



PHYSICS

BOOKS - PEARSON IIT JEE FOUNDATION

MEASUREMENTS

Example

1. Volume of water in a burette is 35 ml. Find the volume of a drop of water if volume of water in the burette is 5 ml when 50 drops of water drained out

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2. Volume of water in a burette is 35 ml. Find the volume of a drop of water if volume of water in the burette is 5 ml when 50 drops of water

drained out



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Very Short Answer Type Question

1. What are 'fundamental quantities' ? Give examples.



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2. If impulse force = force \times time and the S.I unit of force is newton (N), then the S.I unit of impulse is _____.



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3. Mention the various systems of fundamental units.



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4. Numbers of waves of orange light emitted by krypton in 1m is _____.

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5. Define kilogram.

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6. The time taken by the light emitted by cesium-133 atom to complete 9,192,631,770 vibrations is _____ s.

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7. List the fundamental quantities along with their units in S.I. system.

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8. Given the density of air is 1.29kgm^{-3} . Then, the relative density of air is _____.



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9. What is the least count of the following instruments?

- (a) Meter scale
- (b) Wall clock
- (c) Celsius thermometer
- (d) Vernier callipers



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10. If the mass of 100cm^3 of iron is 785g , then the density of iron in S.I. Unit is _____.



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11. Which jaws of the vernier calliper are used to find the internal diameter of a hollow cylinder?

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12. In a given system of units, the ratio of the unit of volume to that of area gives the unit of _____.

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13. Define relative density

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14. If the density of iron is 7.85gcm^{-3} and density of water is 1000 kg m^{-3} , then the relative density of iron is _____.

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15. If the main scale of vernier calliper is graduated in mm and the vernier scale has 20 divisions, then what is the least count?

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16. In a new system of units to be introduced, if the unit of length is 2 m and 2 s is considered as a unit time, then a unit speed is equal to _____.

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17. What is the relation between litre and the C.G.S. and the S.I units of volume?

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18. The volume of a single liquid drop can be measured using a ____.

(a) Measuring jar (b) Measuring flask (c) Pipette (d) Burette

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19. What type of balances are used in laboratories?

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20. The volume of 1 litre is equal to

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21. What are 'derived' quantities'? Give example.

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22. Define metre.

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23. Define second.



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24. Define the least count of an instrument.



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25. What is the use of a vernier calliper?



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26. Define density. Give its unit?



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27. What is the principle used in common balance?





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28. What is the relation between the C.G.S. and the S.I. unit of area?



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29. Name a convenient unit to be used for measuring the following quantities:

- (a) Distance between two cities
- (b) Length of a room in your house
- (c) Height of Qutab Minar
- (d) thickness of a single hair
- (d) Diameter of a tea cup



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30. What is a density bottle?



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Short Answer Type Question

1. what are the characteristic of a standard unit?

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2. List the fundamental quantities along with their units in S.I. system.

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3. Define the least count of a vernier calliper.

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4. A vernier calliper has 20 divisions on the vernier scale. One centimetre on the main scale is divided into 20 equal parts. Find the least count of

this instrument.

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5. While measuring the length of a copper rod using a vernier calliper, the zero of the vernier scale was found to be between 4.6 cm on the main scale. The 6th division of the vernier scale is found to coincide with a division on the main scale. Find the length of the rod if the least count is 0.01 cm.

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6. A vernier scale has 10 divisions. It slides over the main scale, whose 1 M.S.D. is 1.0 mm. If the number of division to the left side of the zero of the vernier scale on the main scale is 49 and the 8th vernier scale division coincides with the main scale, calculate the length in centimetres.

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7. When a vernier calliper is used to measure external and internal diameters of an aluminium tube, the observations were made as follow:

For external diameter:

Main scale reading = 2.2 cm

Vernier coinciding division = 4 and

For inner diameter:

Main scale reading = 1.8 cm

Vernier coinciding division = 8



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8. A vernier calliper has 20 divisions on the vernier scale. One centimetre on the main scale is divided into 20 equal parts. Find the least count of this instrument.



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9. How do you measure the area of an irregular shaped plane figure?

Describe the graphical method to find the area of a leaf.

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10. Describe a method to determine the volume of a single drop of water.

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11. A piece of iron has dimensions $3 \text{ cm} \times 15 \text{ cm} \times 20 \text{ cm}$. If its mass is 7020 g, calculate the density of iron in S.I. System.

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12. Calculate the mass of a body whose volume is $2m^3$ and density $0.52 \frac{g}{cm^3}$.

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13. Taking the value of the acceleration due to gravity as 10 m s^{-2} , Find its value in km h^{-2} .

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14. The surface area of a sphere is 1000 cm^2 . Find its surface area in S.I. system.

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15. Express 1 g cm^{-3} in S.I., is bigger unit? Which of these two units C.G.S or S.I., is a bigger unit?

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Essay Type Question

1. Explain the need for standard and system of units in measurement.



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2. Explain the principle of vernier. Draw a neat diagram of a vernier calliper showing the various parts.



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Level 1 Concept Application

1. A standard unit should not change with respect to time but may change from place to place.



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2. The zeroth division of a vernier scale lies between the 40th and 41th main scale divisions. Then, the M.S.R. = 4 cm if M.S.D = 1 mm.



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3. Given that 1 M.S.D. of a vernier scale is 1 mm and its least count is 0.025 mm, then the number of divisions in the vernier scale is 25.



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4. Given that 1 M.S.D. of a vernier calliper is 1 mm and its least count is 0.001 cm then the number of vernier scale divisions is 100.



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5. In a vernier calipers, if 1 M.S.D. = 0.1 cm and the least count is 0.1 mm, then 1 V.S.D = 0.9 mm



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6. The lower meniscus should be taken into consideration while reading the level of mercury in a burette.

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7. If the number of divisions on a vernier scale is 20 and the least count of the instrument is 0.025 mm, then 1 M.S.d. = _____ cm.

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8. One second is $\left(\frac{1}{k}\right)$ th part of a mean solar day, where $k =$ _____.

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9. On dropping 10 lead shots into a measuring jar containing a liquid, the level of the liquid in the jar increased from 40cm^3 to 100cm^3 . Then, the volume of each lead shot is _____.



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10. While finding the internal diameter of a pipe using a vernier calipers, the M.S.R. = 18 mm, the vernier scale coinciding division is 3. If the least count of the instrument is 0.1 mm, then the internal radius is _____ mm.

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11. If 10 cm is taken as unit of length, then the height of a person 1.78 m tall in the new system of units is _____ units.

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12. If the volume of 1 kg of oil, at a given temperature, is 1000cm^3 , then the volume 1000 kg oil at the same temperature is _____.

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13. The least count of a vernier calipers 'X' is 0.01 cm. If the number of divisions on the vernier scale of another vernier calipers 'y' is double of that in 'X' , then the least count of 'Y' is _____ mm.
 ($\in \perp h \in struments1M. S. D. = 1mm$)

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- | Column A | | Column B | |
|----------|---------------------|----------|-----------------------|
| A. | Temperature () | a. | Definition of metre |
| B. | S.I.unit () | b. | Measurement of volume |
| C. | Roman steelyard () | c. | Fundamental quantity |
| 14. D. | ampere () | d. | Derived unit |
| E. | Krypton () | e. | pound |
| F. | Area () | f. | kilogram |
| G. | newton () | g. | Derived quantity |
| H. | Pipette () | h. | Fundamental unit |
| I. | Cesium-133 () | i. | Measurement of mass |
| J. | FPS system () | j. | Definition of second |

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Level 1 Choose The Correct Option

1. If the unit of mass is doubled and the units of length and time are halved, how much is 20 N of force in new units? ($1 \text{ N} = 1 \text{ kgms}^{-2}$)

- A. 0.5 N
- B. 5 new units of force
- C. 5 N
- D. 0.5 new units of force

Answer: B



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2. Which among the following physical quantities does not possess a unit?

