FIITJEE - JEE (Main)

PHYSICS, CHEMISTRY & MATHEMATICS
BATCHES : Two Year CRP (1820) B LOT - (CPT2)
PHASE TEST-II
Q.P. CODE : SET-A

Time Allotted: 3 Hours **Maximum Marks: 360**

- Do not open this Test Booklet until you are asked to do so.
- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.

Important Instructions:

1. Immediately fill in the particulars on this page of the Test Booklet with *Blue / Black Ball Point Pen. Use of pencil is strictly prohibited.*
2. The Answer Sheet is kept inside this Test Booklet. When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particulars carefully.
3. The test is of **3 hours** duration.
4. The Test Booklet consists of **90** questions. The maximum marks are **360**.
5. There are ***three*** parts in the question paper A, B, C consisting of **Physics, Chemistry** and **Mathematics** having 30 questions in each part of equal weightage. Each question is allotted **4 (four)** marks for correct response.
6. *Candidates will be awarded marks as stated above in instruction No.5 for correct response of each question. ¼ (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.*
7. There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 6 above.
8. Use ***Blue / Black Ball Point Pen only*** for writing particulars / marking responses on ***Side-1*** and ***Side-2*** of the Answer Sheet. ***Use of pencil is strictly prohibited.***
9. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. except the Admit Card inside the examination hall / room.
10. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room / Hall. ***However, the candidates are allowed to take away this Test Booklet with them.***
11. **Do not fold or make any stray marks on the Answer Sheet.**

Atomic No.: H=1, He=2, Li=3, Be=4, B=5, C=6, N=7, O=8, F=9, Na=11, Mg=12, Al = 13, Si = 14, P = 15, S = 16, Cl = 17, Ar =18, K=19, Ca=20,Cr=24, Mn=25, Fe=26, Co=27, Ni=28, Cu=29, Zn=30, As=33, Br = 35, Ag = 47, Si = 21, Sn = 50, Ti = 22,I = 53, Xe = 54, Ba = 56, Pb = 82, U = 92, V = 50.

Atomic masses: H =1, He=4, Li=7, Be=9, B=11, C=12, N=14, O=16, F=19, Na=23, Mg=24, Al=27, Si=28, P=31, S=32, Cl=35.5, K=39, Ca=40, Cr=52, Mn=55, Fe=56, Co=59, Ni=58.7, Cu=63.5, Zn = 65.4, As = 75, Br = 80, Ag = 108, Sn = 118.7, I = 127, Xe = 131, Ba = 137, Pb = 207, U = 238.

Name of the Candidate (in Capital Letters) :_____

Enrolment Number :_____

Batch :_____ **Date of Examination :** _____

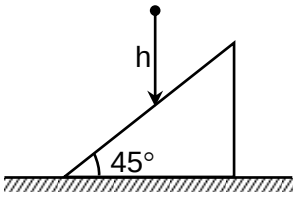
Physics

PART – I

Straight Objective Type

This part contains **30 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

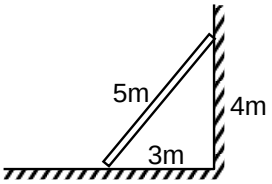
1. A particle of mass m released from some height sticks a wedge of same mass placed on a smooth surface as shown in the figure. The impulse applied by the ground on the wedge is



(A) $m\sqrt{2gh}$ (B) $m\sqrt{gh}$

(C) $m\frac{\sqrt{2gh}}{3}$ (D) $m\sqrt{\frac{3gh}{2}}$

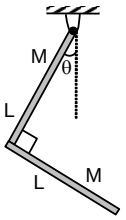
2. A uniform ladder of length 5 m is placed against the smooth wall as shown in the figure. If coefficient of friction for the ground is μ, what is the minimum value of μ for it not to slip?



(A) μ=1/2 (B) μ=1/4

(C) μ=1/3 (D) 3/8

3. L shaped rigid rod is hanged from support as shown in the figure. Length of each limb is L and mass M. Angle θ in equilibrium will be



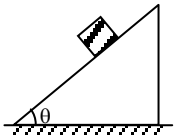
(A) π/4

(B) 0

(C) $\tan^{-1}(1/3)$

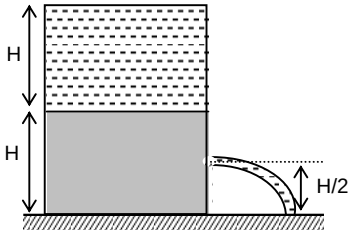
(D) $\tan^{-1}(3/4)$

4. A cube is placed on an inclined plane of inclination θ as shown in the figure. Coefficient of friction between the cube and the plane is μ. As the angle θ is gradually increased, the cube slides before toppling if:



(A) $\mu > 1$ (B) $\mu > 1/2$ (C) $\mu < 1$ (D) μ<½

5. A container of a large uniform cross-section area A resisting on a horizontal surface, holds two immiscible, liquids of densities ρ and 2ρ each of height H. A small hole of area S (S<<A) is punched on the vertical side of the container at a height H/2. Determine initial velocity of efflux of the liquid at the hole.

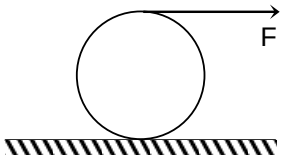


(A) $\sqrt{2Hg}$ (B) $\sqrt{Hg}$

(C) $\sqrt{\frac{3}{2}Hg}$ (D) $\sqrt{\frac{Hg}{2}}$

Space For Rough Work

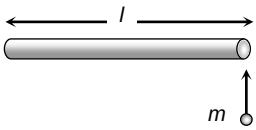
6. A force 'F' is applied at the top of a ring of mass 'M' and radius 'R' placed on a rough horizontal surface as shown in the figure. Friction is sufficient to prevent slipping. The friction force acting on the ring is



(A) $\frac{F}{2}$ towards right (B) $\frac{F}{3}$ towards right

(C) $\frac{2F}{3}$ towards right (D) Zero

7. A stick of length l and mass M lies on a frictionless horizontal surface on which it is free to move in any way. A ball of mass m moving with speed v collides elastically with the stick as shown in the figure. If after the collision ball comes to rest, then what should be the mass of the ball

