PHYSICS

JEE MAIN 2017

***Date:* 08/04/2017** ***Time:* 3 Hours.** ***Max. Marks:* 360**

Important Instructions :

1. The question paper consists of **'90'** objective type questions. There are ***'30'*** questions each in **Physics**, **Chemistry** and **Mathematics** respectively. **Please fill the OMR answer Sheet accordingly and carefully.**
2. Each question has four choices (1), (2), (3) and (4) out of which **ONLY ONE** is correct.
3. You will be **awarded 4 marks** for each question, if you have darkened only the bubble corresponding to the correct answer and zero mark if no bubble are darkened. In all other cases, **minus one (–1) mark** will be awarded.
4. There is only one correct response for each question. Filling up more than one response in each question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 3 above.
5. Use **Black or Blue Ball Point Pen** only for filling particulars.
6. Use of **Calculator, Log Table, Slide Rule and Mobile** is not allowed.
7. Rough work is to be done on the space provided at the bottom and in end of the booklet for this purpose in the Test Booklet only.
8. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator. However, the candidates are allowed to take away this Test Booklet with them.
9. Do not fold or make any stray marks on the Answer Sheet.

महत्वपूर्ण निर्देश :

1. इस प्रश्न पत्र में 90 विकल्पात्मक प्रकार के प्रश्न है **भौतिक, रसायन** तथा **गणित** प्रत्येक में क्रमशः 30 प्रश्न है। **कृपया OMR उत्तर पुस्तिका को सही प्रकार तथा सावधानीपूर्वक भरें।**
2. प्रत्येक प्रश्न के चार विकल्प (1), (2), (3) तथा (4) है जिनमें से **केवल एक** सही है।
3. यदि आपने सही उत्तर से सम्बन्धित गोले को काला किया है, तो आपको **4 अंक प्रदान** किये जायेंगे तथा यदि कोई भी गोला काला नहीं किया गया है तो शून्य अंक दिये जायेंगे। अन्य सभी स्थितियों में **–1 अंक** दिये जायेंगे।
4. प्रत्येक प्रश्न के लिए केवल एक सही उत्तर है। एक से अधिक विकल्प एक प्रश्न में भरनें पर इन्हें गलत विकल्प माना जायेंगा तथा निर्देश 3 के अनुसार गलत विकल्प मानते हुए अंक काट लिये जायेंगे।
5. गोले को भरने के लिये केवल **काला या नीला बॉल प्वाइंट पेन** का प्रयोग करें।
6. संगणक, लघुगणक सारणी, नामांकित पैमाना तथा मोबाईल का प्रयोग वर्जित है।
7. रफ कार्य करने के लिए केवल पृष्ठ के नीचे दिये गये स्थान तथा पुस्तिका के अन्त में छोड़े गये स्थान का ही प्रयोग करें।
8. परीक्षा की समाप्ति पर, विद्यार्थी अपनी उत्तर पुस्तिका वीक्षक को सोपें। यद्यपि प्रश्न पुस्तिका विद्यार्थी अपने साथ ले जा सकते है।
9. उत्तर पुस्तिका को मोड़े नहीं या उस पर किसी तरह का चिन्ह अंकित ना करें।

नोटः– यदि प्रश्न पत्र के हिन्दी अनुवाद में विद्यार्थी किसी भी प्रकार की त्रुटि पाता है तो वह अंग्रेजी माध्यम के प्रश्न को ही सही मानकर हल करें।

Name of the Candidate (in Capitals) : _____

परीक्षार्थी का नाम (बड़े अक्षरों में) :

Roll Number : in figures _____

अनुक्रमांक : अंकों में

: in words _____

: शब्दों में

Centre of Examination (in Capitals) : _____

परीक्षा केन्द्र (बड़े अक्षरों में) :

Candidate's Signature : _____

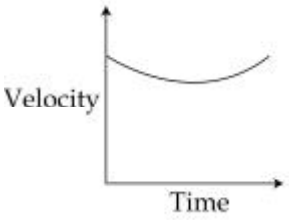
परीक्षार्थी के हस्ताक्षर :

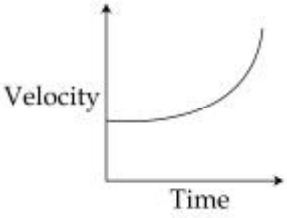
Fascimile signature stamp of Centre Superintendent : _____

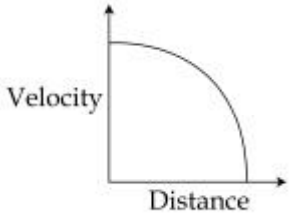
PART A - PHYSICS

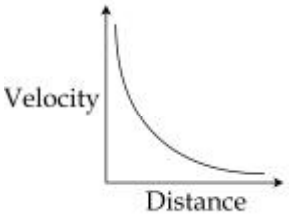
1. Time (T), velocity (C) and angular momentum (h) are chosen as fundamental quantities instead of mass, length and time. In terms of these, the dimensions of mass would be :
(1) $[M] = [T^{-1}C^{-2}h]$ (2) $[M] = [T^{-1}C^{2}h]$ (3) $[M] = [T^{-1}C^{-2}h^{-1}]$ (4) $[M] = [TC^{-2}h]$

