General Certificate of Education (Advanced Level) Examination – March 2021

Grade 13

PHYSICS 1	01	E	I	TIME : TWO HOURS

$g = 10 Nkg^{-1}$

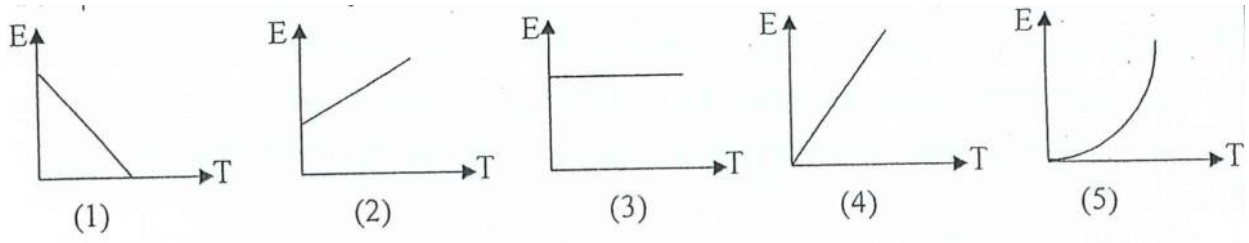
(1) Dimensions of permeability is, (Dimensions of electric current is I)

1) $ML^2T^{-2}I^{-1}$
2) $ML^2T^{-1}I^{-2}$
3) $ML^2T^{-2}I^{-2}$
4) $MLT^{-2}I^{-2}$
5) $MLT^{-1}I^{-2}$

(2) Thermal conductivity of a substance is 400 in SI unit system. What is the value in cm (length) g (mass) and s (time) unit system where temperature is measured in K?

1) 40
2) 4×10^2
3) 4×10^3
4) 4×10^5
5) 4×10^7

(3) Which of the following graphs depict the variation of average kinetic energy of ideal gas molecules (E) with absolute temperature (T)?



(4) Three particles A, B, C are projected at equal V velocity at 15°, 45°, 75° angles to the horizontal, from the same point. Horizontal ranges of the 3 particles A, B, C are S_A, S_B and S_C and the maximum heights they ascend are H_A, H_B and H_C respectively. Which of the following expressions are true? (Neglect any effects due to air resistance)

1) $S_A = S_C < S_B$ and $H_A > H_B > H_C$

2) $S_A = S_C > S_B$ and $H_A = H_C > H_B$

3) $S_A > S_B > S_C$ and $H_A > H_B > H_C$

4) $S_A > S_B > S_C$ and $H_A = H_C > H_B$

5) $S_A = S_C < S_B$ and $H_A < H_B < H_C$

(5) The following electromagnetic rays when arranged in their ascending order of frequency:

A – X ray B – Light ray C – Radio waves D – Microwaves

1) B A C D

2) C B D A

3) A B D C

4) C D B A

5) D A C B

(6) A particle undergoes simple harmonic motion at 40cm amplitude and 24 s time period. The time it takes to displace 20cm from the equilibrium position is ;

1) 1s

2) 2s

3) 4s

4) 5s

5) 6s

(7) The engine of an automobile generated an intensity level I at a certain point O some distance away. To increase the level of intensity of O by 10 dB, how many such engines are to be functioning together?

1) 2

2) 5

3) 10

4) 20

5) 40

(8) A closed resonance tube of length 40 cm resonates at its' fundamental mode with an open resonance tube of length L also at its' fundamental mode. (Neglect the end corrections of the tube) L is equal to;

1) 20 cm

2) 40 cm

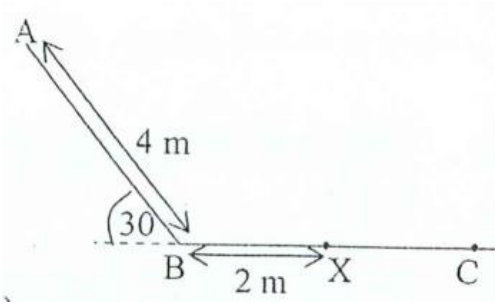
3) 60 cm

4) 80 cm

5) 100 cm

(9) An object of mass 250g is released (from rest) from A. The Path AB is smooth, and BC is rough. The ball moves along AB and enters path BC. Coefficient of dynamic friction between the object and BC path is 0.2 . What is the energy possessed by the object at x ?

