Time: 2:30 PM to 3:45 PM

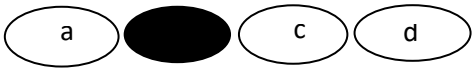
Question Paper Code: 51

Student's Roll No:														

Write the question paper code mentioned above on YOUR OMR Answer Sheet (in the space provided), otherwise your Answer Sheet will NOT be evaluated. Note that the same Question Paper Code appears on each page of the question paper.

Instructions to Candidates:

1. Use of mobile phone, smart watch, and iPad during examination is STRICTLY **PROHIBITED.**
2. In addition to this question paper, you are given OMR Answer Sheet along with candidate's copy.
3. On the OMR sheet, make all the entries carefully in the space provided **ONLY** in **BLOCK CAPITALS** as well as by properly darkening the appropriate bubbles.
   Incomplete/ incorrect/ carelessly filled information may disqualify your candidature.
4. On the OMR Answer Sheet, use only **BLUE or BLACK BALL POINT PEN** for making entries and filling the bubbles.
5. Your **14-digit roll number and date of birth** entered on the OMR Answer Sheet shall remain your login credentials means login id and password respectively for accessing your performance / result in Indian Olympiad Qualifier in Junior Science 2021-22 (Part I).
6. Question paper has two parts. In part A1 (Q. No.1 to 24) each question has four alternatives, out of which **only one** is correct. Choose the correct alternative and fill the appropriate bubble, as shown.

Q.No.12 

In part A2 (Q. No. 25 to 33) each question has four alternatives out of which any number of alternative(s) (1, 2, 3, or 4) may be correct. You have to choose **all** correct alternative(s) and fill the appropriate bubble(s), as shown

Q.No.30 

7. For **Part A1,** each correct answer carries 3 marks whereas 1 mark will be deducted for each wrong answer. In **Part A2,** you get 6 marks if all the correct alternatives are marked and no incorrect. No negative marks in this part.
8. Rough work should be done in the space provided. There are **09** printed pages in this paper
9. Use of **non- programmable scientific** calculator is allowed.
10. No candidate should leave the examination hall before the completion of the examination.
11. After submitting answer paper, take away the question paper & Candidate's copy of OMR for your reference.

Please DO NOT make any mark other than filling the appropriate bubbles properly in the space provided on the OMR answer sheet.

OMR answer sheets are evaluated using machine, hence CHANGE OF ENTRY IS NOT ALLOWED. Scratching or overwriting may result in a wrong score.

DO NOT WRITE ON THE BACK SIDE OF THE OMR ANSWER SHEET.

Instructions to Candidates (Continued) :
You may read the following instructions after submitting the answer sheet.

12. **Comments/Inquiries/Grievances regarding this question paper, if any, can be shared on the Inquiry/Grievance column on www.iapt.org.in on the specified format till January 15, 2022**
13. **The answers/solutions to this question paper will be available on the website: www.iapt.org.in by January 14, 2022.**

14. **CERTIFICATES and AWARDS:**
Following certificates are awarded by IAPT to students, successful in the Indian Olympiad Qualifier in Junior Science 2021-22 (Part I)
(i) "CENTRE TOP 10 %" To be downloaded from iapt.org.in after 15.03.22
(ii) "STATE TOP 1 %" Will be dispatched to the examinee
(iii) "NATIONAL TOP 1 %" Will be dispatched to the examinee
(iv) "GOLD MEDAL & MERIT CERTIFICATE" to all students who attend OCSC – 2022 at HBCSE Mumbai
Certificate for centre toppers shall be uploaded on iapt.org.in

15. List of students (with centre number and roll number only) having score above MAS will be displayed on the website: **www.iapt.org.in** by **February 06, 2022 See the Minimum Admissible Score Clause** on the student's brochure on the web.
16. List of students eligible for evaluation of IOQJS 2021-22 (Part II) shall be displayed on www.iapt.org.in by February 10, 2022.

Physical constants you may need….