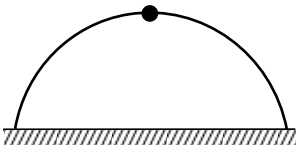


(A) m=2M (B) m=M (C) m=M/2 (D) m=M/4

8. Two particles of masses 1 kg and 2 kg are moving with constant velocities 2 m/s $(\hat{i})$ and 5 m/s $(\hat{i})$ respectively and crosses the y-axis simultaneously at t = 0 sec and are moving on a smooth horizontal xy-plane. The separation between the two particles is 10 meter at t = 0. The angular momentum of 2 kg particle with respect to 1 kg particle at t = 5 sec is

(A) 20 N-m sec (B) 40 N-m-sec (C) 60 N-m-sec (D) 80 N-m-sec

9. A hemisphere of radius R and mass 4 m is free to slide with its base on a smooth horizontal table. A particle of mass m is placed on the top of the hemisphere. The angular velocity of the particle relative to hemisphere at an angular displacement θ when velocity of hemisphere has become v is

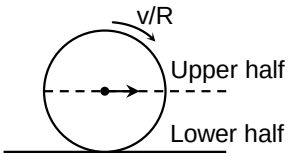


(A) $\frac{5v}{R\cos\theta}$ (B) $\frac{2v}{R\cos\theta}$ (C) $\frac{3v}{R\cos\theta}$ (D) $\frac{2v}{R\sin\theta}$

10. A particle strikes a horizontal rough floor with speed 20 m/s at angle 37° with floor and rebounds with speed 10 m/s at an angle 37° with floor. Find the minimum coefficient of friction between particle and floor.

(A) $\frac{1}{4}$ (B) $\frac{4}{9}$ (C) $\frac{1}{3}$ (D) $\frac{3}{4}$

11. Choose the correct alternative regarding pure rolling of a solid sphere on horizontal surface.



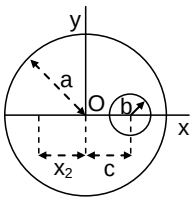
(A) KE of upper half portion of sphere is more than that of lower half as shown.
(B) KE of upper half portion of sphere is less than that of lower half as shown
(C) KE of any two half portions of sphere are equal.
(D) Can't be determined

Space For Rough Work

12. A metallic sphere floats in immiscible mixture of water (density 10^3 kg/m^3) and a liquid (density 8×10^3 kg/m^3) such that its (2/3) part is in water and (1/3) part in the liquid. The density of the metal is

(A) $\frac{5000}{3}$ kg/m^3 (B) $\frac{10000}{3}$ kg/m^3 (C) 5000kg/m^3 (D) 2000 kg/m^3

13. A uniform circular disc of radius a is taken. A circular portion of radius b has been removed from it as shown in the figure. If the centre of hole is at a distance c from the centre of the disc, the distance x_2 of the centre of mass of the remaining part from the initial centre of mass O is given by:



(A) $\frac{\pi b^2}{\left(a^2-c^2\right)}$ (B) $\frac{cb^2}{\left(a^2-b^2\right)}$ (C) $\frac{\pi c^2}{\left(a^2-b^2\right)}$ (D) $\frac{ca^2}{\left(c^2-b^2\right)}$

14. Two blocks of masses 10 kg and 4 kg and are connected by a spring of negligible mass and placed on a frictionless horizontal surface. An impulse gives a horizontal velocity of 14 m/s to the heavier block towards the lighter block. The velocity of the centre of mass of the two block system is :

(A) 30 m/s (B) 20 m/s (C) 10 m/s (D) 5 m/s

15. A man of mass M stands at one end of a plank of length L which lies at rest on a frictionless surface. The man walks to the other end of the plank. If the mass of the plank is $\frac{M}{3}$, the distance that the man moves relative to the ground is

(A) $\frac{3L}{4}$ (B) $\frac{L}{4}$ (C) $\frac{4L}{5}$ (D) $\frac{L}{3}$

16. A uniform rod of mass m, hinged at its upper end, is released from rest from a horizontal position. When it passes through the vertical position, the force on the hinge is:

(A) $\frac{3}{2}$mg (B) 2 mg (C) $\frac{5}{2}$mg (D) 3 mg

17. A cubical block of mass M and edge 'a' slides down a rough inclined plane of inclination θ (with horizontal) with a uniform velocity. The torque of the friction force on the block about its centre of mass has a magnitude:

(A) zero (B) Mga (C) Mg$\frac{a}{2}\sin\theta$ (D) None of these

18. A uniform solid sphere of radius r starts rolling without slipping down from the top of a fixed sphere of radius R. The angular velocity of the sphere at the moment it breaks off the sphere will be:

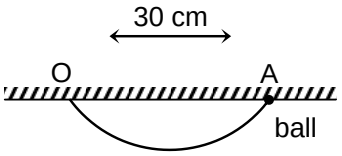
(A) $\sqrt{\frac{3(R+r)g}{4r^2}}$ (B) $\sqrt{\frac{10(R+r)g}{17r^2}}$ (C) $\sqrt{\frac{(R+r)g}{2r^2}}$ (D) $\sqrt{\frac{2(R+r)g}{r^2}}$

Space For Rough Work

19. A vessel having area of cross-section A contains a liquid upto height H. At the bottom of the vessel, there is a small hole having area of cross-section a. Then the time taken for the liquid level to fall from height H_1 to H_2 is given by:

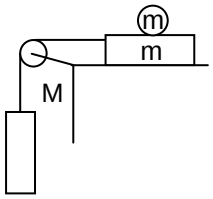
(A) $\sqrt{2g(H_1-H_2)}$ (B) $\frac{A}{a}\sqrt{\frac{2}{g}}\left(\sqrt{H_1}-\sqrt{H_2}\right)$ (C) $\frac{A}{a}\sqrt{\frac{g}{2}}\left(\sqrt{H_1}-\sqrt{H_2}\right)$ (D) $\sqrt{2gH}$

20. A small ball of mass 100 g is attached to a light and inextensible string of length 50 cm. The string is tied to a support O and the mass m released from point A which is at a horizontal distance of 30 cm from the support. Calculate the speed of the ball at its lowest point of the trajectory.