1) 4.0 J
2) 9.5 J
3) 12.0 J
4) 26.0 J
5) zero



(10) A lake is frozen on the top at $-20°C$ atmospheric temperature. The temperature of water in contact with the bottom surface of the layer of ice: θ_1 . Temperature of the bottom most layer of water in the lake: θ_2. Which of the following is true?

1) Θ_1 = 273K and Θ_2 = 277K
2) Θ_1 = 253K and Θ_2 = 273K
3) The temperature from the bottom surface of ice to the bottom of the lake is 277K
4) The temperature from the bottom surface of ice to the bottom of the lake is 273K
5) The temperature from the bottom surface of ice to the bottom of the lake is 253K

(11) The bottom of a tank consists of a glass cube of height 8cm and refractive index 1.6 . On the glass there is a layer of oil 4.5 cm deep. A layer of water of height 6cm floats on the oil layer. A person who looks vertically down at the bottom of the tank, sees the bottom elevated 6 cm. Refractive index of oil is; (Refractive index of water = 4/3)

1) 0.8
2) 1.2
3) 1.5
4) 1.8
5) 2.0

(12) A certain volume of saturated air is trapped in a cylinder at 8°C at 760 Hgmm (The moisture contained in air is just sufficient to saturate it) Saturated vapour pressure at 8°C is 8 Hgmm. Which of the following statement/s is/are true? At constant temperature, when ;

A. Volume is halved pressure becomes 1512Hgmm
B. Volume is doubled pressure becomes 384Hgmm
C. Volume is halved pressure becomes 1528Hgmm
D. Volume is doubled pressure becomes 380Hgmm

1) A and B
2) A and D
3) B and C
4) A only
5) D only

(13) Principal heat capacities of a certain gas are 178 J kg^{-1} K^{-1} and 249 J kg^{-1} K^{-1}. Which of the following statement/s is/are correct ?

A. $C_V = 249 Jkg^{-1}K^{-1}$ and $C_P = 178 Jkg^{-1}K^{-1}$

B. $C_P = 249 Jkg^{-1}K^{-1}$ and $C_V = 178 Jkg^{-1}K^{-1}$

C. $\gamma = 1.4$

D. $\gamma = 0.715$

1) A and C
2) A and D
3) B and C
4) B and D
5) B only

(14) The pressure of an ideal gas is quadrupled (x4) under constant volume. Its' root mean square velocity changes by a factor of :

1) 4
2) 2
3) 1/4
4) 1/2
5) 1

(15) Which of the following seismic waves move through earth's interior?

A – Primary waves
B – Love waves
C – Rayleigh waves
D – Secondary waves

1) A and B
2) B and C
3) C and D
4) A and C
5) A and D

(16) A prism of prism angle 60° produces an angle of minimum deviation 30°. The refractive index of the prism material is;

1) 1.40
2) $\sqrt{2}$
3) 1.50

4) $\sqrt{3}$

5) 1.68

(17) Two sources (A & B) placed at a certain distance emit sound waves of wave length λ. Beat frequency observed by a person walking from A to B with uniform velocity u is ,

1) $\frac{u}{\lambda}$

2) $\frac{u}{2\lambda}$

3) $\frac{u}{3\lambda}$

4) $\frac{2u}{\lambda}$

5) $\frac{2u}{3\lambda}$

(18) 16g of Oxygen and 14g of Nitrogen are mixed in a closed container of volume 5000cm^3 at 300K temperature. The total pressure of this mixture of gases is about. (molar masses of Oxygen and Nitrogen 32g , 28g respectively, R = 8.35$JK^{-1}mol^{-1}$)