- A. Area
- B. Volume

C. Density

D. Specific gravity

Answer: D



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3. Which of the following is not a derived quantity?

A. The floor area of a room

B. the height of a room

C. The volume of air in a room

D. The weight of air in a room

Answer: B



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4. While measuring the diameter of a sphere using a vernier calipers the main scale reading was found to be p while the vernier coinciding division was q . If the least count of the instrument is r , then the radius of the sphere is given by the expression _____.

A. $p+q+r$

B. $\frac{qr + p}{2}$

C. $p+qr$

D. $\frac{pr + q}{2}$

Answer: B



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5. Which of the following equations is true with reference to a vernier calipers?

A. Least count = M.S.D. - 1 V.S.D.

B. $1 \text{ M.S.D.} = (\text{L.C.}) \times \text{number of divisions on the Vernier scale}$

C. If the least is 0.1 mm, then $\text{M.S.D.} = \frac{N}{10} \text{ mm}$

D. All of the above

Answer: D



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6. The following information is given in respect of a vernier calipers.

1 main scale division = 0.3 cm

30 V.S.D. = 29 M.S.D.

The least count of this vernier calipers is _____.

A. 0.01 mm

B. 0.1 cm

C. 0.03 cm

D. 0.1 mm

Answer: D



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7. To determine the diameter of a rod a student wound a thread 5 times round the rod and measured the length of thread as 156 mm on a metre scale. Using this value he calculated the diameter of the rod. If the actual diameter of the rod is 9.94 mm, what is the error that could result in the method followed by the

student? Take $\frac{pr + q}{2}$

A. +0.01 mm

B. -0.01 mm

C. -0.01 mm

D. -0.02 mm

Answer: B



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8. In a vernier calipers 1 M.S.D = 0.1 cm and the least count is 0.05 mm . If the reading on this vernier calipers while taking a measurement is 2.8 mm, then the vernier coinciding division is _____.

A. 20

B. 4

C. 8

D. 16

Answer: D



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9. Which of the following is true about the density of a substance ?

A. It is a derived quantity.

B. The unit of density in S.I. system is kilogram per cubic metre.

C. The density of a substance can be measured if the mass of the substance for a certain volume is known.

D. All of the above

Answer: D

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10. The main scale reading of a vernier calipers (1 M.S.D. = 1 mm) having least count 0.01 cm of the internal and external diameters of a hollow tube are 11 mm and 12 mm. the minimum thickness of the tube is _____.

A. 1 mm

B. 0.1 mm

C. 0.05 mm

D. 0.5 mm

Answer: C

11. The following information is noted in respect of two vernier calipers A

Vernier calipers	1 M.S.D.	No. of divisions on vernier scale
A	1 mm	20
B	3 mm	30

and B.

If N

$V.S.D. = (N-1) M.S.D.$ in the both the vernier calliper, then which of the following statement is true?

- A. The least count of A is less than that of B.
- B. The least count of B is 0.01 cm
- C. The large measurement than can be made between 10 mm and 11 mm with the vernier calliper A is 10.95 mm.
- D. All of the above

Answer: D

12. Three cylindrical flasks A, B and C of diameter 50 mm, 75 mm and 100 mm, respectively have graduation marked in mm and are used for measurement of volume of liquid. Which of the following statement is correct?

- A. A is more accurate than B and C
- B. C has better least count than B
- C. The least count of all three are the same.
- D. B has better least count than A.

Answer: A



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13. R.D of 'x' and 'y' are 3 and 2, respectively. Then the density of 'x' with respect to that of 'y' is _____.

- A. 6

B. 5

C. 1.5

D. 1

Answer: C



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14. The initial and final reading of a burette while draining out 50 drops of a liquid are 10 ml and 40 ml, respectively. Then, the volume of each drop is _____.

A. 0.6 ml

B. 0.06cm^3

C. 6×10^{-2} litres

D. $6 \times 10^{-6}\text{m}^3$

Answer: A



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15. If the ratio of density of ice to that of wood is $(9/8)$ and the relative density of ice is 0.9, then the density of wood is _____ kg m^{-3}

(Take density of water = 10^3 m^{-3})

A. 0.8

B. 800

C. 8×10^3

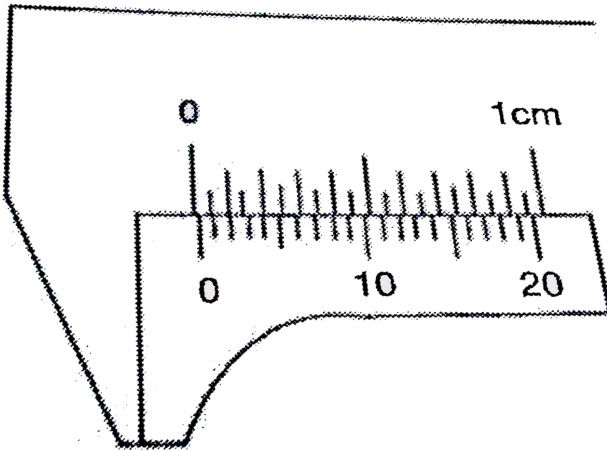
D. 80

Answer: B



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16. The least count of the vernier calipers shown in the figure is _____.



A. 0.25 mm

B. 0.025 mm

C. 0.025 cm

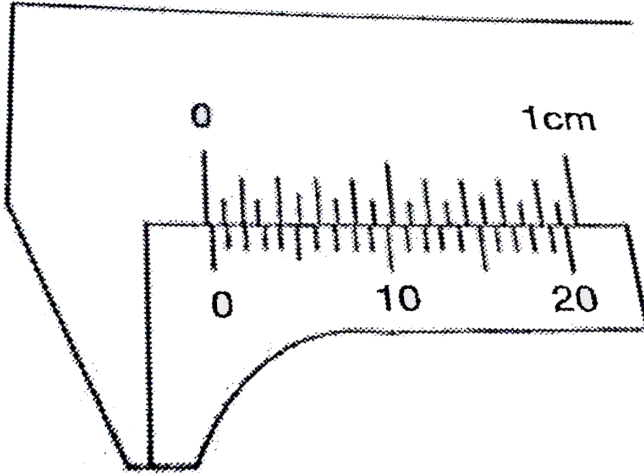
D. $250\mu\text{m}$

Answer: B



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17. The zero error of the vernier calipers shown in the figure is _____.



- A. $+100\mu m$
- B. $+0.01cm$
- C. 0.1 mm
- D. All of the above

Answer: D

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18. Assertion (A): A physical quantity which can be described with both magnitude and direction is called as a vector quantity. Reason (R): All vector quantities are derived quantities.

- A. A and R are correct and R is the correct explanation for A
- B. A and R are correct but R is not the correct explanation for A
- C. A is correct but R is incorrect.
- D. Both A and R are incorrect.

