PHYSICS

BOOKS - BINA LIBRARY PHYSICS (ASSAMESE ENGLISH)

WORK,ENERGY AND POWER

Example

1. Find the angel between the vectors $\overline{A}$ and $\overline{B}$,where

$\overline{A} = \hat{i} + 2\hat{j} - 2\hat{k}$

$\overline{B} = 2\hat{i} - 4\hat{j} - 4\hat{k}$

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2. A particle moves from one position vector $\left(3\hat{i} + 2\hat{j} - 6\hat{k}\right)$ to the position vector $\left(14\hat{i} + 13\hat{j} + 9\hat{k}\right)$ in meter when a unifrom force $\left(4\hat{i} + \hat{j} + 3\hat{k}\right)$ Nacts on it.Calculate the work done .

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3. show the vector represented by

$2\hat{i} + 4\hat{j} + 2\hat{k} +$ and $\hat{i} + 2\hat{j} - 5\hat{k}$ are

perpendiculer to each other.

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4. For what value of λ

$\overline{A} = 2\hat{j} + \lambda\hat{j} + \hat{k}$ and $\overline{B} = 4\hat{i} - 2\hat{j} - 2\hat{k}$ are

perpendiculer to each other?

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5. .The sum and difference of two vectors are perpendicular to each other. Prove that the vectors are equal in magnitude.

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6. Calculate the work doen in moving a partical along a vector $\overline{X} = 3\hat{i} + 2\hat{j} + \hat{k}$ if the applied forced is $\overline{F} = \left(2\hat{i} + 4\hat{j} + 5\hat{k}\right)$

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7. A particle moves from one position vector $\left(3\hat{i}+2\hat{j}-6\hat{k}\right)$ to the position vector $\left(14\hat{i}+13\hat{j}+9\hat{k}\right)$ in meter when a unifrom force $\left(4\hat{i}+\hat{j}+3\hat{k}\right)$ Nacts on it.Calculate the work done .

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8. A boat is being towed at a speed of 20 m per second.The tension in the towling is 6KN.Calculate the power suppiled to boat.

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9. A mass of 5.0 kg is pulled along a horizontal plane by a force in a direction making an angle 45° with the horizontal.The body moves with uniform velocity through a distance of 10 metre. Find the work done by the force(Co-efficient of firction=0.3).

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10. An automobil,e weighing 2000kg climbs up a hill that rises 1m in 20m of its lenth at the rate of 36 km/hr.Find the power developed by the engine.

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11. Calculate the gain in kinetic engery of a body of mass 10 kg after falling from rest for 2 seconds.

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12. A bullet of mass 10 g is fired from a gun with a velocity of $800ms^{-1}$.After passing through a mud wall 100cm thick its velocity drops to $100ms^{-1}$.Calculate the average resistance offered by the wall.

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13. A pump extracts water from 50m depth and ejects per sec 10 kg water with a velocity of 10m/s.Calculate is power.

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14. A ball is dropped from rest at a height 12m.If is loses 25% of its kinetic engeryt of striking the ground,Calculate the height to which it bounces.

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15. A ball falls under gravity from a height of 10m with an initial velocity. It collides with the

ground,loses 50% of its engery and then rises to the same height.Find the initial velocity.

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16. If the momentum of a partical increased by 50%,what is corresponding increases kinetic engery?

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17. Two bodies of masses of 1 g and 4 g are moving with equal kinetic engergies .Find the ratio of their momenta.

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18. A ball is dropped from height of 15m. After striking the ground,it bounces a height of 10m .What fraction of K.E it loses on striking the ground?

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19. A partical moves 0.5kg travels in a straight line with a velocity $v = ax^{\frac{3}{2}}$,where $a = 5m^{-\frac{1}{2}}s^{-1}$.What is the work doen by the net force during the displacment from X=0 to X=2m?