(A) 2.2 m/s (B) 2.5 m/s (C) 3.2 m/s (D) 2.5 m/s

21. A plate of mass m is placed on a frictionless surface. The plate is connected to block of mass M through a string over a massless pulley. A cylinder of mass m is placed on the plate which rolls without slipping. Find the frictional force acting on the cylinder :



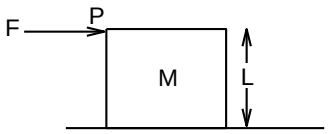
(A) $\frac{(M+m)g}{6}$ (B) $\frac{mg}{6}$

(C) $\frac{Mmg}{3M+4m}$ (D) $\frac{2(M+m)g}{3}$

22. A cube of mass m floats on the surface of a fluid of density ρ. Edge of the cube is a. The distance between lower face of cube and surface of fluid is (surface tension of water = T, contact angle is 0°)

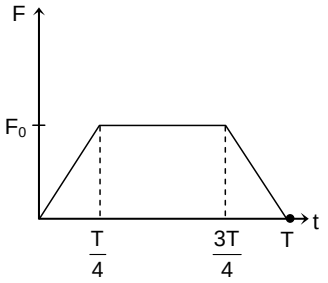
(A) $\frac{mg+4Ta}{\rho a^2 g}$ (B) $\frac{mg-4Ta}{\rho a^2 g}$ (C) $\frac{m}{\rho a^2}$ (D) none of these

23. A cubical block of side L rests on a rough horizontal surface with coefficient of friction μ. A horizontal force F is applied on the block as shown. If the co efficient of friction is sufficiently high so that the block does not slide before toppling, the minimum force F required to topple the block is



(A) Infinitesimal (B) Mg/4 (C) Mg/2 (D) $Mg(1-\mu)$

24. A particle of mass m moving with a velocity u makes an elastic one dimensional collision with a stationary particle of mass m establishing a contact with it for extremely small time T. Their force of contact varies with time as shown the magnitude possessed by F_0 is :

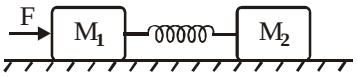


(A) $\frac{mu}{T}$ (B) $\frac{2mu}{T}$

(C) $\frac{4mu}{3T}$ (D) $\frac{3mu}{4T}$

Space For Rough Work

25. Two blocks of masses M_1 and M_2 are connected to each other through a light spring as shown in figure (contact between ground and blocks is smooth). If we push mass M_1 with a force F and cause acceleration a_1 towards right in mass M_1, what will be the acceleration in M_2?

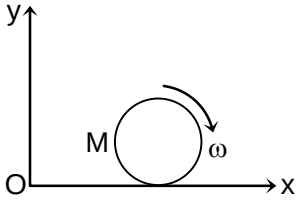


(A) F/M_2 (B) $F/(M_1 + M_2)$ (C) a_1 (D) $(F - M_1a_1)/M_2$

26. The linear density of rod of length L and placed along x–axis with the lighter end at origin, is given by $\lambda = Bx^2$ where B is a constant. Then the co-ordinates of centre of mass are

(A) $\left(\frac{3L}{4},0\right)$ (B) $\left(0,\frac{3L}{4}\right)$ (C) $\left(\frac{4L}{3},0\right)$ (D) $\left(\frac{0,4L}{3}\right)$

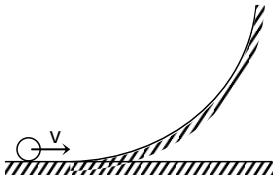
27. A disc of mass M and radius R is rolling with angular speed ω on a horizontal plane as shown in figure. The magnitude of angular momentum of the disc about the origin O is:



(A) $\frac{1}{2}MR^2\omega$ (B) $MR^2\omega$

(C) $\frac{3}{2}MR^2\omega$ (D) $2MR^2\omega$

28. A small object of uniform density rolls up a curved surface with an initial speed v. It reaches up to a maximum height of $3v^2/4g$ with respect to initial position. The object is :



(A) ring (B) solid sphere
(C) hollow sphere (D) disc

29. A rigid body can be hinged about any point on the x-axis. When it is hinged such that the hinge is at a distance x, the moment of inertia is given by $I = 2x^2 - 12x + 27$.
Then the x-coordinate of centre of mass is:

(A) x = 2 (B) x = 0 (C) x = 1 (D) x = 3

30. A particle strikes a horizontal frictionless floor with a speed u, at an angle θ with the vertical and rebounds with a speed v, at an angle φ with the vertical. The coefficient of restitution between the particle and the floor is e. The magnitude of v is:

(A) eu (B) $(1-e)u$

(C) $u\sqrt{\sin^2\theta + e^2\cos^2\theta}$ (D) $u\sqrt{e^2\sin^2\theta + \cos^2\theta}$

Space For Rough Work

Chemistry

PART – II
Straight Objective Type

This part contains 30 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

1 A reaction takes place in three steps; the rate constants are k_1,k_2 and k_3 respectively. The overall rate constant $k=\frac{k_1^{3/2}k_3^{2/3}}{k_2^{1/4}}$. If activation energy of each steps are 50,500 and 90 kJ respectively, then overall activation energy of the reaction is

(A) 10 (B) 270 (C) 300 (D) 620

2. The equilibrium constants for the following reactions at 1400 K are given

$2H_2O(g) \rightleftharpoons 2H_2(g) + O_2(g)$; $K_1=2.1\times10^{-13}$

$CO_2(g) \rightleftharpoons CO(g) + O_2(g)$; $K_2=0.84\times10^{-12}$

Then, the equilibrium constant K for the reaction at same temperature will be

$2H_2(g) + CO_2(g) \rightleftharpoons CO(g) + 2H_2O(g)$ is

(A) 2 (B) 4 (C) 8.4 (D) 20.5

3 For this reaction at equilibrium, which changes will increase the quantity of Fe(s)?

$Fe_3O_4(s) + 4\ H_2(g) \rightleftharpoons 3\ Fe(s) + 4\ H_2O(g)(\Delta H > 0)$

1. increasing temperature
2. decreasing temperature
3. adding $Fe_3O_4(s)$

(A) 1 only (B) 1 and 3 only

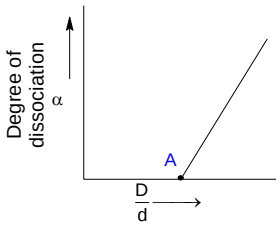
(C) 2 and 3 only (D) 1, 2, and 3

4 The rate law for a reaction between the substances A and B is given by rate = $K[A]^n\ [B]^m$. On doubling the concentration of A and half the concentration of B, the ratio of the new rate to the earlier rate of the reaction will be

(A) $1/2^{m+n}$ (B) $2^{(m+n)}$ (C) (n–m) (D) $2^{(n-m)}$

5. In the dissociation reaction of N_2O_4

$N_2O_4(g) \rightleftharpoons 2NO_2(g)$ if D is the vapour density at initial stage and d is the vapour density of the reaction mixture at equilibrium, then what will be the suitable value of D / d at point A in the following graph?

