Date of Examination: January 17, 2021 Time: 2:30 PM to 03:30 PM Question Paper Code: 51



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.

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 Incomplete/ incorrect/ carelessly filled information may disgualify your candidature.
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- 5. Your **fourteen-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 2020 21 (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(s) and fill the appropriate bubble(s), as shown.



In part A2 (Q. No. 25 to 32) each question has four alternative 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





- 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 only in the space provided. There are 08 printed pages in this paper.
- 9. Use of non-programmable scientific calculator is allowed.
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- 17. List of students eligible for evaluation of IOQJS 2020-21 (Part II) shall be displayed on www.iapt.org.in by March 1, 2021.

Some useful physical constants and useful data								
Physical Constant	Symbol	Magnitude with SI units						
Gravitation Constant	G	6.67×10 ⁻¹¹ Nm ² /kg ²						
Solar mass	M₀	2×10 ³⁰ kg						
Acceleration due to gravity on earth	g	9.8 ms ⁻²						
Charge of an electron	е	1.6 × 10 ⁻¹⁹ C						
Mass of an electron	т	9.1 × 10 ⁻³¹ kg						
1 eV = 1.6 × 10 ⁻¹⁹ J								
An α particle is a doubly ionized He atom								

Question Paper Code: 51

Time: 60 Minutes		Max Marks: 120						
Attem	ot all the Thirty Two questions							
PART: A – 1								
OUT OF FOUR OPTIONS, ONLY ONE IS CORRECT. BUBBLE THE CORRECT OPTION.								
1. Gravitational collapse is the contraction of draws the matter inwards towards the cellapsed core of a giant star. A certain neacceleration due to gravity on the surface (a) $2.0 \times 10^8 \text{ m/s}^2$ (b) $2.0 \times 10^{12} \text{ m/s}^2$	of an astronomical object entre of gravity. A neutror eutron star of radius 10 k e of the neutron star is ne (c) 2.6 × 10 ¹⁶ m/s ²	under its own gravity. This n star is an example of the m is of mass 1.5 <i>M</i> _{☉.} The early (d) 2.6 × 10 ²⁰ m/s ²						
 2. The tympanic membrane (ear drum) is a diameter is 1 cm. The maximum force the sea water of density 1.05 X 10³ kg/m³ with the diver to go into water is about (a) 12 m (b) 9 m 	very delicate component e ear can withstand is 2.5 hout any protective gear, (c) 3 m	of the human ear. Typically, its N. In case a diver has to enter the maximum safe depth for (d) 1.5 m						
 3. Two illuminated point objects O₁ and O₂ a principal axis of a thin convex lens of foca formed at the same position. Then the re (a) 12 and 12 (b) 18 and 6 	are placed at a distance 24 al length 9 cm such that in spective distances of the (c) 14 and 10	4 cm from each other along the nages of both the objects are lens from O₁ and O₂ (in cm) are (d) 16 and 8						
4. A nuclear reactor is working at 30% efficiency. In this reactor $^{235}_{92}U$ nucleus und If 1000 kW of electrical power is obtained disintegrated (undergone fission) per set (a) 1.04×10^{17} (b) 6.5×10^{12}	iency (i.e. conversion of n lergoes fission and releas d in this reactor, then the cond in the reactor is (c) 3.125 × 10 ¹²	nuclear energy to electrical es 200 MeV energy per atom. e number of atoms (d) 3.25 × 10 ³²						
5. Two blocks A and B are in contact with ea	ach other and are placed	on a frictionless horizontal						

5. Two blocks A and B are in contact with each other and are placed on a frictionless horizontal surface. A force of 90N is applied horizontally on block A (situation I) and the same force is applied horizontally on block B (situation II). Mass of A is 20 kg and B is 10 kg. Then the correct statement is



- (a) Since both the blocks are in contact, magnitude of force by block A on B will be 90 N (situation I) and magnitude of force by block B on A will also be 90 N (situation II).
- (b) Magnitude of force by block A on B is 30 N (situation I) and magnitude of force by block B on A is 60 N (situation II).
- (c) Magnitude of force by block A on B is 60 N (situation I) and magnitude of force by block B on A is 30 N (situation II).
- (d) The 90 N force will produce acceleration of different magnitudes in A and B.

6. In the adjoining circuit, $R = 5 \Omega$. It is desired that the voltage across R_x should be 6 V, then the value of R_x should be

(a) 4Ω	(b) 12 Ω
(c) 16 Ω	(d) 20 Ω



7. In one process for waterproofing, a fabric is exposed to $(CH_3)_2SiCl_2$ vapors. The vapors react with the hydroxyl groups on the surface of the fabric or with traces of water to form the waterproofing

film $[(CH_3)_2SiO]_n$, by the reaction; $n(CH_3)_2SiCl_2 + 2nOH^- \rightarrow 2nCl^- + nH_2O + [(CH_3)_2SiO]_n$ where n stands for a larger integer. The waterproofing film is deposited on the fabric layer upon layer. Each layer is 6 Å thick [the thickness of the $(CH_3)_2SiO$ group]. How much $(CH_3)_2SiCl_2$ is needed to waterproof one side of a piece of fabric, 1m by 2m, with a film 300 layers thick? The density of the film is 1.0 g/cm³. (a) 0.63g (b) 0.36g (c) 6.3g (d) 3.6g

- 8. Given that at a certain temperature, in 1.5 L vessel, 5.0 mole of A, 7.0 mole of B and 0.1 mole of C are present. Then the value of equilibrium constant for the reaction: A+ B ⇒ 2C + heat is about
 (a) 7.22 × 10⁻⁴
 (b) 2.31 × 10⁻⁴
 (c) 7.22 × 10⁻⁵
 (d) 6.11 × 10⁻⁴
- 9. An alcohol (A) on dehydration with conc. H₂SO₄ at a high temperature yields compound (B). On ozonolysis every molecule of compound (B) yields two molecules of acetaldehyde. Which of the following is the starting alcohol (A)?