Answer: C



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19. A vernier calipers has positive zero error of 0.05 mm. While finding the diameter a cylinder, the MSR is 9 mm and the VCD is 9. If the least count of the vernier calipers is 0.1 mm, the area of cross-section of the cylinder is _____ mm^2

A. 76.2

B. 19.1

C. 23.6

D. 26.5

Answer: A



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20. If there are 'N' number of vernier scale divisions (VSD) and $N \text{ VSD} = (N - 2) \text{ MSD}$, find the value of L.C. in terms of 'N'.

A. $\frac{1 \text{MSD}}{N}$

B. $\frac{2 \text{MSD}}{N}$

C. $\frac{(N - 2) \text{MSD}}{N}$

D. $\frac{N \text{MSD}}{2}$

Answer: B

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21. Assertion (A): The mass of 150m^3 of iron is greater than the mass of 150m^3 of wood.

Reason (R): The density of iron is less than the density of wood.

- A. A and R are correct and R is the correct explanation for A
- B. A and R are correct but R is not the correct explanation for A
- C. A is correct but R is wrong
- D. Both A and R are wrong.

Answer: C

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22. Write the following steps in a sequential order to show that the volume of a liquid displaced by a solid, which is insoluble and completely immersed in a liquid, increases with increase in the volume of the solid.

- (a) The displaced liquid is collected in a beaker and its volume is measured with the help of a measuring cylinder.
- (b) Different objects such as glass, stone, etc. of different volumes are immersed in different liquids such as water, kerosene, etc.
- (c) The phenomenon is observed at different places and different times.
- (d) It is observed that the volume of displaced liquid increases as the volume of the solid increases.

A. a d b c

B. c b a d

C. b a c d

D. b d c a

Answer: C



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23. The unit of force in SI system is newton and it is given as 1 newton = 1kgms^{-2} . In CGS system its unit is dyne and it is given as 1 dyne = 1 g cm

s^{-2}). Arrange the following steps in a sequential order to relate the SI unit and CGS unit of force.

(a) Write the conversions of kg and m, into g and cm, respectively.

(b) Substitute the conversions in $1 \text{ newton} = 1 \text{ kgm.s}^{-2}$ Write the relation between 1 newton and dyne.

(d) Write in place of 1 g cm s^{-2} as 1 dyne

A. a c b d

B. a b d c

C. b d a c

D. c d a b

Answer: B



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24. If the smallest measurement that can be measured by using a scale is 0.1 mm, then the length of 1 m in the scale is divided into _____ equal parts.

A. 1000

B. 5000

C. 10000

D. 50000

Answer: C



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25. An atlas of india is drawn by taking scale $100 \text{ cm} = 15000 \text{ km}$. If the actual distance between the cties of bhopal and Cochin in 1500 km , the distance between the two places in the atlas will be _____cm.

A. 10

B. 1

C. 10000

D. 1000

Answer: A



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26. Which of the following is true with respect to a standard vernier callipers?

- A. N main scale divisions = $(N-1)$ vernier scale divisions.
- B. N vernier scale divisions = $(N-1)$ main scale divisions
- C. N vernier scale divisions = $(N+1)$ main scale divisions.
- D. None of these.

Answer: B



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27. The zeroth divisions of the vernier and main scales of a standard vernier callipers coincide, then

- A. The external jaws are in contact with each other.
- B. there is some distance between the internal jaws.
- C. Both (a) nor (b)
- D. Neither (a) nor (b).

Answer: A

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28. The least count of a vernier callipers P and Q, 1 MSD = 1 mm. For P, 10 VSD = 8 MSD and for Q, 20 VSD = 15 MSD. The vernier callipers that gives more accurate reading is _____.

- A. 0.1 mm
- B. 0.01 cm
- C. 0.1 cm
- D. 0.001 mm

Answer: B



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29. For each of the two vernier callipers P and Q, 1 MSD = 1mm. For P, 10 VSD = 8 MSD and for Q, 20 VSD = 15 MSD. The vernier callipers that gives more accurate reading is _____.

- A. P
- B. Q
- C. Both P and Q give equal accuracy.
- D. Data insufficient.

Answer: A



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30. The following information is given in respect of a vernier calipers.

1 main scale division = 0.3 cm

30 V.S.D. = 29 M.S.D.

The least count of this vernier calipers is _____.

A. 0.01 mm

B. 0.1 cm

C. 0.03 cm

D. 0.1 mm

Answer: D



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Level 2

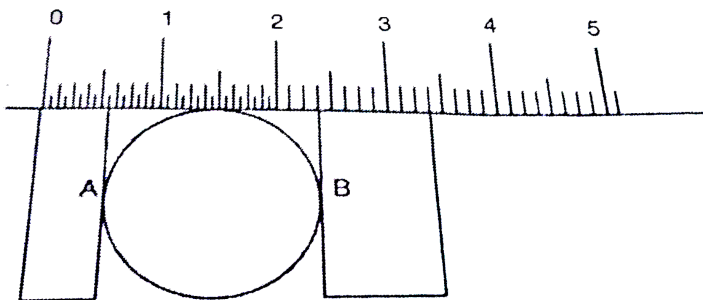
1. Taking 1 ly (light year) = $9.3 \times 10^{15} m$ and one day = 86400 s, express the speed of light (= $3 \times 10^8 m s^{-1}$ as ly (day)⁻¹

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2. The amount of heat absorbed by a body while raising its temperature is given by the equation. $Q = ms\theta$, here Q is the amount of heat, m is the mass of the body, s is the specific heat capacity and θ is the rise in temperature. Determine the S.I. unit and C.G.S. unit of heat and specific heat capacity

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3. A ruler marked in inches is used to measure the diameter of a rod as shown in the figure below.



Find the diameter of the rod in inches. If one inch is approximately equal to 25.4 mm, express this diameter in cm (correct to 2 decimal places).



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4. If p divisions on the vernier scale of vernier calipers correspond to q main scale divisions ($p > q$), derive an expression of the least count of the instrument in terms of p and q . If 1 M.S.D. = k mm, express the least count in cm.



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5. According to Newton's law of gravitation , the force F between two bodies of masses m_1 and m_2 placed at a distance of ' r ' from each other is given as

$F = G \times \frac{m_1 \times m_2}{r^2}$, where G is the universal gravitational constant. Find

the units of G in both C.G.S. and S.I. system.



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6. A student took the least count of a vernier calliper as 0.01 mm instead of 0.01 cm and found that the length of a copper rod was 4.909 cm. If one M.S.D. = 1 mm, then find

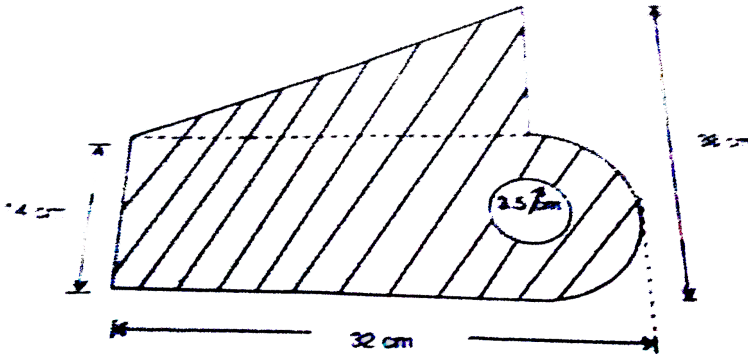
- (1) the main scale reading
- (2) the vernier coinciding division
- (3) the correct length of the rod

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7. The internal jaws of a vernier calipers were held tightly inside a hollow tube when the zero of the vernier scale showed a reading of 1.9 cm and the 18th division on the vernier scale. The thickness of the wall of the tube is 1 mm. If M.S. D. = 1 mm and the number of division on the vernier scale is 20, find the outside diameter of the hollow tube.