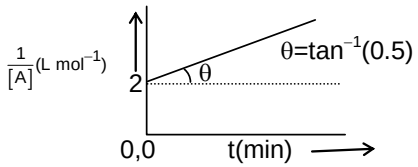


(A) 0 (B) 1.5

(C) 1 (D) 0.5

space For Rough Work

6. Consider the following graph: choose the incorrect statement



(A) The given reaction is a second order reaction
(B) Half life of reaction is 4 min
(C) Order of reaction is one
(D) Initial concentration of reactant is 0.5 M

7. A weak base (BOH) with $K_b=10^{-5}$ is titrated with a strong acid HCl. At 3/4th of the equivalent point, pH of the solution is
(A) 5 + log3 (B) 5–log3 (C) 14–5 + log3 (D) 9 – log 3

8. 500 ml of 0.2 M BOH (a weak base) is mixed with 500 ml of 0.1 M HCl and pH of the resulting buffer solution is 9. What is the pH of a 0.1 M BCl solution? [Antilog (–9) = 10^{-9}]
(A) 2 (B) 3 (C) 4 (D) 5

9. Which one of the following is present in the chain structure of silicates?
(A) $\left(Si_2O_5^{2-}\right)_n$ (B) $\left(SiO_3^{2-}\right)_n$ (C) $\left(SiO_4\right)^{4-}$ (D) $\left(Si_2O_7^{6-}\right)$

10. What is the normal boiling point of mercury?
Given: ΔH_f°(Hg,l)= 0; S° (Hg,l) = 77.4 J/K mol
ΔH_f°(Hg,g)= 60.8 kJ/mol; S° (Hg,g) = 174.4 J/K mol
(A) 624.8 (B) 626.8 (C) 636.8 (D) none of these

11. 18 gm of ice is converted into water at 0°C and 1 atm. The entropies of $H_2O(s)$ and $H_2O(l)$ are 38.2 and 60 J/mol K respectively. The enthalpy change for this conversion is
(A) 5951. 4 J / mol (B) 595. 14 J/mol (C) –5951.4 J/mol (D) none of these

12. If enthalpy of hydrogenation of $C_6H_6(l)$ into $C_6H_{12}(l)$ are –205 kJ and resonance energy of $C_6H_6(l)$ is –152 kJ / mol then enthalpy of hydrogenation of  is
Assume ΔH_{vap} of $C_6H_6(l)$, $C_6H_8(l)$, $C_6H_{12}(l)$ all are equal:
(A) –535.5 kJ / mol (B) –238 kJ / mol (C) –357 kJ / mol (D) –119 kJ / mol

13. In the nuclear reaction, ${}^{235}_{92}U \longrightarrow {}^{207}_{82}Pb$, the number of α- and β-particles lost would be
(A) 8, 4 (B) 6, 2 (C) 7, 4 (D) 4, 3

14. On applying pressure to the equilibrium,
Ice $\rightleftharpoons$ water, which phenomenon will happen
(A) More ice will be formed (B) More water will be formed
(C) Equilibrium will not disturbed (D) Water will evaporate

space For Rough Work

15. Which of the following statements is correct?
(A) BCl_3 and $AlCl_3$ are both Lewis acids and BCl_3 is stronger acid than $AlCl_3$
(B) Both BCl_3 and $AlCl_3$ are Lewis acid and $AlCl_3$ is stronger than BCl_3
(C) Both BCl_3 and $AlCl_3$ are equally strong Lewis acid.
(D) Both BCl_3 & $AlCl_3$ are not Lewis acid.

16. B–H–B bridges in B_2H_6 is formed by sharing of
(A) 2 e^- (B) 4 e^- (C) 1 e^- (D) 3 e^-

17. Based on the values of B.E given, $\Delta_f H°$ of $N_2H_4(g)$ is:
Given: N–N = 159 kJ mol^{-1}; H–H = 436 kJ mol^{-1}
N≡N = 941 kJ mol^{-1}; N–H=398 kJ mol^{-1}
(A) 711 kJ mol^{-1} (B) 62 kJ mol^{-1} (C) –98 kJ mol^{-1} (D) –711 kJ mol^{-1}

18. What is the pH of saturated solution of $Cu(OH)_2$?($K_{sp}= 2.6\times10^{-19}$)?
(A) 6.1 (B) 7.30 (C) 8.42 (D) 7.90

19. A certain weak acid has Ka = 1×10^{-4}: Calculate the equilibrium constant for its reaction with a strong base
(A) 10^{10} (B) 10^{-18} (C) 10^{-10} (D) 10^{+18}

20. Which of the following conditions regarding a chemical process ensure its spontaneity at all temperature?
(A) $\Delta H > 0, \Delta S < 0$ (B) $\Delta H < 0, \Delta S > 0$ (C) $\Delta H < 0, \Delta S < 0$ (D) $\Delta H > 0, \Delta S > 0$

21. In a 1st order reaction the fraction of molecules at 450°C having sufficient energy (or fraction of effective collisions) is 1.92×10^{-16}. What is activation energy value of this reaction? Given log 1.92=0.283.
(A) 21.757×10^2 J $mole^{-1}$ (B) 21.757×10^3 J $mole^{-1}$
(C) 21.75×10^4 J $mole^{-1}$ (D) None of these

22. Identify the incorrect statement about othoboric acid
(A) It has a layer structure in which planar BO_3 units are joined by hydrogen bonds
(B) H_3BO_3 is a weak tribasic Lewis acid
(C) On heating orthoboric acid and sodium meta borate to red hot, forms boric oxide anhydride
(D) It is obtained by reacting borax with HCl using phenolphthalein as an indicator

23. An ideal gas with C_v=3 R expands adiabatically into a vacuum thus doubling its volume. The final temperature is given by:
(A) $T_f = T_i[2^{-1/3}]$ (B) $T_f = T_i$ (C) $T_f = 2T_i$ (D) $T_f = \frac{T_i}{2}$

space For Rough Work

24. The ratio of P to V at any instant is constant and is equal to 1, for a monoatomic ideal gas undergoing a process. What is the molar heat capacity of the gas?