- 10. In an experiment with 100 mL 0.1 M solution of Copper Chloride, by mistake 5 gm of a mixture containing equal weights of Tin, Silver, Lead and Calcium, was added. Finally after some time the solution gets completely decolorized. This is mainly due to:
 - (a) Silver reacts with Copper Chloride
 - (b) Calcium reacts with Copper Chloride
 - (c) All the metals react with Copper Chloride
 - (d) Only Lead reacts with Copper Chloride forming white precipitate of lead chloride
- 11. Triclosan (C₁₂H₇Cl₃O₂) is an antibacterial and antifungal agent. It is a polychloro phenoxy phenol. It is widely used as a preservative and antimicrobial agent in personal care products such as soaps, skin creams, and deodorants etc. A label on a 200 mL hand sanitizer bottle claims that it contain Triclosan 0.2% w/v. What will be the number of molecules of Triclosan present in the bottle? (*N_A* is Avogadro's Number)
 (a) 1.4 X 10²⁵ N_A
 (b) 1.4 X 10²⁴ N_A
 (c) 1.4 X 10²³ N_A
 (d) 1.4 X 10²² N_A
- 12. Suppose that A and B forms compound B₂A₃ and B₂A. If 0.05 mole of B₂A₃ weighs 12 g and 0.1 mole of B₂A weighs 10 g, what are the atomic weight of A and B respectively?
 (a) 70 and 25
 (b) 50 and 20
 (c) 40 and 30
 (d) 30 and 40

- 13. If in a wheat mutant, the length of chromosome 1B was found to be 6.7 μ m instead of 5.0 μ m, approximately how many additional base pairs are incorporated in the mutant chromosome? (a) 0.5 X 10⁴ bp (b) 5 X 10⁴ bp (c) 1.7 X 10⁴ bp (d) 5.78 X 10⁴ bp
- 14. Considering following characteristics, identify the correct inheritance pattern from the given options.
 - Most affected individuals are male.
 - Affected sons result from female parents who are either affected or who are known to be carriers because they have affected brothers, fathers, or maternal uncles.
 - Affected daughters are born to affected fathers and either affected or carrier mothers.
 - The sons of affected mothers should be affected.
 - Approximately half the sons of carrier mothers should be affected.
 - (a) Autosomal Recessive Inheritance (b) Autosomal Dominant Inheritance
 - (c) Sex-Linked Recessive Inheritance (d) Sex-Linked Dominant Inheritance
- 15. In a marine ecosystem with rich diversity of fauna, which of the following images would be a correct representation of pyramid of biomass?



- 16. The transpiration pull is maximum under which of the following conditions?
 - (a) Closed stomata, low light intensity, humid air
 - (b) Open stomata, dry air, moist soil
 - (c) Open stomata, dry air, dry soil
 - (d) Open stomata, high humidity in air, moist soil
- 17. *Curcuma longa, Azadirachta indica,* Basmati Rice, Indian Ginseng are all related to which of the following concepts?
 - (a) Bioterrorism (b) Biomagnification (c) Biopiracy (d) Biodegradation
- 18. Read following criteria carefully.
 - Slow evolutionary change relative to similar entities
 - Gross similarity to an ancestral fossil
 - Very low taxonomic richness today compared to the past
 - Phylogenetic inference of specific characters as plesiomorphic
 - Phylogenetic inference of a genealogical divergence between other groups that diverged in the distant past
 - Known in the fossil record before being discovered alive
 - These criteria can be used to categorize a group of organisms the most probably into
 - (a) Connecting links (b) Living fossils (c) Endangered species (d) Extinct species

- 19. If $x^2 + ax + b = 0$ and $x^2 + bx + a = 0$ have one common root, then (a) a + b = 0 (b) a + b = 1 (c) a + b = -1 (d) $a^2 + b^2 = 1$
- 20. Six circles each of radius 3 cm are inscribed in an equilateral triangle ABC such that they touch each other and also touch the sides of the triangle as shown in the adjacent figure. Then height of triangle ABC is
 - (a) $6(2\sqrt{3}+3)$ (b) $3(2\sqrt{3}+6)$ (c) $3(2\sqrt{3}+3)$ (d) $6(2+\sqrt{3})$



В

- 21. Find the remainder when x^{51} is divided by $x^2 3x + 2$ (a) x (b) $(2^{51}-2)x+2-2^{51}$ (c) $(2^{51}-1)x+2-2^{51}$ (d) 0
- 22. If $\frac{3}{x-2} < 1$, where x is a real number, then (a) 2 < x < 5 (b) x < 2 or 5 < x (c) x < -2 or x > 5 (d) None of these
- 23. If $100^{25} 25$ is written in decimal notations, then the sum of its digits is (a) 444 (b) 442 (c) 424 (d) 422
- 24. ABC is a triangle, the bisector of angle A meets BC in D. The relation between AD, AB and AC is (a) $AD > \sqrt{AB.AC}$ (b) AD > AB.AC (c) $AD = \sqrt{AB.AC}$ (d) $AD < \sqrt{AB.AC}$

PART: A – 2 MORE THAN ONE CORRECT OPTIONS. BUBBLE ALL CORRECT OPTIONS ONLY.

- 25. An infinitely long conductor when carrying current I,
 - produces a magnetic field *B* around it. If such a conductor is placed along the X-axis, then the magnitude of *B* at a distance *r* is given by the relation $B = \frac{\mu_0}{4\pi} \frac{2I}{r}$, (where $\frac{\mu_0}{4\pi} = 10^{-7} \text{ NA}^{-2}$ is a constant). The following figure shows such an infinitely long conductor placed along X-axis carrying current *I* and *B* at S is 2 x 10⁻⁴ T, directed into the plane of the paper at S. Given *r* = 1 cm. Then, the correct statements are



- (a) / = 10 A
- (b) The number of electrons transported across the cross section of the conductor during time 1s is 6.25×10^{19}
- (c) The direction of current I is from X_2 to X_1 .
- (d) The electrons will flow in the direction X_2 to X_1 .
- 26. The ratio of the charge of an ion or subatomic particle to its mass (q/m) is called specific charge. Then the correct options are
 - (a) SI unit of specific charge can be written as $A \cdot s / kg$.
 - (b) If all the isotopes of hydrogen are ionized then tritium will have least specific charge among them.
 - (c) specific charge of an α particle will be greater than that of an electron.
 - (d) specific charge ratio of an electron is 1.75×10^{11} C/kg.
- 27. Acetylene torches and burners used by glassblowers produce intense ultraviolet light. Glassblowers wear special glasses that contain which of the following elements to absorb the UV?
 - (a) Neodymium (b) Praseodymium (c) Cerium (d) Didymium
- 28. Equal lengths of magnesium ribbons are taken in four test tubes A, B, C, and D. In test tube A, 1M acetic acid is added; in test tube B, 1M HCl is added; in test tube C, 1M HNO₃ is added; and in test tube D, 1M NaOH is added. The observed results will be:
 - (a) The fizzing occurs more vigorously in A (b) The fizzing occurs more vigorously in B
 - (c) The fizzing occurs more vigorously in C (d) The fizzing occurs more vigorously in D
- 29. Choose the correct statements from following options.
 - (a) A robust adaptive immune response is initiated using weakened forms of the bacterium known as live attenuated vaccines.
 - (b) Administration of a killed or chemically inactivated virus can trigger a weaker adaptive immune response, but can be strengthened with booster doses.
 - (c) A conjugate or multivalent component always reduces immunogenicity of the vaccine.
 - (d) Inclusion of alum, cytokines, and/or lipids always reduces the immune response to a vaccine.