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8. Find the area of the shaded region in the given figure.



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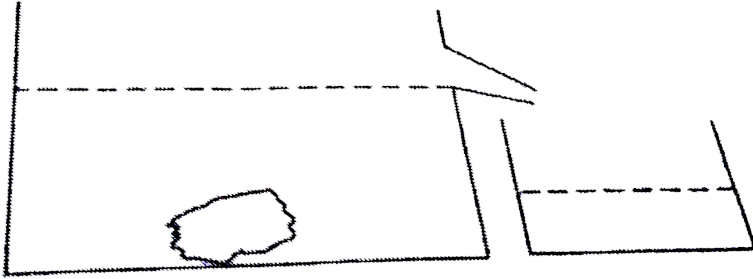
9. A height gauge (an instrument used to measure accurately the height of the part of machinery) is to be constructed using a main scale marked in centimeters and millimetres.

(i) What is the minimum length of the vernier scale if the required least count is 0.001 cm?

(ii) what least count can be achieved if the number of vernier scale divisions cannot be more than 50?

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10. An irregular shaped crystal was dropped into a liquid of density 800 kg m^{-3} and the overflowing liquid was collected and weighed. If the mass of the liquid collected is 120 g and the mass of the crystal is 360 g , find the relative density of the crystal (density of water = 1000 kg m^{-3})



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11. To find the volume of an irregularly shaped wooden piece, a sinker made of steel (relative density = 7.85) having a mass of 157 g was used. If the level of water before and the after immersing the sinker-wood combination are 102 ml and 170 ml , respectively, find the volume of the wooden piece.

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12. On heating, the length, the breadth and the height of a cuboid structure was increased by 20%, 10% and 5% respectively, If the original volume of the structure is 1000 cm^3 , determine the increase in its volume.



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13. Two spheres made of different materials have their masses in the ratio of 1:2. If the diameter of the first sphere is equal to the radius of the second sphere, then determine the ratio of densities of

$$\text{volume of sphere} = \frac{4}{3} \pi r^3$$



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14. A vernier caliper has 25 divisions on the vernier scale, An object is held between the external jaw of this instrument. If the zeroth division of the vernier scale is to the left of the 32nd division of the main scale and the 20th division of the vernier scale coincides with a main scale division, determine the measurement of the object. ($1 \text{ M.S.D.} = 0.5 \text{ mm}$)



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15. If the length of a body is to be measured accurately upto 0.05 mm using a vernier calliper with main scale divisions equal to 0.5 mm, how many divisions should be engraved on the vernier scale?



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16. While measuring the length of a copper rod using a vernier calliper, the zero of the vernier scale was found to be between 4.6 cm and 4.7 cm on the main scale. The 6th division of the vernier scale is found to coincide with a division on the main scale. Find the length of the rod if the least count is 0.01 cm.



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17. A vernier scale has 10 divisions. It slides over the main scale, whose 1 M.S.D. is 1.0 mm. If the number of divisions to the left side of the zero of

the vernier scale on the main scale is 49 and the 8th vernier scale division coincides with the main scale, calculate the length in centimetres.

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18. The relative density of mercury is 13.6. Find the ratio of the mass of mercury of a certain volume to that of water having ten times the volume of mercury.

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19. Two spheres made of different materials but having the same mass, have radii in the ratio of 3 : 4. Find the ratio of their densities.

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20. A king ordered a goldsmith to prepare a crown with 1 kg pure gold. The relative density of pure gold is given as 19. Is it possible to find the

adulteration if the goldsmith adds some impurity in making the crown. If so how? Explain.

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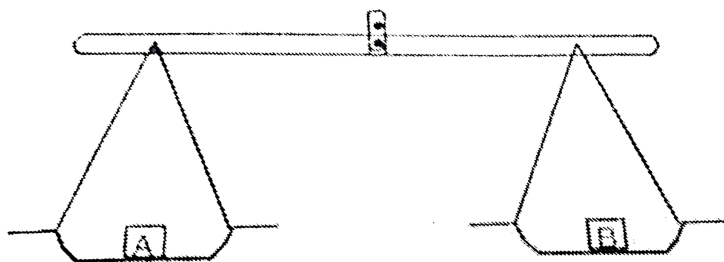
Level 3

1. A vernier calipers has 25 divisions on the vernier scale, An object is held between the external jaw of this instrument. If the zeroth division of the vernier scale is to the left 32nd division of the main scale and the 20th division of the vernier scale coincides with a main scale division, determine the measurement of the object. ($1M. S. D. = 0.5mm$)

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2. Two metal blocks A and B were placed on the two pans of a common balance and the beam of the balance was horizontal. However, when the blocks were interchanged and block B was placed in the left pan and

block A in the right pan, the beam was not balanced and tilted down toward the left. Discuss the various factors that could be the cause of this. Are the masses of two blocks equal?



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3. 100 ml of liquid A ($density = 1200kgm^{-3}$) and 100 g of liquid B ($density = 0.8gcm^{-3}$) are mixed to form a homogeneous mixture. Assuming that two liquids do not chemically react with each other, find the density of the resultant mixture.

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4. If the number of divisions on the vernier scale of a standard vernier calliper is N , then N is always equal to $(N - 1)$ main scale divisions. Would

the vernier calliper be rendered useless if N is equal to fewer number of main scale divisions, for example $N = (N-3)$ M.S.D.? Why? How would the least count calculations be modified?

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5. We know that every derived quantity can be written in terms of some of the fundamental quantities. For

example, volume = (length)³, speed = $\frac{\text{length}}{\text{time}}$. Using

the definitions of the following quantities, express force in terms of fundamental quantities. Represent mass as [M], length as [L] and time as [T].

(i) Displacement = shortest distance between the initial and final positions.

(ii) Velocity = $\frac{\text{displacement}}{\text{time}}$

(iii) Momentum = mass \times velocity brgt (iv) Force = $\frac{\text{momentum}}{\text{time}}$

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6. A metallic rod of unknown radius was held in between the lower jaws of a vernier callipers. The main scale is divided into millimetres and the vernier scale has 50 divisions. The vernier coinciding division is 39. If the zeroth division of the vernier scale lies between 6.3 cm and 6.4 cm of the main scale, find the radius.

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7. In a vernier callipers 15 vernier scale divisions correspond to 14 main scale divisions and one main scale division is equal to 1.5 mm. An object is held between the external jaw of the given vernier callipers. If the zeroth division of the vernier scale is to the left of the 20th division of the main scale, find the measurement of the object, if the 14th division of the vernier scale coincides with the main scale division.

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8. An object 'X' of volume 200 cm^3 and another object Y of volume 250 cm^3 , when placed on the two pans of a common balance they balance each other. Determine the ratio of density of X and density Y



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9. When 100 drops of a liquid P is added into a liquid Q the volume of the liquid in the container which is initially filled with liquid Q doubled. Determine density of the mixture if density of the liquids P and Q are 1.5 g cm^{-3} and 1.3 g cm^{-3} , respectively



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10. A Fortin's barometer has a main scale and a vernier scale to measure the atmospheric pressure. The main scale coincide with 50 vernier divisions, find the least count of the instrument in Pa.
(Given pressure exerted by 76 cm column of mercury = 10^5 Pa)



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Test Your Concepts Very Short Answer Type Questions

1. What are 'fundamental quantities' ? Give examples.



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2. If impulse = force \times time and the S.I unit of force is newton (N), then the S.I unit of impulse is _____.



