FIITJEE Talent Reward Exam

for student presently in

Class 11

A

PAPER–2

Time: 3 Hours | **CODE A11** | ***Maximum Marks: 270***

Instructions:

Caution: Question Paper CODE as given above MUST be correctly marked in the answer OMR sheet before attempting the paper. Wrong CODE or no CODE will give wrong results.

1. **You are advised to devote 1 Hour on Section-I and 2 Hours on Section-II and Section-III.**
2. This Question paper consists of 3 sections. **All questions will be multiple choice single correct out of four choices with marking scheme in table below:**

Section			Question no.	Marking Scheme for each question	
				correct answers	wrong answers
SECTION – I (IQ)			Q. 1 to 8	**+3**	**–1**
			Q. 9 to 16	**+6**	**–2**
SECTION – II (PCM)	Part –A	Physics	Q. 17 to 25	**+4**	**–1**
	Part –B	Chemistry	Q. 26 to 34	**+4**	**–1**
	Part –C	Mathematics	Q. 35 to 43	**+4**	**–1**
SECTION – III (PCM)	Part –A	Physics	Q. 44 to 48	**+6**	**–2**
	Part –B	Chemistry	Q. 49 to 53	**+6**	**–2**
	Part –C	Mathematics	Q. 54 to 58	**+6**	**–2**

3. Answers have to be marked on the OMR sheet.
4. The Question Paper contains blank spaces for your rough work. No additional sheets will be provided for rough work.
5. Blank papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.
6. **Before attempting paper write your Name, Registration number** and **Test Centre** in the space provided at the bottom of this sheet.

Note:

Check all the sheets of this question paper. Please ensure the same SET is marked on header of all the sheets inside as indicated above 'Maximum Marks' of this page. In case SET marked is not the same on all pages, immediately inform the invigilator and CHANGE the Questions paper.

Registration Number : ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Name of the Candidate : ____________________

Test Centre : ____________________

Section-I IQ

Directions (Q. 1 to 2): Read the following information carefully and answer the given questions.
L$M means L is son of M, L*M means L is wife of M, L#M means L is mother of M and L@M means L is sister of M.

1. What does A$B*C mean?
(A) C is husband of A
(B) C is father of A
(C) B is father of A
(D) C is brother of A

2. What does A@B#C mean?
(A) C is nephew of A
(B) C is son of B
(C) A is Aunt of C
(D) B is father of C

Directions (Q. 3 to 5): On the basis of the information given below, answer the given questions:
Eight friends Shobhit, Abhishek, Shaurya, Abhinav, Shubham, Saurav, Animesh and Kartik are sitting in a circle facing the centre. Abhishek is between Animesh and Abhinav. Kartik is third to the left of Abhishek and Second to the right of Shobhit. Shaurya is sitting between Shobhit and Animesh and Abhishek and Shubham are not sitting opposite to each other.

3. Who is third to the left of Abhinav?
(A) Shaurya
(B) Animesh
(C) Saurav
(D) Kartik

4. Which of the following statement is not correct?
(A) Shaurya is third to the right of Abhinav
(B) Shobhit is sitting between Shaurya and Saurav
(C) Abhinav and Shobhit are sitting opposite to each other
(D) Shubham is sitting between Abhishek and Shobhit.

5. Who is second to the left of Kartik?
(A) Shobhit
(B) Animesh
(C) Shubham
(D) Abhishek

Space for Rough Work

6. In a row of girls, Seema is eighth from the left and Reema is seventeenth from the right. If they inter-change their places, Seema becomes fourteenth from the left. How many girls are there in that row?
(A) 30 (B) 25
(C) 29 (D) 27

7. There are two clocks on a wall. One clock gains 2 minutes in one hour while another clock loses 4 minutes in one hour. Both clocks show correct time at 10 am. Find the time difference of the two clocks at 8 pm next day?
(A) 2 hours 16 minutes (B) 3 hours 44 minutes.
(C) 3 hours 24 minutes (D) 2 hours 28 minutes

8. A earns more than B and less than C. D earns more than A and C. E earns more than only B. Who earns the least among the five of them?
(A) E (B) D
(C) B (D) C

9. A's house is located to the north of B's house. C's house is located to the west of B's house. M's house is located to the south-west of B's house and to the south-east of C's house while D's house is located to the north-west of C's house. Then in which direction M's house is located with respect to D's house?
(A) North-West (B) South-West
(C) South-East (D) North-East

Directions (Q. 10 to 12): Study the following information carefully and answer these questions:
P, Q, R, S, T, U and V are students of a school and have different favourite subjects viz Mathematics, History, Biology, Chemistry, English, Physics and Economics but not necessarily in the same order. Each one of them also has a liking for different colours viz Black, Red, Blue, Green, Purple, Yellow and Pink not necessarily in the same order. Q likes Mathematics and Blue colour. T's favourite subject is Physics but his favourite colour is not Purple or Black. The one whose favourite subject is English likes Pink colour. P's favourite subject is Chemistry and he likes Yellow colour. U likes Red colour but his favourite subject is neither Biology nor Economics. The one whose favourite subject is Economics does not like Black colour. R likes Purple colour and V's favourite subject is English.