(A) $\frac{3R}{2}$ (B) 2R (C) $\frac{5R}{2}$ (D) 0

25. Calculate enthalpy change for non–ideal gas, if the change in internal energy is 40 L–atm for the process (5 atm, 10 L) to (2 atm, 15L)

(A) 60 (B) 20 (C) 40 (D) can't be calculated

[

26. The solubility product of lead iodide is 1.4×10^{-8}. The molar solubility of lead iodide in 0.1 M KI solution is

(A) 1.4×10^{-4} (B) 1.4×10^{-6} (C) 1.4×10^{-8} (D) 1.4×10^{-2}

27. For the process $H_2O(l)$ (1 bar, 373 K) $\longrightarrow$ $H_2O(g)$ (1 bar, 373 K), the correct set of thermodynamic parameters is

(A) $\Delta G=0, \Delta S=+ve$ (B) $\Delta G=0, \Delta S= - ve$ (C) $\Delta G=+ve, \Delta S=0$ (D) $\Delta G=-ve, \Delta S=+ve$

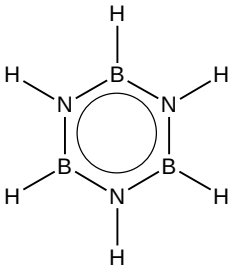
28. 50 mL, N/10 NaOH solution is mixed with 50 mL, N/20 HCl solution. The resulting solution will:

(A) turn phenolphthalein solution pink (B) turn blue litmus red
(C) turn methyl orange red (D) $[H^+] > [OH^-]$

29. On adding 0.1 M solution each of Ag^+, Ba^{2+} and Ca^{2+} in an Na_2SO_4 solution, the species first precipitated is: $\left(K_{sp}BaSO_4 = 10^{-11}, K_{sp}CaSO_4 = 10^{-6}, K_{sp}Ag_2SO_4 = 10^{-5}\right)$

(A) Ag_2SO_4 (B) $BaSO_4$ (C) $CaSO_4$ (D) All of these

30. The structure of $B_3N_3H_6$ is as follows



How many derivative structure of $B_3N_3H_4X_2$ can be derived from the basic structure, by the replacement of two hydrogen atoms?

(A) 2 (B) 3 (C) 4 (D) 5

space For Rough Work

Mathematics

PART – III

Straight Objective Type

This part contains 30 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

1. If $2x + y + k = 0$ is a normal to the parabola $x^2 = 16y$ then the value of k is
   (A) 48 (B) -48 (C) -9 (D) 9

2. Two common tangents to the circle $x^2 + y^2 = a^2$ and parabola $y^2 = 4a\sqrt{2}x$ are
   (A) $x = \pm(y + \sqrt{2}a)$ (B) $y = \pm(x + \sqrt{2}a)$ (C) $x = \pm(y + a)$ (D) $y = \pm(x + a)$

3. The angle subtended by common tangents of two ellipse $4(x-4)^2 + 25y^2 = 100$ and $4(x+1)^2 + y^2 = 4$ at the origin is
   (A) 30 (B) 45 (C) 60 (D) 90

4. If the normal at the point $P(\theta)$ to the ellipse $\frac{x^2}{14} + \frac{y^2}{5} = 1$ intersects it again at the point, $Q(2\theta)$. Then $\cos\theta$ is equal to
   (A) $\frac{2}{3}$ (B) $-\frac{2}{3}$ (C) $\frac{3}{4}$ (D) none of these

5. The focus of the rectangular hyperbola $(x+4)(y-4)=16$ is
   (A) $\left(-4 + 4\sqrt{2}, 4 - 4\sqrt{2}\right)$ (B) $\left(-4 - 4\sqrt{2}, 4 + 4\sqrt{2}\right)$
   (C) $\left(-4 + 4\sqrt{2}, 4 + 4\sqrt{2}\right)$ (D) none of these

6. Asymptotes of the hyperbola $xy=4x+3y$ are
   (A) x=3, y = 4 (B) x = 4, y = 3 (C) x = 2, y = 6 (D) x = 6, y = 2

7. If one root is square of the other root of the equation $x^2 + px + q = 0$, then the relation between p and q is
   (A) $p^3 - q(3p - 1) + q^2 = 0$ (B) $p^3 - q(3p + 1) + q^2 = 0$
   (C) $p^3 + q(3p - 1) + q^2 = 0$ (D) $p^3 + q(3p + 1) + q^2 = 0$

Space For Rough Work

8. In the quadratic equation $ax^2 + bx + c = 0$, if $\Delta = b^2 - 4ac$ and $\alpha + \beta$, $\alpha^2 + \beta^2$, $\alpha^3 + \beta^3$ are in G.P. where α, β are the roots of $ax^2 + bx + c = 0$, then
(A) $\Delta \neq 0$ (B) $b\Delta = 0$
(C) $c\Delta = 0$ (D) $\Delta = 0$

9. The sum of series $1+\frac{4}{5}+\frac{7}{5^2}+\frac{10}{5^3}+....\infty$ is
(A) $\frac{7}{16}$ (B) $\frac{5}{16}$ (C) $\frac{105}{64}$ (D) $\frac{35}{16}$

10. The sum $\frac{1^3}{1}+\frac{1^3+2^3}{1+3}+\frac{1^3+2^3+3^3}{1+3+5}+...$ to 16 terms is
(A) 246 (B) 646
(C) 446 (D) 746

11. Let 'a' be a non-zero real number and α, β be the roots of the equation $ax^2+5x+2=0$. Then, the absolute value of the difference of the roots of the equation $a^3(x+5)^2-25a(x+5)+50=0$ is
(A) $\left|\alpha^2-\beta^2\right|$ (B) $\left|\alpha\beta(\alpha^2-\beta^2)\right|$ (C) $\left|\frac{\alpha^2-\beta^2}{\alpha\beta}\right|$ (D) $\left|\frac{\alpha^2-\beta^2}{\alpha^2\beta^2}\right|$