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3. Mention the various systems of fundamental units.



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4. Numbers of waves of orange light emitted by krypton in 1m is _____.

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5. Define kilogram.

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6. The time taken by the light emitted by cesium-133 atom to complete 9,192,631,770 vibrations is ___s.

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7. The unit of the coefficient of viscosity in S.I. system is

A. Newton

B. ms^{-1}

C. kgm^{-3}

D. no units

Answer:



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8. Given the density of air is $1.29kgm^{-3}$. Then, the relative density of air is _____.



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9. Define the least count of an instrument.

A. Metre scale

B. Wall clock

C. Celsius thermometer

D. Vernier calliper

Answer:



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10. If the mass of 100cm^3 of iron is 785 g, then the density of iron in S.I. unit is ____.



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11. Which jaws of the vernier calliper are used to find the internal diameter of a hollow cylinder?



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12. In a given system of units, the ratio of the unit of volume to that of area gives the unit of _____.

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13. Define relative density.

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14. If the density of iron is 7.85 g cm^{-3} and density of water is 1000 kg m^{-3} , then the relative density of iron is _____.

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15. If the main scale of vernier calliper is graduated in mm and the vernier scale has 20 divisions, then what is the least count?

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16. In a new system of units to be introduced, if the unit of length is 2 m and 2 s is considered as a unit time, then a unit speed is equal to _____.

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17. What is the relation between litre and the C.G.S. and the S.I units of volume?

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18. The volume of a single liquid drop can be measured using a_____.

(a) Measuring jar (b) Measuring flask (c) Pipette (d) Burette

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19. What type of balances are used in laboratories?

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20. What are 'derived' quantities'? Give example.



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21. Define metre.



[Watch Video Solution](#)

22. Define second.



[Watch Video Solution](#)

23. Define the least count of an instrument.



[Watch Video Solution](#)

24. What is the use of a vernier calliper?

 [Watch Video Solution](#)

25. Define density.

 [Watch Video Solution](#)

26. What is the principle used in common balance?

 [Watch Video Solution](#)

27. What is the relation between the C.G.S. and the S.I. unit of area?

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28. Name a convenient unit to be used for measuring the Distance between two cities

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29. Name a convenient unit to be used for measuring the Length of a room in your house

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30. Name a convenient unit to be used for measuring the Height of Qutab Minar

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31. Name a convenient unit to be used for measuring the Thickness of a single hair





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32. Name a convenient unit to be used for measuring the following quantities:

- (a) Distance between two cities
- (b) Length of a room in your house
- (c) Height of Qutab Minar
- (d) thickness of a single hair
- (d) Diameter of a tea cup



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33. What is a density bottle?



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Test Your Concepts Short Answer Type Questions

1. what are the characteristic of a standard unit?

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2. List the fundamental quantities along with their units in S.I. system.

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3. Define least count. Describe the method to find the least count of a vernier calliper.

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4. A vernier calliper has 20 divisions on the vernier scale. One centimetre on the main scale is divided into 20 equal parts. Find the least count of this instrument.

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5. While measuring the length of a copper rod using a vernier calliper, the zero of the vernier scale was found to be between 4.6 cm on the main scale. The 6th division of the vernier scale is found to coincide with a division on the main scale. Find the length of the rod if the least count is 0.01 cm.

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6. A vernier scale has 10 divisions. It slides over the main scale, whose 1 M.S.D. is 1.0 mm. If the number of division to the left side of the zero of the vernier scale on the main scale is 49 and the 8th vernier scale division coincides with the main scale, calculate the length in centimetres.

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7. When a vernier calliper is used to measure external and internal diameters of an aluminium tube, the observations were made as follow:

For external diameter:

Main scale reading = 2.2 cm

Vernier coinciding division = 4 and

For inner diameter:

Main scale reading = 1.8 cm

Vernier coinciding division = 8



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8. A vernier calliper has 20 divisions on the vernier scale. One centimetre on the main scale is divided into 20 equal parts. Find the least count of this instrument.



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9. How do you measure the area of an irregular shaped plane figure? Describe the graphical method to find the area of a leaf.



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10. Describe a method to determine the volume of a single drop of water.

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11. A piece of iron has dimensions $3 \text{ cm} \times 15 \text{ cm} \times 20 \text{ cm}$. If its mass is 7020 g , calculate the density of iron in S.I. System.

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12. Calculate the mass of a body whose volume is 2 m^3 and relative density is 0.52 .

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13. Taking the value of the acceleration due to gravity as 10 m s^{-2} , Find its value in km h^{-2} .

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14. The surface area of a sphere is 1000 cm^2 . Find its surface area in S.I. system.

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15. Express 1 g cm^3 in S.I., is bigger unit? Which of these two units C.G.S or S.I., is a bigger unit?

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16. Explain the need for measurement in physics.

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17. Explain the principle of vernier. Draw a neat diagram of a vernier calliper showing the various parts.



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18. Which jaws of the vernier calliper are used to find the internal diameter of a hollow cylinder?



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19. Draw neat labelled diagrams of a pipette and a burette.



[Watch Video Solution](#)

20. Explain the principle of vernier. Draw a neat diagram of a vernier calliper showing the various parts.



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1. A standard unit should not change with respect to time but may change from place to place.

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2. The zeroth division of a vernier scale lies between the 40th and 41st main scale divisions. Then, the M.S.R. = 4 cm if M.S.D = 1 mm.

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3. Given that 1 M.S.D. of a vernier scale is 1 mm and its least count is 0.025 mm, then the number of divisions in the vernier scale is 25.

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4. Given that 1 M.S.D. of a vernier calliper is 1 mm and it's least count is 0.001 cm then the number of vernier scale divisions is 100.

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5. In a vernier calipers, if 1 M.S.D. = 0.1 cm and the least count is 0.1 mm, then 1 V.S.D = 0.9 mm

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6. The lower meniscus should be taken into consideration while reading the level of mercury in a burette.

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7. What are the other units used to measure the volume of liquids?

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Concept Application Level 1 Fill In The Blanks

1. If the number of divisions on a vernier scale is 20 and the least count of the instrument is 0.025 mm, then 1 M.S.d. = _____ cm.

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2. One second is $\left(\frac{1}{k}\right)$ th part of a mean solar day, where $k =$ _____.

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3. On dropping 10 lead shots into a measuring jar containing a liquid, the level of the liquid in the jar increased from 40cm^3 to 100cm^3 . Then, the volume of each lead shot is _____.

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4. While finding the internal diameter of a pipe using a vernier calipers, the M.S.R. = 18 mm, the vernier scale coinciding division is 3. If the least

count of the instrument is 0.1 mm, then the internal radius is _____ mm.

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5. If 10 cm is taken as unit of length, then the height of a person 1.78 m tall in the new system of units is _____ units.

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6. If the volume of 1 kg of oil, at a given temperature, is 1000cm^3 , then the volume 1000 kg oil at the same temperature is _____.