2. Which graph corresponds to an object moving with a constant negative acceleration and a positive velocity ?

(1) 

(2) 

(3) 

(4) 

3. A 1 kg block attached to a spring vibrates with a frequency of 1 Hz on a frictionless horizontal table. Two springs identical to the original spring are attached in parallel to an 8 kg block placed on the same table. So, the frequency of vibration of the 8 kg block is :
(1) $\frac{1}{4}Hz$ (2) $\frac{1}{2\sqrt{2}}Hz$ (3) $\frac{1}{2}Hz$ (4) 2 Hz

4. An object is dropped from a height h from the ground. Every time it hits the ground it looses 50% of its kinetic energy. The total distance covered as $t \to \infty$ is :
(1) 2h (2) ∞ (3) $\frac{5}{3}$ h (4) $\frac{8}{3}$ h

5. A uniform disc of radius R and mass M is free to rotate only about its axis. A string is wrapped over its rim and a body of mass m is tied to the free end of the string as shown in the figure. The body is released from rest. Then the acceleration of the body is :
(1) $\frac{2mg}{2m+M}$ (2) $\frac{2Mg}{2m+M}$ (3) $\frac{2mg}{2M+m}$ (4) $\frac{2Mg}{2M+m}$

6. Moment of inertia of an equilateral triangular lamina ABC, about the axis passing through its centre O and perpendicular to its plane is I_0 as shown in the figure. A cavity DEF is cut out from the lamina, where D, E, F are the mid points of the sides. Moment of inertia of the remaining part of lamina about the same axis is :
(1) $\frac{7}{8}I_0$ (2) $\frac{15}{16}I_0$ (3) $\frac{3}{4}I_0$ (4) $\frac{31}{32}I_0$

7. If the Earth has no rotational motion, the weight of a person on the equator is W. Determine the speed with which the earth would have to rotate about its axis so that the person at the equator will weigh $\frac{3}{4}$W. Radius of the Earth is 6400 km and g = 10m/s^2.
(1) 1.1×10^{-3} rad/s (2) 0.83×10^{-3} rad/s (3) 0.63×10^{-3} rad/s (4) 0.28×10^{-3} rad/s

8. In an experiment a sphere of aluminium of mass 0.20 kg is heated upto 150°C. Immediately, it is put into water of volume 150 cc at 27°C kept in a calorimeter of water equivalent to 0.025 kg. Final temperature of the system is 40°C. The specific heat of aluminium is : (take 4.2 Joule = 1 calorie)
(1) 378 J/kg-°C (2) 315 J/kg-°C (3) 476J/kg-°C (4) 434J/kg-°C

9. A compressive force, F is applied at the two ends of a long thin steel rod. It is heated, simultaneously, such that its temperature increases by ΔT. The net change in its length is zero. Let *l* be the length of the rod, A its area of cross-section, Y its Young's modulus, and α its coefficient of linear expansion. Then, F is equal to :
(1) l^2YαΔT (2) *l*A Yα ΔT (3) A Yα ΔT (4) $\frac{AY}{\alpha\Delta T}$

10. An engine operates by taking n moles of an ideal gas through the cycle ABCDA shown in figure. The thermal efficiency of the engine is : (Take C_v = 1.5 R, where R is gas constant)
(1) 0.24
(2) 0.15
(3) 0.32
(4) 0.08

11. An ideal gas has molecules with 5 degrees of freedom. The ratio of specific heats at constant pressure (C) and at constant volume (C_v) is :

12. The ratio of maximum acceleration to maximum velocity in a simple harmonic motion is 10 s"[1]. At, t = 0 the displacement is 5 m. What is the maximum acceleration ? The initial phase

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(1) 500 m/s^2
(2) 500 V2 m/s^2
(3) 750 m/s^2
(4) 750 V2 m/s^2

13. Two wires W^ and W_2 have the same radius r and respective densities p and p such that $p_2 = 4p_r$ They are joined together at the point O, as shown in the figure. The combination is used as a sonometer wire and kept under tension T. The point O is midway between the two bridges. When a stationary wave is set up in the composite wire, the joint is found to be a node. The ratio of the number of antinodes formed in W^ to W_2 is :
(1) 1:1
(2) 1:2

(3) 1:3
(4) 4:1

14. There is a uniform electrostatic field in a region. The potential at various points on a small sphere centred at P, in the region, is found to vary between the limits 589.0 V to 589.8 V. What is the potential at a point on the sphere whose radius vector makes an angle of 60° with the direction of the field ?
(1) 589.5 V
(2) 589.2 V
(3) 589.4 V
(4) 589.6 V

