

**PHY · PHYSICS**

03. Work & Energy

Official PMDC Solved Past Paper Topical Booklet · High-Yield Examination Series

© 108 Solved Questions

📅 2008 to 2024 Archive

🛡 Boards: BUMHS, DUHS, KMU, KU, MDCAT, NUMS

📄 Weightage: 27% of MDCAT (54 MCQs)

Curated by Ibrahim for fellow bees. Every question in this chapter has been verified against official UHS, NUMS, SZABMU, DUHS, and KMU answer keys. Propolis cognitive autopsies are provided at the end of this booklet to explain core concepts and break down common distractor traps.

OFFICIAL SOLVED EDITION**Q1.**

SZABMU 2024

In British Engineering system, the unit of power is horsepower. Numerically 1000 hp is equal to **[SZABMU 2024]**

- (A) 7460 watts
- (B) 74600 watts
- (C) 746000 watts
- (D) 7460000 watts

Q2.

SZABMU 2024

A man pulls a trolley through a distance of 50 m by applying a force of 100 N, which makes an angle of 60° with x-axis. Calculate the work done by the man? ($\cos 60^\circ = 0.5$) **[SZABMU 2024]**

- (A) 2500 J
- (B) 5340 J
- (C) 6430 J
- (D) 7120 J

Q3.

SZABMU 2024

Two bodies with kinetic energies having ratio of 4:1, are moving with equal linear momentum. The ratio of their masses is _____. **[SZABMU 2024]**

- (A) 1:1
- (B) 1:2
- (C) 1:4
- (D) 4:1

Q4.

SZABMU 2024

If kinetic energy of a body becomes four times of the initial value, then the new momentum will **[SZABMU 2024]**

- (A) Become twice of its initial value
- (B) Become three times of its initial value
- (C) Become four times of its initial value
- (D) Remain constant

Q5.

SZABMU 2024

The amount of work required to stop a moving object is equal to: **[SZABMU 2024]**

- (A) The velocity of the object
- (B) The change in kinetic energy of the object
- (C) The mass of the object times its acceleration
- (D) The mass of the object times its velocity

Q6.

KU 2024

How does an angle between the force applied and the direction of motion influence the work done on an object? **[KU 2024]**

- (A) Work is constant regardless of the angle
- (B) Work is maximum when the angle is 0°
- (C) Work is negative when the angle is 90°
- (D) Work is 0 when the angle is 45°

Q7.

KU 2024

A nurse is pushing a wheelchair with an 80 kg patient sitting on it. How much work is done by the patient's weight? [KU 2024]

- (A) Half of the work
- (B) Maximum work
- (C) Minimum work
- (D) No work

Q8.

KU 2024

If a constant force of 10 N is applied to move an object 5 m in the direction of the force, what is the work done? [KU 2024]

- (A) 2 J
- (B) 5 J
- (C) 15 J
- (D) 50 J

Q9.

UHS 2024

Which of the following is a non-conservative force? [UHS 2024]

- (A) Frictional force
- (B) Electric force
- (C) Elastic spring force
- (D) Gravitational force

Q10.

UHS 2024

Work done is equal to: [UHS 2024]

- (A) Effort × distance
- (B) Effort + distance
- (C) Effort – distance
- (D) Effort ÷ distance

Q11.

UHS 2024

When a force of 1N displaces its point of application by 1m in the direction of force, the work done is [UHS 2024]

- (A) 1 J
- (B) 10 J
- (C) 0 J
- (D) None of these

Q12.

UHS 2024

An electric motor is used to lift the weight of 2.0 N through a vertical distance of 100 cm in 4 sec. What is the power output of the motor? [UHS 2024]

- (A) 0.25 W
- (B) 0.5 W
- (C) 0.75 W
- (D) 1 W

Q13.

NUMS 2024

At what angle of applied force, work done will be 50%? [NUMS 2024]

- (A) 30°
- (B) 60°
- (C) 90°
- (D) 45°

Q14.

NUMS 2024

The relation between K.E and momentum P is given by: [NUMS 2024]

- (A) $K.E = \frac{P}{2m}$
- (B) $K.E = \frac{P}{2m^2}$
- (C) $K.E = \frac{P^2}{2m}$
- (D) $K.E = \frac{P^2}{2m^2}$

Q15.

NUMS 2024

When dolphin leaves the water it has lots of kinetic energy. At its highest point it's energy is: [NUMS 2024]

- (A) Kinetic energy
- (B) Potential energy
- (C) Elastic potential energy
- (D) Neither kinetic energy nor potential energy

Q16.

NUMS 2024

The absolute potential energy is given as $U_g = -\frac{GM_em}{R}$. The negative sign indicates that Earth's gravitational field for mass "m" is: [NUMS 2024]

- (A) Repulsive
- (B) Less attractive
- (C) Attractive
- (D) More repulsive less attractive

Q17.

BUMHS 2024

If a force of one Newton acts on a body and displaces it through a distance of one meter in the direction of force then work done is one [BUMHS 2024]

- (A) joule
- (B) dyne
- (C) erg
- (D) watt

Q18.

BUMHS 2024

If a force of 1 N acts upon a body as it moves through a displacement of 0.5 m at an angle of 60° with the direction of force then the work done is [BUMHS 2024]

- (A) 0.25 J
- (B) 0.5 J
- (C) 10 J
- (D) +4 J

Q19.

BUMHS 2024

Which of the following force gives rise to ocean tides? [BUMHS 2024]

- (A) Frictional force
- (B) Gravitational force
- (C) Earth's magnetic force
- (D) Nuclear force

Q20.

UHS 2023

The work done by a variable force can be found by dividing the: [UHS 2023]

- (A) Force into small intervals
- (B) The displacement into small intervals
- (C) Both force and displacement into small intervals
- (D) By taking displacements all different angle

Q21.

UHS 2023

Two bodies with kinetic energies in the ratio of 4:1 are moving with equal linear momentum. The ratio of their masses is: [UHS 2023]

- (A) 1:2
- (B) 1:1
- (C) 4:1
- (D) 1:4

Q22.

UHS 2023

A fisherman lifts a fish of mass 250 g from rest through a vertical height of 1.8 m. The fish gains a speed of 1.1 m/s. What is the energy gained by the fish? [UHS 2023]

- (A) 0.15 J
- (B) 4.3 J
- (C) 4.4 J
- (D) 4.6 J

Q23.

UHS 2023

An 8.0 kg box slides along a horizontal frictionless floor at 3 m/s and collides with a relatively massless spring that compresses 12 cm before the box comes to a rest. Calculate the retarding force of the spring. [UHS 2023]

- (A) 3 N
- (B) 30 N
- (C) 300 N
- (D) 3000 N

Q24.

SZABMU 2023

According to work energy principle in linear motion, the work done on the body is equal to: [SZABMU 2023]

- (A) Change in P.E
- (B) Sum of P.E + K.E
- (C) Change of K.E
- (D) Zero

Q25.

SZABMU 2023

If a body of mass 'm' is accelerated on a smooth horizontal surface 'S' by a force 'F'. the work done $F \times S$ is converted into: [SZABMU 2023]

- (A) Heat energy
- (B) Kinetic energy
- (C) Potential energy
- (D) Electromagnetic energy

Q26.

SZABMU 2023

One megawatt hour is equal to: [SZABMU 2023]

- (A) 3.6×10^6 J
- (B) 3.6×10^9 J
- (C) 3.6 MJ
- (D) 3.6 nJ

Q27.

SZABMU 2023

A motor boat is moving with velocity 4 ms^{-1} . The net force acting on it is 4000 N. what will be the power of the engine of boat? [SZABMU 2023]

- (A) 1000 W
- (B) 160 W
- (C) 16 KW
- (D) 1600 W

Q28.

KMU 2023

The weight of a body is 120 N and it is lifted to height 10m, work done on the body is: [ETEA 2023]

- (A) 120 J
- (B) 100 J
- (C) 1000 J
- (D) 1200 J

Q29.

KMU 2023

A 200 N force acts on 8 kg crate that starts from rest. At the instant the object has gone 2m, the rate at which the force is doing work is: [ETEA 2023]

- (A) 2.5 W
- (B) 25 W
- (C) 75 W
- (D) 2000 W

Q30.

KMU 2023

Which of the following bodies has the largest kinetic energy? [ETEA 2023]

- (A) Mass 3M and speed v
- (B) Mass 3M and speed $2v$
- (C) Mass 3M and speed $3v$
- (D) Mass M and speed $4v$

Q31.

KMU 2023

A 2kg object is released from rest 8m above the surface of Earth. During the fall work done against air resistance is 50J just before it hits the surface its speed is: [ETEA 2023]

- (A) 10 m/sec
- (B) 35 m/sec
- (C) 40 m/sec
- (D) 45 m/sec

Q32.

DUHS 2023

1 J/sec equals to: [SINDH 2023]

- (A) 1 K
- (B) 1 N
- (C) 1 T
- (D) 1 Watt

Q33.

DUHS 2023

Which of the following expression is constant for a freely falling body? [SINDH 2023]

- (A) $mgh + mv^2$
- (B) $mgh = mv^2$
- (C) $mgh + \frac{1}{2}mv^2$
- (D) $mgh = -\frac{1}{2}mv^2$

Q34.

DUHS 2023

A body of mass 4 kg is moving a circle of radius 2m. if the body moves round a complete circle, what is the work done by the body? [SINDH 2023]

- (A) 8 J
- (B) 0
- (C) 16 J
- (D) 5 J

Q35.

NUMS 2023

An object has 1J of P.E. what is the work done in term of height? [NUMS 2023]

- (A) 10J
- (B) 0J
- (C) 0.1J
- (D) 1J

Q36.

NUMS 2023

Power is dot product of: [NUMS 2023]

- (A) Force and displacement
- (B) Force and velocity
- (C) Force and time
- (D) Work and time

Q37.

NUMS 2023

The area under force–displacement graph gives: [NUMS 2023]

- (A) Displacement
- (B) Power
- (C) Work
- (D) Acceleration

Q38.

NUMS 2023

A body of mass 'm' is moving with velocity 'v'. after a short interval of time its velocity becomes double. How many time its K.E will increase of decrease? [NUMS 2023]

- (A) 2 time increased
- (B) 2 time decreased
- (C) 4 time increased
- (D) 4 time decreased

Q39.

UHS 2022

The consumption of energy by a 60 W bulb in 2s is: [UHS 2022]

- (A) 120 J
- (B) 30 J
- (C) 60 J
- (D) 0.02 J

Q40.

UHS 2022

Ignoring details associated with friction, extra forces exerted by arm and leg muscles, and other factors, we can consider a pole vault as the conversion of an athlete's running kinetic energy to gravitational potential energy. If an athlete is to lift his body 5m during a vault, what speed must he have when he plants his pole? [UHS 2022]

- (A) 5 ms^{-1}
- (B) 10 ms^{-1}
- (C) 15 ms^{-1}
- (D) 20 ms^{-1}

Q41.

UHS 2022

A particle of mass m at rest is acted upon by a force P for time t. Its kinetic energy after time t is: [UHS 2022]

- (A) $P^2 t^2 / m$
- (B) $P^2 t^2 / 2m$
- (C) $P^2 t^2 / 3m$
- (D) $P^2 t^2 / 4m$

Q42.

SZABMU 2022

The unit of kinetic energy is same as that of: [SZABMU+ETEA 2022]

- (A) Work
- (B) Power/Time
- (C) Time/Power
- (D) Work/Time

Q43.

SZABMU 2022

Kilowatt hour is a unit of: [SZABMU 2022]

- (A) Energy
- (B) Energy $\times$ time
- (C) Power
- (D) (Power) (energy)

Q44.

SZABMU 2022

The unit of power in British engineering system is: [SZABMU 2022]

- (A) Horse power
- (B) Watt
- (C) Js^{-1}
- (D) Js

Q45.

SZABMU 2022

Work done will be negative if the angle between force and displacement is: [SZABMU 2022]

- (A) 0°
- (B) 45°
- (C) 60°
- (D) 180°

Q46.

SZABMU 2022

$1 \text{ Nms}^{-1} = \text{----}$ [SZABMU 2022]

- (A) 1 kWh
- (B) 1 Js
- (C) 1 Watt
- (D) 1 Js^{-2}

Q47.

SZABMU 2022

In inter-conversion of energy, the work done against the friction is: [SZABMU 2022]

- (A) $f + h$
- (B) $f - h$
- (C) fh
- (D) f/h

Q48.

SZABMU 2022

A car of mass 800 kg accelerates from 20 ms^{-1} to 30 ms^{-1} , the increase in K.E will be: [SZABMU 2022]

- (A) 2 J
- (B) 200 kJ
- (C) 200 J
- (D) 2 kJ

Q49.

KMU 2022

When five times momentum of a body is equal to the kinetic energy of the same body then its velocity is equal to: [ETEA 2022]

- (A) 5 m/s
- (B) 10 m/s
- (C) 15 m/s
- (D) 20 m/s

Q50.

KMU 2022

The equation for kinetic energy is: [ETEA 2022]

- (A) $K.E = \frac{p}{2m}$
- (B) $K.E = \frac{1}{2}mv^2$
- (C) $K.E = \frac{1}{2}mv\vec{F}$
- (D) $K.E = \frac{1}{2}m(\vec{v} \cdot \vec{v})$

Q51.

KMU 2022

Electricity consumption is calculated commercially in: [ETEA 2022]

- (A) Kilo-watt
- (B) Kilo-watt hour
- (C) Mega watt
- (D) Giga watt

Q52.

KMU 2022

A cyclist comes to a skidding stop in 10m. During this process, the opposing force on the cycle due to the road is 200N. How much work does the road do on the cycle? [ETEA 2022]

- (A) -1800J
- (B) -2000J
- (C) 2000J
- (D) 1900J

Q53.

BUMHS 2022

An electric motor is used to operate an elevator. The motor does 140000J of work in 70 s. What is the output power of the motor? [BMU 2022]

- (A) 0.50 mW
- (B) 2.0 W
- (C) 2.0 kW
- (D) 9.8 MW

Q54.

BUMHS 2022

A body of mass 5kg is moving with a momentum of 10 Ns. a force of 0.2 N acts on it in the direction of motion of the body for 10s. The increase in its K.E is: [BMU 2022]

- (A) 2.8 J
- (B) 3.2 J
- (C) 3.8 J
- (D) 4.4 J

Q55.

DUHS 2022

If mass and speed of a moving object is doubled, the K.E will be: [DUHS 2022]

- (A) Eight times
- (B) Four times
- (C) Doubled
- (D) Sixteen times

Q56.