1) 5 x 10^5 Pa

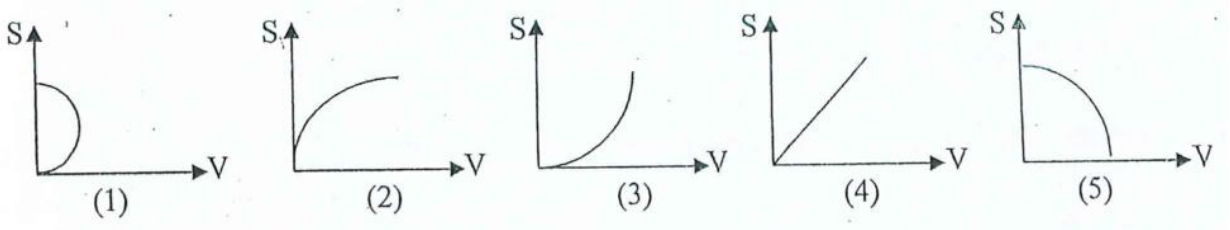
2) 4 x 10^5 Pa

3) 3 x 10^5 Pa

4) 2 x 10^5 Pa

5) 1.2 x 10^5 Pa

(19) Which is the correct displacement velocity (S – V) graph for the motion of an object. Which starts from rest and accelerates uniformly long the direction of motion?



(20) Volume of a certain gas sample at 30^0C temperature and atmospheric pressure is 100cm^3 . Then its' volume is doubled at constant pressure by heating up to ,

1) 606^0C

2) 333^0C

3) 100^0C

4) 60^0C

5) 15^0C

(21) A sonometer wire with 4kg mass suspended at its' free end, vibrates at 256Hz in its' fundamental mode. What mass would double the frequency of its' fundamental mode?

1) 24kg
2) 16kg
3) 12kg
4) 10kg
5) 8kg

(22) An erroneous thermometer reads its' lower fixed point at -2^0C and upper fixed point at 96^0C. A real temperature of 50^0C, as read by this erroneous temperature scale,

1) 37^0C
2) 40^0C
3) 42^0C
4) 47^0C
5) 50^0C

(23) A metal sphere of linear expansivity $1x10^{-5}$ K^{-1} increases its' temperature by 100^0C while being rotated about an axis through its' center. The percentage increase of its' moment of inertia is,

1) 0.002%
2) 0.020%
3) 0.100%
4) 0.200%
5) 0.500%

(24) A real object of height 6cm is placed at 30cm distance from a convex lens. Its' image is formed at 60cm distance from the object on the same side of the lens. The focal length of the lens is,

1) 20.0cm
2) 22.5cm
3) 45.0cm
4) 50.0cm
5) 90.0cm

(25) A motor of power output 2000kW draws water from a 20m deep well and then pumps it at $5m^3s^{-1}$ rate into a tank. Density of water $1000kgm^{-3}$. With what speed, water being pumped to the tank?

1) $10ms^{-1}$
2) $20ms^{-1}$
3) $26ms^{-1}$
4) $32ms^{-1}$
5) $80ms^{-1}$

(26) A wave of frequency 120Hz produces a phase difference of 6π rad between two points on its' path at 9m separation. The speed of the wave is,

1) $180ms^{-1}$
2) $240ms^{-1}$
3) $360ms^{-1}$
4) $480ms^{-1}$
5) $720ms^{-1}$

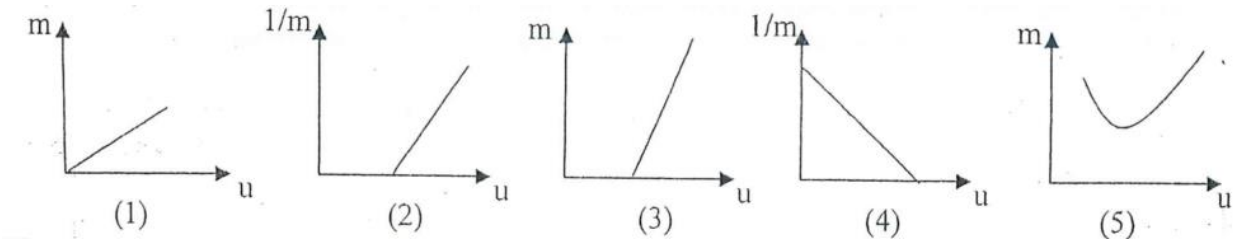
(27) A solid cylinder (A) of radius r and length 2r and a hemisphere (B) of radius r are made of the same material. They are heated to the same temperature and allowed to cool under similar environmental conditions. The rates of heat loss are H_1 and H_2 and the rates of temperature decrease X_1 and X_2 respectively. Which of the following expression is true?