15. The energy stored in the electric field produced by a metal sphere is 4.5 J. If the sphere contains 4 |JLC charge, its radius will be: [Take: -^— = 9 x 10^9 N - m^2/C^2]
L 4 TT6_0 J
(1) 20 mm
(2) 32 mm
(3) 28 mm
(4) 16 mm

16. What is the conductivity of a semiconductor sample having electron concentration of 5xlO^{18} m~^{3}, hole concentration of 5xlO^{19} m~^{3}, electron mobility of 2.0 m^2 V"^{1} s"^{1} and hole mobility of 0.01 m^2 V"^{1} s"^{1} ?
(Take charge of electron as 1.6xlO~^{19} C)
(1) 1.68 (fl-m)"^{1}
(2) 1.83 (fl-m)"^{1}
(3) 0.59 (fl-m)"^{1}
(4) 1.20 (fl-m)"^{1}

A 9 V battery with internal resistance of 0.5 *ft* is connected across an infinite network as shown in the figure. All ammeters *Ay* A_2, A_3 and voltmeter V are ideal.
Choose correct statement.
(1) Reading of A_1 is 2 A
(2) Reading of A_1 is 18 A
(3) Reading of V is 9 V
(4) Reading of V is 7 V

18. In a certain region static electric and magnetic fields exist. The magnetic field is given by B = B_o (? + $_2$y-4fc)- Ifatest charge moving with a velocity *v=vQ* 3^—/ + 2fc experiences no force in that region, then the electric field in the region, in SI units, is :
(1) E = -т;oBo($_3$?$_{-2}$;$_{-4}$£)
(2) 5 = -^oB$_0$(?$_+$; $_+$ $_7$£)
(3) E = tfoBo($_{14}$)$_+$7£)
(4) E = -$_{Bb}$B$_0$($_{14}$)$_{+7}$£)

19. A magnetic dipole in a constant magnetic field has :
(1) maximum potential energy when the torque is maximum.
(2) zero potential energy when the torque is minimum.
(3) zero potential energy when the torque is maximum.
(4) minimum potential energy when the torque is maximum.

20. A small circular loop of wire of radius a is located at the centre of a much larger circular wire loop of radius b. The two loops are in the same plane. The outer loop of radius b carries an alternating current I = I_0 cos

(cot). The emf induced in the smaller inner loop is nearly :

21. Magnetic field in a plane electromagnetic wave is given by

$B = B_0 \sin(kx+cot)$; T

Expression for corresponding electric field will be :

Where c is speed of light.

(1) $E = B_0$ c sin *(kx*+ cot) k V/m

(2) $E = \frac{}{c} \sin(kx+cot)$ k V/m

(3) $E = - B_0$ c sin *(kx*+ cot) k V/m

(4) $E = B_0$ c sin (k *x*- cot) k V/m

22. Let the refractive index of a denser medium with respect to a rarer medium be n_{12} and its critical angle be 9_C. At an angle of incidence A when light is travelling from denser medium to rarer medium, a part of the light is reflected and the rest is refracted and the angle between reflected and refracted rays is 90°. Angle A is given by :

1 W cos"¹ (sin9_c)

1

(²) tan"¹ (sin9_c)

(3) cos"¹ (sin 9_C)

(4) tan"¹ (sin 8_C)

23. A single slit of width b is illuminated by a coherent monochromatic light of wavelength \. If the second and fourth minima in the diffraction pattern at a distance 1 m from the slit are at 3 cm and 6 cm respectively from the central maximum, what is the width of the central maximum ? (i.e. distance between first minimum on either side of the central maximum)

(1) 1.5 cm

(2) 3.0 cm

(3) 4.5 cm

(4) 6.0 cm

24. The maximum velocity of the photoelectrons emitted from the surface is v when light of frequency n falls on a metal surface. If the incident frequency is increased to 3n, the maximum velocity of the ejected photoelectrons will be :

(1) less than ^/3 v

(2) v

(3) more than ^/3 v

(4) equal to ^3 v

25. According to Bohr's theory, the time averaged magnetic field at the centre (i.e. nucleus) of a hydrogen atom due to the motion of electrons in the n^{th} orbit is proportional to : (n = principal quantum number)

(1) n-4

(2) n-5

(3) n-3

(4) n-2

26. Two deuterons undergo nuclear fusion to form a Helium nucleus. Energy released in this process is : (given binding energy per nucleon for deuteron = l.l MeV and for helium = 7.0 MeV)

(1) 30.2 MeV

(2) 32.4 MeV

(3) 23.6 MeV

(4) 25.8 MeV

27. The V-I characteristic of a diode is shown in the figure. The ratio of forward to reverse bias resistance is :

(1) 10

(2) 10 "⁶

(3) 10⁶

(4) 100

28. A signal of frequency 20 kHz and peak voltage of 5 Volt is used to modulate a carrier wave of frequency 1.2

JEE MAIN 2017
CHEMISTRY
08-04-2017

Q.1 Among the following, **correct** statement is :
(1) Brownian movement is more pronounced for smaller particles than for bigger–particles.
(2) Sols of metal sulphides are lyophilic.
(3) Hardy Schulze law states that bigger the size of the ions, the greater is its coagulating power.
(4) One would expect charcoal to adsorb chlorine more than hydrogen sulphide.

