Roll No. | | | | | | | | | | | |

Name :

Booklet Code **V**

Date : 20th December 2020

ENGINEERING

Aakash NATIONAL TALENT HUNT EXAM

ANTHE 2020

(Class XI Studying Moving to Class XII)

Physics, Chemistry & Mathematics

INSTRUCTIONS FOR CANDIDATE

1. Duration of Test is 1 hr.
2. The Test booklet consists of **35** questions. The maximum marks are **90**. There is **no negative marking** for wrong answer.
3. Pattern of the questions are as under:
   (i) This question paper consists of three parts i.e., Physics, Chemistry and Mathematics, each having **five sections**.
   (ii) **Section-I:** This section contains **16** multiple choice questions, which have **only one** correct answer. Each question carries **+2 marks** for correct answer.
   (iii) **Section-II:** This section contains **7** multiple choice questions, in which **more than one** answer may be correct. Each question carries **+4 marks** for correct answer.
   (iv) **Section-III:** This section contains **6** multiple choice questions based on paragraphs, which have **only one** correct answer. Each question carries **+2 marks** for correct answer.
   (v) **Section-IV:** This section contains **3** multiple choice questions based on assertion-reason type, which have **only one** correct answer. Each question carries **+2 marks** for correct answer.
   (vi) **Section-V:** This section contains **3** matrix match type questions. Each question has two matching Columns. Column-I has four entries (A, B, C, D) and Column-II has four entries (P, Q, R, S). Each entry in Column-I may match with one or more entries in Column-II. Each question carries **+4 marks** for correct answer.

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Aakash National Talent Hunt Exam 2020

(*Class XI Studying Moving to Class XII*)

Time : 1 Hour **MM : 90**

PHYSICS

SECTION-I : SINGLE ANSWER TYPE

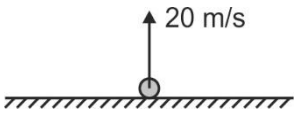
This section contains 5 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4) out of which **ONLY ONE** is correct.

1. Dimensional formula of angular impulse is

   (1) $[MLT^{-1}]$ (2) $[ML^2T^{-1}]$

   (3) $[MLT]$ (4) $[LT^{-2}]$

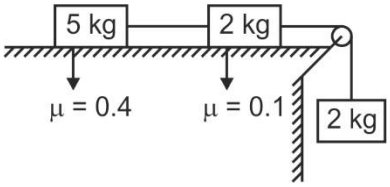
2. A particle is thrown vertically upward with velocity 20 m/s. Velocity of the particle when it would be at half of its maximum height, is



   (1) $20\sqrt{2}$ m/s (2) $10\sqrt{2}$ m/s

   (3) 10 m/s (4) 20 m/s

3. Frictional force on 5 kg block shown in the figure is



   (1) 22 N

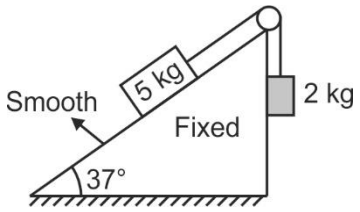
   (2) 15 N

   (3) 20 N

   (4) 18 N

Space for Rough Work

4. In the shown figure, string and pulley are ideal. Tension (T) in the string is



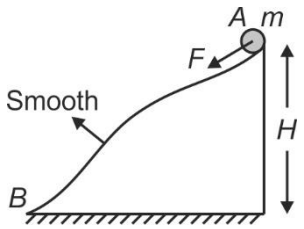
(1) 40 N

(2) $\frac{180}{7}$ N

(3) 60 N

(4) $\frac{160}{7}$ N

5. A particle of mass (m) is taken from point A to point B under the action of force F. Speed of the particle at point B and A are v_0 and zero respectively. Work done by force F is



(1) mgH

(2) $mgH + \frac{1}{2}mv_0^2$

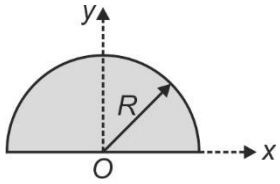
(3) $\frac{1}{2}mv_0^2$

(4) $\frac{1}{2}mv_0^2 - mgH$

SECTION-II : MORE THAN ONE ANSWER TYPE

This section contains 2 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4) out of which **MORE THAN ONE** answer may be correct.