DUHS 2022

One kilowatt hour is equal to: [DUHS 2022]

- (A) 36×10^4 J
- (B) 36×10^6 J
- (C) 3.6×10^5 J
- (D) 3.6×10^6 J

Q57.

DUHS 2022

The rate of doing work is zero, when the angle θ between force and velocity is: [DUHS 2022]

- (A) $\theta = 60^\circ$
- (B) $\theta = 180^\circ$
- (C) $\theta = 0^\circ$
- (D) $\theta = 90^\circ$

Q58.

NUMS 2022

1hp is equal to: [NUMS 2022]

- (A) 476 watts
- (B) 847 watts
- (C) 746 watts
- (D) 467 watts

Q59.

NUMS 2022

The product of force and velocity is equal to: [NUMS 2022]

- (A) Kinetic energy
- (B) Potential energy
- (C) Power
- (D) Work done

Q60.

NUMS 2022

One kilowatt-hour is equal to: [NUMS 2022]

- (A) 36 MJ
- (B) 3.6 MJ
- (C) 38 MJ
- (D) 3.8 MJ

Q61.

NUMS 2022

The amount of work done is moving a body at certain point in a gravitational field to a position of zero potential such that the body is never accelerated is called: [NUMS 2022]

- (A) Kinetic energy
- (B) Potential energy
- (C) Gravitational potential energy
- (D) Absolute potential energy

Q62.

NUMS 2022

If the speed of a body is doubled, its kinetic energy become: [NUMS 2022]

- (A) mv^2
- (B) $2mv^2$
- (C) $16mv^2$
- (D) $4mv^2$

Q63.

NUMS 2022

An electric motor of power 2hp is installed in an industrial unit. Its power is [NUMS 2022]

- (A) 1500 W
- (B) 742 W
- (C) 148 W
- (D) 1492 W

Q64.

PMDC 2021

A field in which the work is done in a moving a body along a closed path is zero is called [NMDCAT 2021]

- (A) Electric field
- (B) Conservative field
- (C) Electromagnetic field
- (D) Gravitational field

Q65.

PMDC 2021

When a force is parallel to the direction of motion of the body, then work done on the body is [NMDCAT 2021]

- (A) Zero
- (B) Minimum
- (C) Infinity
- (D) Maximum

Q66.

PMDC 2021

If a body of mass of 2 kg is raised vertically through 2m, then the work done will be [NMDCAT 2021]

- (A) 38.2 J
- (B) 392.1 J
- (C) 39.2 J
- (D) 3.92 J

Q67.

PMDC 2021

The relation between horsepower and watt is [NMDCAT 2021]

- (A) 1 hp = 546 watts
- (B) 1 hp = 746 watts
- (C) 1 hp = 1000 watts
- (D) 1 hp = 946 watts

Q68.

PMDC 2021

The area under the force displacement graph represents [NMDCAT 2021]

- (A) Area
- (B) Work done
- (C) Power
- (D) None of these

Q69.

PMDC 2021

A machine does 2500 J of work in 1 min. What is the power developed by the machine? [NMDCAT 2021]

- (A) 21 W
- (B) 42 W
- (C) 150 W
- (D) 2500 W

Q70.

PMDC 2021

A moving car possesses [NMDCAT 2021]

- (A) Sound energy
- (B) Mechanical energy
- (C) Heat energy
- (D) Chemical energy

Q71.

PMDC 2021

kWh is the unit of [NMDCAT 2021]

- (A) Force
- (B) Power
- (C) Time
- (D) Energy

Q72.

PMDC 2021

2kg mass is uplifted by the machine through the height of 200m for 10 sec calculate power deliver to the load. ($g = 10\text{m/s}^2$) [NMDCAT 2021]

- (A) 40W
- (B) 400W
- (C) 440W
- (D) 200W

Q73.

PMDC 2021

Light body A and heavy body B have equal K. E of translation. Then [NMDCAT 2021]

- (A) A has larger momentum than B
- (B) B has larger momentum than A
- (C) A and B have same momentum
- (D) None

Q74.

PMDC 2021

If momentum is increased by 13% then K.E increase by [NMDCAT 2021]

- (A) 37%
- (B) 2.27%
- (C) 3.47%
- (D) None

Q75.

PMDC 2020

A 1.75 m heighted weight-lifter raises weights with a mass of 50 kg to a height of .5m above his head. How much work is being done by him? ($g = 10\text{ms}^{-2}$) [NMDCAT 2020]

- (A) 2125J
- (B) 2500 J
- (C) 50J
- (D) 1125 J

Q76.

PMDC 2020

When the speed of your car is halved, by what factor does its kinetic energy decreases? [NMDCAT 2020]

- (A) 1/2
- (B) 1/4
- (C) 1/8
- (D) 1/6

Q77.

PMDC 2020

Which of the following force is non-conservative force? [NMDCAT 2020]

- (A) Frictional force
- (B) Gravitation force
- (C) Electric force
- (D) Elastic spring force

Q78.

NUMS 2020

The area under force – displacement graph gives us: [NUMS 2020]

- (A) Displacement
- (B) Power
- (C) Work
- (D) Acceleration

Q79.

NUMS 2020

Kilowatt-hour is unit of: [NUMS 2020]

- (A) Electric energy
- (B) Power
- (C) Momentum
- (D) Torque

Q80.

MDCAT 2019

An automobile is moving forwards with uniform velocity due to the force exerted by its engine. If that force is double with the velocity remaining constant what happens to its total power? [MDCAT 2019]

- (A) It does not change
- (B) It is halved
- (C) It is squared
- (D) It is doubled

Q81.

MDCAT 2019

Which of the following statement shows that no work is done? [MDCAT 2019]

- (A) Pushing a car to start it moving
- (B) Lifting the weights
- (C) Writing an essay on a page
- (D) The moon orbiting the earths

Q82.

MDCAT 2018

Energy consumed by 60-watt bulb in 2 minutes is equal to [MDCAT 2018]

- (A) 7.2 kilo joules
- (B) 120 joules
- (C) 720 joules
- (D) 72000 joules

Q83.

MDCAT 2018

A stone of mass 2.0 kg is dropped from a rest position 5.0m above the ground. What is its velocity at a height of 3.0m above the ground? [MDCAT 2018]

- (A) 12.5m/s
- (B) 9.3m/s
- (C) 6.3m/s
- (D) 16.0m/s

Q84.

MDCAT 2018

The rate at which work is being done is called: [MDCAT 2018]

- (A) Power
- (B) Density
- (C) Energy
- (D) Force

Q85.

KMU 2018

A man has a mass of 80 kg. He ties himself to one end of rope which passes over a single fixed pulley. He pulls on the other end of the rope to lift himself up at an average speed of 50 cm s^{-1} . What is the average useful power at which he is working? [ETEA 2018]

- (A) 40W
- (B) 0.39kW
- (C) 4.0kW
- (D) 39kW

Q86.

KMU 2018

If the momentum of a body decreases by 20% the percentage decreases in K.E will be: [ETEA 2018]

- (A) 44%
- (B) 36%
- (C) 28%
- (D) 20%

Q87.

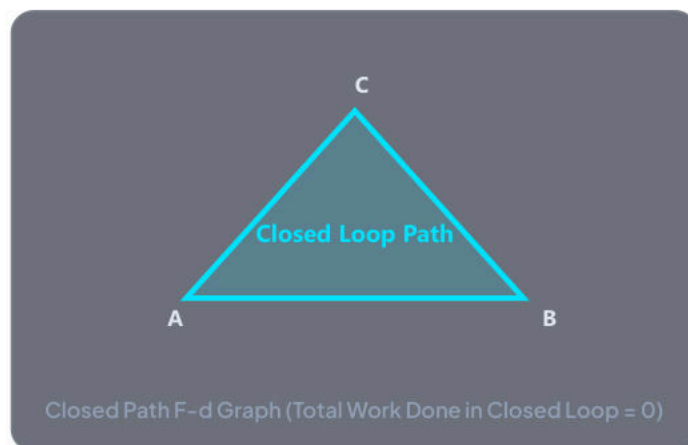
KMU 2018

A man carries a 1 kg body 10m horizontally on a level ground. The work done by the man is: [ETEA 2018]

- (A) 10 J
- (B) 1 J
- (C) 0 J
- (D) 5 J

Q88.

MDCAT 2017



Total work done in figure [MDCAT 2017]

- (A) 24 Nm
- (B) 8 Nm
- (C) 16 Nm
- (D) Zero Nm

Q89.

MDCAT 2017

Work done will be zero if angle between Force and displacement is: [MDCAT 2017]

- (A) 0°
- (B) 270°
- (C) 60°
- (D) 360°

Q90.

MDCAT 2017

If mass 'm' is dropped from height 'h' vertically, f is the force of friction during downward motion and 'v' is the velocity at bottom, following equation will be hold: [MDCAT 2017]

- (A) $\frac{1}{2}mv^2 = mgh + fh$
- (B) $fh = mgh + \frac{1}{2}mv^2$
- (C) $mgh = \frac{1}{2}mv^2 - fh$
- (D) $mgh = \frac{1}{2}mv^2 + fh$

Q91.

MDCAT 2017

At what angle work done will be maximum? [MDCAT 2017]

- (A) 0°
- (B) 45°
- (C) 90°
- (D) 30°

Q92.

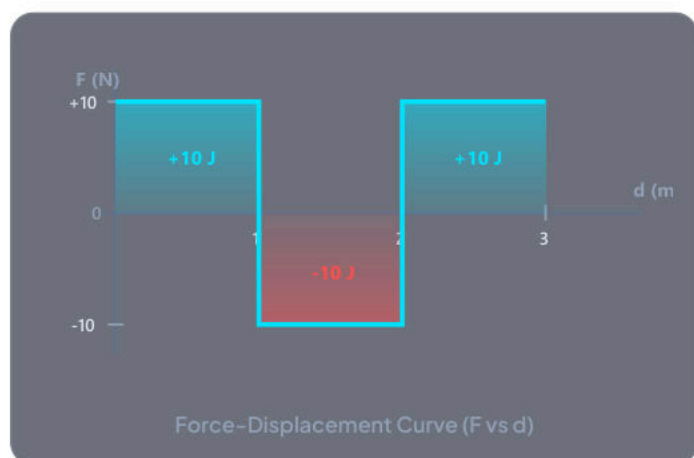
MDCAT 2017

Which one of the following is a greater work? [MDCAT 2017]

- (A) +100 J
- (B) -1000 J
- (C) -100 J
- (D) +200 J

Q93.

MDCAT 2017



The figure shows the force distance curve of a body moving along a straight line. The work done by the force: [MDCAT 2017]

- (A) 10 J
- (B) 30 J
- (C) 20 J
- (D) 40 J

Q94.

KMU 2017

A man of mass 60 kg climbs up a 20m long staircase to the top of a building 10m high. What is the work done by him: Take $g = 10 \text{ ms}^{-2}$ [ETEA 2017]

- (A) 12 KJ
- (B) 6 KJ
- (C) 3 KJ
- (D) None of the above

Q95.

KMU 2017

When a force retards the motion of a body the work done is: [ETEA 2017]

- (A) Zero
- (B) Negative
- (C) Positive
- (D) Positive or negative depending upon the magnitude of force and displacement

Q96.

KMU 2017

An engine pumps out 40 kg of water in one second. The water comes out vertically upwards with a velocity of 3 ms^{-1} , the power of engine in kilowatt is: [ETEA 2017]

- (A) 1.2 kW
- (B) 12 kW
- (C) 120 kW
- (D) 1200 kW

Q97.

KMU 2017

Two boys weighing in the ratio 4:5 goes up stair taking time in the ratio 5:4. The ratio of their power is: [ETEA 2017]

- (A) 1
- (B) $16/25$
- (C) $25/16$
- (D) $4/5$

Q98.

MDCAT 2016

Potential energy per unit volume is given by [MDCAT 2016]

- (A) mgh
- (B) gh
- (C) $\frac{mgh}{\rho}$
- (D) ρgh

Q99.

KMU 2015

A 6.0 kg block is released from rest 80m above the ground. When it has fallen 60m its kinetic energy is approximately: [ETEA 2015]

- (A) 4800 J
- (B) 3500 J
- (C) 1200 J
- (D) 120 J

Q100.

MDCAT 2010

The consumption of energy by 60-watt bulb in 2 seconds is: [MCAT 2010]

- (A) 20 J
- (B) 30 J
- (C) 120 J
- (D) 0.02 J

Q101.

MDCAT 2010

Which one of the following is a non-conservative force? [MCAT 2010]

- (A) Electric force
- (B) Gravitational force
- (C) Elastic spring force
- (D) Frictional force

Q102.

MDCAT 2010

If velocity is double, then. [MCAT 2010]

- (A) Momentum increase 4 times and K.E increases 2 times
- (B) Momentum increases 2 times and K.E increase constant
- (C) Momentum and K.E remain same
- (D) Momentum increases 2 times and K.E increases 4 times

Q103.

KMU 2010

The heat energy dissipated by 40 watts bulb in one hour is [ETEA 2010]

- (A) 1440 J
- (B) 14400 J
- (C) 144000 J
- (D) 1440 000 J

Q104.

KMU 2010

The gravitational potential energy per unit mass is called: [ETEA 2010]

- (A) Gravitational potential
- (B) Absolute P.E
- (C) P.E
- (D) Potential hill

Q105.

MDCAT 2009

If a certain force acts on an object and changes its kinetic energy from 65 J to 130 J, then work done by the force will be: [MCAT 2009]

- (A) 92.5 J
- (B) 65 J
- (C) 97.5 J
- (D) 130 J

Q106.

MDCAT 2008

A force $2\hat{i} + \hat{j}$ has moved its point of application from (2,3) to (6,5). What is work done? [MCAT 2008]

- (A) -10
- (B) -18
- (C) +10
- (D) +18

Q107.

MDCAT 2008

100 joules work has been done by an agency in 10 seconds. What is power of agency? [MCAT 2008]

- (A) 1000-watt
- (B) 10 watt
- (C) 100 watt
- (D) 0.10 watt

Q108.