1) $\frac{H_1}{H_2}=\frac{2}{1}$ and $\frac{X_1}{X_2}=\frac{2}{3}$
2) $\frac{H_1}{H_2}=\frac{2}{3}$ and $\frac{X_1}{X_2}=\frac{1}{4}$
3) $\frac{H_1}{H_2}=\frac{5}{3}$ and $\frac{X_1}{X_2}=\frac{3}{4}$
4) $\frac{H_1}{H_2}=\frac{5}{9}$ and $\frac{X_1}{X_2}=\frac{3}{5}$
5) $\frac{H_1}{H_2}=\frac{5}{9}$ and $\frac{X_1}{X_2}=\frac{5}{3}$

(28) The apparent weight loss of a solid object when completely immersed in a liquid at 0^0C is ω_0. When the liquid is heated to t^0C its' apparent weight loss is ω. Volume expansivities of the solid and the liquid are γ_S and γ_l respectively. Which of following expressions is true? When γ_S and γ_l are very minute Quantities

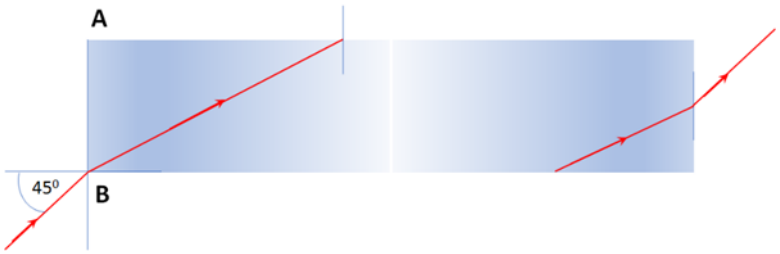
1) $\omega = \omega_0(\gamma_S - \gamma_l)\, t$
2) $\omega = \omega_0[1 + (\gamma_S - \gamma_l)\, t\,]$
3) $\omega=\frac{\omega_0\, t}{\gamma_l-\gamma_s}$
4) $\omega = \omega_0[1 - (\gamma_S - \gamma_l)\, t\,]$
5) $\omega = \omega_0[1 + (\gamma_S - 3\gamma_l)\, t\,]$

(29) Which of the following correctly depicts the relation between the object distance (u) and magnification (m) for real images formed by a convex lens?



(30) Shown here is an optical fiber of length $2\sqrt{3}$ m, diameter 20μm (and refractive index $\sqrt{2}$) a ray of light incidents at 45^0 angle on AB face , enters the fiber. The ray exits from the opposite end of the fiber. How many reflections had it undergone by then?

1) 10^2
2) 10^3
3) 10^4
4) 10^5
5) 10^6



(31) An object rotates on a circular track of radius r, on a horizontal plane at uniform angular velocity. Which of the following statement/s is/are true?

A. Velocity of the object remains a constant at the end of each second.
B. Time period is doubled if angular velocity is doubled.
C. Centripetal force decreases with the decrease in friction of the circular track

1) A only.
2) B only.
3) C only.
4) B and C only.
5) All A, B, C are true.

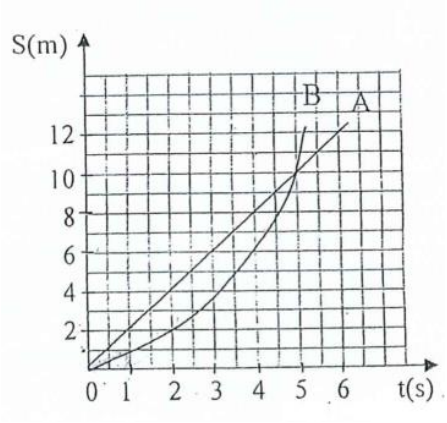
(32)

Θ^0C	10	12	14	16	18	20
P(mmHg)	9.20	10.50	11.96	13.65	15.46	17.51

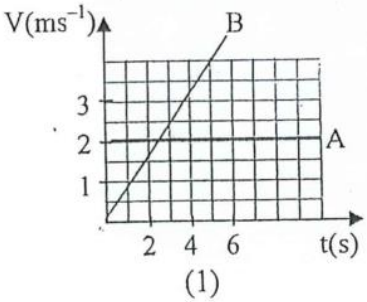
The table shows the variation of saturated vapour pressure with temperature. Which of the following conclusion/s based on the readings above is/are true?

