Centre For Excellence In Basic Sciences

Notations :

1.Options shown in green color and with ✔ icon are correct.

2.Options shown in red color and with ✖ icon are incorrect.

Question Paper Name :	NEST2022 18th June 2022 Shift 1
Subject Name :	NEST 2022
Creation Date :	2022-06-18 14:06:58
Duration :	210
Total Marks :	200
Display Marks:	Yes
Actual Answer Key :	Yes
Calculator :	Normal
Magnifying Glass Required? :	No
Ruler Required? :	No
Eraser Required? :	No
Scratch Pad Required? :	No
Rough Sketch/Notepad Required? :	No
Protractor Required? :	No
Show Watermark on Console? :	Yes
Highlighter :	No
Auto Save on Console?	Yes
Change Font Color :	No
Change Background Color :	No
Change Theme :	No
Help Button :	No
Show Reports :	No
Show Progress Bar :	No

NEST 2022

Group Number :	1
Group Id :	7332354
Group Maximum Duration :	0
Group Minimum Duration :	120
Show Attended Group? :	No
Edit Attended Group? :	No
Break time :	0
Group Marks :	200
Is this Group for Examiner? :	No

Examiner permission :	Cant View
Show Progress Bar? :	No
Revisit allowed for group Instructions? :	No
Maximum Instruction Time :	0
Minimum Instruction Time :	0
Navigate To Group Summary From Last Question? :	No
Disable Submit Button During Assessment? :	No

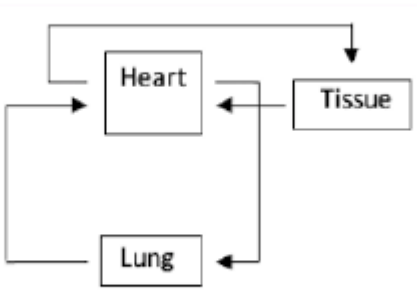
Biology

Section Id :	73323513
Section Number :	1
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	17
Number of Questions to be attempted :	17
Section Marks :	50
Enable Mark as Answered Mark for Review and Clear Response :	Yes
Maximum Instruction Time :	0
Sub-Section Number :	1
Sub-Section Id :	73323525
Question Shuffling Allowed :	Yes

Question Number : 1 Question Id : 733235205 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

The circulatory system of an organism is depicted in the schematic below.



The organism is:

Options :

733235817. ✖ prawn.

733235818. ✖ fish.

733235819. ✔ rabbit.

733235820. ✖ earthworm.

Question Number : 2 Question Id : 733235206 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

A student working in a lab had three tubes with the following preparations:

(i) Freshly extracted nucleic acids dissolved in a buffer.

(ii) Chlorophyll extract from spinach leaf.

(iii) Red coloured anthocyanin from onion cells.

The student used a spectrophotometer to determine the wavelength of light at which each preparation would show maximum absorption (absorption maxima). She noted down these values in her notebook. However, when she came to the lab the next day she realised that she had not mentioned the name of the sample preparation against each value. The values she recorded were 480 nm, 260 nm and 642 nm. The respective values for the samples (i), (ii) and (iii) would most likely be:

Options :

733235821. ✖ 480 nm; 260 nm and 642 nm.

733235822. ✔ 260 nm; 642 nm and 480 nm.

733235823. ✖ 480 nm; 642 nm and 260 nm.

733235824. ✖ 260 nm; 480 nm and 642 nm.

Question Number : 3 Question Id : 733235207 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

An experimenter intends to develop a small molecule drug for inducing polyploidy in a crop plant species. The stage of the cell cycle that such a molecule should affect is:

Options :

733235825. ✖ G_0 phase.

733235826. ✖ S-phase.

733235827. ✔ anaphase.

733235828. ✖ telophase.

Question Number : 4 Question Id : 733235208 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

An organism, **M**, has physiological features as listed in the table below.

Features	**Observation**
Mode of nutrition	Photoautotroph
Respiration	Anaerobic
Photosynthetic parameters	Sulphur as electron donor and generates NADPH
Photophosphorylation	Non-cyclic
Carbon source	Carbon dioxide

Based on this information, the organism **M** is:

Options :

733235829. ✔ Green bacteria.

733235830. ✖ Cyanobacteria.

733235831. ✖ Algae.

733235832. ✖ Dinoflagellates.

Question Number : 5 Question Id : 733235209 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

If the transcription unit of a gene has its promoter and terminator arranged as shown below

5'-...(terminator)ATGCGATACAATAGCAT(promoter)...-3'

then, the sequence of mRNA transcribed from this DNA would be:

Options :

733235833. ✖ 5'-AUGCGAUACAAUAGCAU-3'

733235834. ✔ 5'-AUGCUAUUGUAUCGCAU-3'

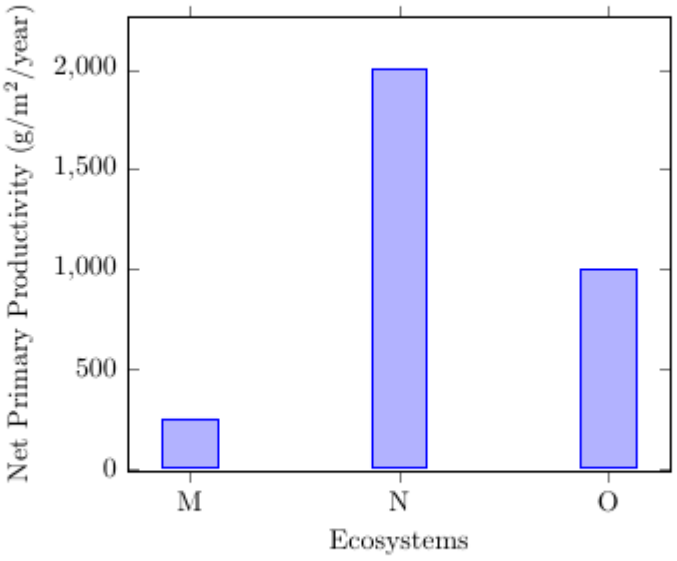
733235835. ✖ 5'-UACGAUAACAUAGCGUA-3'

733235836. ✖ 5'-UACGCUAUGUUAUCGUA-3'

Question Number : 6 Question Id : 733235210 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

A histogram of the net primary productivity ($g/m^2/year$) of selected ecosystems **M**, **N** and **O** is represented below.



M, **N** and **O** most likely represent:

Options :

733235837. ✖ desert, cold deciduous forest and tropical rain forest, respectively.

733235838. ✖ tundra, desert and grassland respectively.

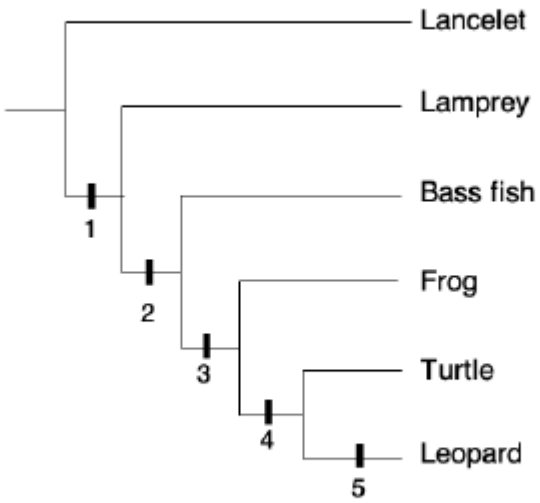
733235839. ✖ cold deciduous forest, tropical rain forest and tundra, respectively.