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20. A partiale of mass m is moving in a circular path of radius r such that its centripetal acceleration is varying with time t as `a_c =

k^2rt^2, where k is constant. The power delivered to the particle by the forces acting on it is

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21. A bullet of mass 10 g is fired into 2 kg pendulum bob and becomes embedded in it.If the pendulum rises to a vertical distance of 10cm..Find the initial velocity of the bullet.

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22. A bullet of mass 12g and horizontal velocity $60ms^{-1}$strikes a block of wood of mass 0.5kg and suspenduded by a string.The bullet instantly comes to rest with respect to the block.Calculate the height to which the block rises.

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23. A partical of mass $4 \cdot 10^{-27}$kg moving with velocity one m/seccolides with another similar partical at rest inelastically.If the partical after

colision combine togather,Find the velocity of the combined mass.

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24. A steel ball of radius 2cm is initially at rest.It is stuck head on by another steel ball of radius 4cm moving with a velocity of 0.72ms^-1.Assuming that the collosion in completely inceelastic.Calculate the velocity of the balls after collision.

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25. A 1kg partical moving with a velocity 5m/s makes an elastic head on collison with a 2kg partical initially at rest. Find the final velocity of each partical .

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26. A partical of mass m1 is travelling with avelocity u1 strikes head-on against partical of mass m2 at rest.After collision the particales move with a velocity v1 and v2 respectively

.show that the ratio of decrese in K.E of the partical of mass m1 to its original K.E is given By $\frac{4m1m2}{(m1+m2)^2}$

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Exercise

1. What is meant by power? How it is related to work?

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2. Define energy. It is a scaler or vector quantity?

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3. Define work.What is its dimmensional formula.

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4. What is the work done by the tension of the string in a simple pendulum?

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5. A man holds a 10 kg box 2m above the ground.What is the work done?

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6. What is the orientation of force to displacement so that work done is negative?

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7. What is the work done on a body of mass m moving around a horizontal circle of radius r?

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8. what are the characteristic of an elastic collision?

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9. Define the co-efficient of restitution.

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10. What is perfectly inelastic collision?

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11. What is elastic potential energy?

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12. Can kinetic energy be negative?

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13. Can a body posses KE without Momentum?

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14. Can a body posses momentum without KE?

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15. Does a man sitting in a moving train posses KE?

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16. Give an example where work done by a force is zero.

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17. What is work? It is a scalar or a vector? What do you mean by watt?

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18. Show that power= force X velocity

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19. What is potential energy ?How is it measured?

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20. Define Kinetic energy of a body.Derived an expression for the K.E of a body in a motion.

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21. Derived an expression for the work done by a constant force.

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22. Verify the law of conservation mechanical-energy for a freely falling body.

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23. Derive an expression for potential energy of a stretched elastic spring.

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24. State and prove work-energy theorem.

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25. State the principle of conservation of energy.How can it be proved in case of a freely

falling body?

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26. Show that work done on a body or by the body is equal to the net change in its kinetic energy.

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27. Show that the sum of potential and kinetic energy of a body falling freely under gravity is

constant.What happens to theses energies when the body hits the ground?

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28. Distinguish between elastic and inelastic collisions.

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29. Show that in one dimensional elastic collision of two particales of equal mass,the

partical exchange velocities after collisions.

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30. Define the co-efficient of restitution. A particle of a mass m moving with a velocity u struck head-on against another particle of mass Km at rest.After collision the particles move with velocities V1 and V2 respectively.If the collision is prefectly elastic.Prove that the loss of kinetic energyof the particle with mass m is maximum when k=1.

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31. The momentum of two different masses are same.Show that the lighter mass has greater kinetic engery.

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32. The K.E of two different masses are equal.Which of the masses,lighter or heavier will have greater momentum?

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33. If K.E of a body is doubled,what happens to its momentum?

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34. Two bodies having masses 1g and 4g are moving with equal K.E find the ratio of their linear momentum.

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35. water of a river is striking the pillar of a bridge.Is work being done in this?

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36. A man is swimming upstream over a river such that he appears to be at rest with respect to the shore.Is he doing work?

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37. How much work is done on a body of mass m in moving it around a horizontal circle of radius R?