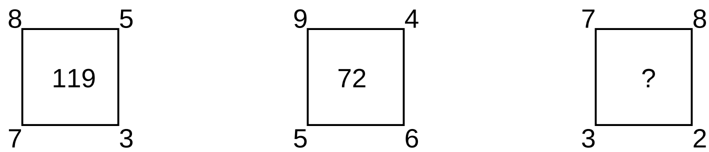
10. Which of the following is correct combination?
(A) V-English-Pink (B) R-Mathematics-Purple
(C) U-Chemistry-Black (D) S-Economics-Black

11. S's favourite subject is?
(A) History (B) English
(C) Biology (D) Economics

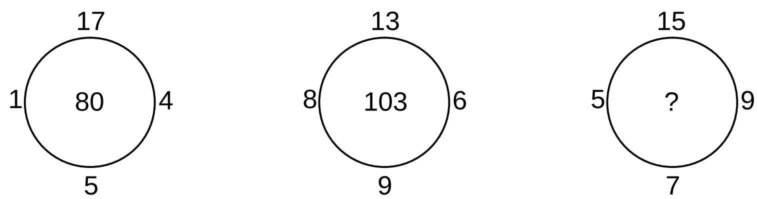
12. Who likes Green colour?
(A) T (B) S
(C) U (D) R

Space for Rough Work

Directions (Q. 13 to 14): Find the missing term in the following figures:

13.


(A) 135
(B) 96
(C) 87
(D) 108

14.


(A) 88
(B) 78
(C) 98
(D) 91

15. If $4 \times 3 = 25$, and $6 \times 7 = 85$, then $8 \times 5 =$
(A) 65
(B) 89
(C) 93
(D) 77

16. Sarita correctly remembers that her father's birthday is after 8 June but before 12th June. Her brother correctly remembers that their father's birthday is after 10th June but before 15th June. On which day of June was definitely their father's birthday?
(A) 10th
(B) 11th
(C) 12th
(D) 9th

Space for Rough Work

Section-II Science and Mathematics (PCM)

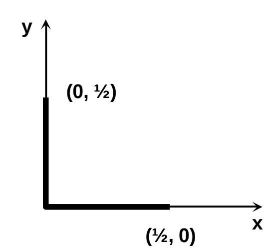
Physics (Part – A)

17. Displacement of an oscillating particle is given by y = A sin(Bx + Ct + D) where x is position of the particle, t is time and A, B, C, D are constants. The dimensional formula for [ABCD] is
(A) $[M^0L^1T^{-1}]$ (B) $[M^0L^{-1}T^0]$
(C) $[M^0L^0T^{-1}]$ (D) $[M^0L^{-1}T^{-1}]$

18. Let $\vec{v}$ and $\vec{a}$ be the instantaneous velocity and the acceleration respectively of a particle moving in a plane. The magnitude of rate of change of speed $\frac{d|\vec{v}|}{dt}$ of the particle is
(A) $|\vec{a}|$ (B) $\frac{|\vec{v}\cdot\vec{a}|}{|\vec{v}|}$
(C) $\frac{|\vec{v}\times\vec{a}|}{|\vec{v}|}$ (D) $\frac{|\vec{v}\cdot\vec{a}|}{|\vec{a}|}$

19. Two identical rings A and B are acted upon by torques τ_A and τ_B respectively. A is rotating about an axis passing through the centre of mass and perpendicular to the plane of the ring. B is rotating about a chord at a distance $\frac{1}{\sqrt{2}}$ times the radius of the ring. If the angular acceleration of the rings is the same, then
(A) $\tau_A = \tau_B$
(B) $\tau_A > \tau_B$
(C) $\tau_A < \tau_B$
(D) nothing can be said about τ_A and τ_B due to insufficient data.

20. A metal rod of uniform linear mass density is placed as shown in the figure. The co-ordinates of centre of mass of the rod is

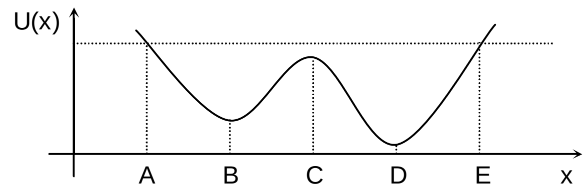


(A) $\left(\frac{1}{2},\frac{1}{2}\right)$ (B) $\left(\frac{1}{4},\frac{1}{4}\right)$
(C) $\left(\frac{1}{8},\frac{1}{8}\right)$ (D) $\left(\frac{1}{16},\frac{1}{16}\right)$

Space for Rough Work

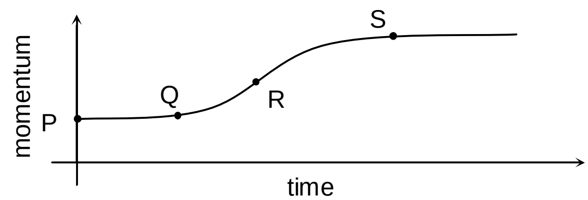
21. The maximum tension in the string of a simple pendulum is three times the minimum tension. If θ_0 be the angular amplitude, then $\cos\theta_0$ is
(A) 1/2 (B) 3/4
(C) 3/5 (D) 2/3

22. A particle moves in one dimension in a conservative force field. The potential energy is depicted in the graph. If the particle starts to move form rest from the point A, then choose the **INCORRECT** Statement.



