

FIITJEE

INDIAN OLYMPIAD QUALIFIER IN JUNIOR SCIENCE (IOQJS)

PART – 1

Held on: March 06, 2022

QUESTION PAPER

INSTRUCTIONS

1. 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 that correct alternative and fill the appropriate bubbles, as shown

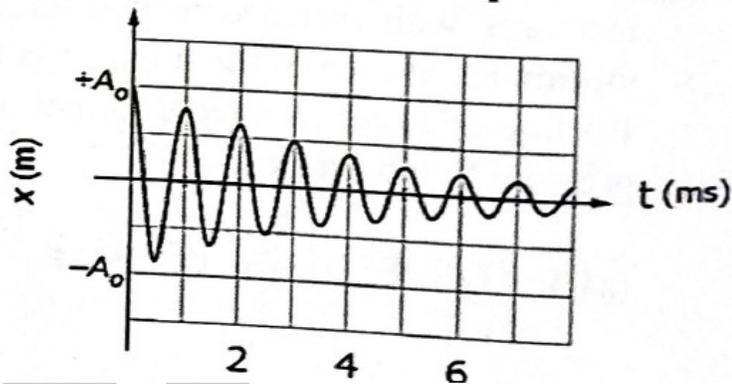


2. In part A 2 (Q. No. 25 to 33) each question has four alternatives out of which any number of alternative (s) (1, 2, 3 or 4) may be correct. You have to choose all correct alternative(s) and fill the appropriate bubble(s), as shown.

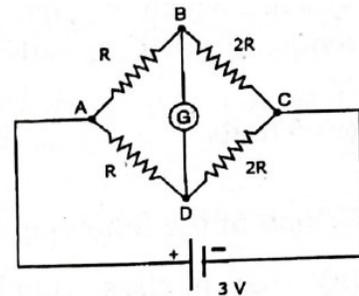


3. For Part A1, each correct answer carries 3 marks whereas 1 mark will be deducted for each wrong answer. In Part A 2, you get 0 marks if all the correct alternatives are marked and no incorrect. No negative marks in this part.
4. Use of non – programmable scientific calculator is allowed.

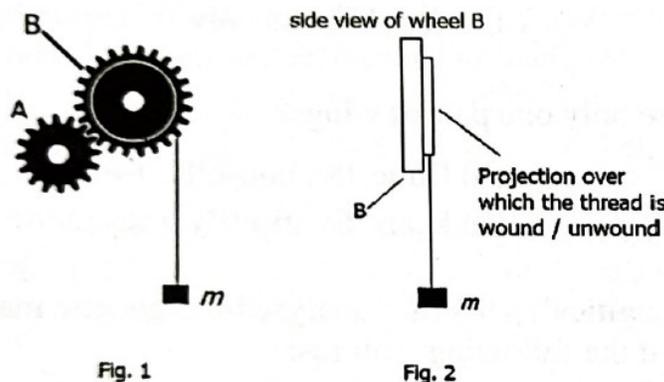
1. The variation of a certain physical parameter Z with variable u is given by the relation $Z = A \left(\frac{R}{R+u} \right)^3$, where R and A are constants and the maximum value of $u \ll R$. Then to find R , a student plots a graph of variation of Z (Y axis) against u (X axis). The graph is a
- straight line passing through origin and slope = $\frac{R}{3}$.
 - straight line with intercept $\frac{3A}{2}$ and slope = $-\frac{R}{3A}$
 - straight line with intercept A and slope = $-\frac{3A}{R}$
 - straight line with intercept $-\frac{A}{2}$ and slope = $-3R$
2. 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, $\rho = 1.03 \times 10^3 \text{ kg/m}^3$)
- 158 m
 - 435 m
 - 530 m
 - 616 m
3. 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.



- Oscillatory motion of an object without damping
 - Oscillatory motion of an object with damping such that time measurement was started when the system was at the mean position.
 - Oscillatory motion of an object with damping with decreasing time period.
 - Oscillatory motion of an object with damping such that time measurement was started when the system had maximum potential energy.
4. In the adjacent circuit, the galvanometer G does not show any deflection. If $R = 2\Omega$, the current drawn from the cell is
- 1A
 - 9A
 - 4A
 - $\frac{9}{4}$ A



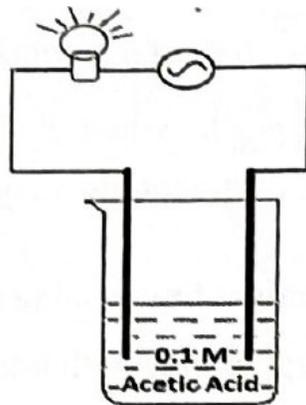
5. Gear is a mechanical system used to transfer mechanical and rotary motion from one mechanical system to another. As shown in the figure below the driving wheel A drives the driven wheel B without slipping and thus forms the gear system. The wheel A has 16 teeth and B has 24 teeth. Wheel B has a projection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



