PHYSICS

RESONANCE ENGLISH

CENTRE OF MASS

Exercise

1. The centre of mass of a body

A. Lies always at the geometrical centre

B. Lies always inside the body

C. Lies always outside the body

D. Lies within or outside the body

Answer: D

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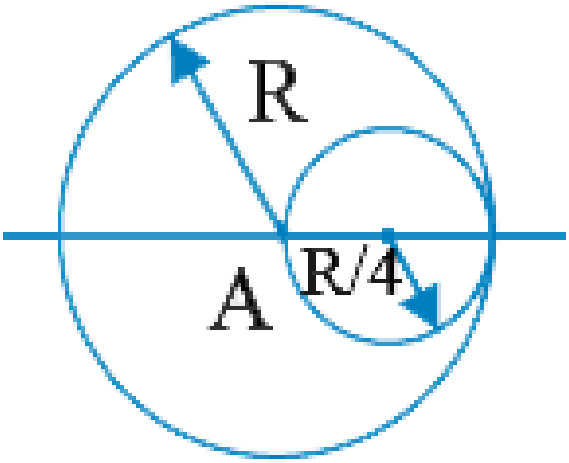
2. The centre of mass of the shaded portion of the disc is :

(The mass is uniformly distributed in the

shaded portion)



A. $\frac{R}{20}$ to the left of A

B. $\frac{R}{12}$ to the left of A

C. $\frac{R}{20}$ to the right of A

D. $\frac{R}{12}$ to the right of A

Answer: A

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3. Two particles of mass 1 kg and 0.5 kg are moving in the same direction with speed of $2m/s$ and 6 m/s respectively on a smooth horizontal surface. The speed of centre of mass of the system is

A. $\frac{10}{3}m/s$

B. $\frac{10}{7}m/s$

C. $\frac{11}{2}m/s$

D. $\frac{12}{3} m/s$

Answer: A

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4. When an explosive shell travelling in a parabolic path under the effect of gravity explodes in the mid air, the centre of mass of the fragments will move

A. Move vertically upwards and then downwards

B. Move vertically downwards

C. Move in irregular path

D. Move in the parabolic path which the unexploded bomb would have travelled.

Answer: D

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5. If a ball is thrown upwards from the surface of earth :

A. The earth remains stationary while the ball moves upwards

B. The ball remains stationary while the earth moves downwards

C. The ball and earth both move towards each other

D. The ball and earth both move away from each other

Answer: D

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6. Two particles A and B intiallly at rest, move towards each other under a mutual force of attraction. AT the instant when the speed of A is v and the speed of B is 2 v, the speed of the centre of mass of the system is

A. velocity remains constant

B. zero

C. 2v

D. 3v/2

Answer: B

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7. A particle of mass 4m which is at rest explodes into three fragments. Two of the fragments, each of mass m, are found to move

with speed v each in mutually perpendicular directions. The total energy released in the process of explosion is _____.

A. $(2/3)mv^2$

B. $(3/2)mv^2$

C. $(4/3)mv^2$

D. $(3/4)mv^2$

Answer: B

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8. A ball of mass 50 g is dropped from a height h = 10 m . It rebounds losing 75 per cent of its kinetic energy . If it remain in contact with the ground for $\Delta t = 0.01$ s , the impulse of the impact force is

A. 1.3 N-s

B. 1.06 N-s

C. 1300 N-s

D. 1.05

Answer: B

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9. A bullet of mass m=50 gm strikes $(\Delta t \approx 0)$a sand bag of mass M =5 kg hanging from a fixed point, with a horizontal velocity $\overrightarrow{v}_p$. If bullet sticks to the sand bag then the ratio of final & initial kinetic energy of the bullet is

A. 10^{-2}

B. 10^{-3}

C. 10^{-6}

D. 10^{-4}

Answer: D

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10. A ball collides with an inclined plane of inclination θ after falling through a distance h . If it moves horizontally just after the impact , the coefficient of restitution is