(A) The speed is zero at the points A and E
(B) The acceleration vanishes at the points A, B, C, D, E
(C) The acceleration vanishes at the points B, C, D
(D) The speed is maximum at point D

23. Variation of momentum with time of one of the bodies in a two body collision is shown in the figure. The instantaneous force is maximum corresponding to the point



(A) P
(B) Q
(C) R
(D) S

24. A stone of mass m, tied to the end of string is whirled around in a horizontal circle. The length of string is reduced gradually keeping the angular momentum of the stone about the centre of circle constant. The tension in the string is proportional to r^n where r is the instantaneous radius of circle. What is the value of n. (neglect force of gravity)?
(A) 2 (B) 3
(C) –2 (D) –3

25. If a lighter body (mass M_1 and velocity V_1) and a heavier body (mass M_2 and velocity V_2) have the same kinetic energy then
(A) $M_2V_2 < M_1V_1$ (B) $M_2V_2 = M_1V_1$
(C) $M_2V_1 = M_1V_2$ (D) $M_2V_2 > M_1V_1$

Space for Rough Work

Chemistry (Part – B)

26. The bond length of O_2, O_2^+, O_2^- & O_2^{2-} in the decreasing order is
(A) $O_2 > O_2^+ > O_2^- > O_2^{2-}$
(B) $O_2^+ > O_2 > O_2^- > O_2^{2-}$
(C) $O_2^- > O_2^{2-} > O_2^- > O_2$
(D) $O_2^{2-} > O_2^- > O_2 > O_2^+$

27. Which of the following statement is true?
(A) Higher the value of critical temperature, easier to liquify a real gas.
(B) Higher the value of 'b' (vander Wall's constant), easier to liquify a real gas.
(C) Lower the value of 'a' (vander Wall's constant), easier to liquify a real gas.
(D) All are correct

28. Enthalpy of combustion of C(graphite), H_2(g) and CH_4(g) are x, y and z kcal/mol respectively. Enthalpy of formation of CH_4 in kcal/mol is
(A) x – xy + z
(B) –x – xy + z
(C) x + 2y – z
(D) x + 2y + z

29. A mixture of 50 ml of H_2 and 50 ml of O_2 is allowed to effuse through an effusometer till the residual gas mixture occupies 90 ml. The volume of H_2 gas diffused is
(A) 2 ml
(B) 8 ml
(C) 5 ml
(D) 4 ml

30. A mixture of CO and CO_2 has molar mass 40 gm. 100 gm of this mixture contains
(A) 0.625 mole of CO
(B) 1.875 mole of CO
(C) 0.375 mole CO
(D) equal mole of CO and CO_2

31. How is the following equilibrium affected by the addition of a catalyst and change in temperature?

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) \qquad \Delta H = -326 \text{ kJ}$$

(A) With the addition of catalyst, equilibrium constant increases.
(B) With the increase in temperature, equilibrium constant increases.
(C) With the addition of catalyst, equilibrium constant is not affected but with the increase in temperature equilibrium constant decreases.
(D) Equilibrium constant is a universal constant and hence can not be affected by any change.

32. The bond energy of B – F bond in BF_3 is 646 kJ/mole, while bond energy of N–F bond in NF_3 is 280 kJ/mole, this is because
(A) N is more electronegative than B
(B) The atomic mass of N is higher than that of B
(C) B–F bond gets a partial double bond character due to P–P overlap
(D) N has a lone pair of electron while B does not have

Space for Rough Work

33. 10 ml of a gaseous hydrocarbon is exploded with 100 ml of oxygen. The residual gas on cooling is found to measure 95 ml. On passing through caustic soda solution, volume decreases by 20 ml and remaining gas is absorbed by alkaline pyrogallol. The formula of the hydrocarbon is
(A) CH_4 (B) C_2H_6
(C) C_2H_4 (D) C_2H_2

34. 50 ml of an aqueous solution of H_2O_2 was treated with an excess of KI solution and dil H_2SO_4. The liberated iodine required 10 ml of 0.1 N. $Na_2S_2O_3$ solution for complete reaction. The concentration of H_2O_2 in g/L is
(A) 0.68 g/L (B) 0.34 g/L
(C) 0.17 g/L (D) 1.36 g/L

Mathematics (Part – C)

35. If y = $x^{3/4}\left(x^{-1/4}+1\right)\left(x^{-1/2}+1\right)\left(x^{1/4}-1\right)$, then $\frac{dy}{dx}$ is equal to
(A) 1 (B) -1
(C) $\frac{3}{4}x^{-1/4}$ (D) none of these

36. The circumcentre of the triangle formed by the line 2x + 3y = 12 and the co– ordinate axes will be
(A) (3, 4) (B) (6, 2)
(C) (3, 2) (D) (0, 0)

37. $\log_{n^p} m^q$ is equal to (where $m = n^k$)
(A) $\frac{pk}{q}$ (B) $\frac{qk}{p}$
(C) $\frac{pq}{k}$ (D) $\frac{p^2}{k}$

Space for Rough Work

38. $\int e^{\sqrt{x}}\,dx$ is

(A) $2\left[e^{\sqrt{x}}\sqrt{x}-e^{-x}\right]+c$

(B) $\left[e^{\sqrt{x}}\sqrt{x}-e^{\sqrt{x}}\right]+c$

(C) $2\left[e^{\sqrt{x}}\sqrt{x}+e^{\sqrt{x}}\right]+c$

(D) $2\left[e^{\sqrt{x}}\sqrt{x}-e^{\sqrt{x}}\right]+c$

39. If a, b $\in$ R, a $\neq$ 0 and the quadratic equation $ax^2-bx+1=0$ has imaginary roots, then a+ b+ 1 is

(A) positive
(B) negative
(C) zero
(D) depends on the sign of b.