12. Let a_1, a_2, a_3, a_4 and a_5 be such that a_1, a_2 and a_3 are in A.P., a_2, a_3 and a_4 are in G.P. and a_3,a_4 and a_5 are in H.P. Then $\log_e a_1$, $\log_e a_3$ and $\log_e a_5$ are in
(A) G.P. (B) A.P. (C) H.P. (D) none of these

13. Let r, s and t be the roots of the equation $8x^3+1001x+2008=0$ the value of $(r+s)^3+(s+t)^3+(t+r)^3$
(A) 251 (B) 751 (C) 735 (D) 753

14. If roots of $x^2-(a-3)x+a=0$ are such that at least one of them is greater than 2, then
(A) $a \in [7,9]$ (B) $a \in [7,\infty)$ (C) $a \in [9,\infty)$ (D) $a \in [7,9)$

15. If x is real, then the maximum value of $\frac{\left(3x^2+9x+17\right)}{\left(3x^2+9x+7\right)}$ is
(A) 1/4 (B) 41 (C) 1 (D) 17/7

Space For Rough Work

16. If the roots of the quadratic equation $(4p - p^2 - 5)x^2-(2p-1)x+3p=0$ lie on either side of unity, then the number of integral values of p is
(A) 1 (B) 2 (C) 3 (D) 4

17. If one root of $x^2 - x - k = 0$ is square of the other, then k =
(A) $2 \pm \sqrt{5}$ (B) $2 \pm \sqrt{3}$ (C) $3 \pm \sqrt{2}$ (D) $5 \pm \sqrt{2}$

18. If the equation $ax^2 + bx + c = 0$ and $x^3 + 3x^2 + 3x + 2 = 0$ have two common roots, then
(A) a = b = c (B) a = b ≠ c (C) c = –b = c (D) none of these

19. Angle between the tangents to the curve $y = x^2 - 5x + 6$ at the point (2,0) and (3,0) is:
(A) $\frac{\pi}{2}$ (B) $\frac{\pi}{3}$ (C) $\frac{\pi}{6}$ (D) $\frac{\pi}{4}$

20. If the line x + y = 1 touches the parabola $y^2 - y + x = 0$, then the coordinates of the point of contact are
(A) (1,1) (B) $\left(\frac{1}{2},\frac{1}{2}\right)$ (C) (0,1) (D) (1,0)

21. The mirror image of the parabola $y^2=4x$ in the tangent to the parabola at the point (1,2) is
(A) $(x-1)^2=4(y+1)$ (B) $(x+1)^2=4(y+1)$ (C) $(x+1)^2=4(y-1)$ (D) $(x-1)^2=4(y-1)$

22. Two mutually perpendicular tangent of the parabola $y^2=4ax$ meet the axis in P_1 and P_2. If S is the focus of the parabola, then $\frac{1}{(SP_1)} + \frac{1}{(SP_2)}$ is equal to
(A) $\frac{4}{a}$ (B) $\frac{2}{a}$ (C) $\frac{1}{a}$ (D) $\frac{1}{4a}$

23. If y = 2x – 3 is a tangent to the parabola $y^2 = 4a\left(x - \frac{1}{3}\right)$, then 'a' is equal to
(A) $\frac{22}{3}$ (B) –1 (C) $\frac{14}{3}$ (D) $\frac{-14}{3}$

24. The slopes of the common tangents of the ellipse $\frac{x^2}{4} + \frac{y^2}{1}$ =1 and the circle $x^2 + y^2 = 3$ are
(A) ± 1 (B) $\pm\sqrt{2}$
(C) $\pm\sqrt{3}$ (D) none of these

Space For Rough Work

25. If the distance between two parallel tangents to the hyperbola $\frac{x^2}{9}-\frac{y^2}{49}=1$ is 2 then their slope is equal to

(A) $\pm\frac{5}{2}$ (B) $\pm\frac{3}{2}$ (C) $\pm\frac{\sqrt{5}}{2}$ (D) $\pm\frac{\sqrt{3}}{2}$

26. The eccentricity of the conic represented by $x^2-y^2-4x+4y+16=0$ is

(A) 1 (B) $\sqrt{2}$ (C) 2 (D) $\frac{1}{2}$

27. The equation $16x^2 - 3y^2 - 32x + 12y - 44 = 0$ represents a hyperbola
(A) the length of whose transverse axis is $4\sqrt{3}$
(B) the length of whose conjugate axis is 4
(C) whose centre is (2,1)
(D) whose eccentricity is $\sqrt{\frac{19}{3}}$

28. The latus rectum of the hyperbola $9x^2 - 16y^2 - 18x - 32y - 151 = 0$ is

(A) $\frac{9}{4}$ (B) 9 (C) $\frac{3}{2}$ (D) $\frac{9}{2}$

29. The eccentricity of the conjugate hyperbola of the hypaerbola $x^2-3y^2=1$ is

(A) 2 (B) $\frac{2}{\sqrt{3}}$ (C) 4 (D) $\frac{4}{5}$

30. If $ax + by = 1$ is tangent to the hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$, then $a^2 - b^2$ equals to

