $\pm\frac{\pi}{2}$ b) $\pm\pi$ c) 0 d) None of these

4. If $\cos^{-1} x + \cos^{-1} y = \frac{\pi}{2}$ and $\tan^{-1} x - \tan^{-1} y = 0$, then $x^2 + xy + y^2$ is equal to

a) 0 b) $\frac{1}{\sqrt{2}}$ c) $\frac{3}{2}$ d) $\frac{1}{8}$

5. $\frac{d}{dx}\sqrt{\frac{1-\sin 2x}{1+\sin 2x}}$ is equal to

a) $\sec^2 x$ b) $-\sec^2\left(\frac{\pi}{4} - x\right)$ c) $\sec^2\left(\frac{\pi}{4} + x\right)$ d) $\sec^2\left(\frac{\pi}{4} - x\right)$

6. If A is the area between the curve $y = \sin x$ and x-axis in the interval $[0, \pi/4]$, then in the same interval, area between the curve $y = \cos x$ and x-axis is

a) A b) $\pi/2 - A$ c) $1 - A$ d) $A - 1$

7. The point in the xy-plane which is equidistant from the points (2,0,3), (0,3,2) and (0,0,1) is

a) (1,2,3) b) (−3,2,0) c) (3, −2,0) d) (3,2,0)

8. If $\sqrt{9x^2 + 6x + 1} < (2 - x)$, then

a) $x \in \left(-\frac{3}{2}, \frac{1}{4}\right)$ b) $x \in \left(-\frac{3}{2}, \frac{1}{4}\right)$ c) $x \in \left[-\frac{3}{2}, \frac{1}{4}\right]$ d) $x < \frac{1}{4}$

9. The value of the integral $\int_1^e (\log x)^3 dx$ is

a) $6 + 2e$ b) $6 - 2e$ c) $2e - 6$ d) None of these

10. A person puts three cards addresses to three different people in three envelopes with three different addresses without looking. What is the probability that the cards go into their respective envelopes?

a) $\frac{2}{3}$ b) $\frac{1}{6}$ c) $\frac{1}{5}$ d) $\frac{2}{5}$

11. The value of $C_0^2 + 3 \cdot C_1^2 + 5 \cdot C_2^2 + \cdots$ to $(n + 1)$ terms, is

a) $^{2n-1}C_{n-1}$

b) $(2n + 1)^{2n-1}C_n$

c) $2(n + 1) \cdot {}^{2n-1}C_{n-1}$

d) $^{2n-1}C_n + (2n + 1)^{2n-1}C_{n-1}$

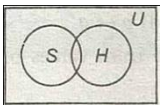
12. The constraints $-x_1 + x_2 \leq 1, -x_1 + 3x_2 \leq 9; x_1, x_2 \geq 0$ defines on

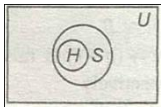
a) Bounded feasible space b) Unbounded feasible space

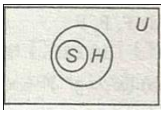
c) Both bounded and unbounded feasible space d) None of the above

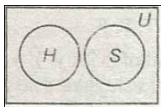
13. H: Set of holidays

S: Set of Sundays
U:Set of day's
Then, the Venn diagram of statement, "Every Sunday implies holiday" is

a) 

b) 

c) 

d) 

14. If $(-4, 5)$ is one vertex and $7x - y + 8 = 0$ is one diagonal of a square, then the equation of the second diagonal is
a) $x + 3y = 21$ b) $2x - 3y = 7$ c) $x + 7y = 31$ d) $2x + 3y = 21$

15. The straight lines I_1, I_2, I_3 are parallel and lie in the same plane. A total numbers of m points are taken on I_1, n points on I_2, k points on I_3. The maximum number of triangles formed with vertices at these points is
a) ${}^{m+n+k}C_3$ b) ${}^{m+n+k}C_3 - {}^{m}C_3 - {}^{n}C_3 - {}^{k}C_3$
c) ${}^{m}C_3 + {}^{n}C_3 + {}^{k}C_3$ d) None of the above