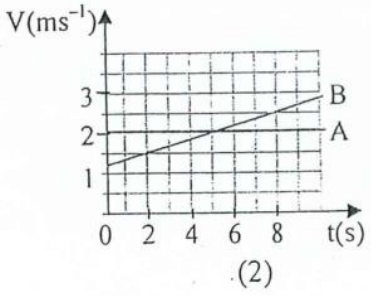
A. P is directly proportional to, Θ.
B. Saturated vapour pressure at 100^0C can be gauged using above data.
C. When atmospheric temperature is at 16^0C and dew point at 12^0C, relative humidity is about 77%.

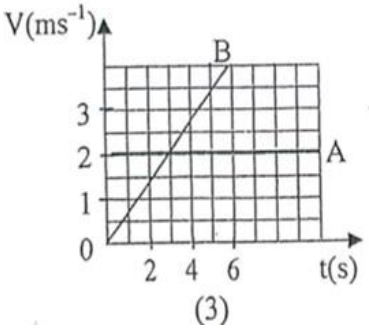
1) A
2) B
3) C
4) A and B
5) A and C

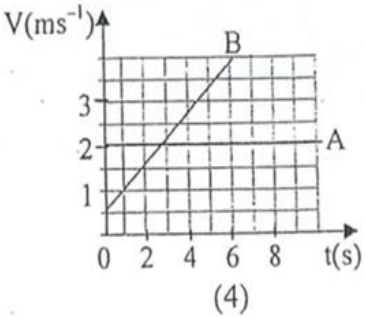
(33) 

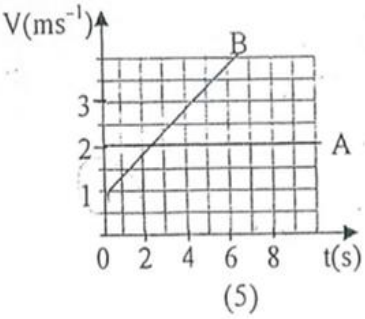
Displacement time graph for two vehicles A and B is shown below. Consider any acceleration to be uniform. Corresponding velocity – time graph is,









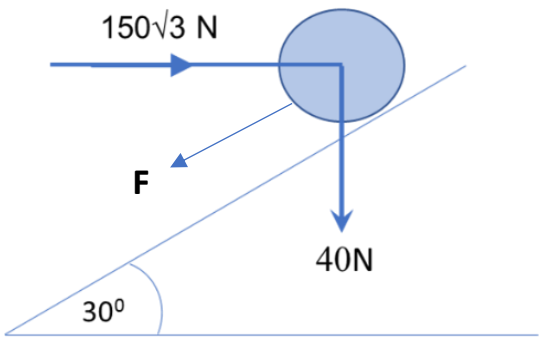


(34) 51kJ of heat energy is being removed from 260g of water at 0^0C. Specific heat capacity of fusion of ice is $3x10^5$ Jkg^{-1}. The mass of liquid water left without freezing.

1) 50g
2) 60g
3) 70g
4) 80g
5) 90g

(35) In the setup shown here, the resultant force acting upwards along the plane of inclination 30^0 to the horizontal (on the 4kg mass) is zero. F is equal to,

1) 30N
2) 90N
3) 205N
4) 210N
5) 312N



(36) A boat ridden at 72kmh^{-1} constant speed takes 1 minute to overtake a ship moving at 54kmh^{-1} (in a parallel path towards the same direction) in still water. The length of the ship is ,

1) 120m
2) 210m
3) 290m
4) 300m
5) 900m

(37) Equal masses of two liquids A and B are contained in two identical calorimeters at the same temperature. They are being heated by two identical thermo coils for the same period of time.

