English Answer Key for IAT 2026 (Provisional)

07-06-2026

Important Note: This document serves as the (provisional) answer key. For all the multiple-choice questions listed below, option **(a)** is the correct answer.

Biology

1. Question 1

   Which of the following processes result in development of a proton gradient across the thylakoid membrane during photosynthesis?

   i. Release of protons into the lumen of the thylakoid by plastoquinone
   ii. Consumption of protons in the stroma during the reduction of $NADP^+$
   iii. Release of protons into the lumen of the thylakoid by ATP synthase
   iv. Release of protons into the lumen of the thylakoid by water splitting reaction

   (a) i, ii and iv

   (b) ii, iii and iv

   (c) i, iii and iv

   (d) i, ii and iii

2. Question 2

Which one of the following choices matches the organs in column I with their vascular system arrangement described in column II?

Column I		Column II	
P.	Dicot root	**i.**	Radial, open, diarch to tetrarch
Q.	Dicot stem	**ii.**	Ring, conjoint, open
R.	Monocot root	**iii.**	Radial, closed, polyarch
S.	Monocot stem	**iv.**	Scattered, conjoint, closed

(a) P - (i); Q - (ii); R - (iii); S - (iv)

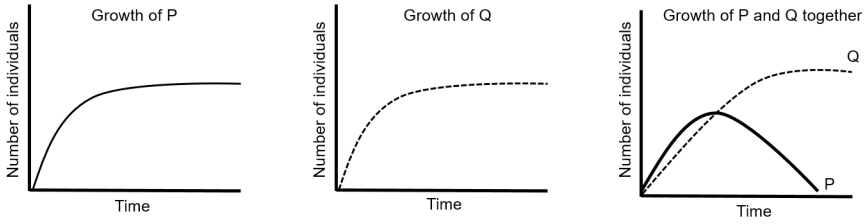
(b) P - (ii); Q - (i); R - (iv); S - (iii)

(c) P - (iii); Q - (iv); R - (i); S - (ii)

(d) P - (iv); Q - (iii); R - (ii); S - (i)

3. Question 3

The graphs below depict the number of individuals of two organisms, named P and Q, when grown independently, and together. Based on these growth patterns, which one of the following statements is correct?



(a) Q is a predator of P

(b) P and Q exhibit mutualism

(c) P is a parasite of Q

(d) Q is a commensal of P

4. Question 4

The pBR322 cloning vector has genes coding for tetracycline and ampicillin resistance. A foreign DNA to be cloned is inserted into the tetracycline resistance gene and the recombinant plasmid is then transformed into *E. coli* cells. Which one of the following choices is the most likely outcome of this cloning reaction?

(a) The cells with the recombinant plasmid can grow in the presence of ampicillin but not tetracycline

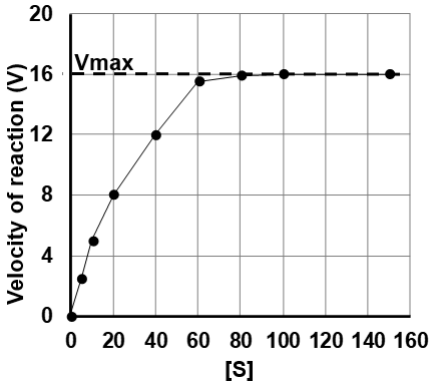
(b) The cells with the recombinant plasmid can grow in the presence of both ampicillin and tetracycline

(c) The cells with the non-recombinant plasmid can grow in the presence of ampicillin but not tetracycline

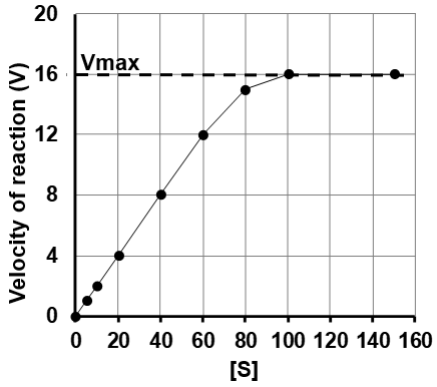
(d) The cells with the non-recombinant plasmid can grow in the presence of tetracycline but not ampicillin

5. Question 5

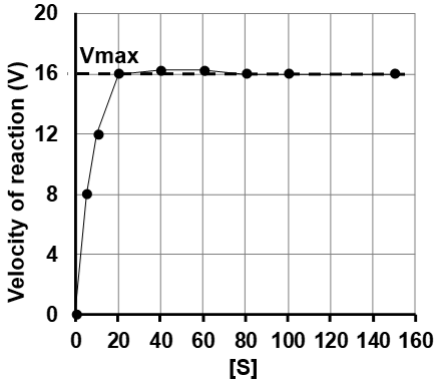
For which one of the following enzyme activity plots, will the K_m of the enzyme for substrate 'S' be 20? [S] indicates substrate concentration.