40. If tan ($\theta-\alpha$) = a and tan ($\theta+\alpha$) = b then tan 2α equals to

(A) $\dfrac{a+b}{1-ab}$

(B) $\dfrac{b-a}{1+ab}$

(C) $\dfrac{a-b}{1+ab}$

(D) none of these

41. The number of numbers from the set of first 500 natural numbers which are multiples of 3 or 5 but not of 7, is

(A) 210
(B) 200
(C) 190
(D) 271

42. The number of values of x for which sin 2x + cos 2x = 2 is

(A) 0
(B) 1
(C) 2
(D) Infinite

43. Largest number out of the following numbers, which divides ${}^{60}C_{30}-1$ is given by

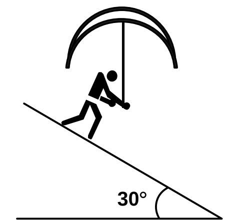
(A) 37
(B) 41
(C) 53
(D) 61

Space for Rough Work

Section-III Science & Mathematics (PCM)

Physics (Part – A)

44. A man is coming down an incline of angle 30°. When he walks with speed $2\sqrt{3}$ m/s, he has to keep his umbrella vertical to protect himself from rain. The actual speed of rain is 5 m/s. at what angle with vertical should he keep his umbrella when he is at rest so that he does not get drenched?



(A) 0° (B) 30°
(C) 37° (D) 53°

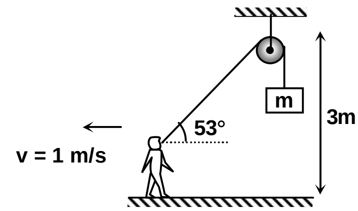
45. An elevator of mass M is accelerated upwards by applying a force F. A mass m initially situated at a height of 1 m above the floor of the elevator is falling freely. It will hit the floor of the elevator after a time equal to:

(A) $\sqrt{\frac{2M}{F+mg}}$ (B) $\sqrt{\frac{2M}{F+Mg}}$
(C) $\sqrt{\frac{2M}{F}}$ (D) $\sqrt{\frac{2m}{F}}$

Space for Rough Work

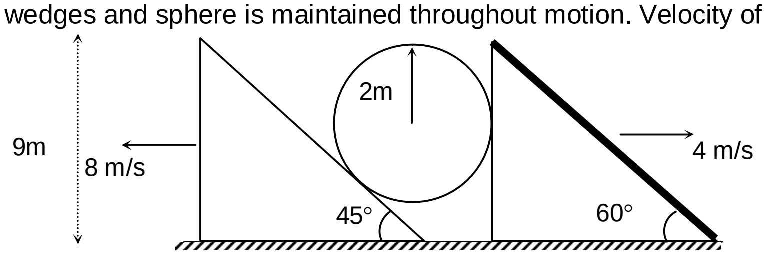
46. A wooden cube is placed on a rough horizontal table. A force is applied to cube. Gradually the force is increased. Whether the cube slides before toppling or topples before sliding is independent of
(A) the position of point of application of the force
(B) the length of the edge of the cube
(C) mass of the cube
(D) coefficient of friction between the cube and the table.

47. A boy is running at a constant speed v = 1 m/s leftward without slipping on a rough horizontal surface. He is holding string which is connected to a block of mass m = 2kg as shown in the figure. Find out the power developed by internal forces of the boy in the situation shown in the figure. (Take g = 10 m/s^2)



(A) 12.2 W
(B) 12 W
(C) 12.8 W
(D) 11.8 W

48. As shown in diagram, two wedges of same height are placed on a smooth surface, and moving in opposite direction with constant velocity. A sphere is placed in such a way that the contact between wedges and sphere is maintained throughout motion. Velocity of sphere will be



(A) $2\sqrt{10}$
(B) 12
(C) 4
(D) $4\sqrt{10}$

Space for Rough Work

Chemistry (Part – B)

49. In a sample of hydrogen atoms, all atoms are originally in 4^{th} excited state. The minimum number of H–atoms that should be present in this sample in order to show all possible spectral lines are
(A) 04
(B) 05
(C) 06
(D) 03

50. A solution is saturated with respect to SrF_2 and $SrCO_3$. If the fluoride ion concentration in the solution is 4×10^{-2} M, the concentration CO_3^{2-} ion in the solution is
$\left[K_{sp}\left(SrF_2\right) = 8\times10^{-10}, K_{sp}\left(SrCO_3\right) = 7\times10^{-10}\right]$
(A) $1.4\times10^{-3}M$
(B) 2.5×10^{-4}
(C) 4.2×10^{-2} M
(D) $1.8\times10^{-2}M$