Mass of electron $m_e = 9.10\times10^{-31} kg$	Magnitude of charge on electron $e = 1.60\times10^{-19} C$
Mass of proton $m_p = 1.67\times10^{-27} kg$	Planck's constant $h = 6.625\times10^{-34} Js$
Acceleration due to gravity g = 9.81 ms^{-2}	Density of seawater at $\rho = 1.03\times10^{3} kg\,m^{-3}$
Universal gravitational constant $G = 6.67\times10^{-11} Nm^2Kg^{-2}$	$(1+x)^n \approx 1+nx,\ \text{if}\ \lvert x\rvert << 1$
Universal gas constant $R = 8.31\ Jmol^{-1}K^{-1}$	$1eV = 1.6\times10^{-19} J$
Boltzmann constant $k = 1.38\times10^{-23} J\,K^{-1}$	$\sin(A-B) = \sin A\cos B - \cos A\sin B$
Avogadro's constant $A = 6.02\times10^{23} mol^{-1}$	$E = mc^2$, It's an equation which gives mass and energy equivalence.
Speed of light in free space $c = 3.0\times10^{8} ms^{-1}$	One unit of electric power = 1kWh

JUNIOR SCIENCE 2021-22 (Part I) (NSEJS 2021 – 22)

Time: 75 Minute **Max. Marks: 126**

Attempt All Thirty Three Questions

A – 1

ONLY ONE OUT OF FOUR OPTIONS IS CORRECT. BUBBLE THE CORRECT OPTION.

1. Which of the following is not a function of mature RBCs?
   (a) Help in classifying blood in different blood groups
   (b) Help in transport of gases
   (c) Synthesis of immunoglobulins
   (d) Help in maintaining acid base balance in the body

2. In which of the following classes of vertebrates there are groups of animals without limbs?
   (a) Fish, reptiles and mammals (b) Reptiles only
   (c) Reptiles and Amphibians (d) Amphibians only

3. Which of the following groups have only one pair of wings?
   (a) Honey bee, beetle, ant (b) Butterfly, housefly, fruitfly
   (c) Dragonfly, butterfly, fruitfly (d) Housefly, fruitfly, mosquito

4. During an expedition to planet 'Imagitica', scientists analysed the genetic material of the organisms found there and noted the following features:
   i. Amount of purines and pyrimidines is unequal
   ii. Absence of thymine
   iii. Unstable genetic material, with high frequency of mutation
   iv. Rapid degradation at pH above 12
   From the above data, what genetic material might the Imagitica inhabitants contain?
   (a) ssDNA (b) dsDNA (c) ssRNA (d) dsRNA

5. Which of the following is most likely to show aerenchyma?
   (a) Leaf base of mango (b) Petiole of water hyacinth
   (c) Seta of moss (d) Stem of *Opuntia*

6. Given below are three statements about bryophytes:
   i. Bryophytes are lower plants with plant body differentiated into root, stem and leaves.
   ii. Bryophytes are devoid of xylem and phloem.
   iii. Bryophytes require water for completion of their life cycle.

   Which of the above statement/s is/are true with respect to bryophytes?
   (a) ii only (b) i and ii (c) i and iii (d) ii and iii

7. Carbon fixation in most of the succulent plants takes place through which pathway?

(a) Calvin cycle
(b) Glycolate pathway
(c) Crassulacean acid metabolism pathway
(d) Hatch-Slack pathway

8. If a flower is large, wide-mouthed, white, showing anthesis after sunset, and emitting fruity or musky fragrance, it is most likely to be pollinated by:

(a) Birds (b) Bats (c) Insects (d) Baboons

9. Coal is a common fossil fuel. It contains 0.2 to 5.0 percent sulphur which on burning produces a gas responsible for acid rain. The number of atoms in one mole of this gas is-

(a) 6.02×10^{23} (b) 1.81×10^{23} (c) 1.81×10^{24} (d) 1.21×10^{24}

10. The stomach fluid in human contains HCl, KCl and NaCl. The stomach fluid is highly acidic and plays an important role in the digestion of food as well as killing of bacteria. The increased acidity may lead to abdominal pain, nausea, bloating, and heartburn. Such a patient is prescribed antacid tablet which mainly contains aluminium hydroxide (Mol. Wt. 78). If the concentrations of HCl, KCl and NaCl are 0.01M each and the stomach fluid volume is 2 litre, the amount of $Al(OH)_3$ required to neutralize the fluid will be-