30. The minimum energy required to exist that is the energy required to perform chemical reactions even when a person is at rest is called the *basal metabolic rate* (BMR), which accounts for about 50 to 70 per cent of the daily energy expenditure in most sedentary individuals. It is influenced by many factors. Some statements are made about these factors. Choose the correct statements from the following options.

(a) Thyroid hormone decreases metabolic rate (b) Growth hormone increases metabolic rate

- (c) Fever decreases metabolic rate (d) Malnutrition decreases metabolic rate
- 31. If $0 \le x \le \pi$ and $81^{\sin^2 x} + 81^{\cos^2 x} = 30$, then x =(a) $\frac{\pi}{6}$ (b) $\frac{\pi}{3}$ (c) $\frac{5\pi}{6}$ (d) $\frac{2\pi}{3}$ [Useful information: $\pi^c = 180^\circ$, sin $(180 - \theta) = \sin \theta$, sin $\theta \ge 0$ when $0 \le \theta \le 180^\circ$]
- 32. Given $(a-b)^2 + (a-c)^2 = (b-c)^2$, then which of the following statements are true? (a) equation is valid when b = c and $a \neq c$
 - (b) equation is valid when a = b
 - (c) equation is valid when a = c
 - (d) Given equation is not valid when a, b and c are distinct.

ROUGH WORK

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An α particle is a doubly ionized He atom								

	Question F	Paper Code: 52	
Time: 60 Min	utes		Max. Marks: 120
OU	Attempt all PA T OF FOUR OPTIONS, ONLY ON	the Thirty Two questions ART: A – 1 E IS CORRECT. BUBBLE THE COR	RECT OPTION.
 In one process for the hydroxyl group film [(CH₃)₂SiO]_n, b 	waterproofing, a fabric is o s on the surface of the fab y the reaction;	exposed to (CH₃)₂SiCl₂ vapo pric or with traces of water	ors. The vapors react with to form the waterproofing
$n(CH_3)_2SiCl_2 + 2nOl$	$H^- \rightarrow 2nCl^- + nH_2O + [(C$	H ₃) ₂ SiO] _n	
where n stands for layer. Each layer is to waterproof one the film is 1.0 g/cm	a larger integer. The wate 6 Å thick [the thickness of side of a piece of fabric, 1 ³ .	erproofing film is deposited the (CH₃)₂SiO group]. How m by 2m, with a film 300 la	l on the fabric layer upon much (CH ₃) ₂ SiCl ₂ is needed ayers thick? The density of
(a) 0.63g	(b) 0.36g	(c) 6.3g	(d) 3.6g
 An alcohol (A) on d ozonolysis every me following is the stat (a) 1- butanol Given that at a cert 	ehydration with conc. H ₂ S olecule of compound (B) y rting alcohol (A)? (b) 2- butanol cain temperature, in 1.5 L v	O₄ at a high temperature y ields two molecules of ace (c) propanal /essel, 5.0 mole of A, 7.0 m	ields compound (B). On taldehyde. Which of the (d) 2-propanol nole of B and 0.1 mole of C
are present. Then t (a) 7.22 × 10 ⁻⁴	the value of equilibrium cc (b) 2.31×10 ⁻⁴	onstant for the reaction: A (c) 7.22×10^{-5}	+ B ≓ 2C + heat is about (d) 6.11 ×10 ⁻⁴
 Triclosan (C₁₂H₇Cl₃4 is widely used as a skin creams, and c Triclosan 0.2% w/v is Avogadro's Num (a) 1.4 X 10²⁵ N_A 	D ₂) is an antibacterial and a preservative and antimica deodorants etc. A label on v. What will be the numbe nber) (b) 1.4 X 10 ²⁴ N _A	antifungal agent. It is a pol ^a robial agent in personal can a 200 mL hand sanitizer bo r of molecules of Triclosan (c) 1.4 X 10 ²³ N _A	ychloro phenoxy phenol. It re products such as soaps, ottle claims that it contains present in the bottle? (N_A (d) 1.4 X 10 ²² N _A
 In an experiment v containing equal w solution gets comp (a) Silver reacts wi (b) Calcium reacts (c) All the metals r (d) Only Lead react 	with 100 mL 0.1 M solution weights of Tin, Silver, Lead a pletely decolorized. This is th Copper Chloride with Copper Chloride react with Copper Chloride ts with Copper Chloride fo	n of Copper Chloride, by mi and Calcium, was added. Fi mainly due to: rming white precipitate of	istake 5 gm of a mixture inally after some time the lead chloride
6. Suppose that A a	and B forms compound B ₂	A ₃ and B ₂ A. If 0.05 mole of	f B_2A_3 weighs 12 g and 0.1

Suppose that A and B forms compound B₂A₃ and B₂A. If 0.05 mole of B₂A₃ weighs 12 g and 0.1 mole of B₂A weighs 10 g, what are the atomic weight of A and B respectively?

(a) 70 and 25 (b) 50 and 20 (c) 40 and 30 (d) 30 and 40

7. The tympanic membrane (ear drum) is a very delicate component of the human ear. Typically its diameter is 1 cm. The maximum force the ear can withstand is 2.5 N. In case a diver has to enter sea water of density 1.05 X 10³ kg/m³ without any protective gear, the maximum safe depth for the diver to go into water is about

(a) 12 m (b) 9 m (c) 3 m (d) 1.5 m

- 8. Gravitational collapse is the contraction of an astronomical object under its own gravity. This draws the matter inwards towards the centre of gravity. A neutron star is an example of the collapsed core of a giant star. A certain neutron star of radius 10 km is of mass $1.5 M_{\odot}$. The acceleration due to gravity on the surface of the neutron star is nearly (a) $2.0 \times 10^8 \text{ m/s}^2$ (b) $2.0 \times 10^{12} \text{ m/s}^2$ (c) $2.6 \times 10^{16} \text{ m/s}^2$ (d) $2.6 \times 10^{20} \text{ m/s}^2$
- 9. Two illuminated point objects O₁ and O₂ are placed at a distance 24 cm from each other along the principal axis of a thin convex lens of focal length 9 cm such that images of both the objects are formed at the same position. Then the respective distances of the lens from O₁ and O₂ (in cm) are (a) 12 and 12 (b) 18 and 6 (c) 14 and 10 (d) 16 and 8
- 10. A nuclear reactor is working at 30% efficiency (i.e. conversion of nuclear energy to electrical energy). In this reactor ${}^{235}_{92}U$ nucleus undergoes fission and releases 200 MeV energy per atom. If 1000 kW of electrical power is obtained in this reactor, then the number of atoms disintegrated (undergone fission) per second in the reactor is
 (a) 1.04×10^{17} (b) 6.5×10^{12} (c) 3.125×10^{12} (d) 3.25×10^{32}
- 11. Two blocks A and B are in contact with each other and are placed on a frictionless horizontal surface. A force of 90N is applied horizontally on block A (situation I) and the same force is applied horizontally on block B (situation II). Mass of A is 20 kg and B is 10 kg. Then the correct statement is