A. $\tan^2\theta$

B. $\cot^2\theta$

C. $\tan\theta$

D. $\cot\theta$

Answer: A

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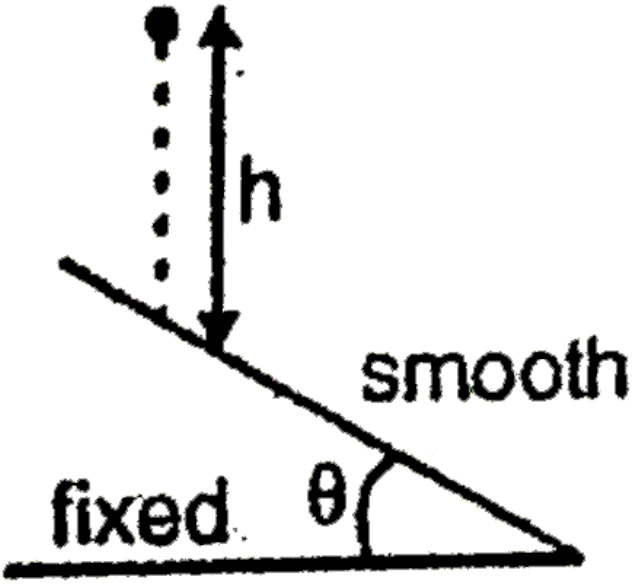
11. A ball of mass m strikes the fixed inclined plane after falling through a height h. if it rebounds elastically. The impulse on the ball is

:



A. $2m\cos\theta\sqrt{2gh}$

B. $2m\cos\theta\sqrt{gh}$

C. $\dfrac{2m\sqrt{2gh}}{\cos\theta}$

D. $2m\sqrt{2gh}$

Answer: A

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12. A rocket with a lift-off mass $3.5 \times 10^4 kg$ is blasted upwards with an initial acceleration of $10 m / s^2$. Then the initial thrust of the blast is

A. $3.5 \times 10^5 N$

B. $7.0 \times 10^5 N$

C. $14.0 \times 10^5 N$

D. $1.75 \times 10^5 N$

Answer: B

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13. A body A of mass M while falling vertically downwards under gravity breaks into two parts: a body B of mass $\frac{1}{3}M$ and a body C of mass $\frac{2}{3}M$ The centre of mass of bodies B and C taken together shifts compared to that of body A towards

A. depends on height of breaking

B. does not shift

C. shift towards body C

D. shift towards body B

Answer: B

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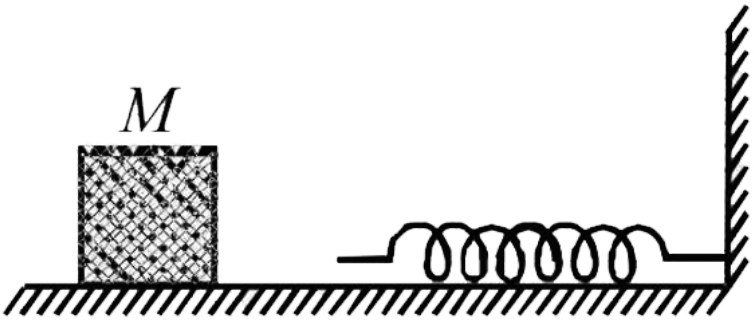
14. The block of mass M moving on the frictionless horizontal surface collides with the spring constant k and compresses it by length L . The maximum momention of the block

after collision is



A. $\sqrt{mk}L$

B. $\frac{kL^2}{2M}$

C. zero

D. $\frac{ML^2}{k}$

Answer: A

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15. Consider a two particle system with the particles having masses m_1 and m_2. If the first particles pushed towards the centre of mass through a distance d, by what distance should the second particle be moved so as the keep the centre of mass at the same position?

A. d

B. $\frac{m_2}{m_1}d$

C. $\frac{m_1}{m_1+m_2}d$

D. $\frac{m_1}{m_2}d$

Answer: D

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16. A body of mass m = 3.513 kg is moving along the x-axis with a speed of $5.00ms^{-1}$. The magnitude of its momentum is recorded as

A. $17.565kgms^{-1}$

B. $17.56 kgms^{-1}$

C. $17.57 kgms^{-1}$

D. $17.6 kgms^{-1}$

Answer: D

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17. A block of mass 0.50 kg is moving with a speed of 2.00 m/s on a smooth surface. It strikes another mass of 1.00 kg and then they

move together as a single body. The energy loss during the collision is

A. 1.00 J

B. 0.67 J

C. 0.34 J

D. 0.16 J

Answer: B

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18. A shell of mass 100 kg is fired horizontally from a cannon with a mass of $5 \times 10^3 kg$. The kinetic energy of the shell at the end of the barrel is $7.5 \times 10^6 J$. The kinetic energy imparted to the cannon by the recoil is

A. $2 \times 10^5 J$

B. $7.5 \times 10^6 J$

C. $1.5 \times 10^5 J$

D. $10^5 J$

Answer: C

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19. Two masses of 1 g and 4 g are moving with equal kinetic energies. The ratio of the magnitudes of their momenta is

A. $1:1$

B. $1:2$

C. $1:3$

D. $1:4$

Answer: B

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20. The spacecraft of mass M moves with velocity v in free space at first, then it explodes breaking into two pieces. If after explosion a piece of mass m comes to rest, the other piece of space craft will have a velocity :