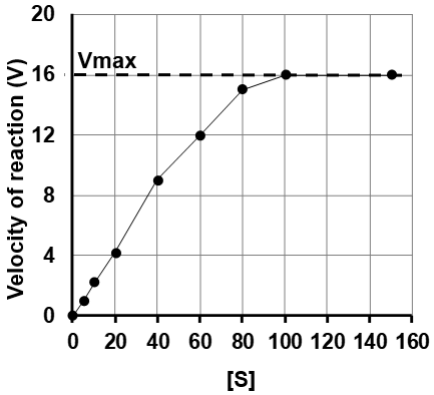
(a)



(b)


Vmax
Velocity of reaction (V)
20
16
12
8
4
0
0 20 40 60 80 100 120 140 160
[S]

(c)


Vmax
Velocity of reaction (V)
20
16
12
8
4
0
0 20 40 60 80 100 120 140 160
[S]

(d)

6. Question 6

Which one of the following correctly describes the mode of action of Follicle Stimulating Hormone (FSH) and estrogen?

(a) FSH interacts with membrane-bound receptor and generates cyclic AMP, while estrogen interacts with intracellular receptor and regulates gene expression

(b) FSH interacts with intracellular receptor and generates cyclic AMP, while estrogen interacts with membrane-bound receptor and regulates cellular metabolism

(c) Both FSH and estrogen regulate gene expression via intracellular receptors

(d) Both FSH and estrogen regulate cellular metabolism via membrane-bound receptors

7. Question 7

If cell wall was used as the only criterion for classifying organisms, then Mycoplasma would have belonged to which one of the following groups?

(a) Animals

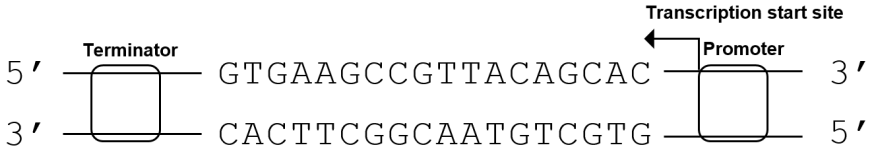
(b) Plants

(c) Fungi

(d) Protists

8. Question 8

Which one of the following is the correct sequence of the coding strand of the given gene?



(a) 5’ GTGCTGTAACGGCTTCAC 3’

(b) 5’ CACTTCGGCAATGTCGTG 3’

(c) 5’ GTGAAGCCGTTACAGCAC 3’

(d) 5’ CACGACATTGCCGAAGTG 3’

9. Question 9

Which one of the following correctly describes the sequence of events leading to muscle contraction following acetylcholine release at the neuromuscular junction?

(a) Increase of Ca^{++} in sarcoplasm, unmasking of active sites for myosin, 'Z' lines pulled inwards

(b) Increase of Ca^{++} in sarcoplasm, masking of active sites for myosin, 'Z' lines pulled inwards

(c) Increase of Ca^{++} in sarcoplasm, unmasking of active sites for myosin, 'Z' lines pulled outwards

(d) Decrease of Ca^{++} in sarcoplasm, masking of active sites for myosin, 'Z' lines pulled inwards

10. Question 10

In which one of the following cases, will an anti-Rh antibody treatment prevent *erythroblastosis foetalis*?

(a) Anti-Rh antibody to the Rh-negative mother after delivery of the first Rh-positive child

(b) Anti-Rh antibody to the Rh-positive mother after delivery of the first Rh-negative child

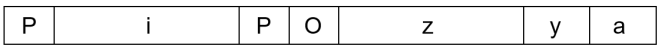
(c) Anti-Rh antibody to the Rh-negative mother after delivery of the first Rh-negative child

(d) Anti-Rh antibody to the Rh-positive mother after delivery of the first Rh-positive child

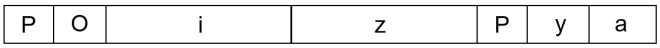
11. Question 11

Which of the following schematics correctly depict a *lac* operon that can be negatively regulated?

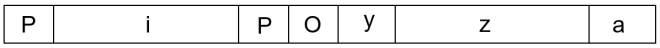
i.



ii.



iii.



iv.

(a) i and iii

(b) i and ii

(c) ii and iv

(d) iii and iv

12. Question 12

For which one of the following parents, their children will NOT have the same blood group phenotype as either of the parents?