MDCAT 2008

Work done on a body equals change in its ____ energy. [MCAT 2008]

- (A) Total
- (B) Kinetic
- (C) Potential
- (D) All of these

RAPID 5–COLUMN ANSWER KEY

Official PMDC verified answer keys for 03. Work & Energy.

beambeprep.com

Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD
1	C	SZABMU 2024	23	C	UHS 2023	45	D	SZABMU 2022	67	B	PMDC 2021	89	B	MDCAT 2017
2	A	SZABMU 2024	24	C	SZABMU 2023	46	C	SZABMU 2022	68	B	PMDC 2021	90	D	MDCAT 2017
3	C	SZABMU 2024	25	B	SZABMU 2023	47	C	SZABMU 2022	69	B	PMDC 2021	91	A	MDCAT 2017
4	A	SZABMU 2024	26	B	SZABMU 2023	48	B	SZABMU 2022	70	B	PMDC 2021	92	B	MDCAT 2017
5	B	SZABMU 2024	27	C	SZABMU 2023	49	B	KMU 2022	71	D	PMDC 2021	93	A	MDCAT 2017
6	B	KU 2024	28	D	KMU 2023	50	B	KMU 2022	72	B	PMDC 2021	94	B	KMU 2017
7	D	KU 2024	29	D	KMU 2023	51	B	KMU 2022	73	B	PMDC 2021	95	B	KMU 2017
8	D	KU 2024	30	C	KMU 2023	52	B	KMU 2022	74	D	PMDC 2021	96	A	KMU 2017
9	A	UHS 2024	31	A	KMU 2023	53	C	BUMHS 2022	75	D	PMDC 2020	97	B	KMU 2017
10	A	UHS 2024	32	D	DUHS 2023	54	D	BUMHS 2022	76	B	PMDC 2020	98	D	MDCAT 2016
11	A	UHS 2024	33	C	DUHS 2023	55	A	DUHS 2022	77	A	PMDC 2020	99	B	KMU 2015
12	B	UHS 2024	34	B	DUHS 2023	56	D	DUHS 2022	78	C	NUMS 2020	100	C	MDCAT 2010
13	B	NUMS 2024	35	D	NUMS 2023	57	D	DUHS 2022	79	A	NUMS 2020	101	D	MDCAT 2010
14	C	NUMS 2024	36	B	NUMS 2023	58	C	NUMS 2022	80	D	MDCAT 2019	102	D	MDCAT 2010
15	B	NUMS 2024	37	C	NUMS 2023	59	C	NUMS 2022	81	D	MDCAT 2019	103	C	KMU 2010
16	C	NUMS 2024	38	C	NUMS 2023	60	B	NUMS 2022	82	A	MDCAT 2018	104	A	KMU 2010
17	A	BUMHS 2024	39	A	UHS 2022	61	D	NUMS 2022	83	C	MDCAT 2018	105	B	MDCAT 2009
18	A	BUMHS 2024	40	B	UHS 2022	62	B	NUMS 2022	84	A	MDCAT 2018	106	C	MDCAT 2008
19	B	BUMHS 2024	41	B	UHS 2022	63	D	NUMS 2022	85	B	KMU 2018	107	B	MDCAT 2008
20	B	UHS 2023	42	A	SZABMU 2022	64	B	PMDC 2021	86	B	KMU 2018	108	D	MDCAT 2008
21	D	UHS 2023	43	A	SZABMU 2022	65	D	PMDC 2021	87	C	KMU 2018			
22	D	UHS 2023	44	A	SZABMU 2022	66	C	PMDC 2021	88	D	MDCAT 2017			

TOTAL
MCQS
108

CORRECT

INCORRECT

BLANK

ACCURACY

%

Scan the booklet QR code to enter answers in
BeambePrep Grind Mode for automated error
autopsies.

PROPOLIS COGNITIVE ERROR AUTOPSIES

Step-by-step conceptual derivations, formula working, and distractor autopsies for every question.

Question #1 Key: (C)

SZABMU 2024

In British Engineering system, the unit of power is horsepower. Numerically 1000 hp is equal to [SZABMU 2024]

CORE CONCEPT AND DERIVATION

Basic conversion between imperial and metric systems of power.

Formula:

$$1 \text{ hp} = 746 \text{ Watts}$$

Solution:

- Given: 1000 hp.
- Multiply by the conversion factor: $1000 \times 746 \text{ W} = 746,000 \text{ W}$.

Why other options are incorrect:

These options are off by factors of 10. You must ensure you match the three zeros from 1000.

Question #2 Key: (A)

SZABMU 2024

A man pulls a trolley through a distance of 50 m by applying a force of 100 N, which makes an angle of 60° with...

CORE CONCEPT AND DERIVATION

Only the component of force acting in the direction of displacement does work.

Formula:

$$W = Fd \cos \theta$$

Solution:

- Force (F) = 100 N
- Displacement (d) = 50 m
- Angle (θ) = 60°
- $W = 100 \times 50 \times \cos(60^\circ)$.
- $W = 5000 \times 0.5 = 2500 \text{ J}$.

Why other options are incorrect:

If you ignore the angle completely and just multiply 100×50 , you get 5000 J (not listed). The other options represent arbitrary math errors.

Question #3 Key: (C)

SZABMU 2024

Two bodies with kinetic energies having ratio of 4:1, are moving with equal linear momentum. The ratio of thei...

CORE CONCEPT AND DERIVATION

Kinetic Energy and Momentum are related by a formula that shows K.E is inversely proportional to mass when momentum is held constant.

Formula:

$$K.E = \frac{p^2}{2m} \implies m = \frac{p^2}{2K.E}$$

Solution:

- Since momentum (p) is the same for both, mass is inversely proportional to K.E.
- $\frac{m_1}{m_2} = \frac{K.E_2}{K.E_1}$.
- Given $K.E_1 : K.E_2 = 4 : 1$, we reverse it for mass.
- $m_1 : m_2 = 1 : 4$.

Why other options are incorrect:

Assuming direct proportionality gives 4:1 (Option D). Taking square roots gives 1:2 (Option B).

Question #4 Key: (A)

SZABMU 2024

If kinetic energy of a body becomes four times of the initial value, then the new momentum will [SZABMU 2024]

CORE CONCEPT AND DERIVATION

Momentum is directly proportional to the square root of Kinetic Energy (assuming mass is constant).

Formula:

$$p = \sqrt{2mK.E}$$

Solution:

- Let initial momentum be $p = \sqrt{2mK.E}$.
- New kinetic energy is $4 \times K.E$.
- New momentum $p' = \sqrt{2m(4K.E)} = \sqrt{4} \times \sqrt{2mK.E}$.
- $p' = 2 \times p$.
- The momentum becomes twice its initial value.

Why other options are incorrect:

Assuming a linear 1:1 relationship leads to Option C (four times). You must take the square root of the scalar change in K.E.

Question #5 Key: (B)

SZABMU 2024

The amount of work required to stop a moving object is equal to:
[SZABMU 2024]

CORE CONCEPT AND DERIVATION

This is the fundamental definition of the Work-Energy Theorem.

Formula:

$$W_{\text{net}} = \Delta K.E = K.E_f - K.E_i$$

Solution:

- To stop an object, its final kinetic energy must become zero.
- The work done against the object (negative work) removes its kinetic energy.
- Therefore, the magnitude of work required is exactly equal to the object's total initial kinetic energy, which represents its change in kinetic energy.

Why other options are incorrect:

Mass $\times$ acceleration is Force. Mass $\times$ velocity is Momentum.
Work is an energy measure, not a force or momentum measure.

Question #6 Key: (B)

KU 2024

How does an angle between the force applied and the direction of motion influence the work done on an object?...

CORE CONCEPT AND DERIVATION

Work done relies on the cosine of the angle between the force and displacement vectors.

Formula:

$$W = Fd \cos \theta$$

Solution:

- The cosine function determines the magnitude of work.
- $\cos(0^\circ) = 1$ (Maximum positive work).
- $\cos(90^\circ) = 0$ (Zero work).
- $\cos(180^\circ) = -1$ (Maximum negative work).
- Therefore, work is absolutely maximum when the angle is 0° .

Why other options are incorrect:

Work is zero at 90° , not negative (Option C). Work at 45° is positive ($0.707 \times Fd$), not zero (Option D).

Question #7 Key: (D)

KU 2024

A nurse is pushing a wheelchair with an 80 kg patient sitting on it. How much work is done by the patient's weight...

CORE CONCEPT AND DERIVATION

Forces that act perpendicularly to the direction of displacement do zero mechanical work on the object.

Formula:

$$W = Fd \cos \theta$$

Solution:

- The wheelchair moves horizontally across the floor.
- The patient's weight (gravity) acts vertically downward.
- The angle θ between horizontal displacement and vertical weight is 90° .
- $\cos(90^\circ) = 0$, so Work = 0 J.

Why other options are incorrect:

While the nurse does work pushing forward against friction, the weight vector itself does not contribute to or oppose the horizontal motion.

Question #8 Key: (D)

KU 2024

If a constant force of 10 N is applied to move an object 5 m in the direction of the force, what is the work done...

CORE CONCEPT AND DERIVATION

When force and displacement are in the same direction, work is simply their direct product.

Formula:

$$W = F \times d$$

Solution:

- Force (F) = 10 N
- Displacement (d) = 5 m
- "In the direction of the force" means $\theta = 0^\circ$, so $\cos(0) = 1$.
- $W = 10 \times 5 = 50 \text{ J}$.

Why other options are incorrect:

Option A divides force by distance. Option C adds them. Option B is just the distance.

Question #9 Key: (A)

UHS 2024

Which of the following is a non-conservative force? [UHS 2024]

CORE CONCEPT AND DERIVATION

A conservative force is one where work done depends only on initial and final positions, not the path taken. A non-conservative force dissipates energy based on the path length.

Formula:

$$W_{\text{closed loop}} \neq 0 \quad (\text{For non-conservative forces})$$

Solution:

- Electric, elastic spring, and gravitational forces have associated potential energies. Energy put into them is fully recoverable.
- Frictional force opposes motion along any path, turning kinetic energy into irrecoverable heat. Thus, it is non-conservative.

Why other options are incorrect:

Options B, C, and D are textbook examples of conservative fields.

Question #10 Key: (A)

UHS 2024

Work done is equal to: [UHS 2024]

CORE CONCEPT AND DERIVATION

In the context of simple machines (like levers or pulleys), the term "Effort" is used as a synonym for the applied input Force.

Formula:

$$W = F \times d$$

Solution:

- Substitute "Force" with "Effort".
- Work input = Effort $\times$ distance moved by effort.
- Therefore, multiplying effort and distance yields work.

Why other options are incorrect:

Adding or subtracting force and distance is dimensionally impossible. Dividing force by distance gives stiffness (like a spring constant), not energy.

Question #11 Key: (A)

UHS 2024

When a force of 1N displaces its point of application by 1m in the direction of force, the work done is [UHS 2024]

CORE CONCEPT AND DERIVATION

This is the literal SI definition of one Joule.

Formula:

$$W = F \times d$$

Solution:

- Force (F) = 1 N
- Displacement (d) = 1 m
- Because they are in the same direction, $\theta = 0^\circ$.
- $W = 1 \text{ N} \times 1 \text{ m} = 1 \text{ J}$.

Why other options are incorrect:

Zero work implies perpendicular force. 10 J is mathematically incorrect for 1×1 .

Question #12 Key: (B)

UHS 2024

An electric motor is used to lift the weight of 2.0 N through a vertical distance of 100 cm in 4 sec. What is ...

CORE CONCEPT AND DERIVATION

Power is the rate at which work is done. You must ensure all units are in standard SI form (meters, seconds, Newtons) before calculating.

Formula:

$$P = \frac{W}{t} = \frac{F \times d}{t}$$

Solution:

- Force applied (Weight) = 2.0 N.
- Distance (d) = 100 cm = 1.0 m.
- Time (t) = 4 sec.
- Work = 2.0 N $\times$ 1.0 m = 2.0 Joules.
- Power = $\frac{2.0}{4}$ = 0.5 Watts.

Why other options are incorrect:

Failing to convert 100 cm to 1 m would give $200/4 = 50$ W. Simple arithmetic errors lead to 0.25 or 1.

Question #13 Key: (B)

NUMS 2024

At what angle of applied force, work done will be 50%? [NUMS 2024]

CORE CONCEPT AND DERIVATION

Work done depends on the cosine of the angle. 50% work means half of the maximum possible work.

Formula:

$$W = W_{\max} \cos \theta \implies W = Fd \cos \theta$$

Solution:

- Maximum work ($W_{\max}$) occurs at 0° ($\cos 0 = 1$).
- We want $W = 0.5 \times W_{\max}$.
- Therefore, we need the angle where $\cos \theta = 0.5$.
- $\cos(60^\circ) = 0.5$.
- Thus, at 60° , the work done is 50% of the maximum.

Why other options are incorrect:

At 45° , it is $\approx 70.7\%$ ($1/\sqrt{2}$). At 30° , it is $\approx 86.6\%$ ($\sqrt{3}/2$). At 90° , it is 0%.

Question #14 Key: (C)

NUMS 2024

The relation between K.E and momentum P is given by: [NUMS 2024]

CORE CONCEPT AND DERIVATION

This requires algebraic substitution of the momentum equation into the kinetic energy equation.

Formula:

$$p = mv \quad \text{and} \quad K.E = \frac{1}{2}mv^2$$

Solution:

- From $p = mv$, isolate v : $v = \frac{p}{m}$.
- Substitute this v into the K.E equation: $K.E = \frac{1}{2}m \left(\frac{p}{m}\right)^2$.
- Expand the square: $K.E = \frac{1}{2}m \left(\frac{p^2}{m^2}\right)$.
- Cancel one mass term (m) from the numerator and denominator: $K.E = \frac{p^2}{2m}$.

Why other options are incorrect:

Option A forgets to square the momentum. Options B and D incorrectly square the mass in the denominator.

Question #15 Key: (B)

NUMS 2024

When dolphin leaves the water it has lots of kinetic energy. At its highest point it's energy is: [NUMS 2024]

CORE CONCEPT AND DERIVATION

By the conservation of mechanical energy in projectile/vertical motion, kinetic energy is traded for gravitational potential energy as an object rises.

Formula:

$$K.E_{\text{initial}} = P.E_{\text{top}}$$

Solution:

- When the dolphin jumps straight up, it decelerates due to gravity until its vertical velocity hits zero at the peak of the jump.
- At this exact highest point, all of its initial upward Kinetic Energy has been converted into Gravitational Potential Energy.

Why other options are incorrect:

If it jumps at an angle, it retains some horizontal K.E, but the primary energy conversion defining the "highest point" is the maximization of Potential energy. It is not elastic, nor is it zero.

Question #16 **Key: (C)**

NUMS 2024

The absolute potential energy is given as [Formula] . The negative sign indicates that Earth's gravitational fi...