(a) 0.52 g (b) 1.08 g (c) 0.81 g (d) 2.16 g

11. A 0.500 g mixture of calcium carbonate and calcium oxide was strongly heated to produce a non-combustible gas. If the weight of the residue obtained on heating is found to be 0.434 g, the percentage of calcium oxide in the mixture is-

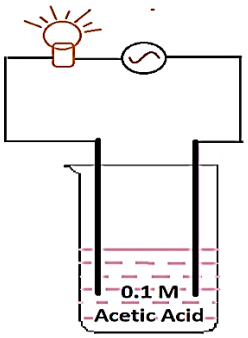
(a) 70% (b) 30% (c) 35% (d) 60%

12. Arrange the following in the increasing order of their metallic character Na, C, O, Li, Be

(a) C < O < Na < Li < Be
(b) O < C < Be < Na < Li
(c) O < C < Be < Li < Na
(d) C < O < Be < Li < Na

13. A 50 mL of 0.1 M acetic acid solution is taken in a beaker and two wires are dipped in it as shown in following figure.

When electric supply is switched on, the bulb glows. To this solution, distilled water is added slowly till the volume doubles. During the addition of water, the intensity of the bulb-



(a) remains unchanged
(b) goes on decreasing
(c) goes on increasing
(d) suddenly becomes zero

14. A compound X when heated with NaOH solution produces a pungent gas that turns red litmus blue. When an aqueous solution of X is treated with $AgNO_3$ solution, a white precipitate Y is obtained which on keeping in sunlight turns grey liberating pale yellowish green gas. The aqueous solution of compound X is

(a) neutral (b) slightly acidic (c) slightly alkaline (d) strongly acidic

15. Equal masses of two gases among N_2, NO, O_2, CO, CO_2 and SO_2 occupy same volume at STP. These two gases are:

(a) N_2 and O_2 (b) CO and NO (c) SO_2 and CO_2 (d) N_2 and CO

16. When a solution and the pure solvent are separated by a semipermeable membrane, the solution exerts a pressure on the membrane called as osmotic pressure. The osmotic pressure increases with increase in number of particles (ions or molecules) in the solution. If 10 millimoles of each of the sulphate salts of sodium, magnesium and aluminium are dissolved in 1.0 litre of water in three different beakers labelled as P, Q and R respectively, the osmotic pressure follows the order-

(a) P < Q < R (b) Q < P < R (c) P > Q > R (d) P > R > Q

17. The axes of a coordinate system S_2 are inclined at an angle θ to those of another coordinate system S_1. The origins of both the systems are coinciding. A particle P_1 at rest in system S_1, starts from point (-2, 0) and travels along positive direction of X_1 axis with uniform acceleration of 1.25 m/s^2 for 4 s and stops. In system S_2, particle P_2, starts from rest from the origin and travels for 2 s along positive direction of X_2 axis with uniform acceleration 5 m/s^2 and stops. If the final distance between P_1 and P_2 is 6 m, then the angle between $+Y_1$ axis and $+X_2$ axis is

(a) 36.8° (b) 53.2° (c) 106.8° (d) 126.8°

18. The variation of a certain physical parameter Z with variable u is given by the relation $Z = A\left(\frac{R}{R+u}\right)^3$, where R and A are constants and the maximum value of $u \ll R$. Then to find R, a student plots a graph of variation of Z (Y axis) against u (X axis). The graph is a

(a) straight line passing through origin and slope = $\frac{R}{3}$

(b) straight line with intercept $\frac{3A}{2}$ and slope = $-\frac{R}{3A}$

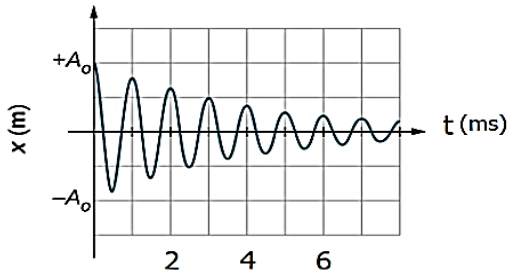
(c) straight line with intercept A and slope = $-\frac{3A}{R}$