Q.2 Excess of NaOH (aq) was added to 100 mL of $FeCl_3$ (aq) resulting into 2.14 g of $Fe(OH)_3$. The molarity of $FeCl_3$ (aq) is :
[Given molar mass of Fe=56 g mol^{-1} and molar mass of Cl=35.5 g mol^{-1}]
(1) 0.2 M (2) 0.3 M (3) 0.6 M (4) 1.8 M

Q.3 Among the following, the **incorrect** statement is :
(1) At low pressure, real gases show ideal behaviour.
(2) At very low temperature, real gases show ideal behaviour.
(3) At very large volume, real gases show ideal behaviour.
(4) At Boyle's temperature, real gases show ideal behaviour.

Q.4 For a reaction, $A(g) \rightarrow A(l)$; $\Delta H = -3RT$.
The **correct** statement for the reaction is :
(1) $\Delta H = \Delta U \neq 0$ (2) $\Delta H = \Delta U = 0$ (3) $|\Delta H| < |\Delta U|$ (4) $|\Delta H| > |\Delta U$

Q.5 What is the standard reduction potential (E°) for $Fe^{3+} \rightarrow Fe$?
Given that :

$Fe^{2+} + 2e^- \rightarrow Fe$; $E^o_{Fe^{2+}/Fe} = -0.47\ V$

$Fe^{3+} + e^- \rightarrow Fe^{2+}$; $E^o_{Fe^{3+}/Fe^{2+}} = +0.77\ V$

(1) – 0.057 V (2) +0.057 V (3) +0.30 V (4) .0.30 V

Q.6 If the shortest wavelength in Lyman series of hydrogen atom is A, then the longest wavelength in Paschen series of He^+ is :

(1) $\frac{5A}{9}$ (2) $\frac{9A}{5}$ (3) $\frac{36A}{5}$ (4) $\frac{36A}{7}$

Q.7 5 g of Na_2SO_4 was dissolved in x g of H_2O. The change in freezing point was found to be 3.82°C. If Na_2SO_4 is 81.5% ionised, the value of x
(K_f for water =1.86°C kg mol^{-1}) is approximately :
(molar mass of S=32 g mol^{-1} and that of Na=23 g mol^{-1})
(1) 15 g (2) 25 g (3) 45 g (4) 65 g

Q.8 Addition of sodium hydroxide solution to a weak acid (HA) results in a buffer of pH 6. If ionisation constant of HA is 10^{-5}, the ratio of salt to acid concentration in the buffer solution will be :
(1) 4 : 5 (2) 1 : 10 (3) 10 : 1 (4) 5 : 4

Q.9 The rate of a reaction A doubles on increasing the temperature from 300 to 310 K. By how much, the temperature of reaction B should be increased from 300 K so that rate doubles if activation energy of the reaction B is twice to that of reaction A.
(1) 9.84 K (2) 4.92 K (3) 2.45 K (4) 19.67 K

Q.10 The enthalpy change on freezing of 1 mol of water at 5°C to ice at –5°C is :
(Given ΔH_{fus}=6 kJ mol^{-1} at 0°C, $C_p(H_2O, l)$=75.3 J mol^{-1} K^{-1}, $C_p(H_2O, s)$=36.8 J mol^{-} K^{-1})
(1) 5.44 kJ mol^{-1} (2) 5.81 kJ mol^{-1} (3) 6.56 kJ mol^{-1} (4) 6.00 kJ mol^{-1}

Q.11 Which of the following is paramagnetic ?
(1) NO^+ (2) CO (3) O_2^{2-} (4) B_2

Q.12 The pair of compounds having metals in their highest oxidation state is :
(1) MnO_2 and CrO_2Cl_2 (2) $[NiCl_4]^{2-}$ and $[CoCl_4]^{2-}$
(3) $[Fe(CN)_6]^{3-}$ and $[Cu(CN)_4]^{2-}$ (4) $[FeCl_4]^{-}$ and Co_2O_3

Q.13 sp^3d^2 hybridization is not displayed by :
(1) BrF_5 (2) SF_6 (3) $[CrF_6]^{3-}$ (4) PF_5

Q.14 Identify the pollutant gases largely responsible for the discoloured and lustreless nature of marble of the Taj Mahal.
(1) O_3 and CO_2 (2) CO_2 and NO_2 (3) SO_2 and NO_2 (4) SO_2 and O_3

Q.15 In which of the following reactions, hydrogen peroxide acts as an oxidizing agent ?
(1) $HOCl + H_2O_2 \longrightarrow H_3O^+ + Cl^- + O_2$
(2) $I_2 + H_2O_2 + 2OH^- \longrightarrow 2I^- + 2H_2O + O_2$
(3) $2MnO_4^- + 3H_2O_2 \longrightarrow 2MnO_2 + 3O_2 + 2H_2O + 2OH^-$
(4) $PbS + 4H_2O_2 \longrightarrow PbSO_4 + 4H_2O$

Q.16 Consider the following ionization enthalpies of two elements 'A' and 'B'.