CORE CONCEPT AND DERIVATION

In physics, a negative potential energy in a field equation signifies a bound state where the force between the objects is universally attractive.

Formula:

$$F = -\frac{dU}{dr}$$

Solution:

- By convention, absolute zero potential energy is set at an infinite distance away.
- Because gravity pulls masses together (does positive work as they approach), the potential energy must decrease as they get closer.
- Dropping below zero makes the value negative, confirming that the force pulling them together is purely Attractive.

Why other options are incorrect:

A positive potential energy (like bringing two positive charges together) indicates a repulsive force. Gravity is never repulsive.

Question #17 **Key: (A)**

BUMHS 2024

If a force of one Newton acts on a body and displaces it through a distance of one meter in the direction of f...

CORE CONCEPT AND DERIVATION

This statement is the exact, standard SI definition of the unit of energy and work.

Formula:

$$1 \text{ Joule} = 1 \text{ Newton} \times 1 \text{ meter}$$

Solution:

- Force = 1 N
- Displacement = 1 m
- Direction is the same ($\cos 0^\circ = 1$)
- Work = $1 \times 1 = 1 \text{ N} \cdot \text{m}$.
- The name for $1 \text{ N} \cdot \text{m}$ is 1 Joule.

Why other options are incorrect:

Erg is the CGS unit of work (dyne-centimeter). Dyne is a CGS unit of force. Watt is a unit of power (Joules/sec).

Question #18 Key: (A)

BUMHS 2024

If a force of 1 N acts upon a body as it moves through a displacement of 0.5 m at an angle of 60° with the dir...

CORE CONCEPT AND DERIVATION

Use the standard work equation accounting for the angle between the force vector and the displacement vector.

Formula:

$$W = Fd \cos \theta$$

Solution:

- Force (F) = 1 N
- Displacement (d) = 0.5 m
- Angle (θ) = 60°
- $\cos(60^\circ) = 0.5$
- $W = 1 \times 0.5 \times 0.5 = 0.25 \text{ J}$.

Why other options are incorrect:

Ignoring the angle (assuming $\cos \theta = 1$) yields 0.5 J (Option B). The other options are mathematically unrelated.

Question #19 Key: (B)

BUMHS 2024

Which of the following force gives rise to ocean tides? [BUMHS 2024]

CORE CONCEPT AND DERIVATION

Ocean tides are caused by the differential gravitational pull of massive celestial bodies on the Earth's oceans.

Formula:

$$F = \frac{GMm}{r^2}$$

Solution:

- The Moon and the Sun exert a gravitational pull on the Earth.
- Because the oceans are fluid, they bulge outward toward the Moon (and slightly toward the Sun) due to this gravitational attraction.
- This gravitational force is exclusively responsible for the rising and falling of ocean tides.

Why other options are incorrect:

Magnetic forces affect charged particles and compasses, not massive bodies of water. Nuclear forces act only at subatomic scales. Friction opposes motion.

Question #20 **Key: (B)**

UHS 2023

The work done by a variable force can be found by dividing the:
[UHS 2023]

CORE CONCEPT AND DERIVATION

When calculating work for a force that changes over a distance, we use the method of integration, which geometrically means dividing the x-axis (displacement) into infinitesimally small chunks.

Formula:

$$W = \sum_i F(x_i) \Delta x_i$$

Solution:

- If force is variable, it changes at every position.
- We assume the force is approximately constant over a very small displacement (Δd).
- Thus, we must divide the total displacement into very small intervals, calculate the tiny work $\Delta W = F \cdot \Delta d$ for each, and sum them up.

Why other options are incorrect:

We do not divide force into intervals; force is the height (y-value) of the graph at a given displacement interval.

Question #21 **Key: (D)**

UHS 2023

Two bodies with kinetic energies in the ratio of 4:1 are moving with equal linear momentum. The ratio of their...

CORE CONCEPT AND DERIVATION

Use the algebraic relationship linking Kinetic Energy, Momentum, and Mass.

Formula:

$$K.E = \frac{p^2}{2m}$$

Solution:

- Since momentum (p) is equal for both bodies, $K.E$ is inversely proportional to mass ($K.E \propto \frac{1}{m}$).
- Therefore, $\frac{K.E_1}{K.E_2} = \frac{m_2}{m_1}$.
- Given $\frac{K.E_1}{K.E_2} = \frac{4}{1}$, it follows that $\frac{m_2}{m_1} = \frac{4}{1}$.
- Inverting this to find the ratio of their masses ($m_1 : m_2$):
 $\frac{m_1}{m_2} = \frac{1}{4}$.
- So, the ratio is 1:4.

Why other options are incorrect:

Assuming direct proportionality yields 4:1. Forgetting to square a velocity term if using $1/2mv^2$ leads to 1:2.

Question #22 **Key: (D)**

UHS 2023

A fisherman lifts a fish of mass 250 g from rest through a vertical height of 1.8 m. The fish gains a speed of...

CORE CONCEPT AND DERIVATION

The total mechanical energy gained by the fish is the sum of its newly acquired gravitational potential energy and its kinetic energy.

Formula:

$$\Delta E_{\text{total}} = \Delta P.E + \Delta K.E = mgh + \frac{1}{2}mv^2$$

Solution:

- Mass (m) = 250 g = 0.25 kg.
- Height (h) = 1.8 m. Velocity (v) = 1.1 m/s.
- $P.E = 0.25 \times 9.8 \times 1.8 = 4.41$ J.
- $K.E = 0.5 \times 0.25 \times (1.1)^2 = 0.125 \times 1.21 = 0.15125$ J.
- Total Energy Gained = $4.41 + 0.15125 = 4.56125$ J.
- Rounding to one decimal place gives 4.6 J. (Using $g = 10$ yields $4.5 + 0.15 = 4.65$ J, which also rounds to 4.6 J).

Why other options are incorrect:

Option C (4.4 J) represents only the potential energy. Option A (0.15 J) represents only the kinetic energy.

Question #23 **Key: (C)**

UHS 2023

An 8.0 kg box slides along a horizontal frictionless floor at 3 m/s and collides with a relatively massless sp...

CORE CONCEPT AND DERIVATION

By the Work-Energy theorem, the work done by the retarding force (average force) equals the total kinetic energy removed from the box.

Formula:

$$W = F_{\text{avg}} \times x = \Delta K.E = \frac{1}{2}mv^2$$

Solution:

- Mass (m) = 8.0 kg, Velocity (v) = 3 m/s.
- Compression distance (x) = 12 cm = 0.12 m.
- Initial $K.E = \frac{1}{2}(8)(3)^2 = 4 \times 9 = 36$ J.
- The spring absorbs this 36 J doing work: $F \times 0.12 = 36$.
- $F = \frac{36}{0.12} = \frac{3600}{12} = 300$ N.

Why other options are incorrect:

Failing to convert 12 cm to meters yields 3 N (Option A). Simple arithmetic errors with decimal places yield 30 N or 3000 N.

Question #24 **Key: (C)**

SZABMU 2023

According to work energy principle in linear motion, the work done on the body is equal to: [SZABMU 2023]

CORE CONCEPT AND DERIVATION

The standard Work-Energy Theorem states that the net work done by all forces on an object equals the change in its kinetic energy.

Formula:

$$W_{\text{net}} = \Delta K.E = K.E_f - K.E_i$$

Solution:

- If a net force acts on a body in linear motion, it accelerates, changing its velocity.
- This change in velocity directly translates to a change in kinetic energy.
- Hence, Net Work = Change in K.E.

Why other options are incorrect:

Work done against gravity specifically equals the change in P.E, but the generalized Work-Energy principle for linear motion explicitly defines it via K.E.

Question #25 **Key: (B)**

SZABMU 2023

If a body of mass 'm' is accelerated on a smooth horizontal surface 'S' by a force 'F', the work done $F \times S$ is c...

CORE CONCEPT AND DERIVATION

Work applied to a mass on a frictionless (smooth) horizontal surface causes it to accelerate without gaining height.

Formula:

$$W = F \times S = \Delta K.E$$

Solution:

- Because the surface is horizontal, height doesn't change, so Potential Energy is zero.
- Because the surface is "smooth" (frictionless), no energy is lost as Heat.
- Therefore, 100% of the work done manifests as an increase in the object's velocity, which is Kinetic Energy.

Why other options are incorrect:

Heat energy requires friction. Potential energy requires a change in height or spring compression.

Question #26 **Key: (B)**

SZABMU 2023

One megawatt hour is equal to: [SZABMU 2023]

CORE CONCEPT AND DERIVATION

Convert Megawatts to Watts, and hours to seconds, then multiply to get Joules.

Formula:

$$E = P \times t$$

Solution:

- 1 Megawatt (MW) = 10^6 Watts.
- 1 hour = 3600 seconds.
- 1 MWh = $10^6 \text{ J/s} \times 3600 \text{ s}$.
- = $3.6 \times 10^3 \times 10^6 \text{ J} = 3.6 \times 10^9 \text{ Joules}$.

Why other options are incorrect:

Option A is the value for one kilowatt-hour (kWh). Option C (3.6 MJ) is exactly the same as Option A.

Question #27 **Key: (C)**

SZABMU 2023

A motor boat is moving with velocity [Formula]. The net force acting on it is 4000 N. what will be the power ...

CORE CONCEPT AND DERIVATION

Power can be calculated dynamically as the product of the driving force and the constant velocity of the object.

Formula:

$$P = F \times v$$

Solution:

- Force (F) = 4000 N
- Velocity (v) = 4 m/s
- $P = 4000 \times 4 = 16,000 \text{ Watts}$
- Convert to Kilowatts: $16,000 \text{ W} = 16 \text{ kW}$.

Why other options are incorrect:

Dividing force by velocity yields 1000 W (Option A). Missing zeros during calculation yields 160 or 1600 W.

Question #28 **Key: (D)**

KMU 2023

The weight of a body is 120 N and it is lifted to height 10m, work done on the body is: [ETEA 2023]

CORE CONCEPT AND DERIVATION

Work done in lifting a body is equal to the force applied (which must equal the body's weight) multiplied by the vertical height.

Formula:

$$W = F \times d = (\text{Weight}) \times h$$

Solution:

- Notice the problem gives "Weight = 120 N". You do not need to multiply by gravity again; weight is already mg .
- Height (h) = 10 m
- $W = 120 \text{ N} \times 10 \text{ m} = 1200 \text{ Joules}$.

Why other options are incorrect:

Option A assumes distance is 1. Options B and C are fabricated arithmetic.

Question #29 **Key: (D)**

KMU 2023

A 200 N force acts on 8 kg crate that starts from rest. At the instant the object has gone 2m, the rate at whi...

CORE CONCEPT AND DERIVATION

The "rate at which work is done" is Power. Find the velocity at the 2m mark using kinematics, then use $P = Fv$.

Formula:

$$a = \frac{F}{m} \quad ; \quad v_f^2 = v_i^2 + 2ad \quad ; \quad P = F \times v_f$$

Solution:

- Acceleration: $a = \frac{200}{8} = 25 \text{ m/s}^2$.
- Velocity at 2m: $v_f^2 = 0 + 2(25)(2) = 100$.
- $v_f = \sqrt{100} = 10 \text{ m/s}$.
- Instantaneous Power: $P = 200 \text{ N} \times 10 \text{ m/s} = 2000 \text{ W}$.

Why other options are incorrect:

Option B (25) is merely the acceleration. If you multiply force by displacement you get Work (400 J), but the question asks for the rate (Power).

Question #30 **Key: (C)**

KMU 2023

Which of the following bodies has the largest kinetic energy? [ETEA 2023]

CORE CONCEPT AND DERIVATION

Kinetic energy scales linearly with mass but quadratically with speed. Calculate the relative coefficient for each option.

Formula:

$$K.E = \frac{1}{2}mv^2$$

Solution:

- Calculate coefficients relative to Mv^2 :
- Option A: $\frac{1}{2}(3)(1)^2 = 1.5$
- Option B: $\frac{1}{2}(3)(2)^2 = \frac{1}{2}(3)(4) = 6$
- Option C: $\frac{1}{2}(3)(3)^2 = \frac{1}{2}(3)(9) = 13.5$
- Option D: $\frac{1}{2}(1)(4)^2 = \frac{1}{2}(16) = 8$
- 13.5 is the largest coefficient, making Option C the greatest kinetic energy.

Why other options are incorrect:

Option D seems intuitively large due to the high speed (4v), but the heavier mass (3M) in Option C combined with a high speed (3v squared = 9) overcomes it.

Question #31 **Key: (A)**

KMU 2023

A 2kg object is released from rest 8m above the surface of Earth. During the fall work done against air resist...

CORE CONCEPT AND DERIVATION

Use the Conservation of Energy with non-conservative forces: The initial potential energy is converted into kinetic energy minus the energy lost to air resistance.

Formula:

$$P.E = K.E + W_{\text{friction}} \implies mgh = \frac{1}{2}mv^2 + W_f$$

Solution:

- Initial P.E = $2 \times 10 \times 8 = 160$ J (Using $g \approx 10$ for simplicity).
- Energy lost = 50 J.
- Remaining energy for K.E = $160 - 50 = 110$ J.
- Set K.E equal to 110: $\frac{1}{2}(2)v^2 = 110$.
- $v^2 = 110 \implies v \approx 10.48$ m/s.
- If we strictly use $g = 9.8$: $P.E = 2 \times 9.8 \times 8 = 156.8$ J. $K.E = 156.8 - 50 = 106.8$ J. $v = \sqrt{106.8} \approx 10.3$ m/s.
- In either case, 10 m/sec is by far the closest option.

Why other options are incorrect:

Options B, C, and D are wildly large and physically impossible for an 8m drop even in a vacuum (max speed in vacuum is ~12.5 m/s).

Question #32 Key: (D)

DUHS 2023

1 J/sec equals to: [SINDH 2023]

CORE CONCEPT AND DERIVATION

Identify the SI unit for the rate of energy transfer.

Formula:

$$P = \frac{E}{t}$$

Solution:

- Joules (J) measure Energy or Work.
- Seconds (sec) measure Time.
- Joules per second (J/s) measures Power.
- The SI unit for Power is the Watt (W). Thus, 1 J/sec = 1 Watt.

Why other options are incorrect:

1 K (Kelvin) is temperature. 1 N (Newton) is force. 1 T (Tesla) is magnetic field strength.

Question #33 Key: (C)

DUHS 2023

Which of the following expression is constant for a freely falling body? [SINDH 2023]

CORE CONCEPT AND DERIVATION

According to the Law of Conservation of Mechanical Energy, in the absence of air resistance, the total mechanical energy of a freely falling body remains constant at every point in its path.