(d) straight line with intercept $-\frac{A}{2}$ and slope = $-3R$

19. A submarine S_1 is parked at a depth of 200 m in an ocean on earth. Assume oceans exist on Mars. At about what depth a submarine S_2 has to be parked in an ocean on Mars so that S_2 will experience same pressure as that of S_1? Acceleration due to gravity on Mars is 3.7 m/s^2. (Assume that sea water density on Earth and Mars is same, $\rho = 1.03 \times 10^3\ kg/m^3$)

(a) 158 m (b) 435 m (c) 530 m (d) 616 m

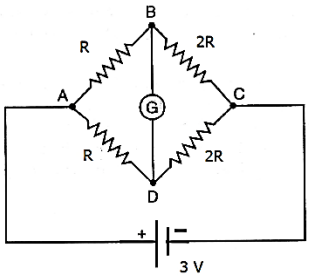
20. In an oscillating system, damping results in dissipation of the stored energy. The following figure shows the variation of displacement x with time t for an oscillating system. Which of the following statements best describes this physical phenomenon.



(a) Oscillatory motion of an object without damping
(b) Oscillatory motion of an object with damping such that time measurement was started when the system was at the mean position.
(c) Oscillatory motion of an object with damping with decreasing time period.
(d) Oscillatory motion of an object with damping such that time measurement was started when the system had maximum potential energy.

21. In the adjacent circuit, the galvanometer *G* does not show any deflection. If $R = 2\ \Omega$, the current drawn from the cell is

(a) 1 A
(b) 9 A
(c) 4 A
(d) $\frac{9}{4}$ A



22. 'Gear' is a mechanical system used to transfer mechanical and rotary motion from one mechanical system to another. As shown in the figure below the driving wheel A drives the driven wheel B without slipping and thus forms the gear system. The wheel A has 16 teeth and B has 24 teeth. Wheel B has a projection (shown by white ring in Fig. 1 and also in the side view of Fig. 2) of radius $\frac{14}{11}$ cm.

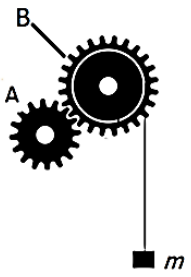


Fig. 1

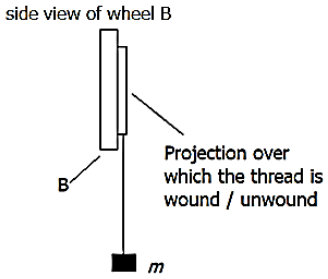


Fig. 2

A long massless, inextensible string can be wound / unwound over this circular projection. A mass *m* is attached to the free end of this long string. If the wheel A makes 6 revolutions per second in the clockwise direction, without slipping, then in $\frac{1}{2}$ second the potential energy of the mass *m* in CGS unit

(a) increases by 32*mg* (b) decreases by 32*mg*
(c) increases by 16*mg* (d) decreases by 16*mg*

23. Canopus is the second brightest star in the night sky. It is about 300 light years away. The energy is produced inside the star through nuclear reactions. If we receive 5.0×10^{-8} W/m^2 energy from Canopus, how much mass does it lose per second?

(a) 1.70×10^{-6} kg (b) 1.91×10^{9} kg (c) 5.62×10^{13} kg (d) 6.34×10^{31} kg

24. An average human adult radiates about 100 W energy mainly in infra-red region of the electromagnetic spectrum. 50 persons are sitting in a hall with an air conditioning system which is 50% efficient. How much electricity must be used to maintain temperature of the hall at 25°C for 4 hours?

(a) 5 units (b) 10 units (c) 20 units (d) 40 units

A - 2

ANY NUMBER OF OPTIONS 4, 3, 2 or 1 MAY BE CORRECT
MARKS WILL BE AWARDED ONLY IF ALL THE CORRECT OPTIONS ARE BUBBLED

25. Given below are four statements about viruses. Which of the following statement/s is/are incorrect?
    (a) All known viruses contain RNA as the genetic material.
    (b) During viral multiplication, a complementary DNA is produced in riboviruses.
    (c) Viruses are the smallest, freely living cells found on the planet.
    (d) DNA containing viruses are more susceptible to mutations when compared to RNA containing viruses and hence show a very rapid evolution.