Which of the following statements is correct ?
(1) Both 'A' and 'B' belong to group-1 where 'B' comes below 'A'.
(2) Both 'A' and 'B' belong to group-1 where 'A' comes below 'B'.
(3) Both 'A' and 'B' belong to group-2 where 'B' comes below 'A'.
(4) Both 'A' and 'B' belong to group-2 where 'A' comes below 'B'.

Q.17 Consider the following standard electrode potentials (E° in volts) in aqueous solution :

Element	M^{3+}/M	M^{+}/M
Al	−1.66	+0.55
Tl	+1.26	−0.34

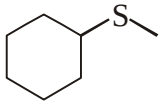
Based on these data, which of the following statements is correct ?
(1) Tl^{+} is more stable than Al^{3+} (2) Al^{+} is more stable than Al^{3+}
(3) Tl^{+} is more stable than Al^{+} (4) Tl^{3+} is more stable than Al^{3+}

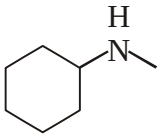
Q.18 A metal 'M' reacts with nitrogen gas to afford 'M_3N'. 'M_3N' on heating at high temperature gives back 'M' and on reaction with water produces a gas 'B'. Gas 'B' reacts with aqueous solution of $CuSO_4$ to form a deep blue compound. 'M' and 'B' respectively are :
(1) Li and NH_3 (2) Ba and N_2 (3) Na and NH_3 (4) Al and N_2

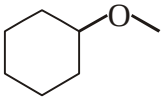
Q.19 The number of S = O and S – OH bonds present in peroxodisulphuric acid and pyrosulphuric acid respectively are :
(1) (2 and 2) and (2 and 2) (2) (2 and 4) and (2 and 4)
(3) (4 and 2) and (2 and 4) (4) (4 and 2) and (4 and 2)

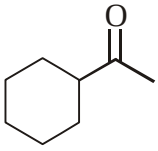
Q.20 A solution containing a group-IV cation gives a precipitate on passing H_2S. A solution of this precipitate in dil.HCl produces a white precipitate with NaOH solution and bluish-white precipitate with basic potassium ferrocyanide. The cation is :
(1) Co^{2+} (2) Ni^{2+} (3) Mn^{2+} (4) Zn^{2+}

Q.21 A mixture containing the following four compounds is extracted with 1M HCl. The compound that goes to aqueous layer is :

(I) 

(II) 

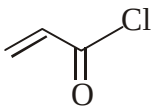
(III) 

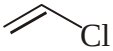
(IV) 

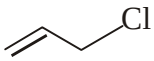
(1) (I) (2) (II) (3) (III) (4) (IV)

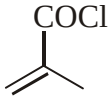
Q.22 The reason for "drug induced poisoning" is :
(1) Binding reversibly at the active site of the enzyme
(2) Bringing conformational change in the binding site of enzyme
(3) Binding irreversibly to the active site of the enzyme
(4) Binding at the allosteric sites of the enzyme

Q.23 Which of the following compounds will not undergo Friedel Craft's reaction with benzene ?

(1) 

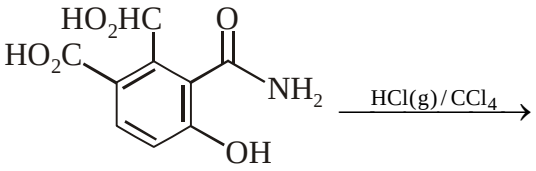
(2) 

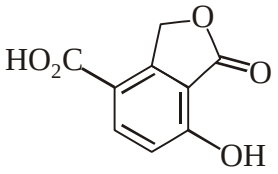
(3) 

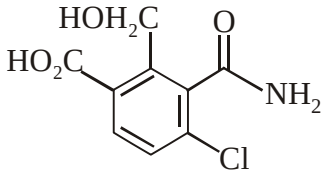
(4) 

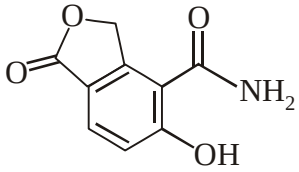
Q.24 Among the following, the essential amino acid is :
(1) Alanine (2) Valine (3) Aspartic acid (4) Serine