Formula:

$$E_{\text{total}} = P.E + K.E = \text{Constant}$$

Solution:

- Potential Energy (P.E) = mgh
- Kinetic Energy (K.E) = $\frac{1}{2}mv^2$
- Their sum, $mgh + \frac{1}{2}mv^2$, represents the total mechanical energy, which is a conserved constant.

Why other options are incorrect:

Option A misses the $1/2$ coefficient for kinetic energy. Option B and D misstate the conservation law as an equality between instantaneous PE and KE, which is only true at exactly half the initial height.

Question #34 **Key: (B)**

DUHS 2023

A body of mass 4 kg is moving a circle of radius 2m. if the body moves round a complete circle, what is the wo...

CORE CONCEPT AND DERIVATION

There are two primary reasons work is zero here: displacement logic and force angle logic.

Formula:

$$W = \vec{F} \cdot \vec{d} = Fd \cos \theta$$

Solution:

- **Reason 1:** Over a complete circle, the start and end points are identical. Total displacement $\vec{d} = 0$. Therefore, Work = 0.
- **Reason 2:** Centripetal force acts towards the center, while instantaneous motion is tangential (angle is 90°). Since $\cos(90^\circ) = 0$, continuous work done is zero at every instant.

Why other options are incorrect:

Options A, C, and D are calculated by blindly multiplying mass, radius, and other numbers given in the prompt, ignoring the vector nature of work.

Question #35 **Key: (D)**

NUMS 2023

An object has 1J of P.E. what is the work done in term of height? [NUMS 2023]

CORE CONCEPT AND DERIVATION

Energy is fundamentally defined as the capacity to do work.

Formula:

$$W = \Delta P.E$$

Solution:

- If a body has 1 Joule of Gravitational Potential Energy, it means exactly 1 Joule of work was done to lift it to that height.
- Conversely, if released, it has the capacity to do exactly 1 Joule of work as it falls back to the reference level.
- Therefore, the work equivalence is directly 1 J.

Why other options are incorrect:

Assuming the mass is 1 kg and gravity is 10 m/s^2 might trick someone into calculating height ($h = 0.1\text{m}$) and picking 0.1J, but the question asks for *work done*, which matches the energy perfectly.

Question #36 Key: (B)

NUMS 2023

Power is dot product of: [NUMS 2023]

CORE CONCEPT AND DERIVATION

Power is the rate of doing work. By substituting the definition of work into the power equation, we uncover a vector relationship.

Formula:

$$P = \frac{W}{t} = \frac{\vec{F} \cdot \vec{d}}{t}$$

Solution:

- Since velocity $\vec{v} = \frac{\vec{d}}{t}$, we can rewrite the equation.
- $P = \vec{F} \cdot \left(\frac{\vec{d}}{t}\right) = \vec{F} \cdot \vec{v}$.
- Power is the scalar dot product of the force vector and the velocity vector.

Why other options are incorrect:

Force dot displacement is Work. Work and time are scalars, and their division (not dot product) gives Power.

Question #37 Key: (C)

NUMS 2023

The area under force-displacement graph gives: [NUMS 2023]

CORE CONCEPT AND DERIVATION

The geometric area under a curve is the integral (product) of the y-axis variable and the x-axis variable.

Formula:

$$\text{Area} = \int F dx = W$$

Solution:

- The y-axis is Force (Newtons).
- The x-axis is Displacement (meters).
- Multiplying them ($N \times m$) yields Joules, which is the unit of Work.

Why other options are incorrect:

Area under Velocity-Time gives displacement. Power is Work divided by Time.

Question #38 Key: (C)

NUMS 2023

A body of mass 'm' is moving with velocity 'v'. after a short interval of time its velocity becomes double. Ho...

CORE CONCEPT AND DERIVATION

Kinetic energy has a quadratic relationship with velocity.

Formula:

$$K.E = \frac{1}{2}mv^2$$

Solution:

- Initial K.E = $\frac{1}{2}mv^2$.
- New velocity is $2v$.
- New K.E = $\frac{1}{2}m(2v)^2 = \frac{1}{2}m(4v^2) = 4 \times (\frac{1}{2}mv^2)$.
- Because 4 is greater than 1, it is a 4 times increase.

Why other options are incorrect:

Option A mistakes the quadratic relationship for a linear one (momentum doubles, but K.E quadruples). Decreasing options are illogical since speed increased.

Question #39 Key: (A)

UHS 2022

The consumption of energy by a 60 W bulb in 2s is: [UHS 2022]

CORE CONCEPT AND DERIVATION

Electrical energy consumed is calculated by multiplying the power rating by the operational time in standard units.

Formula:

$$E = P \times t$$

Solution:

- Power (P) = 60 W (Joules per second)
- Time (t) = 2 s
- Energy $E = 60 \text{ J/s} \times 2 \text{ s} = 120 \text{ Joules}$

Why other options are incorrect:

Dividing power by time yields 30 J (Option B). Forgetting to multiply by 2 gives 60 J (Option C).

Question #40 **Key: (B)**

UHS 2022

Ignoring details associated with friction, extra forces exerted by arm and leg muscles, and other factors, we ...

CORE CONCEPT AND DERIVATION

Using the Law of Conservation of Energy, the initial horizontal kinetic energy is entirely converted into vertical gravitational potential energy at the peak of the vault.

Formula:

$$\frac{1}{2}mv^2 = mgh$$

Solution:

- The mass m cancels out on both sides: $\frac{1}{2}v^2 = gh$.
- Rearrange for velocity: $v = \sqrt{2gh}$.
- Height (h) = 5 m. Assume standard gravity $g = 10 \text{ m/s}^2$.
- $v = \sqrt{2 \times 10 \times 5} = \sqrt{100}$.
- $v = 10 \text{ m/s}$.

Why other options are incorrect:

Failing to multiply by 2 gives $\sqrt{50} \approx 7$. Assuming $v = gh$ directly gives 50. Only 10 is mathematically sound.

Question #41 **Key: (B)**

UHS 2022

A particle of mass m at rest is acted upon by a force P for time t . Its kinetic energy after time t is: [UHS 2...

CORE CONCEPT AND DERIVATION

Newton's Second Law and Kinematics can be used to find the final velocity, which is then substituted into the Kinetic Energy equation.

Formula:

$$a = \frac{F}{m} \quad \text{and} \quad v = u + at \quad \text{and} \quad K.E = \frac{1}{2}mv^2$$

Solution:

- Acceleration $a = \frac{P}{m}$ (where Force is labeled P).
- Since it starts from rest ($u = 0$), final velocity is $v = at = \left(\frac{P}{m}\right)t$.
- Kinetic Energy $K.E = \frac{1}{2}mv^2$.
- Substitute v : $K.E = \frac{1}{2}m\left(\frac{Pt}{m}\right)^2 = \frac{1}{2}m\left(\frac{P^2t^2}{m^2}\right)$.
- Simplify to get: $K.E = \frac{P^2t^2}{2m}$.

Why other options are incorrect:

Option A forgets the $1/2$ factor in the kinetic energy formula. Options C and D introduce incorrect fractional coefficients not present in derivation.

Question #42 Key: (A)

SZABMU 2022

The unit of kinetic energy is same as that of: [SZABMU+ETEA 2022]

CORE CONCEPT AND DERIVATION

By the Work-Energy Theorem, work done on an object equals its change in kinetic energy. They represent the exact same physical dimension.

Formula:

$$\Delta K.E = W$$

Solution:

- Work is measured in Joules (J).
- Kinetic Energy is measured in Joules (J).
- Therefore, they have identical units.

Why other options are incorrect:

Work/Time is Power (Watts). Power/Time gives Watt/second, which is meaningless here.

Question #43 Key: (A)

SZABMU 2022

Kilowatt hour is a unit of: [SZABMU 2022]

CORE CONCEPT AND DERIVATION

The kilowatt-hour is a commercial unit of energy formed by multiplying power (kW) by time (hours).

Formula:

$$E = P \times t$$

Solution:

- Power $\times$ time = Energy.
- 1 kWh = 3.6 Megajoules.
- Therefore, it measures energy, not power itself.

Why other options are incorrect:

Energy $\times$ time is Joule-seconds (action). Power is just Joules/second (Watts).

Question #44 Key: (A)

SZABMU 2022

The unit of power in British engineering system is: [SZABMU 2022]

CORE CONCEPT AND DERIVATION

Different systems of measurement use different standard units for physical quantities. Power is the rate of doing work.

Formula:

$$1 \text{ hp} = 746 \text{ Watts}$$

Solution:

- In the SI system, the unit of power is the Watt (Js^{-1}).
- In the British Imperial (engineering) system, power is traditionally measured in Horsepower (hp) or foot-pounds per second.

Why other options are incorrect:

Watt and Js^{-1} are SI units. Js is a unit of action or angular momentum, not power.

Question #45 Key: (D)

SZABMU 2022

Work done will be negative if the angle between force and displacement is: [SZABMU 2022]

CORE CONCEPT AND DERIVATION

Work is the dot product of force and displacement, making it dependent on the cosine of the angle between them.

Formula:

$$W = Fd \cos \theta$$

Solution:

- If $\theta = 180^\circ$, the force acts in the exact opposite direction of the displacement (like friction).
- $\cos(180^\circ) = -1$.
- Therefore, $W = -Fd$, which is negative work.

Why other options are incorrect:

At 0° , 45° , and 60° , the cosine values are all positive (+1, +0.707, and +0.5 respectively), resulting in positive work.

Question #46 **Key: (C)**

SZABMU 2022

[Formula] ____ [SZABMU 2022]

CORE CONCEPT AND DERIVATION

Deconstruct the given compound unit into its fundamental components to match it with a standard named unit.

Formula:

$$P = \frac{W}{t} = \frac{F \cdot d}{t}$$

Solution:

- The unit is $\text{N} \cdot \text{m} \cdot \text{s}^{-1}$.
- Newton $\times$ meter ($\text{N} \cdot \text{m}$) is the Joule (J), the unit of work.
- Therefore, $\text{N} \cdot \text{m} \cdot \text{s}^{-1} = \text{J} \cdot \text{s}^{-1}$ or Joules per second.
- 1 Joule per second is defined as 1 Watt.

Why other options are incorrect:

kWh is a unit of energy. Js is Joule-seconds. Js^{-2} is dimensionally incorrect for any standard power or energy metric.

Question #47 **Key: (C)**

SZABMU 2022

In inter-conversion of energy, the work done against the friction is:
[SZABMU 2022]

CORE CONCEPT AND DERIVATION

Work is fundamentally defined as the product of force and the displacement over which it acts.

Formula:

$$W = F \times d$$

Solution:

- Let the frictional force be f .
- Let the displacement (or height/distance fallen) be h .
- The magnitude of the work done to overcome this friction over that distance is the product of the two: $W = f \times h = fh$.

Why other options are incorrect:

Adding, subtracting, or dividing force and distance violates dimensional analysis (you cannot add Newtons to meters, and N/m is a spring constant, not energy).

Question #48 Key: (B)

SZABMU 2022

A car of mass 800 kg accelerates from [Formula] to [Formula], the increase in K.E will be: [SZABMU 2022]

CORE CONCEPT AND DERIVATION

The increase in kinetic energy is simply the final kinetic energy minus the initial kinetic energy.

Formula:

$$\Delta K.E = \frac{1}{2}m(v_f^2 - v_i^2)$$

Solution:

- Mass (m) = 800 kg
- Initial velocity (v_i) = 20 m/s
- Final velocity (v_f) = 30 m/s
- $\Delta K.E = \frac{1}{2}(800)(30^2 - 20^2)$
- $\Delta K.E = 400(900 - 400) = 400(500)$
- $\Delta K.E = 200,000 \text{ J}$
- Converting to kilojoules: $200,000 \text{ J} = 200 \text{ kJ}$.

Why other options are incorrect:

A common mistake is doing $\frac{1}{2}m(v_f - v_i)^2$, which yields $400(10)^2 = 40,000 \text{ J} = 40 \text{ kJ}$. Failing to convert Joules to kJ leads to magnitude errors.

Question #49 Key: (B)

KMU 2022

When five times momentum of a body is equal to the kinetic energy of the same body then its velocity is equal ...

CORE CONCEPT AND DERIVATION

Set up an algebraic equation directly from the condition given in the word problem using standard formulas for momentum and kinetic energy.

Formula:

$$5p = K.E$$

Solution:

- Substitute $p = mv$ and $K.E = \frac{1}{2}mv^2$.
- $5(mv) = \frac{1}{2}mv^2$
- Cancel mass m and one v from both sides (assuming $v \neq 0$).
- $5 = \frac{1}{2}v$
- $v = 5 \times 2 = 10 \text{ m/s}$.

Why other options are incorrect:

If you forget the $1/2$ in the K.E formula, you get $5mv = mv^2 \Rightarrow v = 5 \text{ m/s}$ (Option A). Options C and D result from arbitrary arithmetic.

Question #50 **Key: (B)**

KMU 2022

The equation for kinetic energy is: [ETEA 2022]

CORE CONCEPT AND DERIVATION

Kinetic energy is the energy possessed by a body due to its macroscopic motion.

Formula:

$$K.E = \frac{1}{2}mv^2$$

Solution:

- The standard scalar definition of kinetic energy for a non-relativistic mass m moving at speed v is $\frac{1}{2}mv^2$.
- Note: Option D ($\frac{1}{2}m(\vec{v} \cdot \vec{v})$) is also mathematically true since the dot product of a velocity vector with itself gives the speed squared scalar, but Option B is the universal textbook representation.

Why other options are incorrect:

Option A is missing the square on momentum (it should be $p^2/2m$). Option C is dimensionally invalid.

Question #51 **Key: (B)**

KMU 2022

Electricity consumption is calculated commercially in: [ETEA 2022]

CORE CONCEPT AND DERIVATION

Commercial electricity is billed based on total energy consumed, not the instantaneous power draw.

Formula:

$$E = P \times t$$

Solution:

- Power units (Watts, Kilowatts, Megawatts) only measure the rate of energy use.
- To measure total energy, power must be multiplied by time.
- The standard commercial unit is the Kilo-watt hour (kWh), which equals 3.6×10^6 Joules.

Why other options are incorrect:

Options A, C, and D are strictly units of Power, not Energy.

Question #52 **Key: (B)**

KMU 2022

A cyclist comes to a skidding stop in 10m. During this process, the opposing force on the cycle due to the road...

CORE CONCEPT AND DERIVATION

Work done by a force opposing the direction of motion (like friction) is always negative because it removes kinetic energy from the system.