733235840. ✔ desert, tropical rain forest and cold deciduous forest, respectively.

Question Number : 7 Question Id : 733235211 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

A tree depicting the evolutionary relationships between a few animals is given below.



The correct statement regarding the characters 1 – 5 is:

Options :

733235841. ✖ characters 3 and 4 are amnion and four limbs respectively.

733235842. ✖ character 4 could be hair covering the skin.

733235843. ✖ character 1 could represent loss of limbs while 2 could represent lungs.

733235844. ✔ characters 2 and 5 could be hinged jaw and hair respectively.

Question Number : 8 Question Id : 733235212 Question Type : MCQ Option Shuffling : Yes Is

Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

A biochemical reaction $\mathbf{R} \rightleftharpoons \mathbf{P}$ is catalysed by an enzyme **E**. An experimenter measured the amount of product **P** formed in the reaction either in an uncatalyzed or a catalysed (**E** added) reaction, keeping other reaction conditions identical. In the uncatalyzed reaction, 19,800 millimole of **P** is formed from 20,000 millimole of **R** at the end of one hour. Continuing the reaction for another one hour did not increase the amount of **P** any further. In the catalysed reaction, the experimenter added 1 millimole of the enzyme to the reaction. The amount of **P** expected at the end of one hour in the catalysed reaction is:

Options :

733235845. ✖ 20,000 millimole.

733235846. ✖ 19,998 millimole.

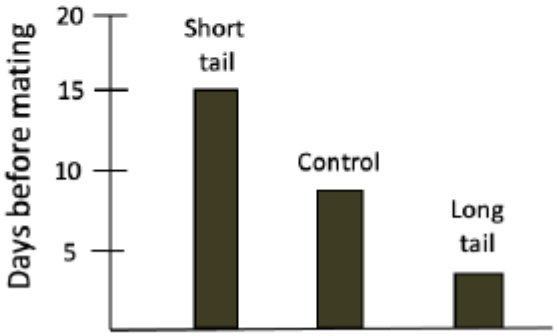
733235847. ✔ 19,800 millimole.

733235848. ✖ 19,801 millimole.

Question Number : 9 Question Id : 733235213 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

In an experiment, a scientist captured and cut the tails of wild male swallow birds that had already set up territories. He then glued tail-feathers back on these birds to get three groups of birds with differing tail lengths: tails longer than before; tails shorter than before; and tails of the same length (control) as before. These males were then allowed to mate. Based on the assumption that attractive male birds would require lesser time (in days) to acquire a mate, the number of days it took to find a mate in each group was recorded. Mean values for each group are shown in the graph below.



Based on the observations, the correct statement is:

Options :

733235849. ✖ Female birds have a higher preference for male birds with short tails.

733235850. ✔ A male normally takes around eight days after arriving in the breeding area to find a mate.

733235851. ✖ There is no difference in the time taken for mating in birds with short tail as compared to birds with unchanged tail length.

733235852. ✖ The presence of tail is more effective in attracting females than the length of the tail.

Question Number : 10 Question Id : 733235214 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

Phytohormones play a crucial role in regulating growth and development of plants. The table below lists a few phytohormones and the physiological responses that they regulate.

	Phytohormones		Physiological responses
i.	Abscisic acid	p.	Apical dominance
ii.	Gibberellic acid	q.	Cellular expansion
iii.	Auxins	r.	Internode elongation
iv.	Cytokinins	s.	Leaf fall and dormancy

Choose the option with the correct match.

Options :

733235853. ✔ i-s; ii-r; iii-p; iv-q

733235854. ✖ i-r; ii-s; iii-p; iv-q

733235855. ✖ i-p; ii-s; iii-q; iv-r

733235856. ✖ i-s; ii-q; iii-r; iv-p

Question Number : 11 Question Id : 733235215 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

Identify the correct statements about thylakoid membranes that make those the sites of light-dependent reaction in photosynthesis.

(i) Carbon dioxide and water can diffuse through the thylakoid membrane.

(ii) Photosystem-II anchored to the thylakoid membrane is involved in both cyclic and non-cyclic photophosphorylation.

(iii) Cytochrome complex embedded in the thylakoid membrane creates a proton gradient.

(iv) Thylakoid membrane with pigments and protein complexes has the capability of harvesting light.

Options :

733235857. ✖ i and ii

733235858. ✖ ii and iii

733235859. ✔ iii and iv

733235860. ✖ ii and iv

Question Number : 12 Question Id : 733235216 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

In a certain population of beetles that is in Hardy-Weinberg equilibrium, black colour is a recessive phenotype (hh) and grey colour is a dominant phenotype found in heterozygous (Hh) and homozygous individuals (HH). If the percentage of individuals with black colour and grey colour in the population is 9% and 91%, respectively, then the percentage (%) of the homozygous dominant (HH) individuals would be:

Options :

733235861. ✖ 45.5

733235862. ✖ 30

733235863. ✔ 49

733235864. ✖ 70

Sub-Section Number :	2
Sub-Section Id :	73323526
Question Shuffling Allowed :	Yes

Question Number : 13 Question Id : 733235217 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 4 Wrong Marks : 0

The purple frog *Nasikabatrachus sahyadrensis* is a species endemic to the Western Ghats of India. Another frog species, marbled balloon frog (*Uperodon globulosum*) looks very similar, and occupies similar habitats as the purple frog. Marbled balloon frog is also endemic to India. Based on these observations, *N. sahyadrensis* and *U. globulosum* are thought to be close relatives. A biologist studying the evolution of frogs of the world finds out that the closest relative of the purple frog is another frog genus *Sooglossus* which is endemic to the islands of Seychelles near Africa, rather than the marbled balloon frog.

A naturalist observed that some species of *Sooglossus* had specialized structures to live on high canopy trees (strongly webbed toes for gliding), some had strong limbs for a burrowing lifestyle while some lived in fast-flowing streams (heightened perching ability) and one species, *Sooglossus seychellensis* lived among the leaf litter of the forest (body shape and colour matches fallen leaf litter).

The tree communities on the western coast of Seychelles is different from that on the eastern coast. As a result, the colour of the leaf litter also varies. The *S. seychellensis* on the eastern coast are black coloured, while the same species is light brown coloured on the western coast. The population size for the intermediate coloured *S. seychellensis* (dark brown) is very small and are rarely found.

Based on this information, choose the correct interpretation(s).

Options :

733235865. ✔ The genus *Sooglossus* has undergone adaptive radiation.

733235866. ✔ The marbled balloon frog and the purple frog have undergone convergent evolution.

733235867. ✔ The species *S. seychellensis* is undergoing disruptive selection.

733235868. ✖ The species *S. seychellensis* is undergoing stabilizing selection.

Question Number : 14 Question Id : 733235218 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 4 Wrong Marks : 0

In corn, the genotype *C/-R/-* results in colored kernels; whereas homozygous recessive condition for at least one of these genes results in colorless kernels. Assuming that *C* and *R* are unlinked genes, choose the correct statement(s):

Options :

733235869. ✔ A cross between plants *CcRr* and *ccRR* would result in 1/2 colored and 1/2 colorless progeny.

733235870. ✔ A cross between plants $CcRr$ and $CcRR$ would result in 3/4 colored and 1/4 colorless progeny.

733235871. ✔ A cross between plants $CcRr$ and $ccrr$ would result in 1/4 colored and 3/4 colorless progeny.

733235872. ✖ A cross between plants $CcRr$ and $CCRr$ would result in 1/2 colored and 1/2 colorless progeny.