6. If (x_{CM}, y_{CM}) are the coordinates of centre of mass of uniform semicircular disk of radius R, then



Space for Rough Work

(1) $x_{CM} = 0$

(2) $y_{CM} = \frac{4R}{3\pi}$

(3) $x_{CM} = \frac{R}{4}$

(4) $y_{CM} = \frac{2R}{3\pi}$

7. If collision between balls *m* and 2*m* are perfectly elastic, then

(1) Velocity of mass *m* just after collision is 4 m/s

(2) Velocity of mass *m* just after collision is $\frac{8}{3}$ m/s

(3) Velocity of mass *2m* just after collision is 2 m/s

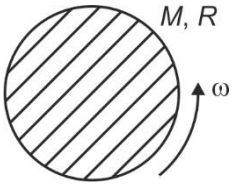
(4) Velocity of mass 2*m* just after collision is $\frac{10}{3}$ m/s

SECTION-III : PARAGRAPH TYPE

This section contains a paragraph. Based upon this paragraph, 2 multiple choice questions have to be answered. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Paragraph for Q. Nos. 8 & 9

A uniform circular disk of mass *M* and radius *R* is rotating with an angular velocity ω on a smooth horizontal surface. Another identical disk is placed gently over it covering the whole disk. After sometime, both disk have common angular velocity ω_0. [*I* : Moment of inertia of a disk about its natural axis]



8. Value of ω_0 is

(1) $\frac{\omega}{2}$

(2) ω

(3) $\frac{\omega}{4}$

(4) $\frac{\omega}{3}$

Space for Rough Work

9. Total work done by the frictional force is

(1) $\frac{I\omega^2}{4}$ (2) $-\frac{I\omega^2}{4}$

(3) $-\frac{I\omega^2}{2}$ (4) $\frac{I\omega^2}{2}$

SECTION-IV : ASSERTION & REASON TYPE

This section contains 1 Assertion-Reason type question, which has 4 choices (1), (2), (3) and (4) out of which **ONLY ONE** is correct.

10. **A :** A man initially at rest cannot run over smooth surface.

R : To accelerate over smooth surface no external force is required.

(1) Both (A) and (R) are true and (R) is the correct explanation of (A)

(2) Both (A) and (R) are true but (R) is not the correct explanation of (A)

(3) (A) is true but (R) is false

(4) (A) is false but (R) is true

SECTION-V : MATRIX MATCH TYPE

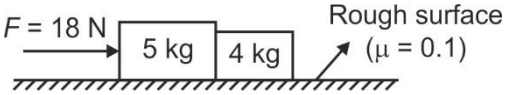
This section contains 1 Matrix Match type question, which has 2 Columns (Column-I and Column-II). Column-I has four entries (A), (B), (C) and (D), Column-II has four entries (P), (Q), (R) and (S). Match the entries in Column-I with the entries in Column-II. Each entry in Column-I may match with one or more entries in Column-II.

For each entry in Column-I, tick the boxes of all the matching entries in Column-II. For example, if entry (A) in Column-I matches with entries (P) & (S) in Column-II, then tick the boxes (P) & (S). Similarly, tick the boxes for entries (B), (C) and (D).

	P	Q	R	S
A.	☑	☐	☐	☑
B.	☐	☐	☐	☐
C.	☐	☐	☐	☐
D.	☐	☐	☐	☐

Space for Rough Work

11. In the shown figure, a horizontal force F = 18 N is applied on the 5 kg block. Match the entries of Column-I with the entries of Column-II. [All values are in SI unit in the Column-II, g = 10 m/s^2]



	Column-I		Column-II
(A)	Normal reaction between two blocks	(P)	1
(B)	Acceleration of 4 kg block	(Q)	8
(C)	Frictional force on 4 kg block	(R)	4
(D)	Net force on 5 kg block	(S)	5

CHEMISTRY

SECTION-I : SINGLE ANSWER TYPE

This section contains 5 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4) out of which **ONLY ONE** is correct.

12. Sodium oxide when dissolved in water, forms a solution of NaOH. What is the molarity (with respect to NaOH) of the solution formed, if 2.7 g sodium oxide is mixed with water such that the final volume is 200 mL?

(1) 0.217 M (2) 0.87 M

(3) 0.435 M (4) 0.108 M

13. Which of the following gas among the given diffuses fastest at similar conditions of T and P?

(1) NH_3 (2) CO_2

(3) CO (4) Cl_2

14. 500 g of nitrogen gas at 300 K are held by a piston under 20 atm. The pressure is suddenly released to 10 atm and gas is allowed to expand adiabatically. If C_v = 20.8 JK^{-1} mol^{-1}, the value of ΔS_{sys} is [ln(0.857) = –0.154]