A. MV/(M-m)

B. MV/(M+m)

C. mV/((M-m)

D. mV/(M+m)

Answer: A

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21. When two blocks connected by a spring move towards each other under mutual interaction,

A. their velocities are equal and opposite.

B. their accelerations are unequal and opposite

C. the force acting on them are equal and opposite

D. their momentum are equal and opposite

Answer: C::D

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22. A ball impinges directly on another ball at rest. The first ball is brought to rest by the impact. If half of the kinetic energy is lost by the impact, the value of coefficient of restitution is

A. $\frac{1}{2\sqrt{2}}$

B. $\frac{1}{\sqrt{3}}$

C. $\frac{1}{\sqrt{2}}$

D. $\frac{\sqrt{3}}{2}$

Answer: C

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23. A continuous stream of particles, of mass m and velocity r, is emitted from a source at a rate of n per second. The particles travel along a straight line, collide with a body of mass M and get embedded in the body. If the mass M was originally at rest, its velocity when it has received N particles will be

A. $\frac{mvn}{Nm+n}$

B. $\frac{mvN}{Nm+M}$

C. $\frac{mv}{Nm+M}$

D. $\frac{Nm+M}{mv}$

Answer: B

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24. If the external forces acting on a system have zero resultant, the centre of mass

A. must not move

B. will accelerate

C. may move

D. may accelerate

Answer: C

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25. Find the position of centre of mass of the section shown in figure

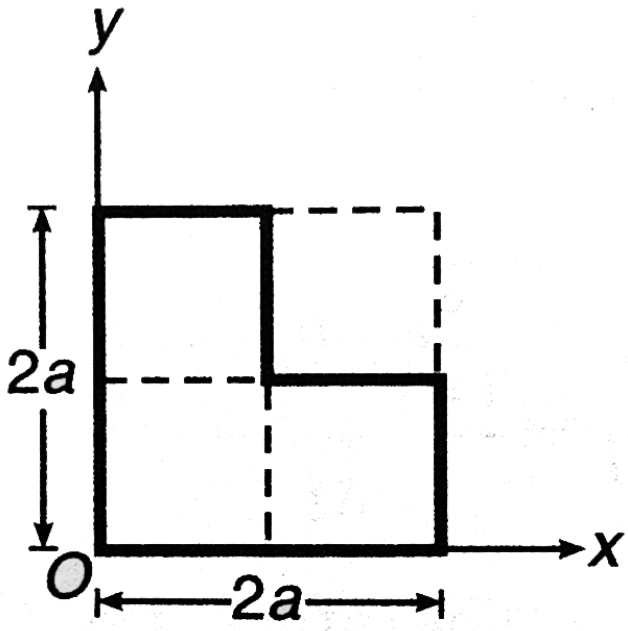

Fig. 11.14

A. $\frac{a}{6}, \frac{a}{6}$

B. $\frac{3a}{2}, \frac{3a}{2}$

C. $\frac{5a}{6}, \frac{5a}{6}$

D. a,a,

Answer: C

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26. A man of mass M hanging with a light rope which is connected with a balloon of mass m. the system is at rest in air. When man rises a distance h with respect to balloon find. The distance raised by man

A. $\frac{mh}{m+M}$

B. $\frac{Mh}{m+M}$

C. $\frac{m+M}{mh}$

D. $\frac{m+M}{Mh}$

Answer: A

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27. Three particles of masses $20g$, $30g$ and $40g$ are initially moving along the positive direction of the three coordinate axes respectively with the same velocity of $20cm/s$. When due to their mutual interaction, the first

particle comes to rest, the second acquires a velocity $\left(10\hat{i}+20\hat{k}\right)cm/s$. What is then the velocity of the third particle?

A. $2\hat{i}+3\hat{j}+4\hat{k}$

B. $2.5\hat{i}+15\hat{j}+5\hat{k}$

C. $2.5\hat{i}+10\hat{j}-5\hat{k}$

D. $2\hat{i}-3\hat{j}-4\hat{k}$

Answer: B

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28. Velocity of a particle of mass 2kg varies with time t according to the equation $\overrightarrow{v} = \left(2t\hat{i} + 4\hat{j}\right)m/s$. Here t is in seconds. Find the impulse imparted to the particle in the time interval from t=0 to t=2s.