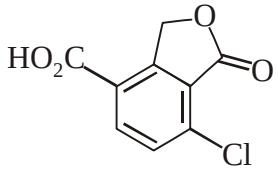
Q.25 The major product expected from the following reaction is :



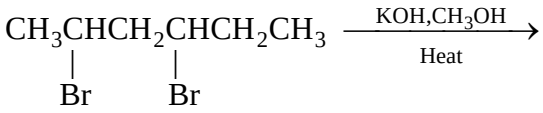
(1) 

(2) 

(3) 

(4) 

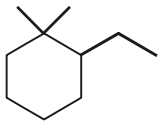
Q.26 The major product of the following reaction is :



(1) $CH_2 = CHCH_2CH = CHCH_3$
(2) $CH_2 = CHCH = CHCH_2CH_3$
(3) $CH_3CH = C = CHCH_2CH_3$
(4) $CH_3CH = CH - CH = CHCH_3$

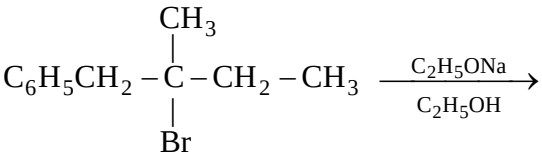
Q.27 Which of the following statements is not true about partition chromatography?
(1) Mobile phase can be a gas
(2) Stationary phase is a finely divided solid adsorbent
(3) Separation depends upon equilibration of solute between a mobile and a stationary phase
(4) Paper chromatography is an example of partition chromatography

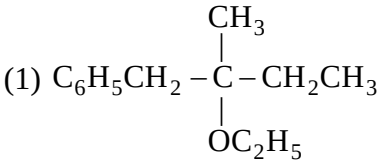
Q.28 The IUPAC name of the following compound is :

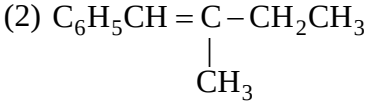


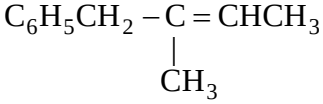
(1) 1, 1-Dimethyl-2-ethylcyclohexane
(2) 2-Ethyl-1, 1-dimethylcyclohexane
(3) 1-Ethyl-2, 2-dimethylcyclohexane
(4) 2, 2-Dimethyl-1-ethylcyclohexane

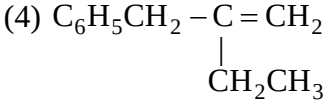
Q.29 The major product of the following reaction is :



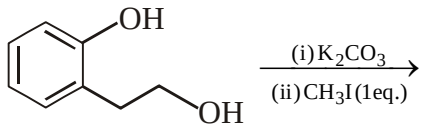
(1) 

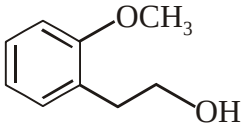
(2) 

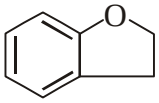
(3) 

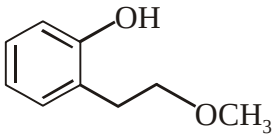
(4) 

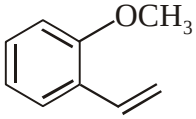
Q.30 The major product of the following reaction is :



(1) 

(2) 

(3) 

(4) 

JEE MAIN 2017
MATHEMATICS
08-04-2017

Q.1 Let $f(x) = 2^{10} \cdot x + 1$ and $g(x) = 3^{10} \cdot x - 1$. If $(fog)(x) = x$, then x is equal to

(1) $\frac{3^{10}-1}{3^{10}-2^{-10}}$ (2) $\frac{2^{10}-1}{2^{10}-3^{-10}}$ (3) $\frac{1-3^{-10}}{2^{10}-3^{-10}}$ (4*) $\frac{1-2^{-10}}{3^{10}-2^{-10}}$

Q.2 Let p(x) be a quadratic polynomial such that p(0) = 1. If p(x) leaves remainder 4 when divided by x – 1 and it leaves remainder 6 when divided by x + 1; then

(1) p(2) = 11 (2) p(2) = 19 (3*) p(– 2) = 19 (4) p(– 2) = 11

Q.3 Let $z \in C$, the set of complex numbers. Then the equation, $2|z + 3i| - |z - i| = 0$ represents :

(1*) a circle with radius $\frac{8}{3}$ (2) a circle with diameter $\frac{10}{3}$

(3) an ellipse with length of major axis $\frac{16}{3}$ (4) an ellipse with length of minor axis $\frac{16}{9}$

Q.4 The number of real values of λ for which the system of linear equations

$2x + 4y - \lambda z = 0$
$4x + \lambda y + 2z = 0$
$\lambda x + 2y + 2z = 0$

has infinitely many solutions, is

(1) 0 (2*) 1 (3) 2 (4) 3

Q.5 Let A be any 3× 3 invertible matrix. Then which one of the following is not always true?