26. During a race, Ramesh was thrown off the horse back and suffered an injury in the front part of head. Upon thorough examination, Ramesh was found to have injury to the front part of the head. Which of the following can be the possible outcome/s of this injury?

    (a) Trouble in speaking properly
    (b) Inability to smell
    (c) Inability to walk on a narrow path
    (d) Inability to maintain blood pressure

27. Which of the following molecules are primarily responsible for structural support and motility?

    (a) Actin (b) Tubulin alpha (c) Lamins (d) Desmin

28. The types of bonding found in dry ice is/are

    (a) Covalent (b) Ionic (c) Metallic (d) Vander Waal forces

29. The compound/s that raise/s the temperature of water (from room temperature) on dissolving in it is/are-

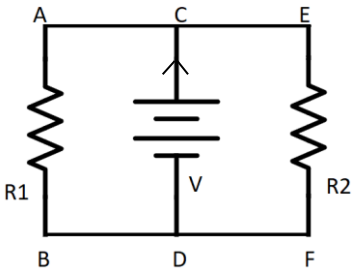
    (a) Ammonium chloride
    (b) Potassium hydroxide
    (c) Glucose
    (d) Conc. HCl

30. Soaps and detergents are common agents used in laundry industry. They are long chain hydrocarbons with ionic terminals of cationic or anionic nature. A 1% (w/v) soap solution X and 1% (w/v) detergent solution Y were prepared in distilled water. Each of the solutions was divided in two equal parts and labelled as X_1, X_2, Y_1 and Y_2. 1 g NaCl was added to X_1 and Y_1 each while 1 g $CaCl_2$ was added to X_2 and Y_2 each. Which of the following observations is/are correct?

    (a) X_1 shows slimy precipitate
    (b) X_2 shows slimy precipitate
    (c) Y_1 shows slimy precipitate
    (d) Y_2 shows slimy precipitate

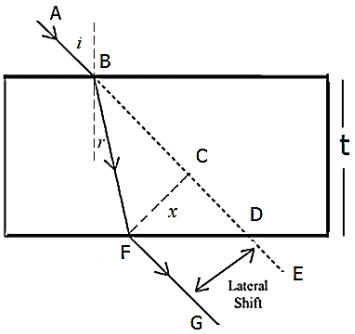
31. According to Einstein's theory, light can be assumed to be in the form of a large number of discrete energy packets called 'photons'. In case of light of frequency ν, each photon carries energy $E = h\nu$. In a certain surgical procedure a surgeon uses LASER beam of wavelength 650 nm in pulses of 30.0 ms duration. The average power of each pulse is 0.6 W. Here h is Planck's constant. Then
(a) the frequency of this LASER photon is 4.6×10^{14} Hz
(b) the energy in each pulse is 1.1×10^{17} eV
(c) energy of one photon is $3.1 \times 10^{-19} J$
(d) number of photons in each pulse is 5.9×10^{16}

32. In the following circuit, $R_1 = 6\ \Omega$, $R_2 = 12\ \Omega$, V = 16 V. The currents I_1 and I_2 flow through the resistances R_1 and R_2 respectively



(a) power generated across R_1 is 42.6 watt
(b) the ratio of $\frac{I_1}{I_2} = 2$
(c) total current drawn from the cell is 4 ampere
(d) as $R_2 = 2\ R_1$, the voltage across R_2 will be twice the voltage across R_1

33. A glass plate of uniform thickness t and refractive index μ is as shown in the diagram. AB is the incident ray and FG is the emergent ray. The angles of incidence and refraction are i and r respectively. The perpendicular distance FC = x between the incident and the emergent rays is called the lateral shift. Then



(a) $x = t\left(\sin i - \frac{\cos i \sin r}{\cos r}\right)$
(b) x depends on refractive index μ
(c) x is independent of the wavelength λ of light
(d) Maximum value of $x = t$ when i is close to 90°

ROUGH WORK