A. $2\hat{i}m/s$

B. $4\hat{i}m/s$

C. $8\hat{i}m/s$

D. $6\hat{i}m/s$

Answer: C

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29. A bullet of mass m and velocity v is fired into a large block of mass M. The final velocity of the system is

A. $\frac{c}{a+b}b$

B. $\frac{a}{a+c}b$

C. $\frac{a+b}{c}a$

D. $\frac{a+c}{a}.b$

Answer: B

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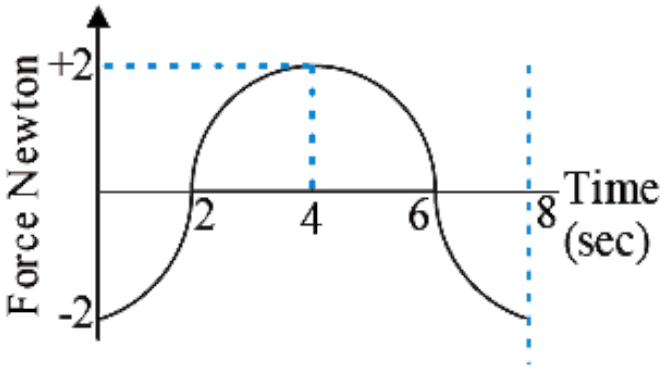
30. A force-time graph for a linear motion is shown in figure where the segments are circular. The linear momentum gained between zero and 8 seconds in :



A. -2π newton $\times$ second

B. zero newton $\times$ second

C. $+4\pi$ newton $\times$ second

D. -6π newton $\times$ second

Answer: B

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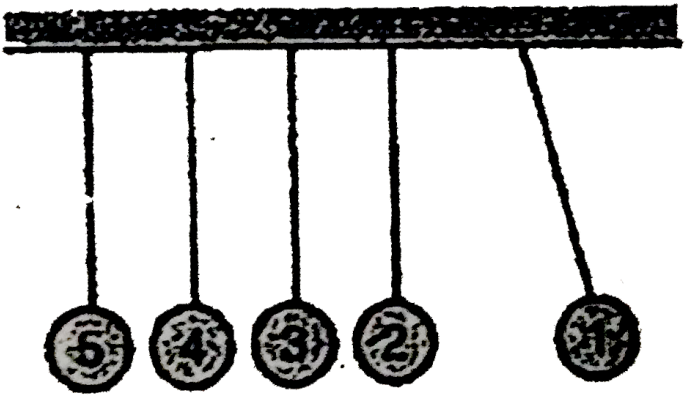
31. Five identical elastic balls are so suspended with strings of equal length in a row that the distance between adjacent balls are very small. If the extreme right ball is moved aside and

released then



A. one extreme left hand ball will bounce off

B. two extreme left hand balls will bounce off

C. three extreme left hand balls will bounce off

D. all the left hand four balls will bounce off

Answer: A

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32. A particle of mass m moving with velocity u_1 collide elastically with another particle of same mass moving with velocity u_2 in the same direction. After collision their speeds are

v_1 and v_2 respectively then

(A) $u_1 + v_1 = v_2 + u_2$, (B) $u_1 - v_1 = v_2 + u_2$

A. Both the equations A and B are correct

B. Both the equation A and B are incorrect

C. Equation A is correct but not B

D. Equation B is correct but not A

Answer: C

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33. Which of the following does not hold when two particles of masses m_1 and m_2 undergo elastic collision

A. when $m_1 = m_2$ and m_2 is stationary, there is maximum transfer to kinetic energy in head an collision

B. when $m_1 = m_2$ and m_2 is stationary, there is maximum transfer to momentum in head an collision

C. where $m_1 >> m_2$ and m_2 is stationary, after head on collision m_2 moves with twice the velocity of m_1

D. when the collision is oblique and $m_1 = m_2$ with m_2 stationary, after the collision the particle move in opposite direction.

Answer: D

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34. The coefficient of restitution e for a perfectly inelastic collision is :

A. 1

B. zero

C. ∞

D. -1

Answer: A

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35. In an elastic one dimensional collision between two particles the relative velocitiy of approach before collision is

A. e times the relative velocity of separation after collision

B. relative velocity of separation after collision

C. sum of the velocities of two bodies

D. 1/e times the relative velocity of separation after collision

Answer: A

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36. Consider the elastic collision of two bodies A and B of equal mass. Initially B is at rest and A moves with velocity u. After the collision :

A. the body A tracks, its path back with the same speed

B. the body A comes to rest and B moves aways in the direction of A' is approach

with the velocity v

C. both the bodies stick together and are rest

D. B moves with velocity $v/2$ and A retraces its path with velocity $v/2$

Answer: B

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37. A body of mass M_1 collides elastically with another body of mass M_2 at rest. There is maximum transfer of energy when

A. $M_1 > M_2$

B. $M_1 < M_2$

C. $M_1 = M_2$

D. same for all values of M_1 and M_2

Answer: C

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38. When two bodies collide elastically. The force of interaction between them is

A. conservative

B. non-conservative

C. either conservative or non-conservative

D. zero

Answer: A

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