51. If the radius of 1^{st} Bohr orbit of hydrogen atom is r, the de Broglie wavelength of an electron in the 2^{nd} Bohr orbit of hydrogen atom is
(A) $2\pi r$
(B) 4r
(C) 2r
(D) $4\pi r$

52. Structure of $N(SiH_3)_3$ is trigonal planar. Which of the statement is correct regarding the geometry of $N(SiH_3)_3$
(A) Nitrogen atom in $N(SiH_3)_3$ has sp^2 hybridization and in π bonding $2p_x$ orbital of N and either d_{xy} or d_{zx} orbital of Si are involved.
(B) Nitrogen atom in $N(SiH_3)_3$ has sp^2 hybridization and in π bonding $2p_z$ orbital of N and d_{z^2} orbital of Si are involved.
(C) Nitrogen atom in $N(SiH_3)_3$ has sp^3 hybridization and there is no lateral overlapping.
(D) In $N(SiH_3)_3$, atomic orbitals of nitrogen do not involve in hybridization at all.

53. The pH of a mixture obtained by mixing 100 ml, 0.1 M H_3PO_4 with 100 ml of 0.3 M Na_3PO_4, is
(For H_3PO_4; $Ka_1 = 1 \times 10^{-4}$, $Ka_2 = 1 \times 10^{-8}$, $Ka_3 = 1 \times 10^{-11}$ and $\log_{10} 3 = 0.47$)
(A) 7.53
(B) 10.53
(C) 11.47
(D) 4.47

Space for Rough Work

Mathematics (Part – C)

54. Let f (x) = $x^2 + bx + c$; where b, c $\in$ R. If f (x) is a factor of both $x^4 + 6x^2 + 25$ and $3x^4 + 4x^2 + 28x + 5$, then the least value of f (x) is
(A) 2
(B) 3
(C) 4
(D) 6

55. $\sum_{r=1}^{\infty} \frac{r^3 + (r^2+1)^2}{(r^4+r^2+1)(r^2+r)}$ is equal to
(A) 4
(B) 1
(C) 2
(D) 3/2

56. If AB is chord of contact of point P (5, –5) to the circle $x^2 + y^2 = 5$ and (α, β) is the orthocentre of triangle PAB, then $|\alpha - 1| + |\beta - 1|$ is equal to
(A) 2
(B) $\sqrt{5}$
(C) $2\sqrt{5}$
(D) 3

57. If H is the orthocentre of acute angled triangle ABC, R is circum–radius and P = AH + BH + CH, then
(A) $2R < P \leq 3R$
(B) $R < P \leq 4R$
(C) $2R < P \leq 5R$
(D) none of these

58. From a point 't' on the parabola $y^2 = 4ax$, a focal chord and a tangent are drawn. Two circles are drawn in which one circle is drawn taking focal chord as diameter and other is drawn by taking intercept of tangent between point 't' and directrix as diameter. Then the locus of mid point of common chord of the circles is
(A) $y = 3x + a$
(B) $9ax^2 - ay^2 - 2xy^2 + 6a^2x + a^3 = 0$
(C) $9ax^2 + ay^2 + 2xy^2 - 6a^2x - a^3 = 0$
(D) None of these

Space for Rough Work

FIITJEE TALENT REWARD EXAM

(FTRE-2013)

CLASS XI
HINTS (SET-A)
PAPER-2

1. (B) Clearly, A$B*C means A is the son of B and B is wife of C. Hence, Answer is (B) i.e. C is father of A.

2. (C) Clearly A@B#C means A is sister of B and B is mother of C. Hence, Answer is (C) i.e. A is Aunt of C.

Directions (Solutions for Q. 3 to 5):

3. (C) Saurav is third to the left of Abhinav.

4. (D) Shubham is sitting between Kartik and Abhinav. So, it is wrong statement.

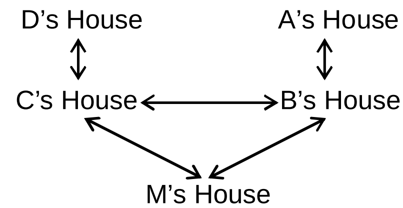
5. (A) Shobhit is second to the left of Kartik.

6. (A) Since Seema and Reema interchange position, so Seema's new position is the same as Reema's earlier position. This position is 14^{th} from the left (Seema's new position).
Number of girls in the row = (13 + 1 + 16) = 30. So, Answer is (A).

7. (C) One clock is gaining 2 min and other clock is losing 4 minutes. So, difference between two clocks = 6 minutes.
It shows correct time at 10 am. So, time difference 10 am – 8 pm (next day) = 34 hours.
Differences of two clocks = 34 hours × 6 minutes
= 204 minutes
$\Rightarrow$ 3 hours and 24 minutes.

8. (C) In terms of earning, we have:
D > C > A > E > B.
So, least among five is B. Hence, Answer is (C).

9. (C) From the figure we can see that M's house is in the south east of D's house.



Directions (Q. 10 to 12): From the given information we can prepare table:

	Subject	Colour
P	Chemistry	Yellow
Q	Mathematics	Blue
R	Economics	Purple
S	Biology	Black
T	Physics	Green
U	History	Red
V	English	Pink

10. (A)

11. (C) S's favourite subject is Biology. Hence Answer is (C).