(a) Father: AB; Mother: O

(b) Father: A; Mother: O

(c) Father: AB; Mother: A

(d) Father: O; Mother: B

13. Question 13

Which one of the following molecules can be used for RNA interference?

```
ACGGAACCAUGCAGAGAGG
||||||||||||||||||||
UGCCUUGGUACGUCUCUCC
```

(a)

```
ACGGAACCAUGCAGAGAGG
```

(b)

```
ACGGAACCATGCAGAGAGG
```

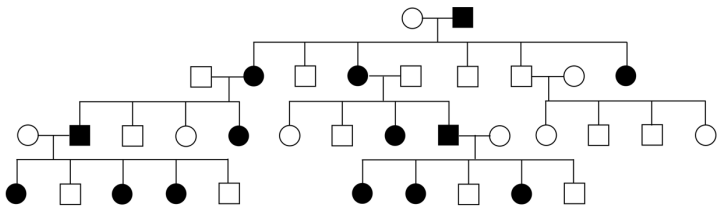
(c)

```
ACGGAACCATGCAGAGAGG
||||||||||||||||||||
TGCCTTGGTACGTCTCTCC
```

(d)

14. Question 14

The following pedigree diagram shows the inheritance of a rare genetic disorder in a family (filled shapes depict affected individuals). Which one of the following is the most likely pattern of inheritance of the disorder?



(a) X-linked dominant

(b) X-linked recessive

(c) Y-linked

(d) Mitochondrial

15. Question 15

A female child is born with all the primary oocytes required during her lifetime. At which one of the following stages of cell division are these oocytes found at birth?

(a) Prophase I

(b) Metaphase I

(c) Anaphase I

(d) Telophase I

Chemistry

1. Question 1

   Which one of the following octahedral complexes has the highest spin-only magnetic moment?

   (a) $[Cr(H_2O)_4(OH)_2]$

   (b) $[V(H_2O)_4I_2]^+$

   (c) $[Fe(NH_3)_4(CN)_2]^+$

   (d) $[Co(NH_3)_4Cl_2]$

2. Question 2

What are the numbers of protons (H^+) and electrons (e^-), respectively, required for the reduction of $[Cr_2O_7]^{2-}$ to Cr^{3+} under an aqueous acidic condition?

(a) $14, 6$

(b) $6, 14$

(c) $7, 3$

(d) $7, 6$

3. Question 3

Which one of the following molecules shows an increase in bond order after loss of an electron from the highest occupied molecular orbital?

(a) F_2

(b) N_2

(c) C_2

(d) B_2

4. Question 4

Metal-ligand π-bond formation in $Mn_2(CO)_{10}$ and $[MnO_4]^-$ requires electron-pair donation between metal and ligand orbitals. Which one of the following represents the direction of electron-pair donation?

(a) $Mn_2(CO)_{10}$: metal orbital $\rightarrow$ ligand orbital
$[MnO_4]^-$: ligand orbital $\rightarrow$ metal orbital

(b) $Mn_2(CO)_{10}$: ligand orbital $\rightarrow$ metal orbital
$[MnO_4]^-$: ligand orbital $\rightarrow$ metal orbital

(c) $Mn_2(CO)_{10}$: metal orbital $\rightarrow$ ligand orbital
$[MnO_4]^-$: metal orbital $\rightarrow$ ligand orbital

(d) $Mn_2(CO)_{10}$: ligand orbital $\rightarrow$ metal orbital
$[MnO_4]^-$: metal orbital $\rightarrow$ ligand orbital

5. Question 5

What is the order of bond energy between C=S & C=Te, and between Cl–Cl & F–F?

(a) C=S > C=Te and Cl–Cl > F–F

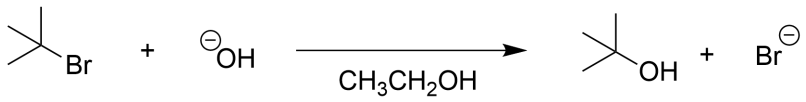
(b) C=Te > C=S and Cl–Cl > F–F

(c) C=Te > C=S and F–F > Cl–Cl

(d) C=S > C=Te and F–F > Cl–Cl

6. Question 6

Which one is an INCORRECT statement with regard to the following reaction?



(a) The reaction rate decreases upon changing the solvent from ethyl alcohol to 1:1 mixture of ethyl alcohol and water.

(b) The reaction rate does not change upon increasing the concentration of hydroxide ion.

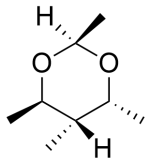
(c) The rate determining step is the dissociation of *tert*-butylbromide.

(d) The reaction rate is proportional to the concentration of *tert*-butylbromide.

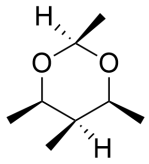
7. Question 7

Which one of the following molecules is chiral?