Question Number : 15 Question Id : 733235219 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 4 Wrong Marks : 0

In humans, breathing involves cycles of inhalation and exhalation. The event(s) that occur(s) during inhalation is/are:

Options :

733235873. ✖ relaxation of the diaphragm.

733235874. ✖ relaxation of the external intercostal muscles.

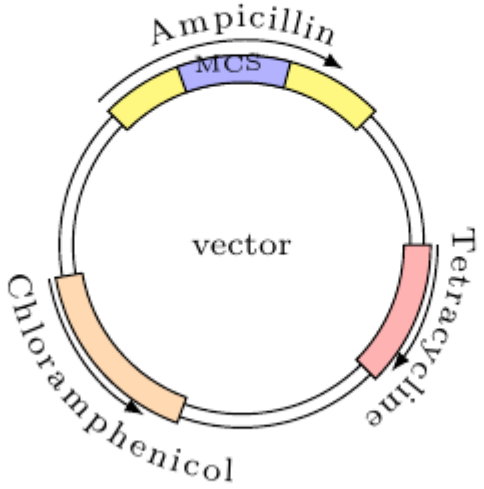
733235875. ✔ expansion of the thoracic cavity.

733235876. ✔ decrease in the intra-pulmonary pressure.

Question Number : 16 Question Id : 733235220 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 4 Wrong Marks : 0

An experimenter ligated cDNA of *p53* gene into the multiple cloning site (MCS) of a vector whose map is shown below. The ligated vector was transformed into *E. coli* cells, and transformants were initially selected on an agar plate containing antibiotic **P**. The bacterial colonies obtained on this plate were further propagated sequentially on antibiotic **Q** and then antibiotic **R** by replica plating.



The correct sequence(s) of **P**, **Q** and **R** to be used to select *E. coli* colonies with *p53* cDNA cloned into the MCS is/are:

Options :

733235877. ✖ Ampicillin → Chloramphenicol → Tetracycline.

733235878. ✔ Chloramphenicol → Tetracycline → Ampicillin.

733235879. ✖ Ampicillin → Tetracycline → Chloramphenicol.

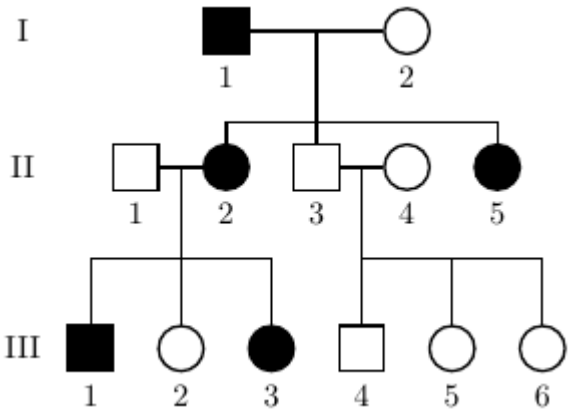
733235880. ✔ Tetracycline → Chloramphenicol → Ampicillin.

Question Number : 17 Question Id : 733235221 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

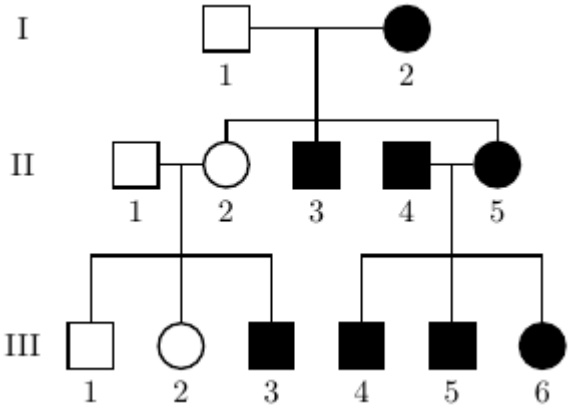
Correct Marks : 4 Wrong Marks : 0

In the given pedigree, circles represent females and squares represent males. Filled shapes indicate affected individuals while unfilled shapes indicate unaffected individuals. Vitamin D resistant rickets exhibits X-linked dominant inheritance. Identify the pedigree from the options that correctly represents the inheritance pattern of vitamin D resistant rickets.

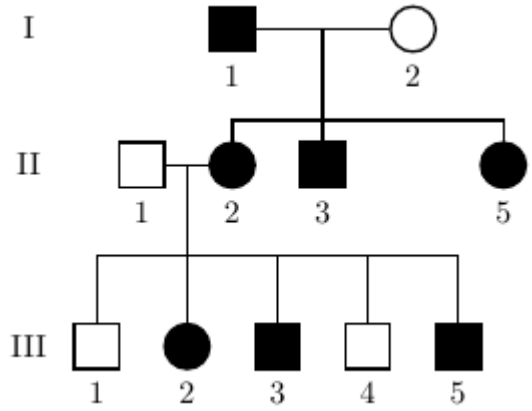
Options :



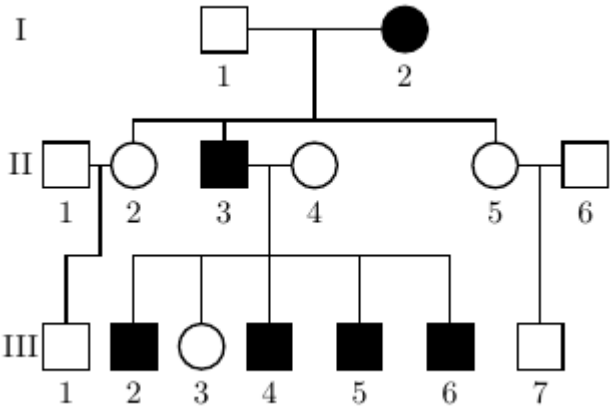
733235881. ✔



733235882. ✖



733235883. ✖



733235884. ✖

Chemistry

Section Id :	73323514
Section Number :	2
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	17
Number of Questions to be attempted :	17
Section Marks :	50
Enable Mark as Answered Mark for Review and Clear Response :	Yes
Maximum Instruction Time :	0
Sub-Section Number :	1
Sub-Section Id :	73323527
Question Shuffling Allowed :	Yes

Question Number : 18 Question Id : 733235222 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

To 5 mL of 0.1 N HCl, 10 mL of 0.1 M H_2SO_4 and 5 mL of 0.1 N NaOH solutions are added. The pH of the resulting solution is

Options :

733235885. ✖ 0.1

733235886. ✖ 0.7

733235887. ✔ 1.0

733235888. ✖ 1.4

Question Number : 19 Question Id : 733235223 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

The polysaccharide that is used as a storage molecule in animals is

Options :

733235889. ✖ cellulose.

733235890. ✖ chitin.

733235891. ✖ starch.

733235892. ✔ glycogen.

Question Number : 20 Question Id : 733235224 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

The correct statement about the Frenkel defect (FD) is

Options :

733235893. ✖ FD decreases the density of the substance.

733235894. ✔ FD occurs due to the dislocation of some of the smaller ions from their original positions to the interstitial sites.

733235895. ✖ FD is a vacancy defect that results due to missing of an equal number of cations and anions, from a crystal lattice.

733235896. ✖ FD is found in all ionic solids.

Question Number : 21 Question Id : 733235225 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

Consider the orbital angular momentum of the highest energy electron in Lithium (Li) and Boron (B) atoms. Orbital angular momentum, in the unit of $(h/2\pi)$, will be

Options :

733235897. ✖ same for both Li and B.

733235898. ✔ zero for Li and $\sqrt{2}$ for B.

733235899. ✖ zero for Li and one for B.