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38. Give an example where work done by a force is zero.

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39. What is the power needed to maintain uniform circuler motion?

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40. Can a body have energy without having momentum?

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41. A ballon filled with hydrogen rises upward gaining both kinetic and potential energy.Does it imply violation of conservation of energy?

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42. A man of mass 60 kg walks up to the top of a building of height 15 m. Calculate the increase in potential energy.

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43. A man cycles up a hill whoes slope is 1 m in 25 at the rate of 10 km/hr.the weight of the man and the cycle is 100 kg.Find the power at which he is working.

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44. A bullet of mass 12 g strikes a soild surface at a speed of 400m/s. It penetrates to a depth of 3cm.Calculate the average resistance offered to the bullet.

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45. A body of mass 1kg falls from the top of a cliff 50 m high and buries itself one metre deep in mud.Find the average resistance offered by a mud and the time of penetration.

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46. A force of 1000 dynes acts on a particle of mass 500 g for 10seconds.Calculate the

velocity of the particle and kinetic energy produced.

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47. Calculate the power of a motor in kilo-watt ,which is capable of rising 200 kg of water in five minutes from a ell 120 meter deep [$g = 10ms^{-2}$].

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48. A pump lifts 20 kg of water in one minute to a vertical height of 30m.Find the power of the pump.

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49. Two bodies having masses 1g and 4g are moving with equal K.E find the ratio of their linear momentum.

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50. A 200 g ball falls from rest through air. If its speed is 10 m/s after having through a distance of 20m, how much energy was lost due to friction against air?

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51. A bullet of mass 100 g strikes a wooden plank with a velocity of $300ms^{-1}$ and emerges with a velocity $100ms^{-1}$.Calculate the work done by the resistive force on the bullet

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52. A force of 100 dynes acts on a particle of mass 0.5 kg for 10 sec. Calculate the velocity of the particle and the K.E produced.

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53. An engine lifts 200kg of metal to a vertical height of 30 m in one minute.Find the horsepower of the engine.

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54. A car of weight 1000 kg moves with a uniform speed of 36Km/hr up an inclined road.The inclined road makes an angle of $30^{o}$with the horizontal.Neglecting friction,Calculate the power of the engine of the car.

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55. An engine of weight one metric ton is going up an inclined plane ,making an angle $30^{o}$with the horizental at the rate of 36 Km h^{-1} .If the co-efficient of frinction is 0.6.calculate the power of engine in KW

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56. A ball of mass 1.2 kg moving with velocity 20cm/s collides with another body of equal mass at rest.Find the loss of K.E of the

system,assuming that co -efficient of restitutionis 0.6.

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57. A block of mass 2kg moving with certain velocity collides with a block of mass 3kg at rest ,After collision the blocks move togather.Find the loss of K.E in the collision.

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58. A block of mass 2 kg moving at 2.0m/s collides with another block of equal mass kept at rest.find the maximum possible loss of K.E due to the collision.

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59. A block of 1.2 kg moving at 20 cm/s collides head-on with a simmilar block kept rest.The co-efficient of restitution is 3/5 .Find the loss of K.E during the collision.

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60. A position dependent force F=(7-2x+$3x^2$)N acts on a small body of mass 2 kg and displaces it from x=0 to x=5m. Work doen in joule is .

A. 135

B. 70

C. 35

D. 270

Answer: C

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61. A body constrained to move in y directions is sunjected to a force F=$\left(-2\hat{i} + 15\hat{j} + 6\hat{k} \right)$ N. What is the work doen by the force in moving through a distance of 10 m along the y-axis?