- (a) Since both the blocks are in contact, magnitude of force by block A on B will be 90 N (situation I) and magnitude of force by block B on A will also be 90 N (situation II).
- (b) Magnitude of force by block A on B is 30 N (situation I) and magnitude of force by block B on A is 60 N (situation II).
- (c) Magnitude of force by block A on B is 60 N (situation I) and magnitude of force by block B on A is 30 N (situation II).
- (d) The 90 N force will produce acceleration of different magnitudes in A and B.



18. ABC is a triangle, the bisector of angle A meets BC in D. The relation between AD, AB and AC is(a) $AD > \sqrt{AB.AC}$ (b) AD > AB.AC(c) $AD = \sqrt{AB.AC}$ (d) $AD < \sqrt{AB.AC}$

С

- 19. If in a wheat mutant, the length of chromosome 1B was found to be 6.7 μm instead of 5.0 μm, approximately how many additional base pairs are incorporated in the mutant chromosome?
 (a) 0.5 X 10⁴ bp
 (b) 5 X 10⁴ bp
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- 20. The transpiration pull is maximum under which of the following conditions?
 - (a) Closed stomata, low light intensity, humid air (b) Open stomata, dry air, moist soil
 - (c) Open stomata, dry air, dry soil (d) Open stomata, high humidity in air, moist soil

- 21. Considering following characteristics, identify the correct inheritance pattern from the given options.
 - Most affected individuals are male.
 - Affected sons result from female parents who are either affected or who are known to be carriers because they have affected brothers, fathers, or maternal uncles.
 - Affected daughters are born to affected fathers and either affected or carrier mothers.
 - The sons of affected mothers should be affected.
 - Approximately half the sons of carrier mothers should be affected.
 - (a) Autosomal Recessive Inheritance (b) Autosomal Dominant Inheritance
 - (c) Sex-Linked Recessive Inheritance (d) Sex-Linked Dominant Inheritance
- 22. In a marine ecosystem with rich diversity of fauna, which of the following images would be a correct representation of pyramid of biomass?



- 23. *Curcuma longa, Azadirachta indica,* Basmati Rice, Indian Ginseng are all related to which of the following concepts?
 - (a) Bioterrorism (b) Biomagnification (c) Biopiracy (d) Biodegradation
- 24. Read following criteria carefully.
 - Slow evolutionary change relative to similar entities
 - Gross similarity to an ancestral fossil
 - Very low taxonomic richness today compared to the past
 - Phylogenetic inference of specific characters as plesiomorphic
 - Phylogenetic inference of a genealogical divergence between other groups that diverged in the distant past
 - Known in the fossil record before being discovered alive

These criteria can be used to categorize a group of organisms the most probably into

(a) Connecting links (b) Living fossils (c) Endangered species (d) Extinct species

PART: A – 2	
MORE THAN ONE CORRECT OPTIONS. BUBBLE ALL CO	ORRECT OPTIONS ONLY.

- 25. Equal lengths of magnesium ribbons are taken in four test tubes A, B, C, and D. In test tube A, 1M acetic acid is added; in test tube B, 1M HCl is added; in test tube C, 1M HNO₃ is added; and in test tube D, 1M NaOH is added. The observed results will be:
 - (a) The fizzing occurs more vigorously in A (b) The fizzing occurs more vigorously in B
 - (c) The fizzing occurs more vigorously in C $\,$ (d) The fizzing occurs more vigorously in D
- 26. Acetylene torches and burners used by glassblowers produce intense ultraviolet light. Glassblowers wear special glasses that contain which of the following elements to absorb the UV?

(c) Cerium

- (a) Neodymium
- 27. An infinitely long conductor when carrying current *I*, produces a magnetic field *B* around it. If such a conductor is placed along the X-axis, then the magnitude of *B* at a distance *r* is given by the relation $B = \frac{\mu_0}{4\pi} \frac{2I}{r}$, (where

(b) Praseodymium

 $\frac{\mu_0}{4\pi}$ =10⁻⁷ NA⁻² is a constant). The following figure shows such an infinitely long conductor placed along X-axis carrying current *I* and *B* at S is 2 x 10⁻⁴ T, directed into the plane of the paper at S. Given *r* = 1 cm. Then, the correct statements are



(d) Didymium

- (a) / = 10 A
- (b) The number of electrons transported across the cross section of the conductor during time 1s is 6.25 $\times 10^{19}$
- (c) The direction of current I is from X_2 to X_1 .
- (d) The electrons will flow in the direction X_2 to X_1 .
- 28. The ratio of the charge of an ion or subatomic particle to its mass (q/m) is called specific charge. Then the correct options are
 - (a) SI unit of specific charge can be written as $A \cdot s / kg$.
 - (b) If all the isotopes of hydrogen are ionized then tritium will have least specific charge among them.
 - (c) specific charge of an α particle will be greater than that of an electron.
 - (d) specific charge ratio of an electron is 1.75×10^{11} C/kg.

29. If $0 \le x \le \pi$ and $81^{\sin^2 x} + 81^{\cos^2 x} = 30$, then $x = \pi$

(a) $\frac{\pi}{6}$ (b) $\frac{\pi}{3}$ (c) $\frac{5\pi}{6}$ (d) $\frac{2\pi}{3}$ [Useful information: $\pi^c = 180^\circ$, sin $(180 - \theta) = \sin \theta$, sin $\theta \ge 0$ when $0 \le \theta \le 180^\circ$]

- 30. Given $(a-b)^2 + (a-c)^2 = (b-c)^2$, then which of the following statements are true? (a) equation is valid when b = c and $a \neq c$
 - (b) equation is valid when a = b
 - (c) equation is valid when a = c
 - (d) Given equation is not valid when a, b and c are distinct.