(1) adj (A) = $|A| \cdot A^{-1}$ (2) adj (adj(A)) = $|A| \cdot A$
(3) adj (adj(A)) = $|A|^2 \cdot (adj(A))^{-1}$ (4*) adj (adj(A)) = $|A| \cdot (adj(A))^{-1}$

Q.6 If all the words, with or without meaning, are written using the letters of the word QUEEN and are arranged as in English dictionary, then the position of the word QUEEN is

(1) 44^{th} (2) 45^{th} (3*) 46^{th} (4) 47^{th}

Q.7 If $(27)^{999}$ is divided by 7, then the remainder is :

(1) 1 (2) 2 (3) 3 (4*) 6

Q.8 If the arithmetic mean of two numbers a and b, $a > b > 0$, is five times their geometric mean, then $\frac{a+b}{a-b}$ is equal to

(1) $\frac{\sqrt{6}}{2}$ (2) $\frac{3\sqrt{2}}{4}$ (3) $\frac{7\sqrt{3}}{12}$ (4*) $\frac{5\sqrt{6}}{12}$

Q.9 If the sum of the first n terms of the series $\sqrt{3} + \sqrt{75} + \sqrt{243} + \sqrt{507} + \ldots\ldots$ is $435\sqrt{3}$ then n equals

(1) 18 (2*) 15 (3) 13 (4) 29

Q.10 $\lim\limits_{x\to 3} \dfrac{\sqrt{3x} - 3}{\sqrt{2x-4} - \sqrt{2}}$ is equal to

(1) $\sqrt{3}$ (2*) $\dfrac{1}{\sqrt{2}}$ (3) $\dfrac{\sqrt{3}}{2}$ (4) $\dfrac{1}{2\sqrt{2}}$

Q.11 The tangent at the point $(2, -2)$ to the curve, $x^2y^2 - 2x = 4(1 - y)$ does not pass through the point

(1) $\left(4, \dfrac{1}{3}\right)$ (2) (8, 5) (3) (–4, – 9) (4*) (–2, – 7)

Q.12 If $y = \left[x + \sqrt{x^2 - 1}\right]^{15} + \left[x - \sqrt{x^2 - 1}\right]^{15}$, then $(x^2 - 1)\dfrac{d^2y}{dx^2} + x\dfrac{dy}{dx}$ is equal to

(1) 125y (2) 224 y^2 (3) 225 y^2 (4*) 225 y

Q.13 If a point P has co-ordinates $(0, -2)$ and Q is any point on the circle, $x^2 + y^2 - 5x - y + 5 = 0$, then the maximum value of $(PQ)^2$ is

(1) $\dfrac{25 + \sqrt{6}}{2}$ (2*) $14 + 5\sqrt{3}$ (3) $\dfrac{47 + 10\sqrt{6}}{2}$ (4) $8 + 5\sqrt{3}$

Q.14 The integral $\int \sqrt{1 + 2\cot x(\operatorname{cosec} x + \cot x)}\, dx$ $\left(0 < x < \dfrac{\pi}{2}\right)$ is equal to

(where C is a constant of integration)

(1) $4\log\left(\sin\dfrac{x}{2}\right) + C$ (2*) $2\log\left(\sin\dfrac{x}{2}\right) + C$

(3) $2\log\left(\cos\dfrac{x}{2}\right) + C$ (4) $4\log\left(\cos\dfrac{x}{2}\right) + C$

Q.15 The integral $\displaystyle\int_{\frac{\pi}{12}}^{\frac{\pi}{4}} \frac{8\cos 2x}{(\tan x + \cot x)^3}\, dx$ equals

(1*) $\dfrac{15}{128}$ (2) $\dfrac{15}{64}$ (3) $\dfrac{13}{32}$ (4) $\dfrac{13}{256}$

Q.16 The area (in sq. units) of the smaller portion enclosed between the curves, $x^2 + y^2 = 4$ and $y^2 = 3x$, is

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

Q.17 The curve satisfying the differential equation, $y\,dx - (x + 3y^2)dy = 0$ and passing through the point (1, 1), also passes through the point

(1) $\left(\frac{1}{4}, \frac{-1}{2}\right)$ (2*) $\left(\frac{-1}{3}, \frac{1}{3}\right)$ (3) $\left(\frac{1}{3}, \frac{-1}{3}\right)$ (4) $\left(\frac{1}{4}, \frac{1}{2}\right)$

Q.18 The locus of the point of intersection of the straight lines, $tx - 2y - 3t = 0$, $x - 2ty + 3 = 0$ $(t \in R)$, is

(1) an ellipse with eccentricity $\frac{2}{\sqrt{5}}$ (2) an ellipse with the length of major axis 6

(3) a hyperbola with eccentricity $\sqrt{5}$ (4*) a hyperbola with the length of conjugate axis 3