(A) $\frac{1}{a^2e^2}$ (B) a^2e^2 (C) b^2e^2 (D) none of these

Space For Rough Work

FIITJEE COMMON TEST

BATCHES: Two Year CRP (1820) B LOT
PHYSICS, CHEMISTRY & MATHEMATICS

JEE MAIN-PHASE-II

ANSWER KEY

Paper Code
SET-A

PART – I (PHYSICS)			PART – II (CHEMISTRY)			PART – III (MATHEMATICS)		
1.	A	P110608	1	A	C123404	1.	C	M110904
2.	D	P111820	2.	B	C110402	2.	B	M110908
3.	C	P111821	3	A	C110403	3.	D	M111028
4.	C	P111817	4	D	C123402	4.	B	M111031
5.	A	P111010	5.	C	C110602	5.	C	M111103
6.	D	P111826	6.	C	C110504	6.	A	M111123
7.	D	P111818	7.	D	C111608	7.	A	M110101
8.	C	P111819	8.	D	C123205	8.	C	M110101
9.	A	P111825	9.	B	C123204	9.	D	M110507
10.	B	P110610	10.	B	C111909	10.	C	M110506
11.	A	P111827	11.	A	C111903	11.	A	M110101
12.	B	P111005	12.	D	C111909	12.	B	M110520
13.	B	P110602	13.	C	C110604	13.	D	M110101
14.	C	P110612	14.	B	C110403	14.	C	M110109
15.	B	P111801	15.	A	C111508	15.	B	M110119
16.	C	P111814	16.	A	C111506	16.	B	M110109
17.	C	P111817	17.	B	C111909	17.	A	M110101
18.	B	P111816	18.	D	C110501	18.	A	M110104
19.	B	P112612	19.	A	C110505	19.	A	M110909
20.	A	P110613	20.	B	C123205	20.	C	M110903
21.	C	P111830	21.	C	C110603	21.	C	M110901
22.	A	P111013	22.	B	C111505	22.	C	M110903
23.	C	P110802	23.	B	C111901	23.	D	M110903
24.	C	P110605	24.	B	C111901	24.	B	M111126
25.	D	P110612	25.	B	C111903	25.	A	M111138
26.	A	P110602	26.	B	C110501	26.	B	M111101
27.	C	P111818	27.	A	C123205	27.	D	M111101
28.	D	P110814	28.	A	C110506	28.	D	M111101
29.	D	P111810	29.	B	C110501	29.	A	M111101
30.	C	P110607	30.	C	C111507	30.	A	M111138

FIITJEE COMMON TEST

BATCHES: Two Year CRP (1820) B LOT (CPT-2)

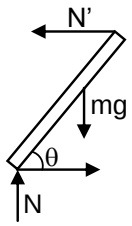
JEE MAIN-PHASE-II

HINTS & SOLUTIONS – PHYSICS

1. A P110608

$\vec{J} = \int \vec{F} dt = \Delta \vec{p}$

2. D P111820



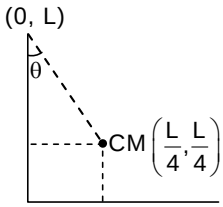
$f = N'$

$N = mg$

$mg\frac{\ell}{2}\cos\theta = f\ell\sin\theta$

$f = \mu_{min} N$

3. C P111821



$$\tan\theta = \frac{\frac{L}{4}}{L - \frac{L}{4}} = \frac{1}{3}$$

4. C P111817

For sliding : $mg \sin\theta > \mu mg \cos\theta$

For toppling : $mg \sin\theta \frac{a}{2} > mg \cos\theta \frac{a}{2}$

5. A P111010

$$v = \sqrt{2g\left(\frac{\rho_1 h_1 + \rho_2 h_2}{\rho_1}\right)}$$

6. D P111826

$F - f = Ma$

$FR + fR = mR^2\alpha$

$a = \alpha R \Rightarrow f = 0$

7. D P111818

$mu = Mv$

$0 = \frac{mu\ell}{2} - \frac{M\ell^2}{12}\omega$

$u = v + \frac{\omega\ell}{2}$

8. C P111819

$\vec{L} = \vec{r} \times m\vec{v}$

9. A P111825

$5\ mv = m\omega R \cos\theta$

10. B P110610

$(10m\cos 37^\circ) = \mu(30m\sin 37^\circ)$

$\mu = \frac{4}{9}$

11. A P111827

Particles in upper half will have more speed than particles in lower half.

12. B P111005

$10^3 \times \left(\frac{2}{3}v\right)g + 8\times 10^3\left(\frac{1}{3}v\right)g = (\rho v)g$

$10^3\left(\frac{2}{3}+\frac{8}{3}\right) = \rho \Rightarrow \frac{10^4}{3} = \rho$

13. B P110602

$x_2 = \frac{\sigma\pi cb^2}{\sigma\pi(a^2-b^2)}$

14. C P110612

$v_{cm} = \frac{m_1v_1 + m_2v_2}{m_1+m_2} = \frac{10\times 14 + 4\times 0}{14} = 10 \text{ m/s}$

15. B P111801

$m_1\Delta x_1 + m_2\Delta x_2 = 0 \Rightarrow M(L+x) + \frac{M}{3}x = 0 \Rightarrow x = -\frac{3L}{4}$

Distance moved relative to ground by the man $= (L+x) = \frac{L}{4}$

16. C P111814

From energy conservation $\frac{1}{2}\left(\frac{m\ell^2}{3}\right)\omega^2 = \frac{mg\ell}{2}$

$\omega^2 = \frac{3g}{\ell}$

$F - mg = m\omega^2\frac{\ell}{2} \Rightarrow F = \frac{5mg}{2}$

17. C P111817

$\tau = (mg\sin\theta)\frac{a}{2}$

18. B P111816

$mg\cos\theta - N = m\omega^2(R+r)$

$N = 0(\text{for this case})$

$\frac{1}{2}mv^2 + \frac{1}{2}I\omega^2 = mg(R+r)(1-\cos\theta)$

19. B P112612

$-A\frac{dx}{dt} = a\sqrt{2gx} \qquad \Rightarrow t = \frac{A}{a}\sqrt{\frac{g}{2}}\left(\sqrt{H_1} - \sqrt{H_2}\right)$

20. A P110613

$mg\times 0.4=\frac{1}{2}mv^2 \Rightarrow v=2\sqrt{2}\,m/s$

(From conservation of mechanical energy just before the string becomes taut)

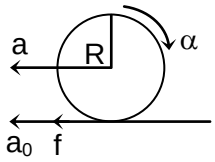
During the application of impulse, velocity along perpendicular to the string remain same.

So after impulse velocity of the ball equal to $\frac{6\sqrt{2}}{5}m/s$

Again from conservation of mechanical energy $\frac{1}{2}m\left(\frac{6\sqrt{2}}{5}\right)^2+mg(0.1)=\frac{1}{2}mv_f^2$

Now velocity at the bottommost point v_{final} = 2.2 m/s

21. C P111830



$Mg - T = Ma_0$

$T - f = ma_0$

$f = ma$

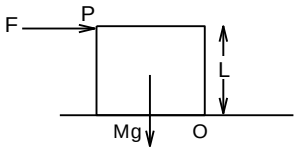
$fR=\frac{1}{2}mR^2\alpha$; $a_0=a+R\alpha$; On solving $f=\frac{Mmg}{3M+4m}$

22. A P111013

Weight + force due to surface tension = buoyancy force

$mg+T(4a)=\rho(a^2x)g$

23. C P110802



Talking torque about 0

$F.L.=Mg.\frac{L}{2}\rightarrow F=\frac{mg}{2}$

24. C P110605

ΔP for second particle = mv = Area under graph.