12. (A) T likes Green colour. Hence Answer is (A).

13. (B) $(7+5)=12, (8-3)=5, \quad 12^2-5^2=119$

$(5+4)=9, (9-6)=3, 9^2-3^2=72$

$(8+3)=11, (7-2)=5, 11^2-5^2=96$

14. (D) $17\times 5=85-(4+1)=85-5=80$

$13\times 9=117-(8+6)=117-14=103$

$15\times 7=105-(9+5)=105-14=91$

15. (B) $4^2+3^2=25, 6^2+7^2=85, 8^2+5^2=89.$

16. (B) Sarita remembers that her father's birthday is after 8^{th} June but before 12^{th} June, while her brother remembers that it falls after 10^{th} June but before 15^{th} June. So, definitely it's falls on 11^{th} June.

17. Bx + Ct + D must be dimensionless
so dimension of B is $[L^{-1}]$, C is $[T^{-1}]$ and D is a dimensionless constant.
A is having dimension $[L^1]$
$\therefore$ [ABCD] is having dimensional formula $[T^{-1}]$

18. $\frac{d|\vec{v}|}{dt}$ is component of $\vec{a}$ along $\vec{v}$. So $\frac{d|\vec{v}|}{dt}=\frac{\vec{v}\cdot\vec{a}}{|\vec{v}|}$

Concept Involved
1. tangential acceleration
2. Dot product

19. Moment of inertia of the ring A, above the axis = mR^2
Moment of inertia of the ring B, above the axis = mR^2

$$\frac{mR^2}{2} + m\left(\frac{R}{\sqrt{2}}\right)^2 = mR^2$$

because angular acceleration of both the rings are equal.
So, $\tau_A = \tau_B$
Concept Involved
1. moment of inertia
2. $\tau = I\alpha$

20. $X_{com} = \dfrac{m\left(\frac{1}{4}\right)}{m+m} = Y_{cm}$

$\therefore$ co-ordinate of C.M. is $\left(\frac{1}{8}, \frac{1}{8}\right)$

Concept Involved
(i) centre of mass

21. Tension is maximum at the bottom most point and $T_{max} = 3mg - 2mg \cos \theta_0$
Tension is minimum at the extreme position and $T_{min} = mg \cos \theta_0$
$\therefore T_{max} = 3 T_{min}$
$\therefore$ $\cos \theta_0 = 3/5$
Concept
(i) relative velocity
(ii) vector diagram

22. At B, C and D, $\dfrac{dV}{dx} = 0$
So, force on the particle is zero
Concept involved
(i) Potential energy
(ii) Conservation of mechanical energy

23. $\dfrac{dv}{dt}$ is increasing upto point R. So at point R acceleration is maximum i.e., force is maximum.
Concept involved
(i) fundamental collision

24. mvr = C (constant)
$\therefore v = \dfrac{C}{mr}$

$$T = \frac{mv^2}{r} = \frac{mC^2}{mr^3} = \frac{C^2}{mr^3}$$

$\therefore T \propto r^{-3}$
Concept involved
(i) Centripetal force
(ii) Angular momentum

25. $\frac{1}{2}M_1V_1^2 = \frac{1}{2}M_2V_2^2$
$M_1 < M_2$
$M_1^2V_1^2 < M_2^2V_2^2$

$M_1V_1 < M_2V_2$
Concept involved
(i) linear momentum
(ii) kinetic energy

26. (D)
The Bond length is inversely proportional to bond order.

27. A
Higher the value of critical temperature easier to liquify a gas.

28. C
$C(gr) + O_2(g) \longrightarrow CO_2(g),\ \Delta H_{comb} C(gr) = x\,Kcal/mol$ .... (1)

$H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(l),\ \Delta H_{comb} H_2(g) = y\,Kcal/mol$ .... (2)

$CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(l),\ \Delta H_{comb} CH_4(g) = z\,Kcal/mol$ .... (3)

Eq(1) + 2 × Eq(2) – Eq(3) $= C(gr) + 2H_2(g) \longrightarrow CH_4(g),\ \Delta H_f(CH_4, g) = (x + 2y - z)Kcal/mol$

29. (B)
$$\frac{r_{H_2}}{r_{O_2}} = \sqrt{\frac{M_{O_2}}{M_{H_2}}} = \sqrt{\frac{32}{2}} = 4$$
∴ Let the volume of H_2 effused be x ml.

$$\therefore \quad \frac{x}{10 - x} = 4$$
x = 8 ml

30. A
Let n_1 mole of CO and n_2 mole of CO_2 are present in the mixture
$$28n_1 + 44n_2 = (n_1 + n_2)40$$
$$n_2 = 3n_1$$
$$\frac{n_1}{n_2 + n_1} = \frac{1}{4}$$
mole of CO in 100 gm sample is $100 \times \frac{1}{40} \times \frac{1}{4} = 0.625\,mole$

31. C
Addition of catalyst do not affect the equilibrium constant. Since the given reaction is exothermic and hence equilibrium constant decreases with increase of temperature.