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7. The least count of a vernier calipers 'X' is 0.01 cm. If the number of divisions on the vernier scale of another vernier calipers 'y' is double of

that in 'X' , then the least count of 'Y' is _____ mm.

($\in \perp h \in struments 1M. S. D. = 1mm$)

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Concept Application Level 1 Match The Column

1. Match the entries in Column A with the appropriate ones in Column B.

Column A	Column B
A. Temperature ()	a. Definition of metre
B. S.I. unit ()	b. Measurement of volume
C. Roman steelyard ()	c. Fundamental quantity
D. ampere ()	d. Derived unit
E. Krypton ()	e. pound
F. Area ()	f. kilogram

Column A		Column B	
G. newton	()	g.	Derived quantity
H. Pipette	()	h.	Fundamental unit
I. Cesium-133	()	i.	Measurement of mass
J. FPS system	()	j.	Definition of second



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Concept Application Level 1 Select The Correct Alternative

1. If the unit of mass is doubled and the units of length and time are halved, how much is 20 N of force in new units? ($1 \text{ N} = 1 \text{ kgms}^{-2}$)
- A. 0.5 N
 - B. 5 new units of force
 - C. 5 N
 - D. 0.5 new units of force

Answer: B



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2. Which among the following physical quantities does not possess a unit?

A. Area

B. Volume

C. Density

D. Specific gravity

Answer: D



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3. Which of the following is not a derived quantity?

A. The floor area of a room

- B. The height of a room
- C. The volume of air in a room
- D. The weight of air in a room

Answer: B



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4. While measuring the diameter of a sphere using a vernier calipers the main scale reading was found to be p while the vernier coinciding division was q . If the least count of the instrument is r , then the radius of the sphere is given by the expression _____.

- A. $p+q+r$
- B. $\frac{qr + p}{2}$
- C. $p + qr$
- D. $\frac{pr + q}{2}$

Answer: B

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5. Which of the following equations is true with reference to a vernier calipers?

A. Least count = 1 M.S.D. - 1 V.S.D.

B. 1 M.S.D. = (L.C.) x number of divisions on the Vernier scale

C. If the least count is 0.1 mm, then 1 M.S.D. = $\frac{N}{10} mm$

D. all the above

Answer: D

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6. The following information is given in respect of a vernier calipers.

1 main scale division = 0.3 cm

30 V.S.D. = 29 M.S.D.

The least count of this vernier calipers is _____.

A. 0.01 mm

B. 0.1 cm

C. 0.03 cm

D. 0.1 mm

Answer: D



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7. To determine the diameter of a rod a student wound a thread 5 times round the rod and measured the length of thread as 156 mm on a metre scale. Using this value he calculated the diameter of the rod. If the actual diameter of the rod is 9.94 mm, what is the error that could result in the method followed by the

student? Take $\frac{pr + q}{2}$

A. + 0.01 mm

B. - 0.01 mm

C. + 0.02 mm

D. - 0.02 mm

Answer: B



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8. In a vernier calipers 1 M.S.D = 0.1 cm and the least count is 0.05 mm . If the reading on this vernier calipers while taking a measurement is 2.8 mm, then the vernier coinciding division is _____.

A. 20

B. 4

C. 8

D. 16

Answer: D



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9. Which of the following is true about the density of a substance ?

- A. It is a derived quantity.
- B. The unit of density in S.I. system is kilogram per cubic metre
- C. The density of a substance can be measured if the mass of the substance for a certain volume is known.
- D. All the above

Answer: D



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10. The main scale reading of a vernier calipers (1 M.S.D. = 1 mm) having least count 0.01 cm of the internal and external diameters of a hollow

tube are 11 mm and 12 mm. the minimum thickness of the tube is _____.

- A. 1 mm
- B. 0.1 mm
- C. 0.05 mm
- D. 0.5 mm

Answer: C

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11. The following information is noted in respect of two vernier calipers A

Vernier calipers	1 M.S.D.	No. of divisions on vernier scale
A	1 mm	20
B	3 mm	30

and B.

If N

V.S.D. = (N-1) M.S.D. in the both the vernier calliper, then which of the following statement is true?

- A. The least count of A is less than that of B.

B. The least count of B is 0.01 cm.

C. The largest measurement that can be made between 10 mm and 11 mm with the vernier calliper A is 10.95 mm.

D. All the above.

Answer: D



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12. Three cylindrical flasks A, B and C of diameter 50 mm, 75 mm and 100 mm, respectively have graduation marked in mm and are used for measurement of volume of liquid. Which of the following statement is correct?

A. A is more accurate than B and C

B. C has better least count than B

C. The least counts of all three are the same.

D. B has better least count than A.

Answer: A



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13. R.D of 'x' and 'y' are 3 and 2, respectively. Then the density of 'x' with respect to that of 'y' is _____.

A. 6

B. 5

C. 1.5

D. 1

Answer: C



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14. The initial and final reading of a burette while draining out 50 drops of a liquid are 10 ml and 40 ml, respectively. Then, the volume of each

drop is _____.

A. 0.6ml

B. 0.06cm^3

C. $6 \times 10^{-2}\text{l}$

D. $6 \times 10^{-6}\text{m}^3$

Answer: A



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15. If the ratio of density of ice to that of wood is $(9/8)$ and the relative density of ice is 0.9, then the density of wood is _____ kg m^{-3}

(*Takedensityofwater = 10^3 m^{-3}*)`

A. 0.8

B. 800

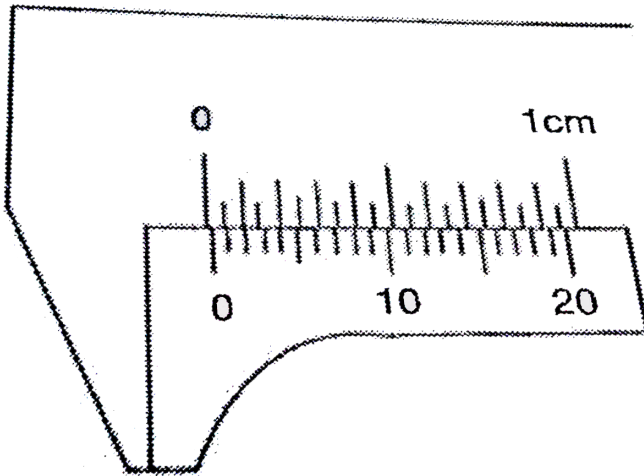
C. 8×10^3

D. $250\ \mu\text{m}$

Answer: B

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17. The zero error of the vernier calipers shown in the figure is _____.



A. $-100\ \mu\text{m}$

B. $+0.01\ \text{cm}$

C. $0.1\ \text{mm}$

D. All the above.

Answer: D



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18. Assertion (A): A physical quantity which can be described with both magnitude and direction is called as a vector quantity. Reason (R): All vector quantities are derived quantities.

- A. A and R are correct and R is the correct explanation for A
- B. A and R are correct but is not the correct explanation for A
- C. A is correct but R is incorrect.
- D. Both A and R are incorrect.

Answer: C



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19. A vernier calipers has positive zero error of 0.05 mm. While finding the diameter a cylinder, the MSR is 9 mm and the VCD is 9. If the least count of the vernier calipers is 0.1 mm, the area of cross-section of the cylinder is _____ mm^2

A. 76.2

B. 19.1

C. 23.6

D. 26.5

Answer: A



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20. If there are 'N' number of vernier scale divisions (VSD) and $N \text{ VSD} = (N - 2) \text{ MSD}$, find the value of L.C. in terms of 'N'.