(1) 36.70 JK^{-1}

(2) 22.80 JK^{-1}

(3) 12.23 JK^{-1}

(4) 48.93 JK^{-1}

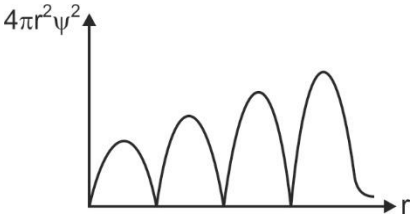
Space for Rough Work

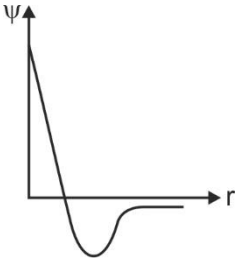
15. The value of speed of an electron in 3rd Bohr orbit of Be^{3+} ion is

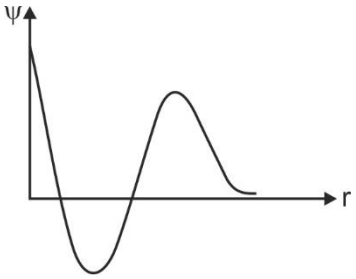
(1) 2.9×10^6 m/s (2) 3.5×10^6 m/s

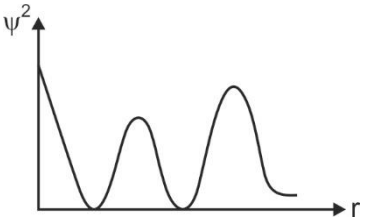
(3) 5.0×10^6 m/s (4) 1.6×10^6 m/s

16. The maximum number of radial nodes are present in which of the following orbitals?

I. 

II. 

III. 

IV. 

(1) I (2) II

(3) III (4) IV

SECTION-II : MORE THAN ONE ANSWER TYPE

This section contains 2 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4) out of which **MORE THAN ONE** answer may be correct.

17. HOMO is highest occupied molecular orbital and u and g represent ungerade and gerade symmetry respectively. Which of the following diatomic molecule is correctly matched with HOMO?

(1) B_2, π_u (2) C_2, π_u

(3) O_2, π_g (4) F_2, σ_u

18. Which of the following among the given has positive value of electron affinities?

Be, B, C, N, O, F, Al, Mg

(1) B, C (2) Be, Mg, N

(3) O, F, Al (4) Be, N

Space for Rough Work

SECTION-III : PARAGRAPH TYPE

This section contains a paragraph. Based upon this paragraph, 2 multiple choice questions have to be answered. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Paragraph for Q. Nos. 19 & 20

The emission spectrum of H-atom and like species were studied by several scientists. All lines in UV region were studied by Lyman, all lines in visible region were studied by Balmer and the lines of longer wavelength were studied by Paschen, Brackett and Pfund.

Answer the following questions.

19. Which electronic transition in an ion emits light of wavelength equal to the longest wavelength emitted in the Paschen series of H-atom? [Assume ion is He^+]

    (1) $9 \rightarrow 6$

    (2) $8 \rightarrow 6$

    (3) $8 \rightarrow 5$

    (4) $7 \rightarrow 3$

20. What electronic transition in H-spectrum would have same wavelength as the transition n = 4 to n = 2 in He^+ ion?

    (1) n = 4 to n = 1

    (2) n = 2 to n = 1

    (3) n = 4 to n = 3

    (4) n = 3 to n = 2

SECTION-IV : ASSERTION & REASON TYPE

This section contains 1 Assertion-Reason type question, which has 4 choices (1), (2), (3) and (4) out of which **ONLY ONE** is correct.

21. **A :** XeF_2 is a polar covalent molecule.

    R : Xe atom is sp^3d hybridised in XeF_2.

    (1) Both (A) and (R) are true and (R) is the correct explanation of (A)

    (2) Both (A) and (R) are true but (R) is not the correct explanation of (A)

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    (4) (A) is false but (R) is true

Space for Rough Work

SECTION-V : MATRIX MATCH TYPE

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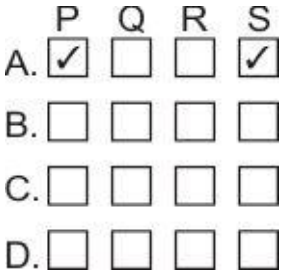

22. Match Column-I with Column-II.

	Column-I		**Column-II**
(A)	PCl_5	(P)	Lone pair on central atom is zero
(B)	$XeOF_4$	(Q)	Hybridisation of central atom is sp^3d^2
(C)	XeF_4	(R)	Non-polar
(D)	NH_3	(S)	Percentage of s-character is 25%

MATHEMATICS

SECTION-I : SINGLE ANSWER TYPE

This section contains 6 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4) out of which **ONLY ONE** is correct.