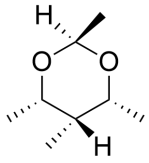
(a)



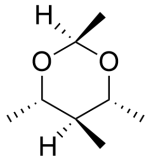
(b)



(c)

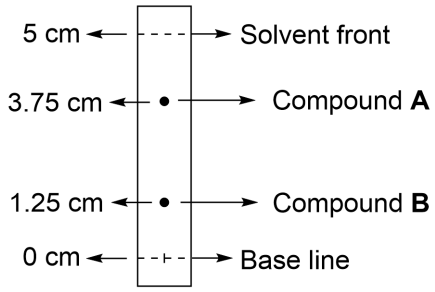


(d)



8. Question 8

Consider the following silica-gel based thin-layer chromatogram of compounds **A** and **B**. Which one of the following statements is correct?



(a) **B** is more polar than **A**; **A** has $R_f = 0.75$.

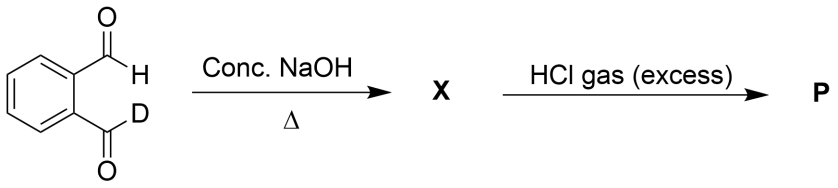
(b) **B** is more polar than **A**; **A** has $R_f = 0.25$.

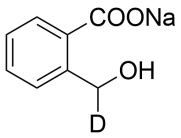
(c) **A** is more polar than **B**; **B** has $R_f = 0.33$.

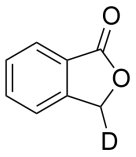
(d) **B** is less polar than **A**; **B** has $R_f = 0.75$.

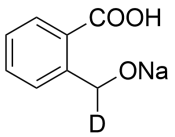
9. Question 9

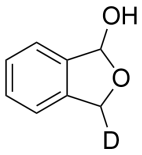
What are **X** and **P** in the following reaction sequence?

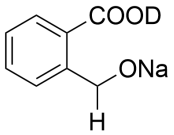


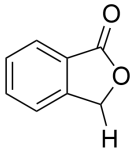
(a) **X** = 

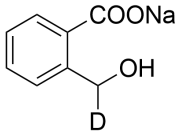
; **P** = 

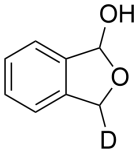
(b) **X** = 

; **P** = 

(c) **X** = 

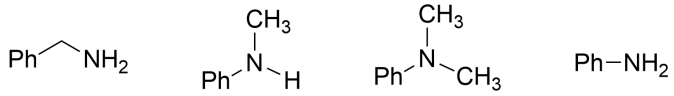
; **P** = 

(d) **X** = 

; **P** = 

10. Question 10

What is the order of pK_b for the following molecules in an aqueous medium?



P **Q** **R** **S**

(a) $\mathbf{P} < \mathbf{R} < \mathbf{Q} < \mathbf{S}$

(b) $\mathbf{P} < \mathbf{Q} < \mathbf{R} < \mathbf{S}$

(c) $\mathbf{S} < \mathbf{P} < \mathbf{R} < \mathbf{Q}$

(d) $\mathbf{S} < \mathbf{P} < \mathbf{Q} < \mathbf{R}$

11. Question 11

100 mL of 1.0 M aqueous NaOH solution was diluted to 1.0 L by adding water. Half of this solution was discarded. A new 100 mL of 0.5 M aqueous NaOH solution was added to the remaining solution. What is the concentration of the final aqueous NaOH solution?

(a) 0.17 M

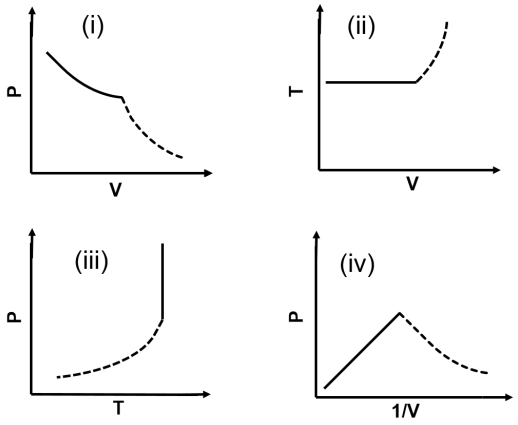
(b) 0.10 M

(c) 0.50 M

(d) 0.33 M

12. Question 12

An ideal gas goes through a reversible isothermal expansion (solid line) followed by a reversible adiabatic expansion (dashed line). Which of the following diagram(s) closely depict(s) the entire process?



(a) (i) and (iii) only

(b) (i) only

(c) (ii) and (iv) only

(d) (i), (ii), and (iii) only

13. Question 13

What is the ratio of the velocity of an electron in the fourth orbit of Be^{3+} to the velocity of the electron in the second orbit of He^{+}?