31. Choose the correct statements from following options.

- (a) A robust adaptive immune response is initiated using weakened forms of the bacterium known as live attenuated vaccines.
- (b) Administration of a killed or chemically inactivated virus can trigger a weaker adaptive immune response, but can be strengthened with booster doses.
- (c) A conjugate or multivalent component always reduces immunogenicity of the vaccine.
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 - (a) Thyroid hormone decreases metabolic rate (b) Growth hormone increases metabolic rate
 - (c) Fever decreases metabolic rate
- (d) Malnutrition decreases metabolic rate

ROUGH WORK

Date of Examination: January 17, 2021 Time: 2:30 PM to 03:30 PM Question Paper Code: 53



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.

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- 5. Your **fourteen-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 2020 21 (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(s) and fill the appropriate bubble(s), as shown.



In part A2 (Q. No. 25 to 32) each question has four alternative 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 $\frac{1}{2}$





- 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.
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- 16. 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 25, 2021. See the Minimum Admissible Score Clause on the Student's brochure on the web.
- 17. List of students eligible for evaluation of IOQJS 2020-21 (Part II) shall be displayed on www.iapt.org.in by March 1, 2021.

Some useful physical constants and useful data								
Physical Constant	Symbol	Magnitude with SI units						
Gravitation Constant	G	6.67×10 ⁻¹¹ Nm ² /kg ²						
Solar mass	M₀	2×10 ³⁰ kg						
Acceleration due to gravity on earth	g	9.8 ms ⁻²						
Charge of an electron	е	1.6 × 10 ⁻¹⁹ C						
Mass of an electron	т	9.1 × 10 ⁻³¹ kg						
1 eV = 1.6 × 10 ⁻¹⁹ J								
An α particle is a doubly ionized He atom								

Time: 60 Minutes		Max. Marks: 120			
	Attempt all the Th	irty Two questions			
0010110080	Friend, ONET ONE IS CO				
Six circles each of radius 3 circles each of radius 3 circles triangle ABC such that they the sides of the triangle as sheight of triangle ABC is	m are inscribed in an o touch each other and hown in the adjacent	equilateral also touch figure. Then	A		
(a) $6(2\sqrt{3}+3)$	(b) $3(2\sqrt{3}+6)$,	$\langle \chi \rangle$		
(c) $3(2\sqrt{3}+3)$	(d) $6(2+\sqrt{3})$	в			
Find the remainder when x^5	¹ is divided by $x^2 - 3x^2$	x+2	Ũ		
(a) x (b) (2^5)	$(x^{51}-2)x+2-2^{51}$ (c) $(2^{51}-1)x+2-$	-2^{51} (d) 0		
If $\frac{3}{x-2} < 1$, where <i>x</i> is a real (a) $2 < x < 5$ (b) $x < 1$	al number, then $< 2 \text{ or } 5 < x $ (c) $x < -2$ or $x > 5$	(d) None of these		
if $x^2 + ax + b = 0$ and $x^2 + ax + b = 0$ (b) (a) $a + b = 0$ (b)	bx + a = 0 have one) $a + b = 1$ (c)	a+b=-1	(d) $a^2 + b^2 = 1$		
If $100^{25} - 25$ is written in de (a) 444 (b) 442	ecimal notations, then c (c) 42	the sum of its dig 24	its is (d) 422		
ABC is a triangle, the bisecto (a) $AD > \sqrt{AB.AC}$ (b	r of angle A meets BC) $AD > AB.AC$ (o	in D. The relation c) $AD = \sqrt{AB.AC}$	between AD, AB and AC is (d) $AD < \sqrt{AB.AC}$		
If in a wheat mutant, the le approximately how many a (a) 0.5×10^4 bp (b) 5	ngth of chromosome additional base pairs a X 10 ⁴ bp (c) 1	1B was found to re incorporated ir7 X 10 ⁴ bp	be 6.7 μm instead of 5.0 μm, the mutant chromosome? (d) 5.78 X 10 ⁴ bp		
 Considering following charactory options. Most affected individua Affected sons result from carriers because they have Affected daughters are 	teristics, identify the Is are male. In female parents wh ave affected brothers born to affected fath	correct inheritanc no are either affer , fathers, or mater ers and either affe	e pattern from the given cted or who are known to be mal uncles.		
 The sons of affected mo Approximately half the (a) Autosomal Recessive In 	others should be affect sons of carrier mothe heritance (b) Auto	ted. rs should be affec somal Dominant I	ted.		

Question Paper Code: 53

(c) Sex-Linked Recessive Inheritance (d) Sex-Linked Dominant Inheritance

- 9. The transpiration pull is maximum under which of the following conditions?
 - (a) Closed stomata, low light intensity, humid air
 - (b) Open stomata, dry air, moist soil
 - (c) Open stomata, dry air, dry soil
 - (d) Open stomata, high humidity in air, moist soil
- 10. In a marine ecosystem with rich diversity of fauna, which of the following images would be a correct representation of pyramid of biomass?



- 11. *Curcuma longa, Azadirachta indica,* Basmati Rice, Indian Ginseng are all related to which of the following concepts?
 - (a) Bioterrorism (b) Biomagnification (c) Biopiracy (d) Biodegradation
- 12. Read following criteria carefully.
 - Slow evolutionary change relative to similar entities
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 - Very low taxonomic richness today compared to the past
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 - Known in the fossil record before being discovered alive
 - These criteria can be used to categorize a group of organisms the most probably into
 - (a) Connecting links (b) Living fossils (c) Endangered species (d) Extinct species
- 13. Gravitational collapse is the contraction of an astronomical object under its own gravity. This draws the matter inwards towards the centre of gravity. A neutron star is an example of the collapsed core of a giant star. A certain neutron star of radius 10 km is of mass $1.5 M_{\odot}$. The acceleration due to gravity on the surface of the neutron star is nearly (a) $2.0 \times 10^8 \text{ m/s}^2$ (b) $2.0 \times 10^{12} \text{ m/s}^2$ (c) $2.6 \times 10^{16} \text{ m/s}^2$ (d) $2.6 \times 10^{20} \text{ m/s}^2$
- 14. The tympanic membrane (ear drum) is a very delicate component of the human ear. Typically, its diameter is 1 cm. The maximum force the ear can withstand is 2.5 N. In case a diver has to enter sea water of density 1.05 X 10³ kg/m³ without any protective gear, the maximum safe depth for the diver to go into water is about
 - (a) 12 m (b) 9 m (c) 3 m (d) 1.5 m
- 15. A nuclear reactor is working at 30% efficiency (i.e. conversion of nuclear energy to electrical energy). In this reactor ${}^{235}_{92}U$ nucleus undergoes fission and releases 200 MeV energy per atom. If 1000 kW of electrical power is obtained in this reactor, then the number of atoms disintegrated (undergone fission) per second in the reactor is (a) 1.04×10^{17} (b) 6.5×10^{12} (c) 3.125×10^{12} (d) 3.25×10^{32}