Formula:

$$W = Fd \cos \theta$$

Solution:

- Force of friction (F) = 200 N
- Displacement (d) = 10 m
- Since the force opposes motion, the angle θ is 180° .
- $W = 200 \times 10 \times \cos(180^\circ)$
- $W = 2000 \times (-1) = -2000 \text{ J}$

Why other options are incorrect:

Option C (+2000J) implies the road pushed the bicycle forward, increasing its speed. Options A and D are calculation errors.

Question #53 Key: (C)

BUMHS 2022

An electric motor is used to operate an elevator. The motor does 140000J of work in 70 s. What is the output p...

CORE CONCEPT AND DERIVATION

Power is the rate at which work is performed over time.

Formula:

$$P = \frac{W}{t}$$

Solution:

- Work (W) = 140,000 J
- Time (t) = 70 s
- $P = \frac{140000}{70} = \frac{14000}{7} = 2000 \text{ W}$
- Convert to kilowatts: $2000 \text{ W} = 2.0 \text{ kW}$.

Why other options are incorrect:

Dividing time by work gives ~0.50 (Option A). Missing zeros gives 2.0 W. Option D is an arbitrary distractor using the value of g .

Question #54 Key: (D)

BUMHS 2022

A body of mass 5kg is moving with a momentum of 10 Ns. a force of 0.2 N acts on it in the direction of motion ...

CORE CONCEPT AND DERIVATION

Use Newton's second law and kinematics to find the final velocity, then apply the work-energy theorem or calculate kinetic energy differences.

Formula:

$$p = mv \quad ; \quad a = \frac{F}{m} \quad ; \quad v_f = v_i + at \quad ; \quad \Delta K.E = \frac{1}{2}m(v_f^2 - v_i^2)$$

Solution:

- Find initial velocity: $10 = 5 \times v_i \Rightarrow v_i = 2 \text{ m/s}$.
- Find acceleration: $a = \frac{0.2}{5} = 0.04 \text{ m/s}^2$.
- Find final velocity after 10s: $v_f = 2 + (0.04 \times 10) = 2 + 0.4 = 2.4 \text{ m/s}$.
- Calculate K.E difference: $\Delta K.E = \frac{1}{2}(5)(2.4^2 - 2^2)$.
- $\Delta K.E = 2.5(5.76 - 4) = 2.5(1.76)$.
- $2.5 \times 1.76 = 4.4 \text{ J}$.

Why other options are incorrect:

Mistakes in calculating 2.4^2 or mistakenly doing $(v_f - v_i)^2$ lead to incorrect values like 0.4 J or other distractors.

Question #55 **Key: (A)**

DUHS 2022

If mass and speed of a moving object is doubled, the K.E will be;
[DUHS 2022]

CORE CONCEPT AND DERIVATION

Kinetic energy is linearly proportional to mass and quadratically proportional to velocity.

Formula:

$$K.E = \frac{1}{2}mv^2$$

Solution:

- Let initial K.E be $E = \frac{1}{2}mv^2$.
- New mass $m' = 2m$. New speed $v' = 2v$.
- New K.E $E' = \frac{1}{2}(2m)(2v)^2$.
- $E' = \frac{1}{2}(2m)(4v^2) = 8 \times (\frac{1}{2}mv^2)$.
- $E' = 8E$. It becomes eight times greater.

Why other options are incorrect:

If only speed is doubled, it's 4 times. If only mass is doubled, it's 2 times. If both were squared, it would be 16 times.

Question #56 **Key: (D)**

DUHS 2022

One kilowatt hour is equal to: [DUHS 2022]

CORE CONCEPT AND DERIVATION

Convert the commercial unit of energy into the SI unit (Joules) by converting both prefixes and time units.

Formula:

$$1 \text{ kWh} = 1 \text{ kW} \times 1 \text{ hour}$$

Solution:

- 1 kilowatt = 1000 Watts (Joules/sec).
- 1 hour = 3600 seconds.
- Multiply them: $1000 \text{ J/s} \times 3600 \text{ s} = 3,600,000 \text{ Joules}$.
- In scientific notation: $3.6 \times 10^6 \text{ J}$.

Why other options are incorrect:

Mismatched exponents: 3.6×10^5 misses a zero (only 10 minutes instead of 60). 36×10^6 is 10 times too large.

Question #57 Key: (D)

DUHS 2022

The rate of doing work is zero, when the angle [Formula] between force and velocity is: [DUHS 2022]

CORE CONCEPT AND DERIVATION

The rate of doing work is Power, which can be expressed as the dot product of the Force and Velocity vectors.

Formula:

$$P = \vec{F} \cdot \vec{v} = Fv \cos \theta$$

Solution:

- For power to be zero while force and velocity are non-zero, the cosine term must be zero.
- $\cos \theta = 0 \implies \theta = 90^\circ$.
- When force is perpendicular to velocity (like centripetal force), no work is done, hence the rate of work is zero.

Why other options are incorrect:

At 0° , rate is maximum. At 180° , rate is maximum negative (rapid deceleration). At 60° , it is exactly half of the maximum.

Question #58 Key: (C)

NUMS 2022

1hp is equal to: [NUMS 2022]

CORE CONCEPT AND DERIVATION

Mechanical horsepower is a legacy unit of power that must be converted to standard SI units for physics calculations.

Formula:

$$1 \text{ hp} = 745.7 \text{ W}$$

Solution:

- By standard convention in physics, this value is rounded to the nearest whole integer.
- Therefore, $1 \text{ hp} = 746 \text{ Watts}$.

Why other options are incorrect:

The other options are dyslexic numeral scrambles of 746 designed to confuse students relying purely on rote memorization.

Question #59 Key: (C)

NUMS 2022

The product of force and velocity is equal to: [NUMS 2022]

CORE CONCEPT AND DERIVATION

Examine the dimensional units of Force multiplied by Velocity.

Formula:

$$P = \frac{W}{t} = \frac{F \cdot d}{t} = F \cdot \left(\frac{d}{t}\right) = F \cdot v$$

Solution:

- Force is in Newtons (N). Velocity is in meters per second (m/s).
- Product units = $\text{N} \times \text{m/s} = (\text{N} \cdot \text{m})/\text{s} = \text{Joules/second}$.
- Joules per second is the definition of Watts, which is the unit of Power.

Why other options are incorrect:

Work done is Force $\times$ Displacement. Kinetic and Potential energy share the same units as Work, not Power.

Question #60 Key: (B)

NUMS 2022

One kilowatt-hour is equal to: [NUMS 2022]

CORE CONCEPT AND DERIVATION

Convert the kilowatt-hour into Joules, then apply the correct SI prefix.

Formula:

$$E = P \times t$$

Solution:

- $1 \text{ kWh} = 1000 \text{ W} \times 3600 \text{ s} = 3,600,000 \text{ Joules}$.
- The prefix for a million (10^6) is Mega (M).
- Therefore, $3,600,000 \text{ J} = 3.6 \times 10^6 \text{ J} = 3.6 \text{ MJ}$.

Why other options are incorrect:

36 MJ would be $36 \times 10^6 \text{ J}$ (10 kWh). 3.8 MJ is a purely fabricated number.

Question #61 Key: (D)

NUMS 2022

The amount of work done is moving a body at certain point in a gravitational field to a position of zero poten...

CORE CONCEPT AND DERIVATION

This is the formal definition of Absolute Gravitational Potential Energy.

Formula:

$$U = -\frac{GMm}{r}$$

Solution:

- "Gravitational potential energy" usually refers to relative changes (mgh) near the Earth's surface.
- When moving a mass from a specific point all the way to infinity (where the gravitational field is strictly zero), the total work done without inducing acceleration defines the "Absolute" potential energy at that specific point.

Why other options are incorrect:

Kinetic energy relates to motion. Standard potential energy is relative (depends on an arbitrary reference frame like the floor or ground).

Question #62 Key: (B)

NUMS 2022

If the speed of a body is doubled, its kinetic energy become:
[NUMS 2022]

CORE CONCEPT AND DERIVATION

Calculate the actual mathematical expression for the new kinetic energy, not just the multiplication factor.

Formula:

$$K.E = \frac{1}{2}mv^2$$

Solution:

- Let initial K.E = $\frac{1}{2}mv^2$.
- Substitute $2v$ for the new speed: New K.E = $\frac{1}{2}m(2v)^2$.
- New K.E = $\frac{1}{2}m(4v^2)$.
- Simplify the fraction: $(\frac{4}{2})mv^2 = 2mv^2$.

Why other options are incorrect:

Students often memorize "it increases by 4 times" and mistakenly select $4mv^2$ (Option D), forgetting the initial $1/2$ coefficient.

Question #63 Key: (D)

NUMS 2022

An electric motor of power 2hp is installed in an industrial unit. Its power is [NUMS 2022]

CORE CONCEPT AND DERIVATION

Convert Mechanical Horsepower into Watts.

Formula:

$$P_{\text{watts}} = P_{\text{hp}} \times 746$$

Solution:

- 1 hp = 746 W.
- Given Power = 2 hp.
- $2 \times 746 = 1492$ W.

Why other options are incorrect:

1500 W is a rough approximation but not exact. 742 W is an incorrect base value. 148 W drops a digit.

Question #64 **Key: (B)**

PMDC 2021

A field in which the work is done in a moving a body along a closed path is zero is called [NMDCAT 2021]

CORE CONCEPT AND DERIVATION

This is the literal definition of a conservative force field in classical mechanics.

Formula:

$$\oint \vec{F} \cdot d\vec{r} = 0$$

Solution:

- If moving a mass around a closed loop results in net zero work done (energy spent getting there is fully recovered returning), the field governing it is broadly termed a "Conservative Field".
- While Gravitational and Electrostatic fields are examples of conservative fields, the overarching generalized term for this property is "Conservative Field".

Why other options are incorrect:

While Options A and D are specific examples, Option B is the definitive, all-encompassing physical term the definition refers to.

Question #65 **Key: (D)**

PMDC 2021

When a force is parallel to the direction of motion of the body, then work done on the body is [NMDCAT 2021]

CORE CONCEPT AND DERIVATION

Work done depends on the orientation of the force relative to the direction of motion (displacement).

Formula:

$$W = Fd \cos \theta$$

Solution:

- "Parallel" means the force and displacement point in the exact same direction.
- The angle $\theta = 0^\circ$.
- $\cos(0^\circ) = 1$, which is the maximum value for cosine.
- Thus, $W = Fd$, yielding the maximum possible work.

Why other options are incorrect:

If perpendicular (90°), work is zero. Work can never be infinite under finite force and displacement.

Question #66 Key: (C)

PMDC 2021

If a body of mass of 2 kg is raised vertically through 2m, then the work done will be [NMDCAT 2021]

CORE CONCEPT AND DERIVATION

Work done to lift a body vertically against gravity is stored as gravitational potential energy.

Formula:

$$W = mgh$$

Solution:

- Mass (m) = 2 kg
- Height (h) = 2 m
- Acceleration due to gravity (g) = 9.8 m/s^2
- $W = 2 \times 9.8 \times 2 = 4 \times 9.8 = 39.2 \text{ J}$

Why other options are incorrect:

Using $g = 10$ gives 40 J. Misplacing decimal points during calculation yields 392.1 or 3.92.

Question #68 Key: (B)

PMDC 2021

The area under the force displacement graph represents [NMDCAT 2021]

CORE CONCEPT AND DERIVATION

Integrating Force over Displacement yields the total Work Done.

Formula:

$$W = \int_{x_i}^{x_f} F dx$$

Solution:

- The product of the units on the axes is Newton $\times$ meters (N.m), which is Joules.
- Joules are the unit of Work. Hence, the geometric area represents Work Done.

Why other options are incorrect:

Area is a geometric measure, not a physical quantity. Power is Force $\times$ Velocity.

Question #67 Key: (B)

PMDC 2021

The relation between horsepower and watt is [NMDCAT 2021]

CORE CONCEPT AND DERIVATION

Horsepower (hp) is an imperial unit of power, while Watt is the standard SI unit.

Formula:

$$1 \text{ mechanical horsepower} \approx 745.7 \text{ W}$$

Solution:

- By standard convention in basic physics, the value is rounded to 746 Watts.
- Therefore, 1 hp = 746 W.

Why other options are incorrect:

These are merely incorrect memory distractors.

Question #69 **Key: (B)**

PMDC 2021

A machine does 2500 J of work in 1 min. What is the power developed by the machine? [NMDCAT 2021]

CORE CONCEPT AND DERIVATION

Power is the rate of doing work. Time must be converted into SI units (seconds).

Formula:

$$P = \frac{W}{t}$$

Solution:

- Work (W) = 2500 J
- Time (t) = 1 min = 60 s
- $P = \frac{2500}{60} = \frac{250}{6} = 41.66 \text{ W}$
- This safely rounds to 42 W.

Why other options are incorrect:

If you fail to convert minutes to seconds, you calculate $2500 / 1 = 2500 \text{ W}$ (Option D). Option C results from flawed mental math.

Question #70 **Key: (B)**

PMDC 2021

A moving car possesses [NMDCAT 2021]

CORE CONCEPT AND DERIVATION

An object in motion intrinsically possesses Kinetic Energy, which is a form of Mechanical Energy.

Formula:

$$M.E = K.E + P.E$$

Solution:

- Because the car is moving, it has velocity, giving it $\frac{1}{2}mv^2$.
- Kinetic energy is categorized broadly as Mechanical energy.

Why other options are incorrect:

While a car produces heat and sound, and uses chemical energy (fuel), its pure state of gross physical motion is represented entirely by Mechanical energy.

Question #71 **Key: (D)**

PMDC 2021

kWh is the unit of [NMDCAT 2021]

CORE CONCEPT AND DERIVATION

Multiplying Power by Time gives Energy.

Formula:

$$E = P \times t$$

Solution:

- kW (Kilowatt) is Power.
- h (hour) is Time.
- Power $\times$ Time = Energy. This is the unit used by electric companies to measure energy consumption.

Why other options are incorrect:

Students confuse "Watt" with Power, failing to notice the multiplication by hours.

Question #72 Key: (B)

PMDC 2021

2kg mass is uplifted by the machine through the height of 200m for 10 sec calculate power deliver to the load....

CORE CONCEPT AND DERIVATION

Power output for lifting is the gravitational potential energy gained divided by the time taken.