(a) 1:1

(b) 1:2

(c) 3:2

(d) 6:1

14. Question 14

For two pure volatile liquids **X** and **Y**, attractive intermolecular interactions of both **X**-**X** and **Y**-**Y** are weaker than those of **X**-**Y**. The total vapour pressure of an equimolar solution of **X** and **Y** is p_{total}. The vapour pressure of pure **X** and pure **Y** are $p^0_{\mathbf{X}}$ and $p^0_{\mathbf{Y}}$, respectively. Which one of the following relations is correct?

(a) $p_{\text{total}} < (p^0_{\mathbf{X}} + p^0_{\mathbf{Y}})/2$

(b) $p_{\text{total}} = (p^0_{\mathbf{X}} + p^0_{\mathbf{Y}})/2$

(c) $p_{\text{total}} = p^0_{\mathbf{X}} + p^0_{\mathbf{Y}}$

(d) $p_{\text{total}} > (p^0_{\mathbf{X}} + p^0_{\mathbf{Y}})/2$

15. Question 15

The rate constant of a reaction at 600 K with an activation energy of 191.47 kJ mol^{-1} is 5.0×10^{-5} s^{-1}. What is the temperature at which the half-life of the reaction becomes 152 s? [Consider pre-exponential factor and activation energy to be independent of temperature. R = 8.314 J $K^{-1}mol^{-1}$]

(a) 680 K

(b) 640 K

(c) 760 K

(d) 720 K

Mathematics

1. Question 1

   Let $p(x)$ be a quadratic polynomial such that $p(1) = p(-1) = 0$. What is the coefficient of x in $p(x)$?

   (a) 0

   (b) 1

   (c) -1

   (d) 2

2. Question 2

Consider the following sets of points in the complex plane

$$A = \left\{ \cos\left(\frac{2n\pi}{5}\right) + i\sin\left(\frac{2n\pi}{5}\right) : \ n \in \mathbb{Z} \right\} \text{ and}$$
$$B = \left\{ \cos\left(\frac{2n}{5}\right) + i\sin\left(\frac{2n}{5}\right) : \ n \in \mathbb{Z} \right\}.$$

Which of the following statements is TRUE?

(a) A is finite but B is infinite.

(b) A is finite and B is also finite.

(c) A is infinite but B is finite.

(d) A is infinite and B is also infinite.

3. Question 3

Consider the points $A(4\hat{i}+\hat{j}+3\hat{k})$, $B(2\hat{j})$ and $C(-4\hat{i}+3\hat{j}-3\hat{k})$. Which of the following statements is TRUE?

(a) A, B and C are collinear.

(b) $\overrightarrow{AB}+3\overrightarrow{BC}$ is perpendicular to $\overrightarrow{AC}$.

(c) $\overrightarrow{AB}\times\overrightarrow{BC}=\hat{i}+\hat{j}+\hat{k}$.

(d) $\overrightarrow{AB}$, $\overrightarrow{BC}$ and $\overrightarrow{CA}$ are mutually perpendicular.

4. Question 4

Let l_1 be the line joining $(1, 1, 1)$ and $(3, 1, 3)$ and let l_2 be the line joining $(0, 2, -1)$ and $(2, 0, 3)$. What is the angle between l_1 and l_2?

(a) 30^o

(b) 60^o

(c) 45^o

(d) 90^o

5. Question 5

Let r, l be two integers such that $r \geq l \geq 3$. What is the total number of functions

$$f : \{1, 2, \ldots, r\} \to \{1, 2, \ldots, r\}$$

such that $f(1), f(2), \ldots, f(l)$ are all distinct?

(a) $r^{r-l+1}(r-1)(r-2)\cdots(r-l+1)$

(b) $r^{r-l}(r-1)(r-2)\cdots(r-l+1)$

(c) $r(r-1)(r-2)\cdots(r-l+1)$

(d) r^r

6. Question 6

Let $\mathcal{C}$ be the set of all the circles in a plane. If

$$\mathcal{R} = \{(C_1, C_2) \in \mathcal{C} \times \mathcal{C} \mid C_1 \text{ and } C_2 \text{ intersect}\},$$

then which of the following statements is TRUE?

(a) $\mathcal{R}$ is reflexive and symmetric but not transitive.

(b) $\mathcal{R}$ is reflexive and transitive but not symmetric.

(c) $\mathcal{R}$ is symmetric and transitive but not reflexive.

(d) $\mathcal{R}$ is not a relation.

7. Question 7

What is the value of $\int_{-1}^{2} \min\{1-x, 1-x^3\}\, dx$?

(a) -1

(b) 0

(c) 1

(d) 2

8. Question 8

Consider the data of scores obtained by students in an examination. If the score of every student is increased by 2 marks, then which of the following statements is TRUE?