733235900. ✖ zero for Li and $\sqrt{6}$ for B.

Question Number : 22 Question Id : 733235226 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

The spin-only magnetic moment of $[FeCl_6]^{3-}$ ion in Bohr Magneton is

Options :

733235901. ✖ 2.96

733235902. ✔ 5.92

733235903. ✖ 1.73

733235904. ✖ 2.84

Question Number : 23 Question Id : 733235227 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

One mole of a compound **X** reacts with one mole of benzenesulphonyl chloride ($C_6H_5SO_2Cl$) to form the compound **Y**. The compound **Y** is not soluble in an alkali. The compound **X** is

Options :

733235905. ✖ $CH_3CH_2CH_2CH_2NH_2$

733235906. ✔ $(CH_3CH_2)_2NH$

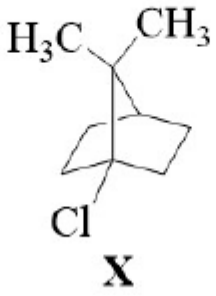
733235907. ✖ $(CH_3)_3CNH_2$

733235908. ✖ $(CH_3)_2NCH_2CH_3$

Question Number : 24 Question Id : 733235228 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

The compound **X**, shown below, does not react with aq. NaOH at 80°C. The reason is that



X

Options :

733235909. ✖ the two methyl groups offer steric hindrance to the incoming nucleophile.

733235910. ✖ the C – Cl bond is strong and does not dissociate under the reaction conditions.

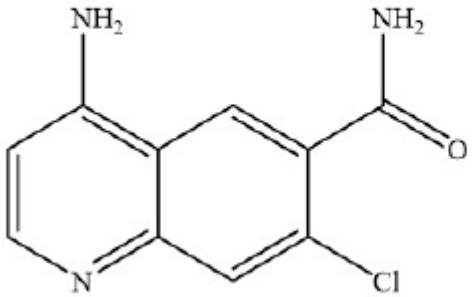
733235911. ✖ the +I effect of the methyl groups destabilizes the carbocation.

733235912. ✔ the cyclic structure prevents the formation of the carbocation.

Question Number : 25 Question Id : 733235229 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

An organic compound **X**, shown below, is subjected to the Kjeldahl method for the determination of nitrogen. The amount of ammonia liberated from 2.21 g of **X** is



X

Options :

733235913. ✔ 0.34 g

733235914. ✖ 0.17 g

733235915. ✖ 0.51 g

733235916. ✖ 0.68 g

Question Number : 26 Question Id : 733235230 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

The correct statement regarding the free energy change (ΔG) and the standard free energy change (ΔG^0) for (i) melting of ice and (ii) a chemical reaction $\mathbf{P} \rightarrow \mathbf{Q}$ is

Options :

733235917. ✖ The process of slow melting of ice at 0°C and atmospheric pressure is associated with a negative value of ΔG.

733235918. ✖ The process of slow melting of ice at 0°C at atmospheric pressure is associated with a positive value of ΔG.

733235919. ✖ The reaction $\mathbf{P} \rightarrow \mathbf{Q}$ with a positive value of ΔG^0 can never be spontaneous.

733235920. ✔ The reaction $\mathbf{P} \rightarrow \mathbf{Q}$ with a positive value of ΔG^0 can be spontaneous, but the reaction will reach equilibrium with $[\mathbf{Q}]_{eq} < [\mathbf{P}]_{eq}$.

Question Number : 27 Question Id : 733235231 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

Consider the following reversible exothermic reaction in an aqueous solution with the equilibrium constant K_c defined in terms of molarity, at temperature T.

$$2\,\mathbf{X}(\text{aq}) \rightleftharpoons \mathbf{Y}(\text{aq}) + 2\,\mathbf{Z}(\text{aq})$$

The reaction is started with the species $\mathbf{X}$ only. The correct statement about this reaction is

Options :

733235921. ✖ The unit of K_c is $\text{mol}^{-1}\ \text{L}^{-1}$.

733235922. ✖ At equilibrium, if the reaction mixture is diluted with water at the same temperature to double the total volume, the value of K_c will be halved after the new equilibrium is established.

733235923. ✔ If the temperature of the equilibrium reaction mixture is increased, the concentration of species **Z** will decrease.

733235924. ✖ If a small amount of **X** is added to the equilibrium reaction mixture, the value of K_c will be reduced after the new equilibrium is established.

Question Number : 28 Question Id : 733235232 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

Consider the expansion of one mole of an ideal gas from an initial state to a final state, with ΔS representing the entropy change in the process. The correct statement is

Options :

733235925. ✖ If the process is carried out reversibly, the value of ΔS will be higher in comparison to its irreversible counterpart.

733235926. ✖ If the process is adiabatic, the value of ΔS is always zero, irrespective of whether the process is carried out reversibly or irreversibly.

733235927. ✖ If the process is isothermal, there will not be any heat exchange with the surrounding since the temperatures of the system and the surrounding are equal.

733235928. ✔ If the process is isothermal and the final volume is double of the initial volume, the value of ΔS will be independent of the temperature.

Question Number : 29 Question Id : 733235233 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

For a chemical reaction, the time taken (τ) for the initial rate of reaction to fall to 90% of its value is found to be independent of the initial concentration. Choose the correct statement for this reaction.

Options :

733235929. ✖ The fraction reacted at time t equals exp[-kt], where k is the rate constant.

733235930. ✖ The half life for the reaction is 5τ.

733235931. ✔ The time taken to complete 75% of the reaction is two times the half life of the reaction.

733235932. ✖ The pre-exponential factor in the Arrhenius equation for this reaction has the dimension of time.

Sub-Section Number : 2
Sub-Section Id : 73323528
Question Shuffling Allowed : Yes

Question Number : 30 Question Id : 733235234 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical
Correct Marks : 4 Wrong Marks : 0

The correct statement(s) about $[MnCl_6]^{4-}$, $[Mn(CN)_6]^{3-}$ and $[MnCl_4]^{2-}$ is/are

Options :

733235933. ✖ All these complexes have center of symmetry.

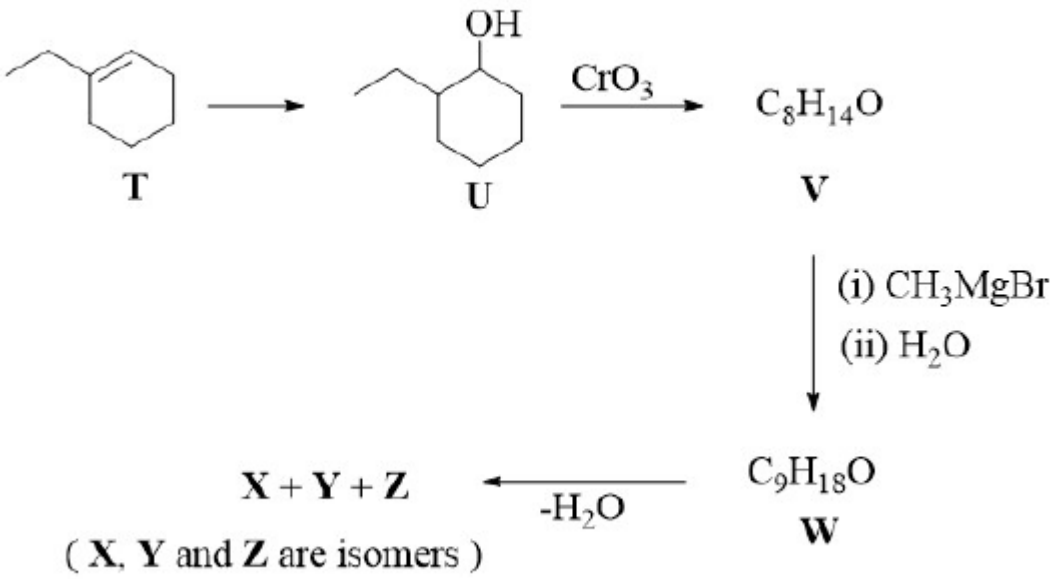
733235934. ✖ According to the Valence Bond Theory (VBT), the hybridization of Mn in $[MnCl_6]^{4-}$ and that in $[Mn(CN)_6]^{3-}$ are d^2sp^3 and sp^3d^2, respectively.