A. 20J

B. 150J

C. 160J

D. 190J

Answer: B

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62. The K.E acquired by a mass m travelling a certain distance d starting from rest under the action of a constant force is directluy prportional to

A. m

B. `sqrtm

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

D. independent of m

Answer: D

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63. A 4 kg mass and a 1 kg mass are moving with equal K.E.The ratio of their momentum is

A. $1:2$

B. $1:1$

C. $2:1$

D. $4:1$

Answer: C

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64. If the momentum of a body increases by 50%,its K.E,increases by

A. 5

B. 1

C. 125

D. 1.5

Answer: C

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65. A ball whoes K.E is K is projected at an angle 45° to the horizental.The K.E of the ball at the hightest point of flight is

A. K

B. $\frac{k}{\sqrt{2}}$

C. k/2

D. Zero

Answer: C

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66. A stationary particle explodes into two particle of masses m1 and m2 and move in

opposite directions with velocities v1 and v2.The ratio of their K.E is

A. m2/m1

B. m1/m2

C. 1

D. m1v1/m1v2

Answer: A

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67. Two bodies with K.E in ratio 4:1 are moving with equal linear momentum.The ratio of their masses is

A. $1:2$

B. $1:1$

C. $4:1$

D. $1:4$

Answer: D

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68. The P.E of a string when stretched by 2 cm is U.Its P.E when stretched by 10 cm is

A. U/25

B. U/5

C. 25U

D. 5U

Answer: C

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69. A spring of force constant 800 N/m has an extension of 5 cm . The work done in extending it from 5 cm to 15 cm is

A. 16 J

B. 8 J

C. 32J

D. 24J

Answer: B

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70. If water falls from a dam into a turbine wheel 19.6m below ,the velocity of the water at the turbine is

A. 9.8m/s

B. 19.6m/s

C. 39.2 m/s

D. 9.8 m/s

Answer: B

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71. An elastic ball is dropped from a height to 100m.It lose s 20% of its energy .To what height will the ball rebound?

A. 80 m

B. 40 m

C. 60 m

D. 20m

Answer: A

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72. A ball dropped from a height og h.If the co-efficient of restitution be e , to what height will it rise after jumping twice from the ground.

A. eh/2

B. 2eh

C. eh

D. e^4h

Answer: D

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73. A ball of mass m moving with a constant velocity strikes against a ball of same mass at rest.If e is the co-efficient if restitution what will be the ratio of velocity of two balls after collision?

A. (1-e)/(1+e)

B. (e-1)/(e+1)

C. (1+e)/(1-E)

D. (2+e)/(e-1)

Answer: A

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74. Two particle of masses 1 g and 4g are moving with equal K.E. What is the ratio of their linear momentum?

A. $4:1$

B. $\sqrt{2}:1$

C. $1:2$

D. $1:10$

Answer: C

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75. A body of mass m is moved to a height to equal to the radius of earth.The increase in P.E is

A. mgR

B. 1/2 mgR

C. 2mgR

D. 1/4 mgR

Answer: B

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76. The momentum of a body is doubled. Its K.E will

A. be doubled

B. be halved

C. increase four times

D. decrease four times

Answer: C

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77. A wound spring has

A. no energy

B. P.E

C. K.E

D. electric energy

Answer: B

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78. The unit of energy is

A. joule-sec

B. newton-metre

C. newtone/meter

D. joule/sec

Answer: B

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79. If a force F is applied on a body and it moves with a velocity V ,the power will be

A. $F \cdot V$

B. F/v

C. F/v^2

D. F^*v^2

Answer:

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80. If m is the mass and E the K.E of a body then its linear momenta is

A. $m\sqrt{E}$

B. $2\sqrt{mE}$

C. $\sqrt{m}.\ E$

D. $\sqrt{2mE}$

Answer: D

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81. The power of awater pump is 2 kw.If g=10 ms^{-1} the amount of water it can raise to a height of 10 m in minute is

A. 2000litre

B. 1000litre

C. 100litre

D. 1200litre

Answer: D

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82. The P.E of a string when stretched by 2 cm is U.Its P.E when stretched by 10 cm is

A. U/25

B. U/5

C. 5U

D. 25U

Answer: D

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83. A bullet hits and gets embedded in a solid block resting on a frictionless table. What Is conserved?

A. Momentum and K.E

B. momentum alone

C. K.E alone

D. neither momentum nor K.E

Answer: B

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