A. $\frac{1 \text{MSD}}{N}$

B. $\frac{2MSD}{N}$

C. $\frac{(N - 2)MSD}{N}$

D. $\frac{NMSD}{2}$

Answer: B



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21. Assertion (A): The mass of $150m^3$ of iron is greater than the mass of $150 m^{(3)}$ of wood.

Reason (R): The density of iron is less than the density of wood.

- A. A and R are correct and R is the correct explanation for A
- B. A and R are correct but is not the correct explanation for A
- C. A is correct but R is incorrect.
- D. Both A and R are incorrect.

Answer: C



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22. Assertion (A): The liquid displaced by a solid cube of a side 3 cm when completely immersed in the liquid is more than displaced by a solid cube of side 2 cm.

Reason (R) : The liquid displaced by a solid increases with increase in the volume of the solid.

A. ADBC

B. CBAD

C. BACD

D. BDCA

Answer: C



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23. The unit of force in SI system is newton and it is given as 1 newton = 1kgms^{-2} . In CGS system its unit is dyne and it is given as 1 dyne = 1g cm s^{-2} . Arrange the following steps in a sequential order to relate the SI unit and CGS unit of force.

- (a) Write the conversions of kg and m, into g and cm, respectively.
- (b) Substitute the conversions in $1\text{ newton} = 1\text{kgms}^2$ Write the relation between 1 newton and dyne.
- (d) Write in place of 1g cm s^{-2} as 1 dyne

A. A C B D

B. A B D C

C. BDAC

D. CDAB

Answer: B



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24. If the smallest measurement that can be measured by using a scale is 0.1 mm, then the length of 1 m in the scale is divided into _____ equal parts.

- A. 1000
- B. 5000
- C. 10000
- D. 50000

Answer: C



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25. An atlas of India is drawn by taking scale 10 cm=15000 km. If the actual distance between the cities of Bhopal and Cochin is 1500 km, the distance between the two places in the atlas will be ____ cm.

- A. 10

B. 1

C. 10000

D. 1000

Answer: A



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26. Which of the following is true with respect to a standard vernier callipers?

A. N main scale divisions = $(N-1)$ vernier scale divisions.

B. N vernier scale divisions = $(N-1)$ main scale divisions.

C. N vernier scale divisions = $(N + 1)$ main scale divisions.

D. None of these.

Answer: B



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27. The zeroth divisions of the vernier and main scales of a standard vernier callipers coincide, then

- A. the external jaws are in contact with each other
- B. there is some distance between the internal jaws.
- C. Both (a) and (b).
- D. Neither (a) nor (b).

Answer: A



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28. Define the least count of a vernier calliper.

- A. 0.01 mm
- B. 0.01 cm
- C. 0.1 cm

D. 0.001 mm

Answer: B

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29. For each of the two vernier callipers P and Q, 1 MSD = 1mm. For P, 10 VSD = 8 MSD and for Q, 20 VSD = 15 MSD. The vernier callipers that gives more accurate reading is _____.

- A. P
- B. Q
- C. Both P and Q give equal accuracy.
- D. Data insufficient.

Answer: A

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30. The following information is given in respect of a vernier calipers.

1 main scale division = 0.3 cm

30 V.S.D. = 29 M.S.D.

The least count of this vernier calipers is _____.

A. 0.01 mm

B. 0.1 cm

C. 0.03 cm

D. 0.1 mm

Answer: D



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Concept Application Level 2

1. Taking 1 ly (light year) = $9.3 \times 10^{15} m$ and one day = 86400 s, express the speed of light (= $3 \times 10^8 ms^{-1}$ as ly (day)⁻¹

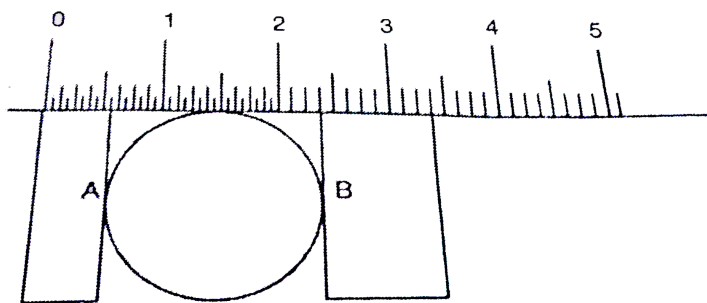


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2. The amount of heat absorbed by a body while raising its temperature is given by the equation. $Q = ms\theta$, here Q is the amount of heat, m is the mass of the body, s is the specific heat capacity and θ is the rise in temperature. Determine the S.I. unit and C.G.S. unit of heat and specific heat capacity

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3. A ruler marked in inches is used to measure the diameter of a ball as shown in the figure below.



Find the diameter of the ball in inches. If one inch is approximately equal to 25.4 mm, express the diameter in cm (correct to 2 decimal places).

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4. If p divisions on the vernier scale of vernier calipers correspond to q main scale divisions ($p > q$), derive an expression for the least count of the instrument in terms of p and q . If 1 M.S.D. = k mm, express the least count in cm.

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5. According to Newton's law of gravitation, the force F between two bodies of masses m_1 and m_2 placed at a distance of ' r ' from each other is given as

$F = G \times \frac{m_1 \times m_2}{r^2}$, where G is the universal gravitational constant. Find

the units of G in both C.G.S. and S.I. system.

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6. A student took the least count of a vernier calliper as 0.01 mm instead of 0.01 cm and found that the length of a copper rod was 4.909 cm. If one M.S.D. = 1 mm, then find

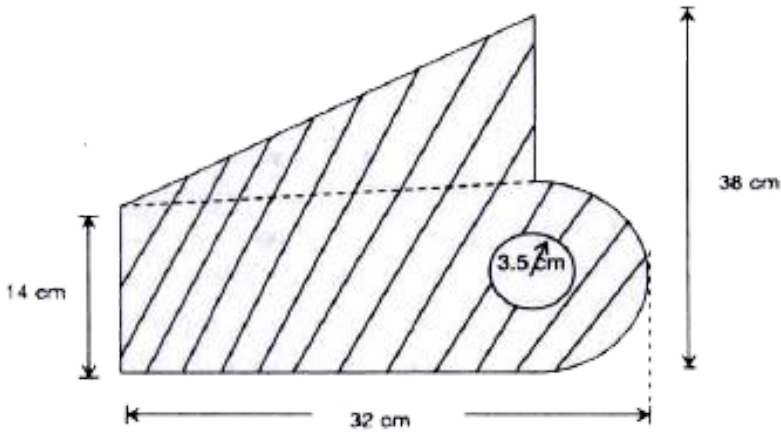
- (1) the main scale reading
- (2) the vernier coinciding division
- (3) the correct length of the rod

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7. The internal jaws of a vernier calipers were held tightly inside a hollow tube when the zero of the vernier scale showed a reading of 1.9 cm and the 18th division on the vernier scale was coinciding the division on the main scale. The thickness of the wall of the tube is 1 mm. If M.S. D. = 1 mm and the number of division on the vernier scale is 20, find the outside diameter of the hollow tube.

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8. Find the area of the shaded region in the given figure:



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9. A height gauge (an instrument used to measure accurately the height of the part of machinery) is to be constructed using a main scale marked in centimeters and millimetres.