733235935. ✔ The $d-d$ electronic transition is possible in $[MnCl_6]^{4-}$, $[Mn(CN)_6]^{3-}$ and $[MnCl_4]^{2-}$.

733235936. ✔ The spin-only magnetic moments of the metal ions in $[MnCl_6]^{4-}$ and $[MnCl_4]^{2-}$ are equal.

Question Number : 31 Question Id : 733235235 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical
Correct Marks : 4 Wrong Marks : 0

Consider the reaction sequence shown below and the product(s) formed therein.



The correct statement(s) is/are

Options :

733235937. ✖ Acid catalyzed hydration of **T** provides **U** as the major product.

733235938. ✔ Compound **W** reacts rapidly with conc. HCl to give a turbid solution.

733235939. ✖ Dehydration of compound **W** gives a mixture of **X**, **Y**, and **Z** in equal quantity.

733235940. ✖ Hydrogenation of the mixture of **X**, **Y**, and **Z** gives a single compound.

Question Number : 32 Question Id : 733235236 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical
Correct Marks : 4 Wrong Marks : 0

The correct statement(s) regarding the basicity of amines is/are

Options :

733235941. ✔ The order of basic strength of methyl substituted amines in aqueous solution is $(CH_3)_2NH > CH_3NH_2 > (CH_3)_3N$.

733235942. ✖ The solvent stabilization of the conjugate acid of $(CH_3)_2NH$ in aqueous solution is more than that of the conjugate acid of CH_3NH_2.

733235943. ✔ The order of basic strength of ethyl substituted amines in aqueous solution is $(C_2H_5)_2NH > (C_2H_5)_3N > C_2H_5NH_2$.

733235944. ✔ Cyclohexylamine is a stronger base than aniline.

Question Number : 33 Question Id : 733235237 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 4 Wrong Marks : 0

The correct statement(s) about the atomic orbital (AO), molecular orbital (MO), and chemical bonding is/are

Options :

733235945. ✔ The linear combination of atomic orbitals (LCAO) used for forming MOs employs AOs located on different atoms.

733235946. ✔ Hybridization uses a linear combination of AOs located on the same atom to generate new hybrid AOs for the same atom.

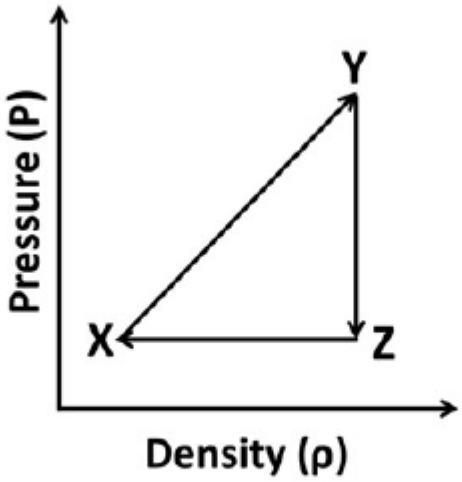
733235947. ✖ The p_x orbital of an atom **Q** and the p_y orbital of another atom **R** can overlap to form a covalent bond between **Q** and **R** in the XY plane.

733235948. ✔ The maximum number of π-bonds that can be formed from the p-orbitals of the two atoms **Q** and **R** is 2.

Question Number : 34 Question Id : 733235238 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

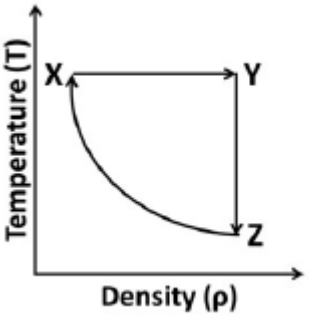
Correct Marks : 4 Wrong Marks : 0

The Pressure(P) – Density (ρ) plot of a cyclic process involving an ideal gas is shown below.

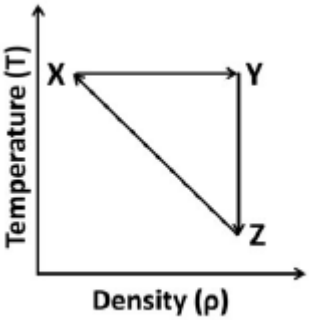


Four representations of this process using other thermodynamic variables, such as Temperature (T), Volume (V), etc., are provided below. The correct representation(s) of the process is/are

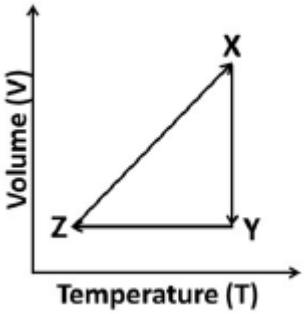
Options :



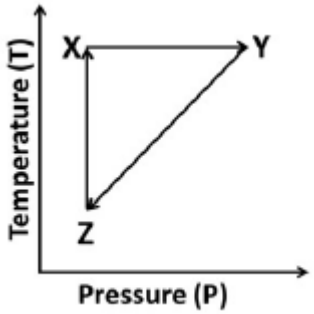
733235949. ✔



733235950. ✖



733235951. ✔



733235952. ✔

Mathematics

Section Id :	73323515
Section Number :	3
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	17
Number of Questions to be attempted :	17
Section Marks :	50
Enable Mark as Answered Mark for Review and Clear Response :	Yes
Maximum Instruction Time :	0
Sub-Section Number :	1
Sub-Section Id :	73323529
Question Shuffling Allowed :	Yes

Question Number : 35 Question Id : 733235239 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

The ratio of the perimeter and the diameter of a circle is always

Options :

733235953. ✖ a rational number.

733235954. ✖ an integer.

733235955. ✔ an irrational number.

733235956. ✖ $\frac{22}{7}$.

Question Number : 36 Question Id : 733235240 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

If α, β are the roots of $3x^2 + 10x + 6 = 0$, then the value of $\frac{1}{\alpha^2} + \frac{1}{\beta^2}$ is

Options :

733235957. ✔ $\frac{16}{9}$

733235958. ✖ $\frac{9}{16}$

733235959. ✖ $\frac{25}{9}$

733235960. ✖ $\frac{9}{25}$

Question Number : 37 Question Id : 733235241 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

Class XI has 4 boys and 6 girls, and Class XII has 4 boys and 3 girls. One student is selected at random from one of the classes (either class being equally likely). The selected student is a girl. The probability that she was from class XI is

Options :

733235961. ✔ $\frac{7}{12}$

733235962. ✖ $\frac{3}{5}$

733235963. ✖ $\frac{2}{3}$

733235964. ✖ $\frac{14}{29}$

Question Number : 38 Question Id : 733235242 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

The value of

$$\cos\frac{\pi}{2022}+\cos\frac{2\pi}{2022}+\cdots+\cos\frac{2021\pi}{2022}$$

is equal to

Options :