- 16. Two illuminated point objects O₁ and O₂ are placed at a distance 24 cm from each other along the principal axis of a thin convex lens of focal length 9 cm such that images of both the objects are formed at the same position. Then the respective distances of the lens from O₁ and O₂ (in cm) are (a) 12 and 12 (b) 18 and 6 (c) 14 and 10 (d) 16 and 8
- 17. Two blocks A and B are in contact with each other and are placed on a frictionless horizontal surface. A force of 90N is applied horizontally on block A (situation I) and the same force is applied horizontally on block B (situation II). Mass of A is 20 kg and B is 10 kg. Then the correct statement is



- (a) Since both the blocks are in contact, magnitude of force by block A on B will be 90 N (situation I) and magnitude of force by block B on A will also be 90 N (situation II).
- (b) Magnitude of force by block A on B is 30 N (situation I) and magnitude of force by block B on A is 60 N (situation II).
- (c) Magnitude of force by block A on B is 60 N (situation I) and magnitude of force by block B on A is 30 N (situation II).
- (d) The 90 N force will produce acceleration of different magnitudes in A and B.

18. In the adjoining circuit, $R = 5 \Omega$. It is desired that the voltage across R_x should be 6 V, then the value of R_x should be

(a) 4Ω	(b) 12 Ω
(c) 16 Ω	(d) 20 Ω



19. In one process for waterproofing, a fabric is exposed to (CH₃)₂SiCl₂ vapors. The vapors react with the hydroxyl groups on the surface of the fabric or with traces of water to form the waterproofing

film $[(CH_3)_2SiO]_n$, by the reaction; $n(CH_3)_2SiCI_2 + 2nOH^- \rightarrow 2nCI^- + nH_2O + [(CH_3)_2SiO]_n$ where n stands for a larger integer. The waterproofing film is deposited on the fabric layer upon layer. Each layer is 6 Å thick [the thickness of the $(CH_3)_2SiO$ group]. How much $(CH_3)_2SiCI_2$ is needed to waterproof one side of a piece of fabric, 1m by 2m, with a film 300 layers thick? The density of the film is 1.0 g/cm³.

(a) 0.63g	(b) 0.36g	(c) 6.3g	(d) 3.6g

- 20. Given that at a certain temperature, in 1.5 L vessel, 5.0 mole of A, 7.0 mole of B and 0.1 mole of C are present. Then the value of equilibrium constant for the reaction: A+ B \rightleftharpoons 2C + heat is about (a) 7.22 × 10⁻⁴ (b) 2.31 × 10⁻⁴ (c) 7.22 × 10⁻⁵ (d) 6.11 × 10⁻⁴
- 21. An alcohol (A) on dehydration with conc. H₂SO₄ at a high temperature yields compound (B). On ozonolysis every molecule of compound (B) yields two molecules of acetaldehyde. Which of the following is the starting alcohol (A)?

(a) 1- butanol (b) 2- bu	tanol (c) propanal	(d) 2-propanol
--------------------------	--------------------	----------------

- 22. In an experiment with 100 mL 0.1 M solution of Copper Chloride, by mistake 5 gm of a mixture containing equal weights of Tin, Silver, Lead and Calcium, was added. Finally after some time the solution gets completely decolorized. This is mainly due to:
 - (a) Silver reacts with Copper Chloride
 - (b) Calcium reacts with Copper Chloride
 - (c) All the metals react with Copper Chloride
 - (d) Only Lead reacts with Copper Chloride forming white precipitate of lead chloride
- 23. Suppose that A and B forms compound B₂A₃ and B₂A. If 0.05 mole of B₂A₃ weighs 12 g and 0.1 mole of B₂A weighs 10 g, what are the atomic weight of A and B respectively?
 (a) 70 and 25 (b) 50 and 20 (c) 40 and 30 (d) 30 and 40
- 24. Triclosan ($C_{12}H_7CI_3O_2$) is an antibacterial and antifungal agent. It is a polychloro phenoxy phenol. It is widely used as a preservative and antimicrobial agent in personal care products such as soaps, skin creams, and deodorants etc. A label on a 200 mL hand sanitizer bottle claims that it contain Triclosan 0.2% w/v. What will be the number of molecules of Triclosan present in the bottle? (N_A is Avogadro's Number)

(a) $1.4 \times 10^{25} N_A$ (b) $1.4 \times 10^{24} N_A$ (c) $1.4 \times 10^{23} N_A$ (d) $1.4 \times 10^{22} N_A$

PART: A – 2

MORE THAN ONE CORRECT OPTIONS. BUBBLE ALL CORRECT OPTIONS ONLY.

25. If
$$0 \le x \le \pi$$
 and $81^{\sin^2 x} + 81^{\cos^2 x} = 30$, then $x =$
(a) $\frac{\pi}{6}$ (b) $\frac{\pi}{3}$ (c) $\frac{5\pi}{6}$
[Useful information: $\pi^c = 180^\circ$, sin $(180 - \theta) = \sin \theta$, sin $\theta \ge 0$ when $0 \le \theta \le 10^{-10}$

- 26. Given $(a-b)^2 + (a-c)^2 = (b-c)^2$, then which of the following statements are true? (a) equation is valid when b = c and $a \neq c$
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27. Choose the correct statements from following options.

- (a) A robust adaptive immune response is initiated using weakened forms of the bacterium known as live attenuated vaccines.
- (b) Administration of a killed or chemically inactivated virus can trigger a weaker adaptive immune response, but can be strengthened with booster doses.
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- 28. The minimum energy required to exist that is the energy required to perform chemical reactions even when a person is at rest is called the *basal metabolic rate* (BMR), which accounts for about 50 to 70 per cent of the daily energy expenditure in most sedentary individuals. It is influenced by many factors. Some statements are made about these factors. Choose the correct statements from the following options.