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

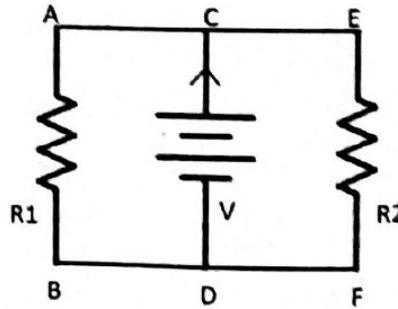
- (a) increases by 32 mg
(b) decreases by 32 mg
(c) increases by 16 mg
(d) decreases by 16 mg
6. Canopus is the second brightest star in the night sky. It is about 300 light years away. The energy is produced inside the star through nuclear reaction. If we receive $5.0 \times 10^{-8} \text{ W/m}^2$ energy from Canopus, how much mass does it lose per second?
- (a) $1.70 \times 10^{-6} \text{ kg}$
(b) $1.91 \times 10^9 \text{ kg}$
(c) $5.62 \times 10^{13} \text{ kg}$
(d) $6.34 \times 10^{31} \text{ kg}$
7. 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
8. Which of the following is not a function of mature RBCs?
- (a) Help in classifying blood in different blood groups
(b) Helps in transport of gases
(c) Synthesis of immunoglobulins
(d) Help in maintaining acid base balance in the body
9. 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
10. 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
11. 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 Imagitical inhabitants contain?
- (a) ssDNA (b) dsDNA
(c) ssRNA (d) dsRNA
12. 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
13. 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 required 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
14. 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
15. 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
16. 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}
17. The stomach fluids 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, cause, bloating and hearten. Such a pastiest is prescribed antacid tablet which mainly contains aluminium hydroxide (Mol. Wt. 78). If the concentrations of HCl, KCl and NaCl are 0.01 M each and the stomach fluid volume is 2 litre, the amount of $\text{Al}(\text{OH})_3$ required to neutralize the fluid will be
(a) 0.52 g (b) 1.08 g
(c) 0.81 g (d) 2.16 g
18. 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%
19. Arrange the following in the increasing order of their metallic character Na, C, O, Li, Be
(a) $\text{C} < \text{O} < \text{Na} < \text{Li} < \text{Be}$ (b) $\text{O} < \text{C} < \text{Be} < \text{Na} < \text{Li}$
(c) $\text{O} < \text{C} < \text{Be} < \text{Li} < \text{Na}$ (d) $\text{C} < \text{O} < \text{Be} < \text{Li} < \text{Na}$
20. 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 bulbs glows. To this solution, distilled water is added slowly till the volume doubles. During the addition of water, the intensity of the bulb

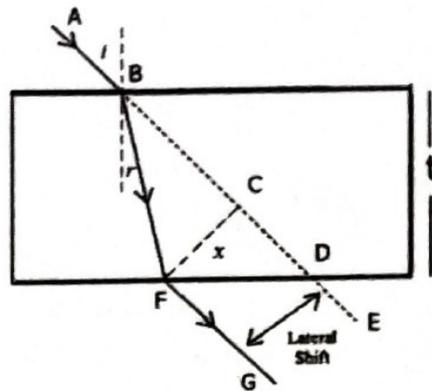


- (a) remains unchanged
(c) goes on increasing
- (b) goes on decreasing
(d) suddenly becomes zero
21. A compound X when heated with NaOH solution produces a pungent gas that turns red litmus blue. When an aqueous solution of X is treated with AgNO_3 solution, a white precipitate Y is obtained which on keeping in sunlight turns grey liberating pale yellowish green gas. The aqueous solution of compound X is
(a) neutral
(c) slightly alkaline
- (b) slightly acidic
(d) strongly acidic
22. 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
(c) SO_2 and CO_2
- (b) CO and NO
(d) N_2 and CO
23. When a solution and pure solvent are separated by a semispherical 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 labeled as P, Q, and R respectively, the osmotic pressure follows the order.
(a) $P < Q < R$
(c) $P > Q > R$
- (b) $Q < P < R$
(d) $P > R > Q$
24. 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 4s 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°
(c) 106.8°
- (b) 53.2°
(d) 126.8°
25. According to Einstein's theory, light can be assumed to be in 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 $4.6 \times 10^{14} \text{ Hz}$
(b) the energy in each pulse is $1.1 \times 10^{14} \text{ eV}$
(c) energy of one photon is $3.1 \times 10^{-19} \text{ J}$
(d) number of photons in each pulse is 5.9×10^{16}

26. In the following circuit, $R_1 = 6 \Omega$, $R_2 = 12 \Omega$, $V = 16 \text{ V}$. The current I_1 and I_2 flow through the resistance R_1 and R_2 respectively



- (a) power generated across R_1 and 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
27. 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°
28. Given below are four statements about viruses. Which of the following statements 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.
29. 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 head. Which of the following can be possible outcomes 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

30. Which of the following molecules are primarily responsible for structure support and motility?
(a) Actin (b) Tubulin alpha
(c) Lamins (d) Desmin
31. The type of bonding found in dry ice is/are
(a) Covalent (b) Ionic
(c) Metallic (d) Vander Wall forces
32. The compounds 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
33. 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 labeled as X₁, X₂, Y₁ and Y₂. 1 g of NaCl was added to X₁ and Y₁ each while 1 g CaCl₂ was added to X₂ and Y₂ each. Which of the following observations is / are correct?
(a) X₁ shows slimy precipitate (b) X₂, shows slimy precipitate
(c) Y₁ shows slimy precipitate (d) Y₂ shows slimy precipitate