(a) The mean deviation about the mean does not change.

(b) The mean deviation about the mean is increased by 2.

(c) The mean deviation about the median is increased by 2.

(d) The variance is increased by 2.

9. Question 9

Consider the function $f : \mathbb{R} \to \mathbb{R}$ defined by $f(x) = \sin^2(7x) - \sin^2(5x)$.
Which of the following statements is **NOT** TRUE?

(a) f is increasing on $\left(\frac{3\pi}{2}, 2\pi\right)$.

(b) $f(x) > 0$, for all $x \in \left(0, \frac{\pi}{48}\right)$.

(c) $f\left(x + \frac{\pi}{2}\right) + f(x) = 0$, for all $x \in \mathbb{R}$.

(d) $f\left(\frac{\pi}{12}\right) = 0$

10. Question 10

For real numbers a and b, consider the function $f : \mathbb{R} \to \mathbb{R}$ given by

$$f(x) = \begin{cases} -ax - b & \text{if } x < -1, \\ 5x + 1 & \text{if } -1 \leq x \leq 1, \\ a^2x + 3b & \text{if } x > 1. \end{cases}$$

How many pairs (a, b) are there for which f is continuous at every point of $\mathbb{R}$?

(a) 0

(b) 1

(c) 2

(d) infinitely many

11. Question 11

For a 2×2 matrix A, whose elements are real numbers, denote by A^m the product $\underbrace{AA\cdots A}_{m \text{ times}}$, where m is a positive integer. Define $x_0 = 0$, $x_1 = 1$, $x_n = x_{n-1} + x_{n-2}$, for all $n \geq 2$ and

$$A_n = \begin{bmatrix} x_{n+1} & x_n \\ x_n & x_{n-1} \end{bmatrix}, \text{ for all } n \geq 1.$$

Which of the following statements is TRUE for all $m \geq 3$?

(a) $A_1^m = A_1^{m-1} + A_1^{m-2}$

(b) $\det(A_m) = -1$

(c) $A_1^m - A_1^{m-1} + \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

(d) $A_m - A_{m-1} - \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

12. Question 12

Let $a_1, a_2, a_3, \ldots$ be a geometric progression of positive integers such that $a_1 = 3$ and $a_{n+2} - 2a_n = a_{n+1}$ for all positive integers n. What is the value of $a_1 + a_2 + a_3 + a_4 + a_5$?

(a) 93

(b) 120

(c) 255

(d) 99

13. Question 13

Let $n = 20^{26}$. What is the remainder when $49^n + 41^n + 10n$ is divided by 100?

(a) 2

(b) 1

(c) 90

(d) 49

14. Question 14

Suppose there are two boxes B_1 and B_2, each having 3 red and 4 black balls. One ball is drawn at random from B_1. If it is red, 4 red balls are put into B_2, otherwise 3 black balls are put into B_2. Then one ball is randomly drawn from B_2. If this ball is red, what is the conditional probability that the ball drawn from B_1 was also red?

(a) $\frac{35}{57}$

(b) $\frac{99}{257}$

(c) $\frac{3}{7}$

(d) $\frac{33}{53}$

15. Question 15

Let $f : \mathbb{R} \to \mathbb{R}$ be the function given by

$$f(x) = |x - 2| + 3|x - 1| + ||x - 2| - 1|\,.$$

What is the number of points where f is **NOT** differentiable?

(a) 2

(b) 1

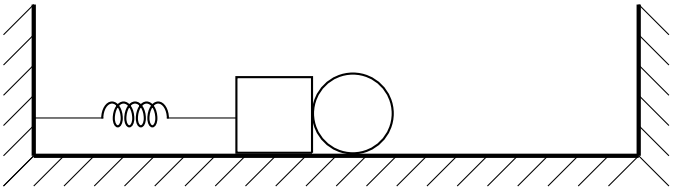
(c) 0

(d) 3

Physics

1. Question 1

A sphere and a cube of equal masses on a horizontal frictionless floor, are confined between two vertical walls, as shown in the figure. The cube is attached to the wall by a massless spring. At the equilibrium position of the spring, the sphere just touches the cube. The cube is moved towards the left by a small amount ℓ from its equilibrium position, compressing the spring and is released at $t = 0$. The system keeps returning to its initial configuration as that of $t = 0$ with a time period T. If all the collisions are elastic, which of the following statements is correct?



(a) If ℓ increases, T decreases.