(a) Thyroid hormone decreases metabolic rate (b) Growth hormone increases metabolic rate

- (c) Fever decreases metabolic rate
 - (d) Malnutrition decreases metabolic rate
- 29. An infinitely long conductor when carrying current *I*, produces a magnetic field *B* around it. If such a conductor is placed along the X-axis, then the magnitude of *B* at a distance *r* is given by the relation $B = \frac{\mu_0}{4\pi} \frac{2I}{r}$, (where $\frac{\mu_0}{4\pi} = 10^{-7} \text{ NA}^{-2}$ is a constant). The following figure shows such an infinitely long conductor placed along X-axis carrying current *I* and *B* at S is 2 x 10⁻⁴ T, directed into the plane of the paper at S. Given *r* = 1 cm. Then, the correct statements are



(d) $\frac{2\pi}{3}$

(a) *I* = 10 A

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 - (a) SI unit of specific charge can be written as $A \cdot s / kg$.
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ROUGH WORK

54 Date of Examination: January 17, 2021 Time: 2:30 PM to 03:30 PM Question Paper Code: 54

Student's							
Roll No:							

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1 eV = 1.6 × 10 ⁻¹⁹ J			
An α particle is a doubly ionized He atom			

Question Paper Code: 54

Time: 60 Minutes		Max. Marks: 120
	Attempt all the Thirty Two questions	
	PART: A – 1	

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

- 1. Considering following characteristics, identify the correct inheritance pattern from the given options.
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 - Affected sons result from female parents who are either affected or who are known to be carriers because they have affected brothers, fathers, or maternal uncles.
 - Affected daughters are born to affected fathers and either affected or carrier mothers.
 - The sons of affected mothers should be affected.
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 - (a) Closed stomata, low light intensity, humid air
 - (b) Open stomata, dry air, moist soil
 - (c) Open stomata, dry air, dry soil
 - (d) Open stomata, high humidity in air, moist soil
- 5. Read following criteria carefully.
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 - Very low taxonomic richness today compared to the past
 - Phylogenetic inference of specific characters as plesiomorphic
 - Phylogenetic inference of a genealogical divergence between other groups that diverged in the distant past
 - Known in the fossil record before being discovered alive

These criteria can be used to categorize a group of organisms the most probably into

(a) Connecting links (b) Living fossils (c) Endangered species (d) Extinct species

- 6. If in a wheat mutant, the length of chromosome 1B was found to be 6.7 μ m instead of 5.0 μ m, approximately how many additional base pairs are incorporated in the mutant chromosome? (a) 0.5 X 10⁴ bp (b) 5 X 10⁴ bp (c) 1.7 X 10⁴ bp (d) 5.78 X 10⁴ bp
- 7. Six circles each of radius 3 cm are inscribed in an equilateral triangle ABC such that they touch each other and also touch the sides of the triangle as shown in the adjacent figure. Then height of triangle ABC is
 - (a) $6(2\sqrt{3}+3)$ (b) $3(2\sqrt{3}+6)$ (c) $3(2\sqrt{3}+3)$ (d) $6(2+\sqrt{3})$
- 8. If $x^2 + ax + b = 0$ and $x^2 + bx + a = 0$ have one common root, then (a) a + b = 0 (b) a + b = 1 (c) a + b = -1 (d) $a^2 + b^2 = 1$
- 9. Find the remainder when x^{51} is divided by $x^2 3x + 2$ (a) x (b) $(2^{51} - 2)x + 2 - 2^{51}$ (c) $(2^{51} - 1)x + 2 - 2^{51}$ (d) 0
- 10. If $100^{25} 25$ is written in decimal notations, then the sum of its digits is (a) 444 (b) 442 (c) 424 (d) 422
- 11. If $\frac{3}{x-2} < 1$, where x is a real number, then (a) 2 < x < 5 (b) x < 2 or 5 < x (c) x < -2 or x > 5 (d) None of these
- 12. ABC is a triangle, the bisector of angle A meets BC in D. The relation between AD, AB and AC is (a) $AD > \sqrt{AB.AC}$ (b) AD > AB.AC (c) $AD = \sqrt{AB.AC}$ (d) $AD < \sqrt{AB.AC}$
- 13. Given that at a certain temperature, in 1.5 L vessel, 5.0 mole of A, 7.0 mole of B and 0.1 mole of
C are present. Then the value of equilibrium constant for the reaction: $A + B \rightleftharpoons 2C + heat$ is
about
(a) 7.22×10^{-4} (b) 2.31×10^{-4} (c) 7.22×10^{-5} (d) 6.11×10^{-4}
- 14. An alcohol (A) on dehydration with conc. H₂SO₄ at a high temperature yields compound (B). On ozonolysis every molecule of compound (B) yields two molecules of acetaldehyde. Which of the following is the starting alcohol (A)?
 (a) 1- butanol
 (b) 2- butanol
 (c) propanal
 (d) 2-propanol
- 15. In one process for waterproofing, a fabric is exposed to $(CH_3)_2SiCl_2$ vapors. The vapors react with the hydroxyl groups on the surface of the fabric or with traces of water to form the waterproofing

film $[(CH_3)_2SiO]_n$, by the reaction; $n(CH_3)_2SiCI_2 + 2nOH^- \rightarrow 2nCI^- + nH_2O + [(CH_3)_2SiO]_n$ where n stands for a larger integer. The waterproofing film is deposited on the fabric layer upon layer. Each layer is 6 Å thick [the thickness of the $(CH_3)_2SiO$ group]. How much $(CH_3)_2SiCI_2$ is needed to waterproof one side of a piece of fabric, 1m by 2m, with a film 300 layers thick? The density of the film is 1.0 g/cm³. (a) 0.63g (b) 0.36g (c) 6.3g (d) 3.6g

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В

С

- 16. In an experiment with 100 mL 0.1 M solution of Copper Chloride, by mistake 5 gm of a mixture containing equal weights of Tin, Silver, Lead and Calcium, was added. Finally after some time the solution gets completely decolorized. This is mainly due to:
 - (a) Silver reacts with Copper Chloride
 - (b) Calcium reacts with Copper Chloride
 - (c) All the metals react with Copper Chloride
 - (d) Only Lead reacts with Copper Chloride forming white precipitate of lead chloride
- 17. Suppose that A and B forms compound B₂A₃ and B₂A. If 0.05 mole of B₂A₃ weighs 12 g and 0.1 mole of B₂A weighs 10 g, what are the atomic weight of A and B respectively?
 (a) 70 and 25
 (b) 50 and 20
 (c) 40 and 30
 (d) 30 and 40
- 18. Triclosan ($C_{12}H_7CI_3O_2$) is an antibacterial and antifungal agent. It is a polychloro phenoxy phenol. It is widely used as a preservative and antimicrobial agent in personal care products such as soaps, skin creams, and deodorants etc. A label on a 200 mL hand sanitizer bottle claims that it contain Triclosan 0.2% w/v. What will be the number of molecules of Triclosan present in the bottle? (N_A is Avogadro's Number)
 - (a) $1.4 \times 10^{25} N_A$ (b) $1.4 \times 10^{24} N_A$ (c) $1.4 \times 10^{23} N_A$ (d) $1.4 \times 10^{22} N_A$
- 19. Two blocks A and B are in contact with each other and are placed on a frictionless horizontal surface. A force of 90N is applied horizontally on block A (situation I) and the same force is applied horizontally on block B (situation II). Mass of A is 20 kg and B is 10 kg. Then the correct statement is