1) Temperatures of both calorimeters are equal.
2) The liquid having greater specific heat capacity shows higher temperature.
3) The liquid having less specific heat capacity shows higher temperature.
4) The calorimeter which contains the liquid heaving greater heat capacity starts cooling at a higher rate.
5) For both calorimeters, initial rates of cooling are equal.

(38) A uniform glass tube of length 1m is inverted and immersed into a dish of mercury. When the atmospheric pressure is 76cmHg , mercury raised to 24cm height in the tube. Height of the tube submerged in mercury is,

1) 50cm
2) 48cm
3) 45cm
4) 36cm
5) 30cm

(39) The focal length of lens of a lens combination is 20cm. The power of the other lens is -3.75D. The power of the lens combination is positive. Focal length of this lens combination,

1) 20cm
2) 60cm
3) 75cm
4) 80cm
5) 100cm

(40) A kettle is made of a substance having thermal conductivity 210Wm^{-1}K^{-1}. The area and thickness of the bottom of the kettle are 300cm^2 and 2mm respectively. The rate of vaporization of water from the kettle is 1gmin^{-1}. The temperature difference on either side of the bottom of the kettle is,(latent heat of vapourization of water is 2.268x10^6 Jkg^{-1})

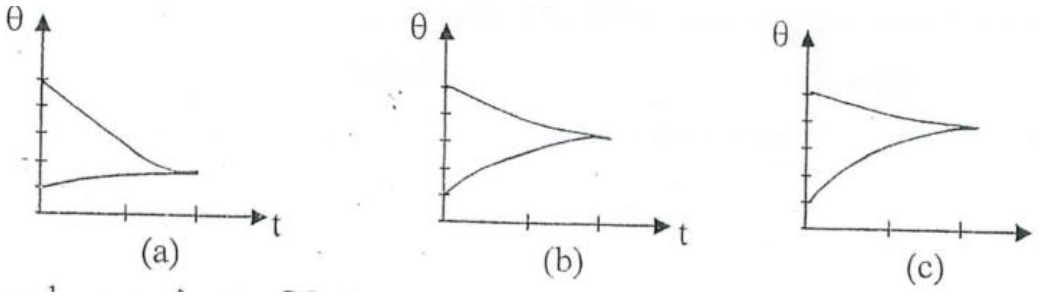
1) 12^0C
2) 1.2^0C

3) 0.12^0C

4) 0.012^0C

5) 0.0012^0C

(41) Three cylinders a , b , c of equal mass and made of different metals heated to the same temperature, and introduced to three identical insulating containers having equal volumes of water at room temperature. The graphs show the variation of temperature with time as the three systems attain the state of thermal equilibrium. The descending order of specific heat capacities of the metal cylinders in a , b , c is



1) b > a < c

2) c > b > a

3) a > b > c

4) b > c > a

5) c > a > b

(42) Three metal rods with identical dimensions and of thermal conductivities K_1 , K_2 and K_3 are fastened as shown here. Temperature at the junctions A and B are maintained constant at Θ_1 and Θ_2. The rates of heat flow along the paths AB and ACB are equal. Which of the following expressions is true?

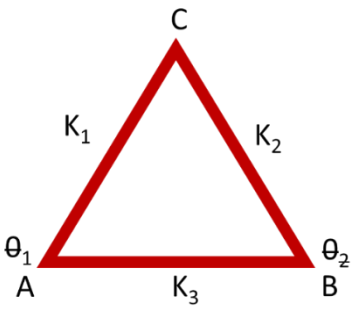
1) $K_3 = 2\,(K_1 + K_2)$

2) $K_3 = \frac{K_1 K_2}{K_1 + K_2}$

3) $K_3 = K_1 + K_2$

4) $K_3 = \frac{K_1 + K_2}{2}$

5) $K_3 = \frac{K_1 + K_2}{K_1 K_2}$



(43) Focal lengths of the two lenses used in the telescope of a spectrometer are 10cm and 2cm. Focal length of the system of lenses used in its' collimator is 8cm. Which of the following statement/s is/are true about an experiment to determine the minimum deviation through a prism?