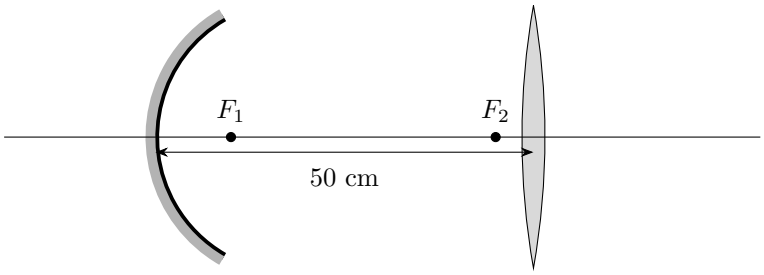
(b) If ℓ increases, T does not change.

(c) If ℓ increases, T increases.

(d) The sphere never moves.

2. Question 2

A spherical concave mirror of focal length 10 cm and a double convex lens of focal length 5 cm are arranged on the common principal axis as shown in the figure. A small object is placed on the principal axis between the focal points F_1 and F_2 of the mirror and the lens, respectively. If two real and mutually inverted images are formed by the lens at the same location on the principal axis, what is the distance of the object from the mirror on the principal axis?



(a) 20 cm

(b) 30 cm

(c) 25 cm

(d) 12 cm

3. Question 3

A simple pendulum of length L, mass m and electric charge q on its bob is oscillating with a time period T under uniform gravity which is in the $-\hat{\mathbf{z}}$ direction. Upon applying a uniform electric field $|E|\hat{\mathbf{n}}$ (where $\hat{\mathbf{n}}$ is a unit vector in the plane of oscillation), the time period of the pendulum decreases. Which of the following statements is NOT correct?

(a) q is positive and $\hat{\mathbf{n}} = \hat{\mathbf{z}}$

(b) q is positive and $\hat{\mathbf{n}} = -\hat{\mathbf{z}}$

(c) q is negative and $\hat{\mathbf{n}} = \hat{\mathbf{z}}$

(d) q is positive and $\hat{\mathbf{n}} \cdot \hat{\mathbf{z}} = -\frac{1}{\sqrt{2}}$

4. Question 4

A particle of mass m_1 and electric charge q starts from rest under the influence of a uniform external electric field $\mathbf{E}$ to travel a distance d in time t_1. If the particle had mass m_2, it would take time t_2 to travel the same distance. What is the ratio $\dfrac{t_1}{t_2}$?

(a) $\sqrt{\dfrac{m_1}{m_2}}$

(b) $\sqrt{\dfrac{m_2}{m_1}}$

(c) $\dfrac{m_2}{m_1}$

(d) $\dfrac{m_1}{m_2}$

5. Question 5

An exotic spherical jellyfish has a bulk modulus B. Close to the surface of the sea (depth d=0), its radius is R. When it dives to a depth d ($d \gg R$), its radius is reduced by $\Delta R > 0$. Given the density of the incompressible sea water ρ, and the uniform acceleration due to gravity g such that $\rho g d \ll B$, what is $\dfrac{\Delta R}{R}$?

(a) $\left[1 - \left(1 - \frac{\rho g d}{B}\right)^{1/3}\right]$

(b) $\left[1 - \left(1 - \frac{\rho g d}{B}\right)^{2/3}\right]$

(c) $\left[\left(1 + \frac{\rho g d}{B}\right)^{2/3} - 1\right]$

(d) $\left[\left(1 + \frac{\rho g d}{B}\right)^{1/3} - 1\right]$

6. Question 6

A planet is revolving in a circular orbit with a time period T around the center of a star solely under the gravity of the star. Suppose the distance between the star and the planet is halved. The individual radii of the star and the planet are also halved, keeping their uniform mass densities unchanged. What will be the time period of the new orbit of the planet?

(a) T

(b) $2T$

(c) $\frac{T}{2}$

(d) $\frac{T}{4}$

7. Question 7

The position of a particle of mass 1 kg at time t is given by $\mathbf{r} = t\,\hat{\mathbf{i}} + \hat{\mathbf{j}} + 2\,t^2\,\hat{\mathbf{k}}$, where t is in seconds and the coefficients have the proper units for $\mathbf{r}$ to be in metres. What is the component of the angular momentum (with respect to the origin) in kg m^2 s^{-1} along the vector $(\hat{\mathbf{i}} + \hat{\mathbf{j}})$?

(a) $\frac{1}{\sqrt{2}}(4t - 2t^2)$

(b) $\frac{1}{\sqrt{2}}(4t + 6t^2)$

(c) $4t - 2t^2$

(d) $4t + 6t^2$

8. Question 8

A long solenoid of initial radius R_0 is put in a region of uniform magnetic field $\mathbf{B}$ with the axis of the solenoid aligned along the magnetic field. The solenoid is a part of a closed circuit that has no initial current running through it. If the radius of the solenoid starts increasing at a uniform rate, how do the magnetic field strength B_{in} and the associated magnetic energy U_{in} inside the solenoid change?

(a) B_{in} decreases, U_{in} decreases.

(b) B_{in} increases, U_{in} decreases.