Q.19 If two parallel chords of a circle, having diameter 4 units, lie on the opposite sides of the centre and subtend angles $\cos^{-1}\left(\frac{1}{7}\right)$ and $\sec^{-1}(7)$ at the centre respectively, then the distance between these chords, is

(1) $\frac{4}{\sqrt{7}}$ (2*) $\frac{8}{\sqrt{7}}$ (3) $\frac{8}{7}$ (4) $\frac{16}{7}$

Q.20 If the common tangents to the parabola, $x^2 = 4y$ and the circle, $x^2 + y^2 = 4$ intersect at the point P, then the distance of P from the origin, is

(1) $\sqrt{2} + 1$ (2) $2\left(3 + 2\sqrt{2}\right)$ (3*) $2\left(\sqrt{2} + 1\right)$ (4) $3 + 2\sqrt{2}$

Q.21 Consider an ellipse, whose centre is at the origin and its major axis is along the x-axis. If its eccentricity is $\frac{3}{5}$ and the distance between its foci is 6, then the area (in sq. units) of the quadrilateral inscribed in the ellipse, with the vertices as the vertices of the ellipse, is

(1) 8 (2) 32 (3) 80 (4*) 40

Q.22 The coordinates of the foot of the perpendicular from the point (1, – 2, 1) on the plane containing the lines, $\frac{x+1}{6} = \frac{y-1}{7} = \frac{z-3}{8}$ and $\frac{x-1}{3} = \frac{y-2}{5} = \frac{z-3}{7}$ is

(1) (2, – 4, 2) (2) (–1, 2, – 1) (3*) (0, 0, 0) (4) (1, 1, 1)

Q.23 The line of intersection of the planes $\vec{r}\cdot\left(3\hat{i}-\hat{j}+\hat{k}\right)=1$ and $\vec{r}\cdot\left(\hat{i}+4\hat{j}-2\hat{k}\right)=2$, is

(1) $\frac{x-\frac{4}{7}}{-2}=\frac{y}{7}=\frac{z-\frac{5}{7}}{13}$ (2) $\frac{x-\frac{4}{7}}{2}=\frac{y}{-7}=\frac{z+\frac{5}{7}}{13}$

(3*) $\frac{x-\frac{6}{13}}{2}=\frac{y-\frac{5}{13}}{-7}=\frac{z}{-13}$ (4) $\frac{x-\frac{6}{13}}{2}=\frac{y-\frac{5}{13}}{7}=\frac{z}{-13}$

Q.24 The area (in sq. units) of the parallelogram whose diagonals are along the vectors $8\hat{i}-6\hat{j}$ and $3\hat{i}+4\hat{j}-12\hat{k}$, is

(1) 26 (2*) 65 (3) 20 (4) 52

Q.25 The mean age of 25 teachers in a school is 40 years. A teacher retires at the age of 60 years and a new teacher is appointed in his place. If now the mean age of the teachers in this school is 39 years, then the age (in years) of the newly appointed teacher is :

(1) 25 (2) 30 (3*) 35 (4) 40

Q.26 Three persons P, Q and R independently try to hit a target. If the probabilities of their hitting the target are $\frac{3}{4}, \frac{1}{2}$ and $\frac{5}{8}$ respectively, then the probability that the target is hit by P or Q but not by R is

(1*) $\frac{21}{64}$ (2) $\frac{9}{64}$ (3) $\frac{15}{64}$ (4) $\frac{39}{64}$

Q.27 An unbiased coin is tossed eight times. The probability of obtaining at least one head and at least one tail is

(1) $\frac{255}{256}$ (2*) $\frac{127}{128}$ (3) $\frac{63}{64}$ (4) $\frac{1}{2}$

Q.28 If $S=\left\{x\in[0,2\pi]:\begin{vmatrix}0 & \cos x & -\sin x\\ \sin x & 0 & \cos x\\ \cos x & \sin x & 0\end{vmatrix}=0\right\}$, then $\sum_{x\in S}\tan\left(\frac{\pi}{3}+x\right)$ is equal to

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

Q.29 The value of $\tan^{-1}\left[\frac{\sqrt{1+x^2}+\sqrt{1-x^2}}{\sqrt{1+x^2}-\sqrt{1-x^2}}\right]$, $|x|<\frac{1}{2}$, $x\neq 0$, is equal to

(1*) $\frac{\pi}{4}+\frac{1}{2}\cos^{-1}x^2$ (2) $\frac{\pi}{4}+\cos^{-1}x^2$ (3) $\frac{\pi}{4}-\frac{1}{2}\cos^{-1}x^2$ (4) $\frac{\pi}{4}-\cos^{-1}x^2$

Q.30 The proposition $(\sim p)\vee(p\wedge\sim q)$ is equivalent to

(1) $p\vee\sim q$ (2*) $p\rightarrow\sim q$ (3) $p\wedge\sim q$ (4) $q\rightarrow p$