16. The angle of depression of a point situated at a distance of 70 metres from the base of a tower is 45°. The height of the tower is
a) 70 m b) $70\sqrt{2}$m c) $\frac{70}{\sqrt{2}}$m d) 35 m

17. The value of $\cos^2 A\,(3 - 4\cos^2 A)^2 + \sin^2 A\,(3 - 4\sin^2 A)^2$ is equal to
a) $\cos 4A$ b) $\sin 4A$ c) 1 d) None of these

18. The value of c, in the Lagrange's Mean value theorem $\frac{f(b)-f(a)}{b-a} = f'(c)$, for the function $f(x) = x(x-1)(x-2)$ in the interval $[0, 1/2]$, is
a) $\frac{1}{4}$ b) $1 - \frac{\sqrt{21}}{6}$ c) $\frac{9}{8}$ d) $1 + \frac{\sqrt{21}}{6}$

19. The value of derivative of $|x-1| + |x-3|$ at $x = 2$, is
a) -2 b) 0 c) 2 d) Not defined

20. The value of $\frac{[(\cos 20° + i\sin 20°)(\cos 75° + i\sin 75°)(\cos 10° + i\sin 10°)]}{\sin 15° - i\cos 15°}$ is
a) 0 b) -1 c) i d) 1

Integer Answer Type

21. The integer n, for which $\lim_{x\to 0} \frac{(\cos x - 1)(\cos x - e^{x^2})}{x^n}$ is a finite non-zero number, is

22. If $\begin{vmatrix} (\beta+\gamma-\alpha-\delta)^4 & (\beta+\gamma-\alpha-\delta)^2 & 1 \\ (\gamma+\alpha-\beta-\delta)^4 & (\gamma+\alpha-\beta-\delta)^2 & 1 \\ (\alpha+\beta-\gamma-\delta)^4 & (\alpha+\beta-\gamma-\delta)^2 & 1 \end{vmatrix} = -k(\alpha-\beta)(\alpha-\gamma)(\alpha-\delta)(\beta-\gamma)(\beta-\delta)(\gamma-\delta)$, then the value of $(k)^{1/2}$ is

23. Let $f: R \to R$ be a continuous onto function satisfying $f(x) + f(-x) = 0, \forall\, x \in R$. If $f(-3) = 2$ and $f(5) = 4$ in $[-5,5]$, then the minimum number of roots of the equation $f(x)=0$ is

24. Let ABC be a triangle whose centroid is G. Orthocentre is H and circumcentre is the origin $'O'$.If D is any point in the plane of the triangle such that no three of O, A, C and D are collinear satisfying the relation If $\vec{AD} + \vec{BD} + \vec{CH} + 3\vec{HG} = \lambda\vec{HD}$, then what is the value of the scalar $'\lambda'$?

25. Let $S = \sum_{n=1}^{9999} \frac{1}{(\sqrt{n}+\sqrt{n+1})\left(\sqrt[4]{n}+\sqrt[4]{n+1}\right)}$, then S equals

26. Number of solution for $|\,3x^2 - 2\,| = [-2\pi]$ is ($[\cdot]$ denotes greatest integer)

27. If $\frac{{}^{n}C_0}{2} - \frac{{}^{n}C_1}{3} + \frac{{}^{n}C_2}{4} + \ldots + (-1)^n \frac{{}^{n}C_n}{n+2} = \frac{1}{2001 \times 2000}$, then n is …….

28. Value of $\frac{1}{81^n} - \frac{10}{81^n}\,{}^{2n}C_1 + \frac{10^2}{81^n}\,{}^{2n}C_2 - \frac{10^3}{81^n}\,{}^{2n}C_3 \ldots\ldots\ldots + \frac{10^{2n}}{81^n}$ is .....

29. The equation of perpendicular bisectors of the sides AB and AC of a triangle ABC are $x - y + 5 = 0$and $x + 2y = 0$ respectively. If the point A is $(1, -2)$, then the equation of line BC is $14x + ay - b = 0$.Find $a + b$.

30. Let P = $\log_5(\log_5 3)$. If $3^{C+5^{-P}} = 405$ then C equals