(c) B_{in} increases, U_{in} increases.

(d) B_{in} decreases, U_{in} increases.

9. Question 9

The acceleration of a point particle is given by the equation

$$\frac{d^2\mathbf{x}}{dt^2} = \alpha\frac{\mathbf{x}}{|\mathbf{x}|^7} + \beta\frac{d\mathbf{x}}{dt}$$

where $\mathbf{x}$ denotes position and t denotes time. Which of the following relations show the correct dimensions for α and β?

$$[\alpha] = [M^0L^7T^{-2}]$$
$$[\beta] = [M^0L^0T^{-1}]$$

(a)

$$[\alpha] = [M^1L^6T^{-2}]$$
$$[\beta] = [M^0L^0T^{-3}]$$

(b)

$$[\alpha] = [M^0L^6T^{-1}]$$
$$[\beta] = [M^0L^1T^{-2}]$$

(c)

$$[\alpha] = [M^0L^7T^{-2}]$$
$$[\beta] = [M^0L^0T^0]$$

(d)

10. Question 10

Consider normal incidence of a monochromatic beam of photons of power P on a flat surface. Of the incident beam, 10% gets absorbed, 10% gets transmitted, and the rest is reflected by the flat surface. If c is the speed of light, what is the force exerted on the flat surface by the beam?

(a) $1.7\frac{P}{c}$

(b) $1.8\frac{P}{c}$

(c) $1.6\frac{P}{c}$

(d) $0.9\frac{P}{c}$

11. Question 11

An experimental study of the photoelectric effect involves a metal of work function ϕ_0. What is the smallest wavelength of the incident photon to photoemit an electron of mass m which has the same de Broglie wavelength as that of the incident photon? [Given h is the Planck's constant, c is the speed of light, and $\phi_0 \ll mc^2$]

(a) $$\frac{h}{mc}\left(1+\sqrt{1-\frac{2\phi_0}{mc^2}}\right)^{-1}$$

(b) $$\frac{h}{mc}\left(1-\sqrt{1-\frac{2\phi_0}{mc^2}}\right)^{-1}$$

(c) $$\frac{h}{mc}\left(1-\sqrt{1-\frac{\phi_0}{mc^2}}\right)^{-1}$$

(d) $$\frac{h}{mc}\left(1+\sqrt{1-\frac{\phi_0}{mc^2}}\right)^{-1}$$

12. Question 12

The three numbers: (number of protons, number of neutrons, the radius) characterize a nucleus. What is the value of $\frac{r_1}{r_2}$ for two nuclei characterized by $(1, 0, r_1)$ and $(4, 4, r_2)$?

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

(b) 2

(c) 8

(d) $\frac{1}{8}$

13. Question 13

A jar is filled with two monoatomic non-interacting gases A and B with total masses M_A and M_B, respectively. The molar mass of A is double the molar mass of B. If the jar is kept at temperature T, what is the ratio of the total pressure of the combined gas to the partial pressure due to the gas A?

(a) $1 + 2\dfrac{M_B}{M_A}$

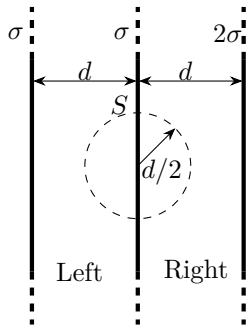
(b) $1 + \dfrac{1}{2}\dfrac{M_B}{M_A}$

(c) $1 + \dfrac{1}{2}\dfrac{M_A}{M_B}$

(d) $1 + 2\dfrac{M_A}{M_B}$

14. Question 14

Three infinite plane sheets which have uniform positive surface charge densities σ, σ and 2σ, are arranged parallel to each other with a separation of d as shown in the figure. A spherical Gaussian surface S of radius $d/2$ has its center on the middle sheet. Which of the following statements regarding the electric flux Φ_L through the left hemisphere and the electric flux Φ_R through the right hemisphere of the Gaussian surface is correct?



(a) $\Phi_L > \Phi_R$.

(b) $\Phi_L < \Phi_R$.

(c) $\Phi_L = \Phi_R$.

(d) $\Phi_L = 2\Phi_R$.

15. Question 15

Consider two Carnot engines of efficiencies η_1 and η_2. The first engine absorbs heat Q_1 from a heat reservoir A and releases heat Q_2 to a heat reservoir B. The second engine takes heat Q_2 from B and releases heat Q_3 to a heat reservoir C. If $Q_1 > Q_2 > Q_3$, what is the net efficiency of this combination of the two Carnot engines?

(a) $\eta_1 + \eta_2 - \eta_1\eta_2$

(b) $\eta_1 + \eta_2 + \eta_1\eta_2$

(c) $\eta_1\eta_2$

(d) $\eta_1 + \eta_2$