733235965. ✔ 0

733235966. ✖ 1

733235967. ✖ $\frac{1}{2022}$

733235968. ✖ $\frac{2021}{2022}$

Question Number : 39 Question Id : 733235243 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

The number of solutions of $e^{-x}=\sin x$ is

Options :

733235969. ✖ 0

733235970. ✖ 1

733235971. ✖ 2

733235972. ✔ more than 1000

Question Number : 40 Question Id : 733235244 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

Suppose $f : (-\pi/2, \pi/2) \to \mathbb{R}$ is a continuous function such that $f(x) = \dfrac{\sqrt{9-x} - \sqrt{9+x}}{\sin x \cos x}$ for all $x \neq 0$. Then the value of $f(0)$ is

Options :

733235973. ✖ $-\dfrac{1}{9}$

733235974. ✖ $-\dfrac{1}{6}$

733235975. ✔ $-\dfrac{1}{3}$

733235976. ✖ 0

Question Number : 41 Question Id : 733235245 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

Let $S = \{(x, y) \in \mathbb{N} \times \mathbb{N} : x^2 - y^2 = 2022\}$. Then the number of elements in S is

Options :

733235977. ✔ 0

733235978. ✖ 1

733235979. ✖ 2

733235980. ✖ greater than 2

Question Number : 42 Question Id : 733235246 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

Let a and b be non-negative real numbers satisfying $a^2 + b^2 = 4$. Then the minimum value of $4^a + 4^b$ is

Options :

733235981. ✖ $2^{1-2\sqrt{2}}$

733235982. ✔ $2^{1+2\sqrt{2}}$

733235983. ✖ $2^{1-\frac{1}{\sqrt{2}}}$

733235984. ✖ $2^{2\sqrt{2}-1}$

Question Number : 43 Question Id : 733235247 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

Let $S = \{x \in \mathbb{C} : x^3 - x^2 - x - 2 = 0\}$ and $T = \{x \in \mathbb{C} : x^{2020} + x^{202} + 1 = 0\}$. Then the number of elements in $S \cap T$ is

Options :

733235985. ✖ 1

733235986. ✖ 2

733235987. ✖ 3

733235988. ✔ 0

Question Number : 44 Question Id : 733235248 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

A right circular conical glass bottle with a base radius r and height h contains a coloured liquid upto half of its height. When the bottle is inverted and held vertically on its tip, the height of the liquid in the bottle is

Options :

733235989. ✖ $\frac{h}{2}$

733235990. ✖ $\frac{hr}{2}$

733235991. ✔ $\frac{7^{\frac{1}{3}}h}{2}$

733235992. ✖ $\frac{7^{\frac{1}{3}}hr}{2}$

Question Number : 45 Question Id : 733235249 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

For sets S and T, define

$$S \setminus T = \{x \in S \ : \ x \notin T\}.$$

Let P, Q and R be distinct sets. Then

Options :

733235993. ✖ $P \cup (Q \setminus P) = Q.$

733235994. ✔ if $R \subset Q$ then $P \cap (R \cup (Q \setminus R)) = P \cap Q.$

733235995. ✖ $P \cup (Q \setminus R) = (P \cup Q) \setminus (P \cup R).$

733235996. ✖ if $R \subset P$ then $P \cap (R \cup (Q \setminus R)) = P \cap Q.$

Question Number : 46 Question Id : 733235250 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

The number of arrangements of the letters of the word "PARALLEL" such that the letters P and R are together is

Options :

733235997. ✔ 840

733235998. ✖ 420

733235999. ✖ 5040

7332351000. ✖ 2520

Sub-Section Number : 2
Sub-Section Id : 73323530
Question Shuffling Allowed : Yes

Question Number : 47 Question Id : 733235251 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical
Correct Marks : 4 Wrong Marks : 0

Let $f : \mathbb{R} \to \mathbb{R}$ be a function satisfying

$$|f(x) - f(y)| \leq |x - y|^{\frac{3}{2}} \quad \text{for all } x, y \in \mathbb{R}.$$

Then

Options :

7332351001. ✖ $|f(x)| \leq |x|^{\frac{3}{2}}$ for all $x \in \mathbb{R}$.

7332351002. ✔ there exists $M \in \mathbb{R}$ such that $|f(x)| \leq M$ for all $x \in \mathbb{R}$.

7332351003. ✔ f is differentiable everywhere.

7332351004. ✖ $f(1) < f(0)$.

Question Number : 48 Question Id : 733235252 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical
Correct Marks : 4 Wrong Marks : 0

Let P be a non-zero 3×3 matrix with real entries. Let m and n be distinct natural numbers such that $P^m = P^n$. Then

Options :

7332351005. ✖ P is equal to the identity matrix.

7332351006. ✖ there exists a non-zero 3×1 matrix X such that $PX = X$.

7332351007. ✖ P^k is the zero matrix for some $k \in \mathbb{N}$.

7332351008. ✔ if $PX = \lambda X$ for some non-zero 3×1 matrix X and $\lambda \in \mathbb{R}$, then the possible values of $|\lambda|$ are 0 and 1.

Question Number : 49 Question Id : 733235253 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 4 Wrong Marks : 0

Given a prime p and an integer n, let $\nu(n)$ denote the largest integer k such that p^k divides n. Define $f(n) = p^{-\nu(n)}$. Then

Options :

7332351009. ✖ $f(p^r) < f(p^s)$ if $r < s$.

7332351010. ✖ $f(m) \leq f(n)$ if m divides n.

7332351011. ✔ $f(nm) = f(n)f(m)$ for all $n, m \in \mathbb{N}$.

7332351012. ✖ $f(n+m) = p^{\max(-\nu(n),-\nu(m))}$ for all $n, m \in \mathbb{N}$, where $\max(-\nu(n), -\nu(m))$ is the maximum of $-\nu(n)$ and $-\nu(m)$.

Question Number : 50 Question Id : 733235254 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 4 Wrong Marks : 0

Let $\vec{P}$ and $\vec{Q}$ be two nonzero and non-parallel vectors in three dimensional right handed rectangular coordinate system. Consider the set

$$V = \{\alpha\vec{P} + \beta\vec{Q} : \alpha, \beta \in \mathbb{R}\}.$$

Then

Options :

7332351013. ✔ for any vector $\vec{R}$, $\vec{R} \times (\vec{P} \times \vec{Q})$ is an element of V.

7332351014. ✔ given any element $\vec{S} \in V$, there exists a vector $\vec{R}$ such that $\vec{R} \times (\vec{P} \times \vec{Q}) = \vec{S}$.

7332351015. ✖ if $\vec{S_1}, \vec{S_2} \in V$ then $\vec{S_1} \times \vec{S_2} \in V$.

7332351016. ✖ for vectors $\vec{R_1}$ and $\vec{R_2}$, if $\vec{R_1} \times (\vec{P} \times \vec{Q}) = \vec{R_2} \times (\vec{P} \times \vec{Q})$, then $\vec{R_1} = \vec{R_2}$.

Question Number : 51 Question Id : 733235255 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 4 Wrong Marks : 0

Let z_1, z_2 and z_3 be three distinct complex numbers. If $z_1^2+z_2^2+z_3^2 = z_1z_2+z_2z_3+z_3z_1$, then

Options :

7332351017. ✔ z_1, z_2, z_3 form the vertices of an equilateral triangle.

7332351018. ✖ $z_1 - z_2, z_2 - z_3, z_1 - z_3$ form the vertices of an equilateral triangle.

7332351019. ✔ $(z_1 - z_2)^3 + (z_2 - z_3)^3 + (z_3 - z_1)^3 \neq 0$.