32. C
Due to $p\pi - p\pi$ bonding

33. D
$$C_xH_y + \left(x + \frac{y}{4}\right)O_2 \longrightarrow xCO_2 + \frac{y}{2}H_2O$$
10 ml $\quad 10\left(x + \frac{y}{4}\right)O_2\,ml$ $\quad$ 10x ml

Volume of CO_2 = 20 ml
$10x = 20$, so $x = 2$
Volume of O_2 = 75 ml
Volume of O_2 reacted = 100 – 75 = 25 ml

$$\therefore \quad 10\left(x+\frac{y}{4}\right)=25$$

$$10\left(2+\frac{y}{4}\right)=25$$

$$y=2$$

Formula of hydrocarbon = C_2H_2

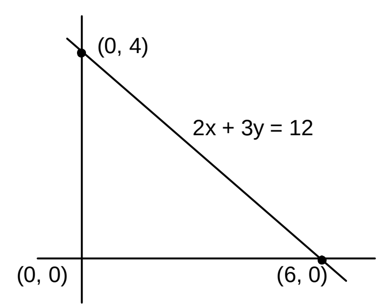
34. B
meq of $Na_2S_2O_3$ = meq of I_2 = meq of H_2O_2
meq of $H_2O_2 = 10 \times 0.1 = 1$
$50 \times N = 1$

$$N=\frac{1}{50}$$

$\therefore$ conc. of H_2O_2 in g/L = N × E = $\frac{1}{50}\times 17 = 0.34\,g/L$

35. On solving we get, $y = x - 1$
$\Rightarrow \frac{dy}{dx} = 1.$

36. Hint : We know that in a right angled triangle circumcentre is a middle point of hypotenuse
Solution : $\left(\frac{6+0}{2}, \frac{0+4}{2}\right)=(3,2)$



37. We have $\log_{n^p} m^q = \log_{n^p} n^{kq} = \frac{qk}{p}$.

38. $\int e^{\sqrt{x}}\,dx$
Hint : Method of substitution
Solution : Let $\sqrt{x} = t$

$$\frac{1}{2\sqrt{x}}dx = dt \quad \Rightarrow \quad dx = 2t\,dt$$

$$\int e^t \cdot 2t\,dt = 2\left[e^t \cdot t - \int e^t dt\right]$$

$$= 2\left[e^{\sqrt{x}}\sqrt{x} - e^{\sqrt{x}}\right] + c\ .$$

39. $f(x) = ax^2 - bx + 1$
f(0) = 1 (positive)
i.e. $f(x) = ax^2 - bx + 1 > 0$ $\quad (\because\ ax^2 - bx + 1 = 0$ has imaginary roots)

$f(-1) = a + b + 1 > 0$

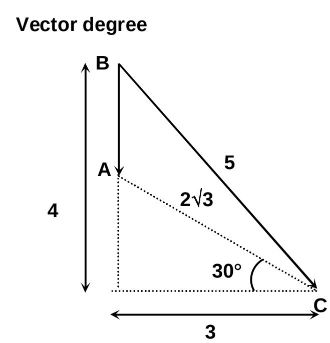
40. $\tan 2\alpha = \tan [(\theta + \alpha) - (\theta - \alpha)]$
$= \dfrac{\tan(\theta+\alpha) - \tan(\theta-\alpha)}{1+\tan(\theta+\alpha)\tan(\theta-\alpha)} = \dfrac{b-a}{1+ab}$

41. Let A = {3, 6, 9, …, 498}
B = {5, 10, 15, …, 500}
C = {7, 14, 21, …, 497}
Required number = $n(A \cup B \cup C) - n(C)$
$= n(A) + n(B) + n(C) - n(A \cap B) - n(B \cap C) - n(C \cap A) + n(A \cap B \cap C) - n(C)$
$= 166 + 100 - 33 - 23 - 14 + 4 = 200.$

42. As $|\sin 2x + \cos 2x| \le \sqrt{2} \Rightarrow$ no solution.

43. We have ${}^{60}C_{30} - 1 = \dfrac{60!}{30!30!} - 1$
$= \dfrac{(60\times 59\times ...\times 31) - (30\times 29\times ...\times 1)}{30!}$
$= \dfrac{(61-1)(61-2)\ ....(61-30) - (30\times 29\times ...\times 1)}{30!} = 61k\,.$
$\therefore$

44. $\therefore \angle ABC = 37°$



Concept:
(i) Relative velocity
(ii) Vector diagram

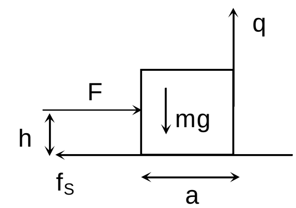
45. $a_e = \dfrac{F - Mg}{M}$
$a_m = g$
$g + a_e = \dfrac{F}{M}$
$1 = \dfrac{1}{2}\dfrac{F}{M}t^2$
$t = \sqrt{\dfrac{2M}{F}}$
Concept
(i) Laws of Motion
(ii) Relative Motion

46. Block of slide
If $F > \mu mg$
Block will topple if

$Fh > mg\frac{a}{2}$ or $F > \frac{mga}{2h}$

The sliding will occur earlier if $\mu mg < \frac{mga}{2h}$

$\Rightarrow$ $\mu < a/2h$
and toppling will occur earlier if $\mu > a/2h$, so independent of mass
Concept involved
(i) Toppling
(ii) Shifting of normal