A. Distance between the two lenses in the telescope are adjusted at 12cm.

B. Distance between the system of lenses and the slit of the telescope is adjusted at 8cm.

C. A monochromatic source of light is placed in front of the slit.

1) A only

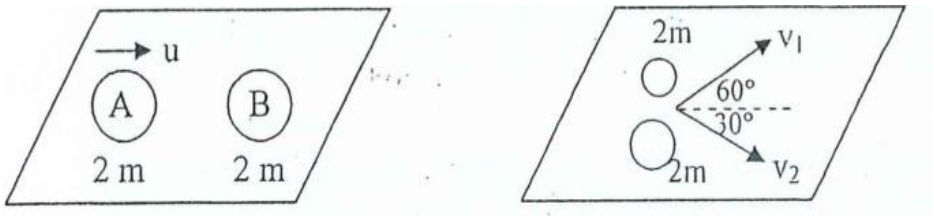
2) B only

3) C only

4) A and B only

5) All A, B, C

(44) Before collision After collision



Two objects A and B collide on a smooth table as shown above. v_1 given in terms of u is,

1) $\frac{u}{2}$

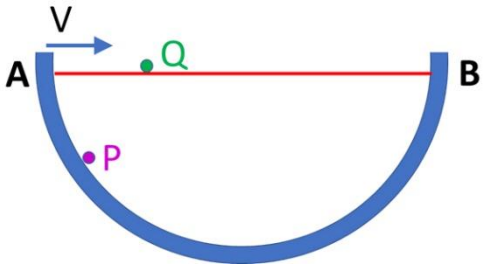
2) u

3) $\frac{\sqrt{3}}{2}u$

4) $2u$

5) $\sqrt{3}$ u

(45) Figure shows a semicircular smooth container and a horizontal string AB. A particle P is released from A at t=0. It slides down along the surface of the container smoothly. Horizontal component of the velocity of P at A (when t=0) is v. Another particle Q (of equal mass to P) is projected at v horizontal velocity from A simultaneously (when t=0) and it moves along AB under negligible friction with the string AB. P and Q takes t_P and t_Q time intervals respectively to reach B. Which of the following expressions is correct?



1) $t_P < t_Q$

2) $t_P = t_Q$

3) $t_P > t_Q$

4) $\frac{t_P}{t_Q} = \frac{length\ of\ arc\ ABC}{length\ of\ string\ AB}$

5) $\frac{t_P}{t_Q} = \frac{length\ of\ arc\ AB}{length\ of\ string\ ABC}$

(46) Which of the following expression/s is/are true?

A. Moment of force is a vector quantity.

B. Moment of a couple occurs due to two (similar or opposite) parallel forces.

C. Closing a window is made easier by applying the force by hand, closer to the hinge.

1) A only

2) B only

3) C only

4) A and B only

5) A and C only

(47) Choose the **wrong** statement out of the following.

1) When an object is in static equilibrium, its' center of gravity is located at a lowest position.
2) The center of gravity and center of mass of any system of objects in the universe always coincide.
3) Center of gravity of a regular object is where its' axes of symmetry intersects.
4) The center of buoyancy of an object which is being sunk and floating in water is above its' center of gravity.
5) A non-uniform rod is being balanced horizontally on a knife edge. The reaction by the knife edge is equal to the weight of the rod.

(48) A mass M is pulled by a horizontal wire of mass m on a smooth horizontal plane, by a force P applied at the free end of wire. The force by the wire on the mass,

1) *zero*
2) P
3) $\frac{MP}{M+m}$
4) $\frac{mP}{M+m}$
5) $\frac{MP}{M-m}$

(49) Which of the following condition/s is/are satisfied when an object is in equilibrium due to the action of three forces?

A. The forces are coplanar.
B. Magnitudes and directions of the three forces can be depicted by the sides of a triangle.
C. Algebraic sum of the resolved components of the three forces along any direction is zero.

1) A only
2) B only
3) C only
4) A and B only
5) A and B only

(50) Shown below is a three-level energy diagram used for the production of laser. Frequency of radiation that is pumped into the above system for producing laser

1) 5×10^{14} Hz
2) 8×10^{14} Hz
3) 5×10^{33} Hz
4) 2.6×10^{14} Hz
5) 2.6×10^{33} Hz