7332351020. ✔ $z_1 - z_2, z_2 - z_3, z_3 - z_1$ are cube roots of a fixed complex number.

Physics

Section Id :	73323516
Section Number :	4
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	17
Number of Questions to be attempted :	17
Section Marks :	50
Enable Mark as Answered Mark for Review and Clear Response :	Yes
Maximum Instruction Time :	0
Sub-Section Number :	1
Sub-Section Id :	73323531
Question Shuffling Allowed :	Yes

Question Number : 52 Question Id : 733235256 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

The following property is common to both charge and mass:

Options :

7332351021. ✖ Both are always positive.

7332351022. ✖ Both are strictly conserved.

7332351023. ✖ Two particles with equal charge and mass will always attract each other.

7332351024. ✔ Both are scalars.

Question Number : 53 Question Id : 733235257 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

Choose the **INCORRECT** statement about the dimension of following quantities in terms of mass (M), length(L) and time(T).

Options :

7332351025. ✖ The dimension of pressure is $M^1\ L^{-1}\ T^{-2}$.

7332351026. ✖ The dimension of power is $M^1\ L^2\ T^{-3}$.

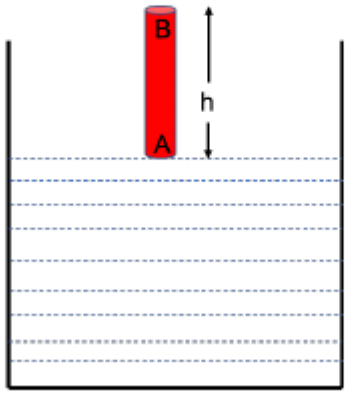
7332351027. ✔ The dimension of impulse is $M^1\ L^1\ T^{-2}$.

7332351028. ✖ The dimension of energy flux is $M^1\ L^0\ T^{-3}$.

Question Number : 54 Question Id : 733235258 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

A cylinder (density $= 5.0 \times 10^3$ kg·m^{-3}) of height $h = 2.0$ m is vertically released from rest in a water-filled tank (density of water $= 1.0 \times 10^3$ kg·m^{-3}) when the top surface A just touches the water as shown in the figure. Assume that the cylinder remains exactly vertical while it is sinking. The velocity of the cylinder at the instance when its top surface (B) just touches the water is



Options :

7332351029. ✖ 5.5 m·s^{-1}

7332351030. ✔ 6 m·s^{-1}

7332351031. ✖ 5 m·s^{-1}

7332351032. ✖ 6.5 m·s^{-1}

Question Number : 55 Question Id : 733235259 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

A turbo-pump working at constant pumping speed of 200 L·s^{-1} is used to evacuate a vessel of 1000 L of an ideal gas at room temperature. The approximate time (in seconds) required to reduce inside pressure of the vessel from 10^{-3} mbar to 10^{-6} mbar is closest to

Options :

7332351033. ✖ 30.0

7332351034. ✖ 32.0

7332351035. ✔ 34.0

7332351036. ✖ 36.0

Question Number : 56 Question Id : 733235260 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

A star of radius R_S and surface temperature of T_S, irradiates a planet of radius R_E. The distance between the star and the planet is R_{SE}. The average temperature T_E on the surface of the planet can be estimated from balance of energy flux between incoming and outgoing radiation. Assuming that the radiation from the star is uniformly distributed over the planet, select the correct option.

Options :

7332351037. ✖ $T_E \propto R_E^2$

7332351038. ✖ $T_E \propto R_{SE}^{-1}$

7332351039. ✖ T_E depends on Stefan-Boltzmann constant.

7332351040. ✔ $T_E \propto R_S^{1/2}$

Question Number : 57 Question Id : 733235261 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

A body of mass $m = 10.0$ kg, initially at rest, moves along a line under the action of constant force $F = 10.0$ N. The drag force experienced by the body is given by $-Cv^2$ where v is the instantaneous speed and $C = 10.0$ kg·m^{-1}. The time (in seconds) required for the body to achieve half of the terminal speed is closest to

Options :

7332351041. ✖ 1.3

7332351042. ✔ 0.5

7332351043. ✖ 0.8

7332351044. ✖ 0.1

Question Number : 58 Question Id : 733235262 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

The length of a stick is measured by a large number of students using an instrument having a least count of 0.1 cm. It is found to vary in a uniform fashion between 95.0 cm and 105.0 cm. Then the standard deviation is closest to

Options :

7332351045. ✖ $\pm 5.0\,\text{cm}$

7332351046. ✔ $\pm 3.0\,\text{cm}$

7332351047. ✖ $\pm 1.0\,\text{cm}$

7332351048. ✖ $\pm 0.1\,\text{cm}$

Question Number : 59 Question Id : 733235263 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

An electromagnetic wave is travelling in the direction of $-2\hat{i} + 3\hat{j} - \hat{k}$. The wave is polarized along the direction of $5\hat{i} + b\hat{j} + 2\hat{k}$. The value of b is

Options :

7332351049. ✖ -3

7332351050. ✔ 4

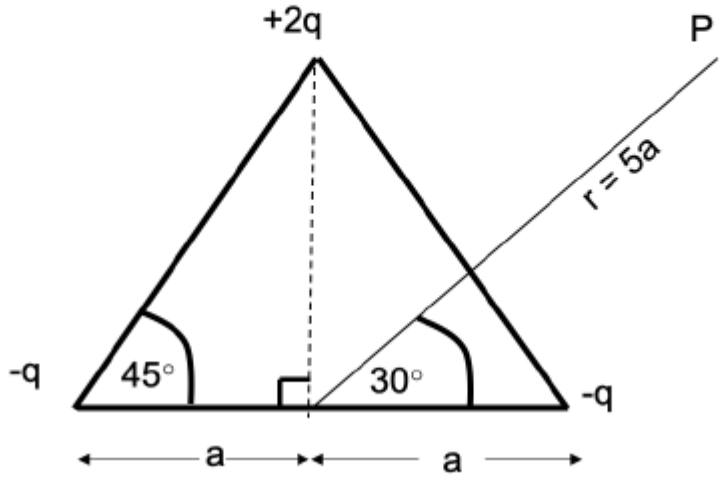
7332351051. ✖ 3

7332351052. ✖ 0

Question Number : 60 Question Id : 733235264 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

Three point charges are arranged in the $x-y$ plane as shown in the figure. Assuming that the potential at the infinity is zero, the approximate potential at the point P in the figure is



Options :

7332351053. ✔ $q/\left(100\pi\epsilon_0 a\right)$

7332351054. ✖ $q/\left(20\pi\epsilon_0 a\right)$

7332351055. ✖ $\sqrt{3}q/\left(40\pi\epsilon_0 a\right)$

7332351056. ✖ $q/\left(200\pi\epsilon_0 a\right)$

Question Number : 61 Question Id : 733235265 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

Planck had proposed that the oscillator energy E_n is directly proportional to n, a positive integer. We assume that this also holds for the energy of the electron in the hydrogen atom. In that case the angular momentum would be proportional to

Options :

7332351057. ✖ $1/n$

7332351058. ✔ $1/\sqrt{n}$

7332351059. ✖ $\sqrt{n}$

7332351060. ✖ n

Question Number : 62 Question Id : 733235266 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

A detector records 200 events from the decay of a radioactive sample in the first 10 s. It records 74 events in the next 10 s. The half life of the sample is

Options :

