

STUDYNEST | CLASS 11 PHYSICS QUESTION PAPER 1

Chapter 5: Work, Energy and Power

Maximum Marks: 40 | Suggested time: 60 minutes

Instructions: Answer all questions. Show calculation steps and units. Original practice paper, not an official examination.

Section A 1-mark questions - $8 \times 1 = 8$ marks

1. When is work zero with displacement? [1]
2. Kinetic energy? [1]
3. SI unit of power? [1]
4. Work-energy theorem? [1]
5. Spring energy? [1]
6. What is conserved in an isolated elastic collision? [1]
7. Near-earth gravitational potential energy? [1]
8. Work by centripetal force in uniform circular motion? [1]

Section B 2-mark questions - $6 \times 2 = 12$ marks

9. 10 N over 4 m along force: work? [2]
10. 3 kg at 4 m/s: K? [2]
11. 100 W for 20 s: energy? [2]
12. 200 N perpendicular to 5 m displacement: work? [2]
13. $k=200$ N/m, spring stretched .1 m: energy? [2]
14. 1 kg cart at 5 m/s sticks to stationary 4 kg: speed? [2]

Section C 3-mark questions - $4 \times 3 = 12$ marks

15. 2 kg speeds from 2 to 6 m/s: net work? [3]
16. 5 kg falls 3 m, $g=10$: final speed? [3]
17. $F=4x$ N from $x=0$ to 3 m: work? [3]
18. 1000 kg car at 20 m/s stops in 50 m: W and force magnitude? [3]

Section D 4-mark questions - $2 \times 4 = 8$ marks

19. 2 kg drops 5 m frictionlessly, $g=10$: speed; with 20 J loss? [4]
20. 1 kg cart at 8 m/s sticks to 3 kg stationary: speed and energy loss? [4]

End of question paper.

FORMULA AND EQUATION REFERENCE

Chapter-specific equations worth knowing

- Work: $W = F_s \cos(\theta)$; if force is perpendicular, $W=0$.
- Kinetic energy $K = \frac{1}{2}mv^2$; gravitational potential near Earth $U = mgh$; spring energy $U_s = \frac{1}{2}kx^2$.
- Work-energy theorem: $W_{\text{net}} = \Delta K = \frac{1}{2}m(v^2 - u^2)$.
- Power $P = W/t$; energy transferred $E = Pt$.
- Momentum conservation in a perfectly inelastic collision: $m_1u_1 + m_2u_2 = (m_1 + m_2)v$.
- For $F = kx$ from $x=0$ to $x=a$: $W = \int_0^a F \, dx = \frac{1}{2}ka^2$.
- For a falling body without losses: $mgh = \frac{1}{2}mv^2$, so $v = \sqrt{2gh}$.
- Stopping force magnitude for constant force: $|F| = |W|/\text{distance}$.

Use each equation only when its assumptions apply; keep units consistent.

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STEP-BY-STEP SOLUTIONS

Solutions are grouped here after the question paper and formula reference.

Question 1

Principle / definition: Recall the relevant definition or equation from the formula reference.

Apply it to this question: When force is perpendicular to displacement.

Final answer: When force is perpendicular to displacement.

Question 2

Principle / definition: Recall the relevant definition or equation from the formula reference.

Apply it to this question: mv^2 .

Final answer: mv^2 .

Question 3

Principle / definition: Recall the relevant definition or equation from the formula reference.

Apply it to this question: Watt.

Final answer: Watt.

Question 4

Principle / definition: Recall the relevant definition or equation from the formula reference.

Apply it to this question: Net work equals change in kinetic energy.

Final answer: Net work equals change in kinetic energy.

Question 5

Principle / definition: Recall the relevant definition or equation from the formula reference.

Apply it to this question: kx^2 .

Final answer: kx^2 .

Question 6

Principle / definition: Recall the relevant definition or equation from the formula reference.

Apply it to this question: Momentum and kinetic energy.

Final answer: Momentum and kinetic energy.

Question 7

Principle / definition: Recall the relevant definition or equation from the formula reference.

Apply it to this question: mgh .

Final answer: mgh .

Question 8

Principle / definition: Recall the relevant definition or equation from the formula reference.

Apply it to this question: Zero.

Final answer: Zero.

Question 9

Working: Work $W = Fs \cos 0 = 10(4)(1) = 40$ J.

Final answer: 40 J.

Question 10

Working: $K = \frac{1}{2}mv^2 = 0.5(3)(4^2) = 1.5(16) = 24$ J.

Final answer: 24 J.

Question 11

Working: Energy transferred $E = Pt = 100(20) = 2000$ J.

Final answer: 2000 J.

Question 12

Working: $W = Fs \cos 90^\circ = 0$ J because the force is perpendicular to displacement.

Final answer: 0 J.

Question 13

Working: Spring energy $U = \frac{1}{2}kx^2 = 0.5(200)(0.1^2) = 100(0.01) = 1$ J.

Final answer: 1 J.

Question 14

Working: Conserve momentum: $(1)(5) + (4)(0) = (1+4)v$, so $v = 5/5 = 1$ m/s.

Final answer: 1 m/s.

Question 15

Working: Net work = change in kinetic energy $= 0.5m(v^2 - u^2) = 0.5(2)(36 - 4) = 32$ J.

Final answer: 32 J.

Question 16

Working: $mgh = (1/2)mv^2$; mass cancels, so $v = \sqrt{2gh} = \sqrt{2(10)(3)} = \sqrt{60} = 7.75 \text{ m/s}$.

Final answer: $\sqrt{60}$ approx 7.75 m/s.

Question 17

Working: $F = 4x$. Work is the area under F-x graph: integral from 0 to 3 of $4x \, dx = [2x^2]_0^3 = 18 \text{ J}$.

Final answer: 18 J.

Question 18

Working: Initial $K = 0.5(1000)(20^2) = 200,000 \text{ J}$. Work by braking $= -200,000 \text{ J} = -200 \text{ kJ}$. Average stopping force magnitude $= 200,000/50 = 4000 \text{ N}$.

Final answer: -200 kJ; 4000 N.

Question 19

Working: Without loss, $mgh = K$ gives $v = \sqrt{2gh} = \sqrt{100} = 10 \text{ m/s}$. If 20 J is lost, initial potential energy $= 2(10)(5) = 100 \text{ J}$ and final $K = 80 \text{ J}$; $v = \sqrt{2K/m} = \sqrt{80} = 8.94 \text{ m/s}$.

Final answer: 10 m/s; $\sqrt{80}$ approx 8.94 m/s.

Question 20

Working: Momentum conservation gives $(1)(8) = (1+3)v$, so $v = 2 \text{ m/s}$. Initial $K = 0.5(1)(64) = 32 \text{ J}$; final $K = 0.5(4)(2^2) = 8 \text{ J}$; energy lost $= 32 - 8 = 24 \text{ J}$.

Final answer: 2 m/s; 24 J lost.

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