25. D P110612

$a_{cm}=\frac{M_1a_2+M_2a_2}{M_1+M_2}$; $F=(m_1+m_2)a_{cm}$

26. A P110602

$X_{cm}=\frac{\int dm}{\int dm}=\frac{\int\times\lambda dx}{\int\lambda dx}$

27. C P111818

$\vec{L}_0=\vec{L}_{Body\rightarrow CM}+\vec{L}_{CM\rightarrow 0}$

28. D P110814

$mg\frac{3v^2}{4g}=\frac{1}{2}mv^2+\frac{1}{2}I\omega^2$ $\left(\omega=\frac{v}{R}\right)$

29. D P111810

$\frac{dI}{dx}=0$

Moment of inertia is minimum about COM

30. C P110607

$v\cos\phi=eu\cos\theta$

$v\sin\phi=u\sin\theta$

Chemistry

1 A C123404
2. B C110402
3 A C110403
4 D C123402
5. C C110602
6. C C110504
7. D C111608
8. D C123205
9. B C123204
10. B C111909

$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ = 0$

11. A C111903

$H_2O(s) \longrightarrow H_2O(l)$

$\Delta S = \Delta S_{H_2O(l)} - S_{H_2O(s)} = 21.8\ J/mol.K$

$\Delta H = 273 \times 21.8 = 5951.4\ J/mol$

12. D C111909
13. C C110604
14. B C110403
15. A C111508
16. A C111506
17. B C111909
18. D C110501
19. A C110505
20. B C123205
21. C C110603
22. B C111505
23. B C111901
24. B C111901
25. B C111903
26. B C110501

$PbI_2 \rightleftharpoons Pb^{2+} + 2I^-$

S S 2S

$KI \longrightarrow K^+ + I^-$

0.1M 0.1M 0.1M

Let, new solubility of PbI_2 in KI is S'.

So, $[Pb^{2+}] = S',\ [I^-] = (2S' + 0.1) \approx 0.1$, since S' is very small.

So, $K_{sp} = [Pb^{2+}]\ [I^-]^2$

$1.4 \times 10^{-8} = S' \times (0.1)^2$

$$S' = \frac{1.4 \times 10^{-8}}{10^{-2}} = 1.4 \times 10^{-6}$$

27. A C123205
28. A C110506
29. B C110501
30. C C111507

MATHEMATICS

1. C M110904
2. B M110908
3. D M111028
4. B M111031
5. C M111103
6. A M111123
7. A M110101

Let the roots be α, α^2

$\Rightarrow \alpha^2 + \alpha = -p, \alpha^3 = q$

$\Rightarrow \alpha(\alpha + 1) = -p \Rightarrow \alpha^3(\alpha^3 + 1 + 3(\alpha^2 + \alpha)) = -p^3 \Rightarrow p^3 - q(3p - 1) + q^2 = 0$

8. C M110101

We have $(\alpha^2 + \beta^2)^2 = (\alpha + \beta)(\alpha^3 + \beta^3) \Rightarrow \alpha\beta(\alpha - \beta)^2 = 0$

$\Rightarrow c\Delta = 0.$

9. D M110507
10. C M1105`6
11. A M110101

Since α and β are the roots of $ax^2 + 5x + 2 = 0$

$\Rightarrow$ α -5 and β - 5 are the roots of $a(x+5)^2 + 5(x+5) + 2 = 0$

Let α_1 and β_1 be roots of $a^3(x+5)^2 - 25a(x+5) + 50 = 0$

$\Rightarrow$ $\alpha_1 + 5$ and $\beta_1 + 5$ be roots of $a^3x^2 - 25ax + 50 = 0$

$$\Rightarrow \alpha_1 - \beta_1 = \sqrt{(\alpha_1 + 5 + \beta_1 + 5)^2 - 4(\alpha_1 + 5)(\beta_1 + 5)} = \frac{5}{a^2}\sqrt{25 - 8a}$$

$$= \frac{5}{a}\sqrt{\left(\frac{5}{a}\right)^2 - 4\left(\frac{2}{a}\right)}$$

$$= (\alpha + \beta)\sqrt{(\alpha + \beta)^2 - 4\alpha\beta} = \left|\alpha^2 - \beta^2\right|$$

12. B M110520
13. D M110101
14. C M110109
15. B M110119
16. B M110109
17. A M110101
18. A M110104
19. A M110909
20. C M110903
21. C M110901

Any point on the given parabola is $(t^2, 2t)$. The equation of the tangent at (1,2) is $x - y + 1 = 0$

The image (h,k) of the point $(t^2, 2t)$ in $x - y + 1 = 0$

The image (h,k) of the point $(t^2, 2t)$ in $x - y + 1 = 0$ is given by $\frac{h - t^2}{1} = \frac{k - 2t}{-1} = -\frac{2(t^2 - 2t + 1)}{1 + 1}$

$h = t^2 - t^2 + 2t - 1 = 2t - 1$ and $k = 2t + t^2 - 2t + 1 = t^2 + 1$

Eliminating t from $h = 2t - 1$ and $k = t^2 + 1$,

We get $(h+1)^2 = 4(k-1)$

The required equation of reflection is $(x+1)^2 = 4(y-1)$.

22. C M110903
23. D M110903
24. B M111126

Let m be the slope of the common tangent then $\pm\sqrt{3}\sqrt{1 + m^2} = \pm\sqrt{4m^2 + 1}$

$\Rightarrow 3 + 3m^2 = 4m^2 + 1$

$\Rightarrow m^2 = 2 \Rightarrow m = \pm\sqrt{2}$.

25. A M111138

$\frac{2\sqrt{9m^2-49}}{\sqrt{1+m^2}} = 2$ $\Rightarrow 9m^2-49 = 1 + m^2$

i.e. $8m^2 = 50$ $\Rightarrow m = \pm 5/2$

26. B M111101

27. D M111101

28. D M111101

29. A M111101

30. A M111138