Work, Energy, and Simple Machines

Standard difficulty · 20 questions · 40 marks · Time: 36 minutes

Name: _____ Date: _____ Score: ____ / 40

Show your working for Sections B and C. Answers are on the last page — try every question first!

Section A — Choose the correct answer — 8 × 1 = 8 marks

1. A force of 35 N moves an object 22 m in the direction of the force. The work done is:
(a) 1.59 J **(b)** 57 J **(c)** 1,540 J **(d)** 770 J

2. The kinetic energy of a 51 kg body moving at 20 m/s is:
(a) 10,200 J **(b)** 20,400 J **(c)** 510 J **(d)** 1,020 J

3. The potential energy of a 16 kg object at a height of 2 m is ($g = 9.8\ m/s^2$):
(a) 156.8 J **(b)** 32 J **(c)** 176.4 J **(d)** 313.6 J

4. 3,424 J of work is done in 8 s. The power is:
(a) 3424 W **(b)** 27,392 W **(c)** 428 W **(d)** 436 W

5. The SI unit of work is:
(a) pascal (Pa) **(b)** watt (W) **(c)** joule (J) **(d)** newton (N)

6. 10 kWh of energy in joules is:
(a) 3.6×10^7 J **(b)** 3.6×10^6 J **(c)** 3.6×10^4 J **(d)** 10,000 J

7. A 2000 W appliance is used for 2 hours a day for 20 days. The energy used is:
(a) 800 kWh **(b)** 80,000 kWh **(c)** 4 kWh **(d)** 80 kWh

8. A ramp is 9 m long and 1 m high. Ignoring friction, the effort needed to push a 3,600 N load up it is:
(a) 401 N **(b)** 3,600 N **(c)** 400 N **(d)** 800 N

Section B — Short answer — 8 × 2 = 16 marks

9. Find the work done in lifting a 48 kg load through a height of 16 m. Take $g = 9.8\ m/s^2$.

10. A 29 kg body speeds up from 2 m/s to 10 m/s. Find the work done on it. (Give the answer to 2 decimal places where needed.)

11. If its mass is multiplied by 4 and the speed of a body is divided by 5, what happens to its kinetic energy?

12. A motor lifts 180 kg through 21 m in 30 s. Find its power. Take g = 9.8 m/s^2. (Give the answer to 2 decimal places where needed.)

13. A house uses 301 units of electricity in a month. Find the bill at Rs 6.5 per unit.

14. A porter carries a 38 kg load on the head and walks 142 m along a level road. How much work is done against gravity?

15. A ball falls from rest through a height of 122.5 m. Find its speed just before it hits the ground. Take g = 9.8 m/s^2.

16. Using a lemon squeezer (a lever of the second class), a load of 120 N is 50 cm from the fulcrum and the effort is applied 400 cm from it. Find the effort needed and the mechanical advantage.

Section C — Word problems — 4 × 4 = 16 marks

17. A family uses 6 bulbs of 60 W for 4 hours a day and a 75 W fan for 6 hours a day. Find the electricity used in 30 days and the cost at Rs 5 per unit.

18. A car of mass 1,700 kg speeds up from 18 km/h to 90 km/h. Find the work done by its engine (ignore friction).

19. A crane lifts a load of 1,700 kg through 14 m in 40 s. Find the work done and the power of the crane. Take g = 9.8 m/s^2. (Give the answer to 2 decimal places where needed.)

20. A worker pushes a box of weight 1,440 N up a ramp 3 m long onto a platform 1 m high, using an effort of 600 N along the ramp. Find the useful work done, the work put in, the efficiency of the ramp and its mechanical advantage.

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Answer key

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Q	Answer	Working
1	**(d) 770 J**	W = F × s = 35 × 22
2	**(a) 10,200 J**	½mv^2 = ½ × 51 × 400
3	**(d) 313.6 J**	mgh = 16 × 9.8 × 2
4	**(c) 428 W**	P = W ÷ t = 3424 ÷ 8
5	**(c) joule (J)**	—
6	**(a) 3.6 × 10^7 J**	1 kWh = 3.6 × 10^6 J; × 10
7	**(d) 80 kWh**	2000 × 2 × 20 ÷ 1000
8	**(c) 400 N**	effort = load × height ÷ length = 3600 × 1 ÷ 9
9	**7,526.4 J**	W = mgh = 48 × 9.8 × 16
10	**1,392 J**	work = change in KE = ½ × 29 × (100 − 4)
11	**it becomes 4/25 times what it was**	KE ∝ mv^2: 4 × (1/5)^2 = 4/25
12	**1,234.8 W**	P = mgh ÷ t = 180 × 9.8 × 21 ÷ 30
13	**Rs 1,956.5**	301 × 6.5
14	**0 J**	gravity acts downwards and the motion is horizontal, at 90° to the force
15	**49 m/s**	mgh = ½mv^2, so v = √(2gh) = √(2 × 9.8 × 122.5) = √2401
16	**15 N; MA = 8**	effort × 400 = 120 × 50, so effort = 15; MA = load ÷ effort = 120 ÷ 15
17	**56.7 kWh; Rs 283.5**	(6 × 60 × 4 + 75 × 6) × 30 ÷ 1000 kWh
18	**510,000 J**	18 km/h = 5 m/s, 90 km/h = 25 m/s; work = ½ × 1700 × (625 − 25)
19	**233,240 J; 5,831 W**	W = mgh; P = W ÷ 40
20	**useful work 1,440 J; work put in 1,800 J; efficiency 80%; MA = 2.4**	useful work = 1440 × 1; work put in = 600 × 3; efficiency = 1440 ÷ 1800 × 100; MA = load ÷ effort = 1440 ÷ 600

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