(i) What is the minimum length of the vernier scale if the required least count is 0.001 cm?

(ii) what least count can be achieved if the number of vernier scale divisions cannot be more than 50?

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10. A height gauge (an instrument used to measure accurately the height of the part of machinery) is to be constructed using a main scale marked in centimeters and millimetres.

(i) What is the minimum length of the vernier scale if the required least count is 0.001 cm?

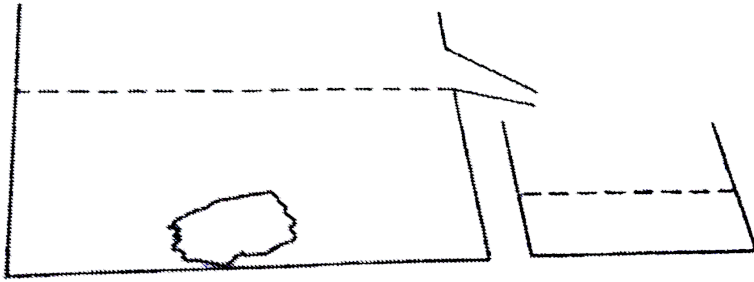
(ii) what least count can be achieved if the number of vernier scale divisions cannot be more than 50?



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11. An irregular shaped crystal was dropped into a liquid of density 800 kg m^{-3} and the overflowing liquid was collected and weighed. If the mass of the liquid collected is 120 g and the mass of the crystal is 360 g, find

the relative density of the crystal (density of water = 1000 kg m^{-3})



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12. To find the volume of an irregularly shaped wooden piece, a sinker made of steel (relative density = 7.85) having a mass of 157 g was used. If the level of water before and the after immersing the sinker-wood combination are 102 ml and 170 ml, respectively, find the volume of the wooden piece.

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13. On heating, the length, the breadth and the height of a cuboid structure was increased by 20%, 10% and 5% respectively, If the original volume of

the structure is 1000 cm^3 , determine the increase in its volume.

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14. Two spheres made of different materials have their masses in the ratio of 1:2. If the diameter of the first sphere is equal to the radius of the second sphere, then determine the ratio of densities of the

$$\text{Volume of sphere} = \frac{4}{3} \pi r^3$$

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15. A vernier caliper has 25 divisions on the vernier scale. An object is held between the external jaws of this instrument. If the zeroth division of the vernier scale is to the left of the 32nd division of the main scale and the 20th division of the vernier scale coincides with a main scale division, determine the measurement of the object. ($1 \text{ M.S.D.} = 0.5 \text{ mm}$)

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16. If the length of a body is to be measured accurately up to 0.05 mm using a vernier calliper with main scale divisions equal to 0.5 mm, how many divisions should be engraved on the vernier scale?



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17. While measuring the length of a copper rod using a vernier calliper, the zero of the vernier scale was found to be between 4.6 cm on the main scale. The 6th division of the vernier scale is found to coincide with a division on the main scale. Find the length of the rod if the least count is 0.01 cm.



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18. A vernier scale has 10 divisions. It slides over the main scale, whose 1 M.S.D. is 1.0 mm. If the number of division to the left side of the zero of the vernier scale on the main scale is 49 and the 8th vernier scale division coincides with the main scale, calculate the length in centimetres.

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19. The relative density of mercury is 13.6. Find the ratio of the mass of mercury of a certain volume to that of water having ten times the volume of mercury.

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20. Two spheres made of different materials but having the same mass, have radii in the ratio of 3 : 4. Find the ratio of their densities.

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21. A king ordered a goldsmith to prepare a crown with 1 kg pure gold. The relative density of pure gold is given as 19. Is it possible to find the adulteration if the goldsmith adds some impurity in making the crown. If so how? Explain.

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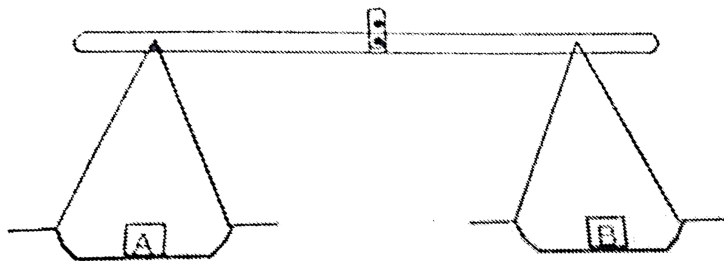
Concept Application Level 3

1. A vernier calipers has 25 divisions on the vernier scale, An object is held between the external jaw of this instrument. If the zeroth division of the vernier scale is to the left 32nd division of the main scale and the 20th division of the vernier scale coincides with a main scale division, determine the measurement of the object. ($1M. S. D. = 0.5mm$)

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2. Two metal blocks A and B were placed on the two pans of a common balance and the beam of the balance was horizontal. However, when the blocks were interchanged and block B was placed in the left pan and block A in the right pan, the beam was not balanced and tilted down toward the left. Discuss the various factors that could be the cause of

this. Are the masses of two blocks equal?



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3. 100 ml of liquid A ($density = 1200kgm^{-3}$) and 100 g of liquid B ($density = 0.8gcm^{-3}$) are mixed to form a homogeneous mixture.

Assuming that two liquids do not chemically react with each other, find the density of the resultant mixture.

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4. If the number of divisions on the vernier scale of a standard vernier calliper is N , then N is always equal to $(N - 1)$ main scale divisions. Would the vernier calliper be rendered useless if N is equal to a fewer number of

main scale divisions, for example $N = (N-3)$ M.S.D.? Why? How would the least count calculations be modified?

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5. We know that every derived quantity can be written in terms of some of the fundamental quantities. For

example, volume = (length)³, speed = $\frac{\text{length}}{\text{time}}$. Using

the definitions of the following quantities, express force in terms of fundamental quantities. Represent mass as [M], length as [L] and time as [T].

(i) Displacement = shortest distance between the initial and final positions.

(ii) Velocity = $\frac{\text{displacement}}{\text{time}}$

(iii) Momentum = mass \times velocity brgt (iv) Force = $\frac{\text{momentum}}{\text{time}}$

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6. A metallic rod of unknown radius was held in between the lower jaws of a vernier callipers. The main scale is divided into millimetres and the vernier scale has 50 divisions. The vernier coinciding division is 39. If the zeroth division of the vernier scale lies between 6.3 cm and 6.4 cm of the main scale, find the radius.

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7. In a vernier callipers 15 vernier scale divisions correspond to 14 main scale divisions and one main scale division is equal to 1.5 mm. . An object is held between the external jaw of the given vernier callipers. If the zeroth division of the vernier scale is to the left of the 20th division of the main scale, find the measurement of the object, if the 14th division of the vernier scale coincides with the main scale division.

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8. An object 'X' of volume 200 cm^3 and another object Y of volume 250 cm^3 , when placed on the two pans of a common balance they balance each other. Determine the ratio of density of X and density Y



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9. When 100 drops of a liquid P is added into a liquid Q the volume of the liquid in the container which is initially filled with liquid Q doubled. Determine density of the mixture if density of the liquids P and Q are 1.5 g cm^{-3} and 1.3 g cm^{-3} , respectively



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10. A Fortin's barometer has a main scale and a vernier scale to measure the atmospheric pressure. The main scale coincide with 50 vernier divisions, find the least count of the instrument in Pa. (Given pressure exerted by 76 cm column of mercury = 10^5 Pa)



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