7332351061. ✖ 10 s

7332351062. ✖ 9 s

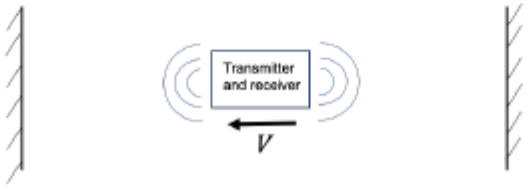
7332351063. ✔ 7 s

7332351064. ✖ 3 s

Question Number : 63 Question Id : 733235267 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

A device having a transmitter and a receiver on-board is moving with speed V between two walls as shown in the figure. The transmitter sends out signal of frequency f_s and speed C towards both the walls whereas the receiver is designed to detect the frequencies of echoes from the walls. Assuming that the walls are sufficiently away from the device to allow for multiple reflections, the frequency which will **NOT** be detected by the device is



Options :

7332351065. ✖ $f_s\left(\frac{C+V}{C-V}\right)$

7332351066. ✖ $f_s\left(\frac{C-V}{C+V}\right)$

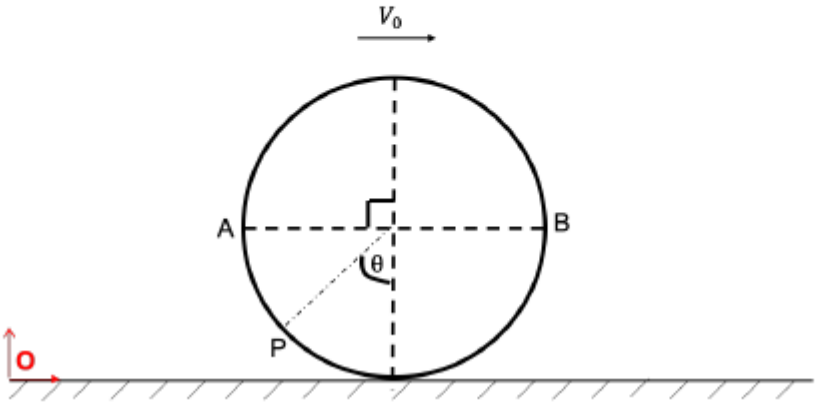
7332351067. ✖ f_s

7332351068. ✔ $f_s\left(\frac{C}{C-V}\right)$

Sub-Section Number : 2
Sub-Section Id : 73323532
Question Shuffling Allowed : Yes

Question Number : 64 Question Id : 733235268 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical
Correct Marks : 4 Wrong Marks : 0

A wheel of radius R is rolling without slipping on a stationary flat surface with a translational speed of V_0. The positions of points A, B and P on the rim of the wheel at time $t = T$ are shown in the figure. The point A covers a distance of 100.0 cm before it comes in contact with the surface. Assuming that the reference frame is fixed on the flat surface, select the correct statement(s).



Options :

7332351069. ✔ The radius of the wheel is 14.6 cm.

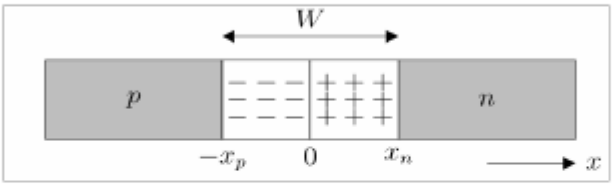
7332351070. ✖ The velocity of point B at time $t = T$ is in the vertically downward direction.

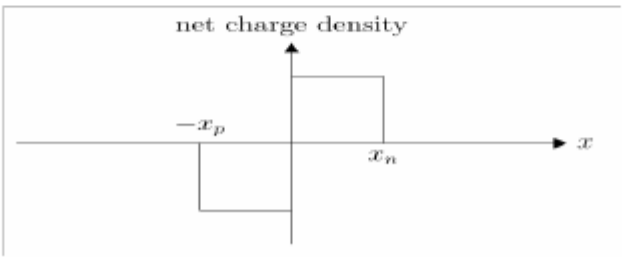
7332351071. ✔ The speed of point P at time $t = T$ is given by $2V_0 \sin(\theta/2)$.

7332351072. ✖ The radius of the wheel is 21.1 cm.

Question Number : 65 Question Id : 733235269 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical
Correct Marks : 4 Wrong Marks : 0

An unbiased silicon based p-n junction along with the net charge density profile is shown in the figure. The n and p sides are doped with phosphorus and boron atoms respectively, each of density $10^{22}\,\mathrm{m}^{-3}$. Taking $x_n = 3.3 \times 10^{-7}\,\mathrm{m}$ and relative permitivity of silicon to be 11.7, select the correct statement(s):





Options :

7332351073. ✔ The electric field is in the negative x-direction.

7332351074. ✔ $x_p = 3.3 \times 10^{-7}\,\mathrm{m}$

7332351075. ✔ The magnitude of the electric field at $x = 0$ is $4.9 \times 10^{6}\,\mathrm{V{\cdot}m^{-1}}$.

7332351076. ✖ The magnitude of the electric field from x_n to x_p decays exponentially.

Question Number : 66 Question Id : 733235270 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 4 Wrong Marks : 0

In an adiabatic expansion process, the density of an ideal gas changes from ρ_1 to ρ_2 such that $\rho_2/\rho_1 = \alpha$. Select the correct statement(s) about this process.

Options :

7332351077. ✖ The corresponding change in temperature is given by $T_2/T_1 = \alpha^{1-\gamma}$.

7332351078. ✔ The corresponding change in the speed of sound is given by $C_2/C_1 = \alpha^{(\gamma-1)/2}$.

7332351079. ✔ The corresponding change in averaged collision frequency is given by $\nu_2/\nu_1 = \alpha^{(\gamma+1)/2}$.

7332351080. ✔ The corresponding change in mean free path is given by $\lambda_2/\lambda_1 = \alpha^{-1}$.

Question Number : 67 Question Id : 733235271 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 4 Wrong Marks : 0

An atom is modelled by a stationary central positive point charge $+Q$ surrounded by a spherical electron cloud (radius R, total charge of $-Q$) of uniform charge density. The electron cloud is displaced slightly from its equilibrium position and released. Assuming that the cloud maintains its shape, select the correct statement(s) from the following options.

Options :

7332351081. ✔ The frequency of oscillation of electron cloud around positive charge is proportional to $R^{-3/2}$.

7332351082. ✔ The force due to electron cloud on positive charge is inversely proportional to R^3.

7332351083. ✖ The frequency of oscillation of electron cloud around positive charge is inversely proportional to R.

7332351084. ✖ The motion of displaced electron cloud is periodic but not simple harmonic.

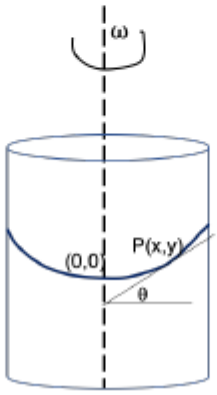
Question Number : 68 Question Id : 733235272 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 4 Wrong Marks : 0

A beaker containing a liquid with a reflecting surface is placed on a turntable and set to rotate about its axis as shown in the figure. The angle θ made by the reflecting surface with the horizontal is given by

$$\tan(\theta) = \frac{\omega^2 x}{g}$$

The radius of curvature of the surface $R \gg x$. Then



Options :

7332351085. ✖ y is proportional to x^4.

7332351086. ✔ y is proportional to x^2.

7332351087. ✔ The focal length of the reflecting surface is $g/2\omega^2$.

7332351088. ✔ If the angular speed of rotation is 2 rad.s^{-1} then the radius of curvature of the mirror is 2.5 m.