23. Sum of the series $S = 1 + 4 + 7 + 10 + 13 + \ldots$ up to 21 terms is

(1) 441 (2) 479

(3) 651 (4) 691

Space for Rough Work

24. Complete solution of inequality $|3x - 4| < 2$ is

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

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

25. If product of roots of the equation $(p + 1)x^2 + (2p + 3)x + (3p + 4) = 0$ is 2, then sum of its roots is

(1) –2 (2) 2

(3) –1 (4) 1

26. Minimum value of $f(x) = x^2 + 4x + 3$ is

(1) 2 (2) 1

(3) –2 (4) –1

27. Value of $(1 + i)^6 + (1 - i)^6$ is (where $i = \sqrt{-1}$)

(1) Zero (2) $-8i$

(3) $16i$ (4) $-16i$

28. Modulus of $(3 - 4i)$ is (where $i = \sqrt{-1}$)

(1) 1 (2) 5

(3) 25 (4) 15

SECTION-II : MORE THAN ONE ANSWER TYPE

This section contains 3 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4) out of which **MORE THAN ONE** answer may be correct.

29. Consider $S_n = \frac{1}{2} + \frac{1}{3} + \frac{1}{2^2} + \frac{1}{3^2} + \ldots$ up to n terms, then

(1) $S_{16} = \frac{3}{2} - \frac{1}{2^8} - \frac{1}{2 \cdot 3^8}$

(2) $S_{16} = \frac{1}{2} - \frac{1}{2^8} - \frac{1}{3^8}$

(3) $S_\infty = \frac{3}{2}$

(4) $S_\infty = 2$

Space for Rough Work

30. Which of the following represents a set?

(1) The collection of intelligent students in a class

(2) The collection of those students who secured above 90 marks in class XI exam

(3) The collection of prime numbers

(4) The collection of teachers in the XYZ school

31. For which of the following functions, domain is R (set of real numbers)?

(1) $f_1(x) = \sin x$ (2) $f_2(x) = \text{sgn}(x)$

(3) $f_3(x) = \ln x$ (4) $f_4(x) = \dfrac{x^2+1}{x^2+2}$

SECTION-III : PARAGRAPH TYPE

This section contains a paragraph. Based upon this paragraph, 2 multiple choice questions have to be answered. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Paragraph for Q. Nos. 32 & 33

Consider the letters of the word 'BANGLORE'.

32. Possible number of letters taking all letters at a time such that no two vowels are together, is

(1) 9600 (2) 12600

(3) 7200 (4) 14400

33. Possible number of words taking all letters at a time, is

(1) 8! (2) $\dfrac{8!}{2}$

(3) $\dfrac{8!}{4}$ (4) 7!

SECTION-IV : ASSERTION & REASON TYPE

This section contains 1 Assertion-Reason type question, which has 4 choices (1), (2), (3) and (4) out of which **ONLY ONE** is correct.

34. **A :** Value of $\sin^2 15° + \cos^2 15° = \dfrac{3}{4}$.

R : Value of $\sin^2 x + \cos^2 x = 1$, $\forall\, x \in R$.

Space for Rough Work

(1) Both (A) and (R) are true and (R) is the correct explanation of (A)

(2) Both (A) and (R) are true but (R) is not the correct explanation of (A)

(3) (A) is true but (R) is false

(4) (A) is false but (R) is true

SECTION-V : MATRIX MATCH TYPE

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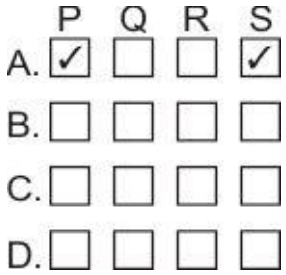

35. Match the functions given in Column-I with their ranges in Column-II.

	Column-I		**Column-II**
(A)	$f_1(x) = \sin x + \cos x$	(P)	$(0, \infty)$
(B)	$f_2(x) = \tan x$	(Q)	$[0, \infty)$
(C)	$f_3(x) = \ln x$	(R)	R
(D)	$f_4(x) = e^x$	(S)	$[-\sqrt{2}, \sqrt{2}]$

❑ ❑ ❑

Space for Rough Work

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450 385 Classroom + 65 Distance & Digital in KVPY Fellowship Award 2019-20	**767** 701 Classroom + 66 Distance & Digital in NSEs 2019	**481** 466 Classroom + 15 Distance & Digital in IMO (Level-I) 2018-19	**800** 728 Classroom + 72 Distance & Digital in NSO (Level-I) 2019-20	**26** 20 Classroom + 06 Distance & Digital in INO 2020

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