Formula:

$$P = \frac{mgh}{t}$$

Solution:

- Mass (m) = 2 kg
- Gravity (g) = 10 m/s²
- Height (h) = 200 m
- Time (t) = 10 s
- Work Done = $mgh = 2 \times 10 \times 200 = 4000 \text{ J}$
- Power = $\frac{4000}{10} = 400 \text{ W}$

Why other options are incorrect:

Omitting gravity gives 40 W. Using an incorrect height or time gives extraneous results.

Question #73 Key: (B)

PMDC 2021

Light body A and heavy body B have equal K. E of translation. Then [NMDCAT 2021]

CORE CONCEPT AND DERIVATION

Relate kinetic energy and momentum directly using algebra.

Formula:

$$p = \sqrt{2mK.E}$$

Solution:

- Kinetic Energy (K.E) is equal for both bodies.
- The formula shows that momentum p is proportional to $\sqrt{m}$.
- Since body B is heavier ($m_B > m_A$), it will have a larger momentum ($p_B > p_A$).

Why other options are incorrect:

People confuse the velocity relationships. A light body moves much faster to have the same KE, but momentum heavily favors the mass component when KE is held constant.

Question #74 Key: (D)

PMDC 2021

If momentum is increased by 13% then K.E increase by [NMDCAT 2021]

CORE CONCEPT AND DERIVATION

Kinetic energy varies as the square of momentum.

Formula:

$$K.E \propto p^2$$

Solution:

- Let initial momentum $p_1 = 1$. Then initial K.E $E_1 = 1^2 = 1$.
- Increase p by 13%. New momentum $p_2 = 1.13$.
- New K.E $E_2 = (1.13)^2 = 1.2769$.
- The increase in K.E is $1.2769 - 1 = 0.2769$, or 27.69%.
- Since 27.69% is not present in options A, B, or C, the answer is None.

Why other options are incorrect:

Students might do simple additive math or miscalculate 1.13^2 . None of the distractors mathematically align with squaring 1.13.

Question #75 Key: (D)

PMDC 2020

A 1.75 m heighted weight-lifter raises weights with a mass of 50 kg to a height of .5m above his head. How muc...

CORE CONCEPT AND DERIVATION

Work done against gravity is the product of weight (mg) and the total vertical displacement from the ground.

Formula:

$$W = mgh$$

Solution:

- Mass (m) = 50 kg
- Total vertical height from ground (h) = Lifter's height + extra height = $1.75 + 0.5 = 2.25$ m
- $g = 10 \text{ m/s}^2$
- $W = 50 \times 10 \times 2.25 = 500 \times 2.25 = 1125 \text{ J}$

Why other options are incorrect:

Using only the lifter's height gives 875 J. Using only the height above the head gives 250 J. You must use the total vertical lift distance from rest.

Question #76 **Key: (B)**

PMDC 2020

When the speed of your car is halved, by what factor does its kinetic energy decrease? [NMDCAT 2020]

CORE CONCEPT AND DERIVATION

Kinetic energy is directly proportional to the square of velocity.

Formula:

$$K.E = \frac{1}{2}mv^2$$

Solution:

- Let initial velocity be v and initial kinetic energy be $K.E$.
- New velocity is $v/2$.
- New $K.E = \frac{1}{2}m\left(\frac{v}{2}\right)^2 = \frac{1}{2}m\left(\frac{v^2}{4}\right)$
- New $K.E = \frac{1}{4} \times \left(\frac{1}{2}mv^2\right) = \frac{1}{4}K.E$
- Therefore, it decreases by a factor of $1/4$.

Why other options are incorrect:

Assuming a linear relationship leads to $1/2$. The correct quadratic relationship dictates $1/4$.

Question #77 **Key: (A)**

PMDC 2020

Which of the following force is non-conservative force? [NMDCAT 2020]

CORE CONCEPT AND DERIVATION

A non-conservative force dissipates mechanical energy (often into heat) and the work done by it depends entirely on the path taken, not just initial and final positions.

Formula:

$$W_{\text{closed}} \neq 0$$

Solution:

- Frictional force opposes motion constantly. If you move an object in a closed loop, friction does negative work the entire time, dissipating energy.
- Therefore, friction is path-dependent and non-conservative.

Why other options are incorrect:

Gravitational, electric, and spring forces are conservative. Energy stored against them can be perfectly recovered as kinetic energy.

Question #78 **Key: (C)**

NUMS 2020

The area under force - displacement graph gives us: [NUMS 2020]

CORE CONCEPT AND DERIVATION

On a graph, the area under the curve is the product of the quantities on the y-axis and x-axis.

Formula:

$$W = \int F dx$$

Solution:

- The y-axis represents Force (F).
- The x-axis represents Displacement (d).
- Area = $F \times d$, which is the definition of Work Done.

Why other options are incorrect:

Area under Velocity-Time gives displacement. Power is work divided by time, not force times displacement. Acceleration is force divided by mass.

Question #79 Key: (A)

NUMS 2020

Kilowatt-hour is unit of: [NUMS 2020]

CORE CONCEPT AND DERIVATION

A unit formed by multiplying Power and Time always yields a measure of Energy.

Formula:

$$E = P \times t$$

Solution:

- Kilowatt (kW) is a unit of Power.
- Hour (h) is a unit of Time.
- Power $\times$ Time = Energy.
- $1 \text{ kWh} = 1000 \text{ W} \times 3600 \text{ s} = 3.6 \times 10^6 \text{ Joules}$, which is the standard commercial unit of electrical energy.

Why other options are incorrect:

Students often see "Watt" and immediately assume Power. However, multiplying it by time converts it back to Energy.

Question #80 Key: (D)

MDCAT 2019

An automobile is moving forwards with uniform velocity due to the force exerted by its engine. If that force i...

CORE CONCEPT AND DERIVATION

Power output is directly proportional to both the force exerted and the velocity at which the object moves.

Formula:

$$P = F \times v$$

Solution:

- Initial Power $P = Fv$
- New Force $= 2F$
- Velocity remains v
- New Power $P' = (2F)v = 2(Fv) = 2P$
- Thus, the power is doubled.

Why other options are incorrect:

Since the relationship is strictly linear, doubling one variable (while keeping the other constant) doubles the product. It does not square it or halve it.

Question #81 Key: (D)

MDCAT 2019

Which of the following statement shows that no work is done?
[MDCAT 2019]

CORE CONCEPT AND DERIVATION

In physics, mechanical work is zero if the force acts perpendicularly to the direction of motion at all times.

Formula:

$$W = Fd \cos(90^\circ) = 0$$

Solution:

- For a moon orbiting Earth in a circular path, the gravitational force provides centripetal force, pointing towards Earth's center.
- The velocity (and instantaneous displacement) is tangential, forming a 90° angle with the force.
- Therefore, $\cos(90^\circ) = 0$, so no work is done.

Why other options are incorrect:

Pushing a car and lifting weights involve forces applied in the same direction as displacement, doing positive work. Writing involves frictional forces and micro-displacements, doing work.

Question #82 Key: (A)

MDCAT 2018

Energy consumed by 60-watt bulb in 2 minutes is equal to [MDCAT 2018]

CORE CONCEPT AND DERIVATION

Electrical energy consumed is calculated by multiplying the power rating by the time in seconds.

Formula:

$$E = P \times t$$

Solution:

- Power (P) = 60 W
- Time (t) = 2 minutes = $2 \times 60 = 120$ seconds
- $E = 60 \times 120 = 7200$ Joules
- Convert to kilo-joules: $7200 \text{ J} = 7.2 \text{ kJ}$

Why other options are incorrect:

Failing to convert minutes to seconds yields $60 \times 2 = 120 \text{ J}$ (Option B). Dropping a zero yields 720 J (Option C).

Question #83 **Key: (C)**

MDCAT 2018

A stone of mass 2.0 kg is dropped from a rest position 5.0m above the ground. What is its velocity at a height...

CORE CONCEPT AND DERIVATION

Using the Law of Conservation of Energy, the loss in potential energy equals the gain in kinetic energy. The velocity depends only on the distance it has fallen, not the mass.

Formula:

$$v = \sqrt{2g\Delta h}$$

Solution:

- Initial height = 5.0 m
- Final height = 3.0 m
- Distance fallen (Δh) = 5.0 - 3.0 = 2.0 m
- $v = \sqrt{2 \times 9.8 \times 2.0} = \sqrt{39.2}$
- Since $6^2 = 36$ and $7^2 = 49$, $\sqrt{39.2}$ is slightly more than 6.
- $v \approx 6.26$ m/s, which rounds to 6.3 m/s.

Why other options are incorrect:

Using the remaining height (3m) instead of the fallen distance gives $\sqrt{2 \times 9.8 \times 3} \approx 7.7$ m/s. Calculating velocity at the very bottom ($h=5m$) gives $\sqrt{98} \approx 9.9$ m/s.

Question #84 **Key: (A)**

MDCAT 2018

The rate at which work is being done is called: [MDCAT 2018]

CORE CONCEPT AND DERIVATION

By fundamental physics definitions, power is the measure of how fast work is accomplished or energy is transferred.

Formula:

$$P = \frac{\Delta W}{\Delta t}$$

Solution:

- The term "rate" implies division by time.
- Work divided by time is Power, measured in Watts (J/s).

Why other options are incorrect:

Energy is the capacity to do work, not the rate. Force is a push or pull. Density is mass per unit volume.

Question #85 **Key: (B)**

KMU 2018

A man has a mass of 80 kg. He ties himself to one end of rope which passes over a single fixed pulley. He pull...

CORE CONCEPT AND DERIVATION

Power can be calculated as the product of the upward force applied (to overcome gravity) and the constant velocity of the mass.

Formula:

$$P = F \cdot v = (mg) \cdot v$$

Solution:

- Mass (m) = 80 kg
- Velocity (v) = 50 cm/s = 0.5 m/s
- Force required = Weight = $mg = 80 \times 9.8 = 784$ N
- Power $P = 784 \times 0.5 = 392$ W
- Convert to kilowatts: $\frac{392}{1000} = 0.392$ kW

Why other options are incorrect:

If $g = 10$ is used, $P = 800 \times 0.5 = 400$ W = 0.4 kW. The closest exact answer using 9.8 is 0.39 kW. Failing to convert cm/s to m/s results in large values like 39 kW.

Question #86 **Key: (B)**

KMU 2018

If the momentum of a body decreases by 20% the percentage decreases in K.E will be: [ETEA 2018]

CORE CONCEPT AND DERIVATION

Kinetic energy is directly proportional to the square of momentum.

Formula:

$$K.E = \frac{p^2}{2m} \implies K.E \propto p^2$$

Solution:

- Let initial momentum be $p_1 = 100$. Initial K.E $\propto (100)^2 = 10000$.
- A 20% decrease means new momentum $p_2 = 80$.
- New K.E $\propto (80)^2 = 6400$.
- Decrease in K.E = $10000 - 6400 = 3600$.
- Percentage decrease = $\frac{3600}{10000} \times 100\% = 36\%$.

Why other options are incorrect:

Directly assuming K.E decreases by the same 20% ignores the squared relationship. 44% is the answer for a 20% increase in momentum.

Question #87 Key: (C)

KMU 2018

A man carries a 1 kg body 10m horizontally on a level ground. The work done by the man is: [ETEA 2018]

CORE CONCEPT AND DERIVATION

Work is calculated as the dot product of force and displacement. When moving horizontally at constant speed, the applied lifting force is upward (against gravity), while the displacement is horizontal.

Formula:

$$W = Fd \cos \theta$$

Solution:

- The force holding the object up is vertical.
- The displacement is horizontal.
- The angle θ between force and displacement is 90° .
- $\cos(90^\circ) = 0$
- $W = Fd(0) = 0 \text{ J}$

Why other options are incorrect:

Multiplying mass and distance (1×10) yields 10, which incorrectly assumes the force and displacement are in the same direction.

Question #88 Key: (D)

MDCAT 2017

A B C Closed Loop Path Closed Path F-d Graph (Total Work Done in Closed Loop = 0) Total work done in figure [M...

CORE CONCEPT AND DERIVATION

The net work done by a conservative force in moving an object along a closed path (returning to the exact starting position) is always zero.

Formula:

$$\oint \vec{F} \cdot d\vec{r} = 0$$

Solution:

- The figure represents a cyclic process forming a closed loop on a Force-Displacement graph.
- In a closed path under a conservative field, the positive work done expanding is exactly canceled by the negative work done returning to the origin.
- Thus, the net work is 0 Nm.

Why other options are incorrect:

Calculating the geometric area inside the loop gives the work done during one specific cycle segment, but the total/net displacement from start to finish is zero, yielding zero net work.

Question #89 Key: (B)

MDCAT 2017

Work done will be zero if angle between Force and displacement is:
[MDCAT 2017]

CORE CONCEPT AND DERIVATION

Work is the dot product of force and displacement, meaning it depends directly on the cosine of the angle between them.

Formula:

$$W = Fd \cos \theta$$

Solution:

- When $\theta = 270^\circ$, the force and displacement are perpendicular to each other.
- $\cos(270^\circ) = 0$
- Therefore, $W = Fd(0) = 0$

Why other options are incorrect:

At 0° and 360° , $\cos \theta = 1$, yielding maximum positive work. At 60° , $\cos(60^\circ) = 0.5$, yielding half the maximum work.

Question #90 Key: (D)

MDCAT 2017

If mass 'm' is dropped from height 'h' vertically, f is the force of friction during downward motion and 'v' i...

CORE CONCEPT AND DERIVATION

According to the Conservation of Energy in the presence of non-conservative forces, the initial potential energy is converted into kinetic energy plus the work done against friction.

Formula:

$$E_{\text{initial}} = E_{\text{final}} + W_{\text{friction}}$$

Solution:

- Initial energy at height h is entirely Potential Energy:
 $P.E = mgh$
- Final energy at the bottom is Kinetic Energy: $K.E = \frac{1}{2}mv^2$
- Work done against air friction over distance h : $W = fh$
- Equating them: $mgh = \frac{1}{2}mv^2 + fh$

Why other options are incorrect:

Option A implies energy is created. Option B implies friction work equals total energy. Option C incorrectly subtracts friction work instead of adding it to the final state energies.

Question #91 Key: (A)

MDCAT 2017

At what angle work done will be maximum? [MDCAT 2017]

CORE CONCEPT AND DERIVATION

Work depends on the cosine of the angle between the applied force vector and the displacement vector.

Formula:

$$W = Fd \cos \theta$$

Solution:

- The cosine function reaches its maximum positive value when the angle $\theta = 0^\circ$.
- $\cos(0^\circ) = 1$
- Therefore, the work done is $W = Fd(1) = Fd$, which is the maximum possible work.