- (a) Since both the blocks are in contact, magnitude of force by block A on B will be 90 N (situation I) and magnitude of force by block B on A will also be 90 N (situation II).
- (b) Magnitude of force by block A on B is 30 N (situation I) and magnitude of force by block B on A is 60 N (situation II).
- (c) Magnitude of force by block A on B is 60 N (situation I) and magnitude of force by block B on A is 30 N (situation II).
- (d) The 90 N force will produce acceleration of different magnitudes in A and B.
- 20. Gravitational collapse is the contraction of an astronomical object under its own gravity. This draws the matter inwards towards the centre of gravity. A neutron star is an example of the collapsed core of a giant star. A certain neutron star of radius 10 km is of mass $1.5 M_{\odot}$. The acceleration due to gravity on the surface of the neutron star is nearly (a) $2.0 \times 10^8 \text{ m/s}^2$ (b) $2.0 \times 10^{12} \text{ m/s}^2$ (c) $2.6 \times 10^{16} \text{ m/s}^2$ (d) $2.6 \times 10^{20} \text{ m/s}^2$
 - (a) $2.0 \times 10^8 \text{ m/s}^2$ (b) $2.0 \times 10^{12} \text{ m/s}^2$ (c) $2.6 \times 10^{16} \text{ m/s}^2$ (d) $2.6 \times 10^{20} \text{ m/s}^2$
- 21. Two illuminated point objects O_1 and O_2 are placed at a distance 24 cm from each other along the principal axis of a thin convex lens of focal length 9 cm such that images of both the objects are formed at the same position. Then the respective distances of the lens from O_1 and O_2 (in cm) are

(a) 12 and 12 (b) 18 and 6 (c) 14 and 10 (d) 16 and 8

- 22. The tympanic membrane (ear drum) is a very delicate component of the human ear. Typically, its diameter is 1 cm. The maximum force the ear can withstand is 2.5 N. In case a diver has to enter sea water of density 1.05 X 10³ kg/m³ without any protective gear, the maximum safe depth for the diver to go into water is about
 - (a) 12 m (b) 9 m (c) 3 m
 - (d) 1.5 m



24. A nuclear reactor is working at 30% efficiency (i.e. conversion of nuclear energy to electrical energy). In this reactor ${}^{235}_{92}U$ nucleus undergoes fission and releases 200 MeV energy per atom. If 1000 kW of electrical power is obtained in this reactor, then the number of atoms disintegrated (undergone fission) per second in the reactor is (a) 1.04×10^{17} (b) 6.5×10^{12} (c) 3.125×10^{12} (d) 3.25×10^{32}

PART: A – 2 MORE THAN ONE CORRECT OPTIONS. BUBBLE ALL CORRECT OPTIONS ONLY.

- 25. Choose the correct statements from following options.
 - (a) A robust adaptive immune response is initiated using weakened forms of the bacterium known as live attenuated vaccines.
 - (b) Administration of a killed or chemically inactivated virus can trigger a weaker adaptive immune response, but can be strengthened with booster doses.
 - (c) A conjugate or multivalent component always reduces immunogenicity of the vaccine.
 - (d) Inclusion of alum, cytokines, and/or lipids always reduces the immune response to a vaccine.
- 26. The minimum energy required to exist that is the energy required to perform chemical reactions even when a person is at rest is called the *basal metabolic rate* (BMR), which accounts for about 50 to 70 per cent of the daily energy expenditure in most sedentary individuals. It is influenced by many factors. Some statements are made about these factors. Choose the correct statements from the following options.
 - (a) Thyroid hormone decreases metabolic rate (b) Growth hormone increases metabolic rate
 - (c) Fever decreases metabolic rate (d) Malnutrition decreases metabolic rate
- 27. Given $(a-b)^2 + (a-c)^2 = (b-c)^2$, then which of the following statements are true?
 - (a) equation is valid when b = c and $a \neq c$
 - (b) equation is valid when a = b
 - (c) equation is valid when a = c
 - (d) Given equation is not valid when a, b and c are distinct.
- 28. If $0 \le x \le \pi$ and $81^{\sin^2 x} + 81^{\cos^2 x} = 30$, then x =(a) $\frac{\pi}{6}$ (b) $\frac{\pi}{3}$ (c) $\frac{5\pi}{6}$ (d) $\frac{2\pi}{3}$ [Useful information: $\pi^c = 180^\circ$, sin $(180 - \theta) = \sin \theta$, sin $\theta \ge 0$ when $0 \le \theta \le 180^\circ$]
- 29. Equal lengths of magnesium ribbons are taken in four test tubes A, B, C, and D. In test tube A, 1M acetic acid is added; in test tube B, 1M HCl is added; in test tube C, 1M HNO₃ is added; and in test tube D, 1M NaOH is added. The observed results will be:
 - (a) The fizzing occurs more vigorously in A (b) The fizzing occurs more vigorously in B
 - (c) The fizzing occurs more vigorously in C (d) The fizzing occurs more vigorously in D
- 30. Acetylene torches and burners used by glassblowers produce intense ultraviolet light. Glassblowers wear special glasses that contain which of the following elements to absorb the UV?
 - (a) Neodymium (b) Praseodymium (c) Cerium (d) Didymium
- 31. The ratio of the charge of an ion or subatomic particle to its mass (q/m) is called specific charge. Then the correct options are

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- (a) SI unit of specific charge can be written as $A \cdot s / kg$.
- (b) If all the isotopes of hydrogen are ionized then tritium will have least specific charge among them.
- (c) specific charge of an α particle will be greater than that of an electron.
- (d) specific charge ratio of an electron is 1.75×10^{11} C/kg.

32. An infinitely long conductor when carrying current *I*, produces a magnetic field *B* around it. If such a conductor is placed along the X-axis, then the magnitude of *B* at a distance *r* is given by the relation $B = \frac{\mu_0}{4\pi} \frac{2I}{r}$, (where $\frac{\mu_0}{4\pi} = 10^{-7} \text{ NA}^{-2}$ is a constant). The following figure shows such an infinitely long conductor placed along X-axis carrying current *I* and *B* at S is 2 x 10⁻⁴ T, directed into the plane of the paper at S. Given *r* = 1 cm. Then, the correct statements are



- (a) / = 10 A
- (b) The number of electrons transported across the cross section of the conductor during time 1s is 6.25×10^{19}
- (c) The direction of current I is from X_2 to X_1 .
- (d) The electrons will flow in the direction X_2 to X_1 .

ROUGH WORK