47. $P_{f_s} + P_b + P_w = \frac{d}{dt}\left(\frac{1}{2}mv_m^2\right)$

$0 + P_b - mgv_m = \frac{1}{2}m\frac{d}{dt}\left(v_m^2\right)$

$P_b - mgv_m = \frac{1}{2}m\frac{d}{dt}\left(v^2\cos^2\theta\right)$

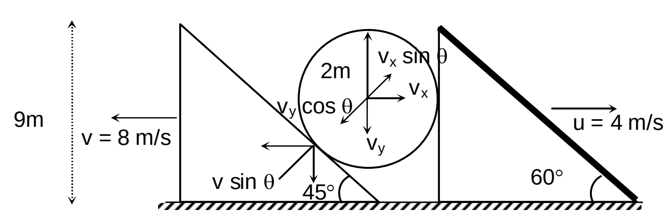
$P_b - mgv_m = \frac{1}{2}mv^2 2\cos\theta(-\propto\theta)\frac{d\theta}{dt}$

$P_b = mgv_m + mv^2\sin\theta\cos\theta\frac{v\sin^2\theta}{3}$

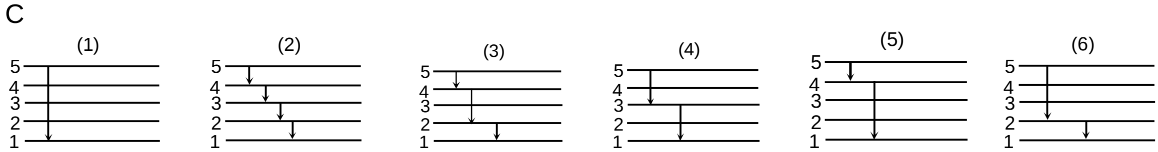
$= mgv\cos\theta + \frac{mv^3}{3}\sin^3\cos\theta$

$= (2)\ (10)\ (1)\frac{3}{5} + \frac{2}{3}\times\frac{64}{125}\times\frac{3}{5}$ = 12 + 0.2 = 12.2 Watt
Concept involved
(i) Power
(ii) Work done by internal force

48. $v\sin\theta = v_y\cos\theta - v_x\sin\theta$
and $v_x = u = 4$ m/s
$v\sin\theta = v_y\cos\theta - u\sin\theta$
$(u + v)\sin\theta = v_y\cos\theta$
$v_y = (u + v)\tan\theta$
$v_y = v + u$
$v_y = 12$ *m/s*
. Concept involved
(i) velocity constraints



49. C



50. A

$$\left[Sr^{2+}\right] = \frac{8\times10^{-10}}{\left(4\times10^{-2}\right)^2} = 5\times10^{-7}M$$

$$\left[CO_3^{2-}\right] = \frac{7\times10^{-10}}{5\times10^{-7}} = 1.4\times10^{-3}$$

51. D

$$r_n = r_0\times n^2 = r_0\times 2^2 = 4r$$

$$mv = \frac{nh}{2\pi r_2} = \frac{h}{4\pi r}$$

$$\lambda = \frac{h}{mv} = 4\pi r$$

52. A

In $p\pi$– $d\pi$ overlapping d_{z^2} and $d_{x^2-y^2}$ can not be involved.

53. B

	PO_4^{3-}	+	H_3PO_4	$\rightleftharpoons$	HPO_4^{2-}	+	$H_2PO_4^-$
Initial m.mol	30		10		0		0
m.mol after neutralization	20		0		10		10

also

	PO_4^{3-}	+	$H_2PO_4^-$	$\rightleftharpoons$	$2HPO_4^{2-}$
Initial m.mols	20		10		10
m.mol after neutralization	10		0		30

So it is a buffer so,

$$pH = pka_3 + \log\frac{\left[PO_4^{3-}\right]}{\left[HPO_4^{2-}\right]}$$

$$pH = 11 + \log\frac{10}{30}$$

$$pH = 10.53$$

54. f (x) will also be a factor of 3 (x^4 + 6x^2 + 25) – (3x^4 + 4x^2 + 28x + 5); which is equal to 14 (x^2 – 2x + 5)

So, f (x) = $x^2 - 2x + 5 \geq 4$.

55. $$\sum_{r=1}^{\infty}\frac{r^3+\left(r^2+1\right)^2}{\left(r^4+r^2+1\right)\left(r^2+r\right)} = \sum_{r=1}^{\infty}\frac{r}{r^4+r^2+1} + \sum_{r=1}^{\infty}\frac{1}{r\,(r+1)}$$

$$= \frac{1}{2}\sum_{r=1}^{\infty}\left(\frac{1}{r^2-r+1} - \frac{1}{r^2+r+1}\right) + \sum_{r=1}^{\infty}\left(\frac{1}{r} - \frac{1}{r+1}\right)$$

Applying V_n method we get,

$$S = \frac{1}{2} + 1 = \frac{3}{2}.$$

56. $\because (\alpha, \beta)$ has image in AB as (0, 0).

57. P = 2R(cos A + cosB + cosC)

Since $1 < \cos A + \cos B + \cos C \le \frac{3}{2} \Rightarrow 2R < P \le 3R$.

58. Locus is mid point of AD
On solving, we get the locus as
$9ax^2 - ay^2 - 2xy^2 + 6a^2x + a^3 = 0$