Why other options are incorrect:

At 90° , work is zero. At 30° and 45° , the cosine values are $\frac{\sqrt{3}}{2}$ and $\frac{1}{\sqrt{2}}$ respectively, which yield fractions of the maximum work.

Question #92 Key: (B)

MDCAT 2017

Which one of the following is a greater work? [MDCAT 2017]

CORE CONCEPT AND DERIVATION

Work is a scalar quantity. The positive (+) or negative (-) signs merely indicate whether energy is being transferred to the system (positive) or from the system (negative, like work done against friction). "Greater work" refers to the largest absolute magnitude of energy transferred.

Formula:

$$|W| = \text{Magnitude of energy transfer}$$

Solution:

- Compare the absolute magnitudes of the given options:
- $|+100| = 100 \text{ J}$
- $|-1000| = 1000 \text{ J}$
- $|-100| = 100 \text{ J}$
- $|+200| = 200 \text{ J}$
- 1000 J is the greatest magnitude of energy transferred.

Why other options are incorrect:

Students often mistake the (-) sign for a mathematical algebraic value (where -1000 is smaller than +100). In physics, a negative work of 1000 J means 1000 J of energy was removed, which is a "greater" amount of work than adding 100 J.

Question #93 Key: (A)

MDCAT 2017

$d(m)$ $F(N)$ $+10$ -10 0 1 2 3 $+10$ J -10 J $+10$ J Force-Displacement Curve (F vs d) The figure shows the force dis...

CORE CONCEPT AND DERIVATION

The work done by a variable force is equal to the net area under the Force-Displacement (F - d) graph. Areas above the x -axis represent positive work, and areas below represent negative work.

Formula:

$$W = \sum \text{Area}$$

Solution:

- Based on standard graph variations of this problem: The graph consists of three rectangular segments.
- Segment 1: Force = $+10$ N, Displacement = 1 m. Area = $10 \times 1 = +10$ J
- Segment 2: Force = -10 N, Displacement = 1 m. Area = $-10 \times 1 = -10$ J
- Segment 3: Force = $+10$ N, Displacement = 1 m. Area = $10 \times 1 = +10$ J
- Net Work = $(+10) + (-10) + (+10) = 10$ J

Why other options are incorrect:

Ignoring the negative sign for areas below the x -axis results in 30 J (Option B). Only looking at two positive segments gives 20 J (Option C).

Question #94 Key: (B)

KMU 2017

A man of mass 60 kg climbs up a 20 m long staircase to the top of a building 10 m high. What is the work done by...

CORE CONCEPT AND DERIVATION

Work done against gravity depends entirely on the vertical height gained, independent of the actual path taken (like the slope length of the stairs).

Formula:

$$W = mgh$$

Solution:

- Mass (m) = 60 kg
- Vertical Height (h) = 10 m (Ignore the 20 m staircase length; it is path-dependent data irrelevant for conservative gravitational work).
- $W = 60 \times 10 \times 10 = 6000$ J
- Convert to kilo-joules: 6000 J = 6 KJ

Why other options are incorrect:

Using the slant length of the staircase (20 m) instead of vertical height yields $60 \times 10 \times 20 = 12000$ J or 12 KJ (Option A), which is incorrect because gravity only acts vertically.

Question #95 **Key: (B)**

KMU 2017

When a force retards the motion of a body the work done is: [ETEA 2017]

CORE CONCEPT AND DERIVATION

A retarding force is one that opposes the direction of motion (e.g., friction or braking force). In this case, the angle between force and displacement is 180° .

Formula:

$$W = Fd \cos \theta$$

Solution:

- Angle $\theta = 180^\circ$
- $\cos(180^\circ) = -1$
- $W = Fd(-1) = -Fd$
- The work done is fundamentally negative because energy is being removed from the moving body.

Why other options are incorrect:

Positive work implies the force aids motion (speeding the object up). Zero work implies force acts perpendicularly. Option D is incorrect because retardation strictly implies opposition.

Question #96 **Key: (A)**

KMU 2017

An engine pumps out 40 kg of water in one second. The water comes out vertically upwards with a velocity of [F...]

CORE CONCEPT AND DERIVATION

Power can be calculated using the force exerted and the velocity at which the mass moves. Since water is pumped vertically, the force must overcome gravity.

Formula:

$$P = F \cdot v = (mg) \cdot v$$

Solution:

- Mass per second (m/t) = 40 kg/s
- Velocity (v) = 3 m/s
- Assume $g = 10 \text{ m/s}^2$ for standard ETEA simplicity.
- $P = (40 \times 10) \times 3 = 400 \times 3 = 1200 \text{ W}$
- Convert to kilowatts: $1200 \text{ W} = 1.2 \text{ kW}$

Why other options are incorrect:

Forgetting to convert Watts to Kilowatts yields 1200 (Option D). Dividing by 10 instead of 1000 yields 120 kW. These are unit conversion errors.

Question #97 **Key: (B)**

KMU 2017

Two boys weighing in the ratio 4:5 goes up stair taking time in the ratio 5:4. The ratio of their power is: [E...]

CORE CONCEPT AND DERIVATION

Power is the rate of doing work. In climbing stairs, work done is equal to the potential energy gained (weight $\times$ height).

Formula:

$$P = \frac{W}{t} = \frac{mgh}{t}$$

Solution:

- Weight ratio: $\frac{w_1}{w_2} = \frac{m_1g}{m_2g} = \frac{4}{5}$
- Time ratio: $\frac{t_1}{t_2} = \frac{5}{4}$
- Since they climb the same stairs, height h is constant.
- $\frac{P_1}{P_2} = \left(\frac{w_1}{w_2}\right) \times \left(\frac{t_2}{t_1}\right)$
- Notice we must flip the time ratio because time is in the denominator: $\frac{t_2}{t_1} = \frac{4}{5}$
- $\frac{P_1}{P_2} = \left(\frac{4}{5}\right) \times \left(\frac{4}{5}\right) = \frac{16}{25}$

Why other options are incorrect:

If you multiply the direct ratios without flipping time ($4/5 \times 5/4$), you get 1 (Option A). If you flip weight instead of time, you get $25/16$ (Option C).

Question #98 **Key: (D)**

MDCAT 2016

Potential energy per unit volume is given by [MDCAT 2016]

CORE CONCEPT AND DERIVATION

Density (ρ) is defined as mass per unit volume (m/V). We can substitute this into the standard potential energy formula.

Formula:

$$\frac{P.E}{V} = \frac{mgh}{V}$$

Solution:

- Gravitational Potential Energy = mgh
- Divide by Volume (V): $\frac{mgh}{V}$
- Since mass/volume ($\frac{m}{V}$) is density (ρ), the expression becomes ρgh .

Why other options are incorrect:

Option A is total potential energy. Option B is potential energy per unit mass. Option C wrongly divides by density instead of multiplying.

Question #99 Key: (B)

KMU 2015

A 6.0 kg block is released from rest 80m above the ground. When it has fallen 60m its kinetic energy is approx...

CORE CONCEPT AND DERIVATION

According to the Law of Conservation of Energy, the loss in gravitational potential energy equals the gain in kinetic energy for a freely falling body.

Formula:

$$\text{Loss in P.E} = \text{Gain in K.E} = mg\Delta h$$

Solution:

- Mass (m) = 6.0 kg
- Distance fallen (Δh) = 60 m (Note: we use the distance it has *fallen*, not its height from the ground).
- Using $g \approx 9.8 \text{ m/s}^2$:
- $K.E = 6.0 \times 9.8 \times 60 = 58.8 \times 60 = 3528 \text{ J}$
- This is approximately 3500 J.

Why other options are incorrect:

Using the remaining height of 20m instead of the fallen distance gives $6 \times 9.8 \times 20 \approx 1200 \text{ J}$ (Option C). Using the total height 80m gives $\approx 4800 \text{ J}$ (Option A).

Question #100 Key: (C)

MDCAT 2010

The consumption of energy by 60-watt bulb in 2 seconds is: [MCAT 2010]

CORE CONCEPT AND DERIVATION

Energy consumption is the product of the power of the device and the time it operates.

Formula:

$$E = P \times t$$

Solution:

- Given Power (P) = 60 W (which is 60 Joules/second)
- Given Time (t) = 2 s
- $E = 60 \text{ J/s} \times 2 \text{ s} = 120 \text{ J}$

Why other options are incorrect:

Dividing power by time ($60/2$) gives 30 J (Option B). Other options arise from incorrect arithmetic manipulation of the given numbers.

Question #101 Key: (D)

MDCAT 2010

Which one of the following is a non-conservative force? [MCAT 2010]

CORE CONCEPT AND DERIVATION

A non-conservative force is a force for which the work done depends on the path taken. The mechanical energy of a system is not conserved when non-conservative forces act (it dissipates as heat or sound).

Formula:

$$W_{\text{closed path}} \neq 0$$

Solution:

- Electric, gravitational, and elastic spring forces are all conservative forces because work done by them over a closed loop is zero.
- Frictional force is path-dependent and dissipates energy as heat, making it a classic non-conservative force.

Why other options are incorrect:

Options A, B, and C are fundamental conservative fields where potential energy can be perfectly defined and recovered.

Question #102 Key: (D)

MDCAT 2010

*If velocity is double, then. [MCAT 2010]***CORE CONCEPT AND DERIVATION**

Momentum is directly proportional to velocity, while kinetic energy is proportional to the square of velocity.

Formula:

$$p = mv \quad \text{and} \quad K.E = \frac{1}{2}mv^2$$

Solution:

- If $v' = 2v$:
- New momentum: $p' = m(2v) = 2mv = 2p$ (Increases 2 times)
- New Kinetic Energy: $K.E' = \frac{1}{2}m(2v)^2 = \frac{1}{2}m(4v^2) = 4 \times (\frac{1}{2}mv^2) = 4K.E$ (Increases 4 times)

Why other options are incorrect:

Options A, B, and C swap or ignore the linear relationship of momentum and the quadratic relationship of kinetic energy with velocity.

Question #103 Key: (C)

KMU 2010

*The heat energy dissipated by 40 watts bulb in one hour is [ETEA 2010]***CORE CONCEPT AND DERIVATION**

Energy dissipated is the product of power output and the time period in standard SI units (seconds).

Formula:

$$E = P \times t$$

Solution:

- Power (P) = 40 W
- Time (t) = 1 hour = 3600 seconds
- $E = 40 \times 3600$
- $E = 144000$ Joules

Why other options are incorrect:

Failing to convert hours to seconds (using $t=60$ for minutes, etc.) or making a zero-counting error leads to options A, B, or D.

Question #104 Key: (A)

KMU 2010

The gravitational potential energy per unit mass is called: [ETEA 2010]

CORE CONCEPT AND DERIVATION

Gravitational potential at a point in a gravitational field is defined as the work done per unit mass to bring a test mass from infinity to that point.

Formula:

$$V_g = \frac{U}{m} = \frac{mgh}{m} = gh$$

Solution:

- Potential Energy (U) is energy associated with a specific mass m .
- When we divide this energy by the mass (U/m), we get a property of the field itself, independent of the test mass. This is called Gravitational Potential.

Why other options are incorrect:

Absolute P.E and regular P.E are measures of total energy (Joules), not energy per unit mass (Joules/kg). A potential hill is a visual analogy, not the physical quantity.

Question #105 Key: (B)

MDCAT 2009

If a certain force acts on an object and changes its kinetic energy from 65 J to 130 J, then work done by the ...

CORE CONCEPT AND DERIVATION

According to the Work-Energy Principle, the net work done on an object is strictly equal to the change in its kinetic energy.

Formula:

$$W = \Delta K.E = K.E_f - K.E_i$$

Solution:

- Final Kinetic Energy ($K.E_f$) = 130 J
- Initial Kinetic Energy ($K.E_i$) = 65 J
- $W = 130 \text{ J} - 65 \text{ J} = 65 \text{ J}$

Why other options are incorrect:

Option D represents only the final kinetic energy. Options A and C result from arbitrary arithmetic (like taking averages) rather than applying the direct difference.

Question #106 Key: (C)

MDCAT 2008

A force [Formula] has moved its point of application from (2,3) to (6,5). What is work done? [MCAT 2008]

CORE CONCEPT AND DERIVATION

Work done by a constant force is the dot product of the force vector and the displacement vector.

Formula:

$$W = \vec{F} \cdot \vec{d}$$

Solution:

- First, calculate the displacement vector $\vec{d}$ by subtracting the initial position from the final position.
- $\vec{d} = (6 - 2)\hat{i} + (5 - 3)\hat{j} = 4\hat{i} + 2\hat{j}$
- Now, take the dot product of $\vec{F}$ and $\vec{d}$.
- $W = (2\hat{i} + \hat{j}) \cdot (4\hat{i} + 2\hat{j})$
- $W = (2 \times 4) + (1 \times 2) = 8 + 2 = 10 \text{ J}$

Why other options are incorrect:

Subtracting the coordinates incorrectly or failing to apply the dot product rule (e.g., multiplying mismatched components) leads to incorrect negative or larger values like -10, -18, or +18.

Question #107 Key: (B)

MDCAT 2008

100 joules work has been done by an agency in 10 seconds. What is power of agency? [MCAT 2008]

CORE CONCEPT AND DERIVATION

Power is defined as the rate at which work is done or energy is transferred.

Formula:

$$P = \frac{W}{t}$$

Solution:

- Given Work (W) = 100 J
- Given Time (t) = 10 s
- Substitute the values: $P = \frac{100}{10} = 10 \text{ W}$

Why other options are incorrect:

Multiplying work and time gives 1000 W (Option A). Confusing the values or incorrectly placing the decimal gives 100 W or 0.10 W.

Question #108 Key: (D)

MDCAT 2008

Work done on a body equals change in its ____ energy. [MCAT 2008]

CORE CONCEPT AND DERIVATION

The generalized Work-Energy Principle states that the net work done on a system can manifest as a change in kinetic energy, potential energy, or total mechanical energy, depending on the forces acting (conservative vs. non-conservative).

Formula:

$$W_{\text{net}} = \Delta K.E + \Delta P.E$$

Solution:

- Work done on a freely moving body changes its Kinetic Energy (Work-Kinetic Energy Theorem).
- Work done against a conservative force (like gravity or a spring) changes its Potential Energy.
- Work done on a mass-spring system can change the Total Energy.
- Therefore, work can equal the change in any of these energies depending on the exact conditions.

Why other options are incorrect:

While work equals change in kinetic energy specifically for the net force, and change in potential energy for conservative forces, stating only one of them is incomplete in a general sense.