Energy

GCSE Science • **Combined and Triple** • Grades 3–6

WORKED SOLUTIONS

Name: worked example Class: _____ Total: 55 / 55

Show all your working. Marks are given for correct method as well as the final answer.

1. Name the energy store of a moving car. **[1 mark]**

anything moving has a kinetic store

Answer: kinetic

2. Name the energy store of a book on a high shelf. **[1 mark]**

raised above the ground in a gravitational field

Answer: gravitational potential

3. Name the energy store of a stretched spring. **[1 mark]**

stretched or squashed, so elastic

Answer: elastic potential

4. Describe the energy transfer when a ball is dropped. **[2 marks]**

it loses height and gains speed
say the STORES, not energy is lost

Answer: gravitational potential → kinetic

5. State the principle of conservation of energy. **[2 marks]**

the total stays the same
it moves between stores

Answer: energy is not created or destroyed, only transferred

6. Write down the equation for kinetic energy. **[1 mark]**

half, times mass, times speed squared

Answer: $E_k = \frac{1}{2}mv^2$

7. A 1 200 kg car travels at 20 m/s. Work out its kinetic energy. **[3 marks]**

$\frac{1}{2} \times 1200 \times 20^2$
$20^2 = 400$
square the speed BEFORE multiplying
$0.5 \times 1200 \times 400 = 240\,000$ J

Answer: 240 000 **J**

8. The same car doubles its speed to 40 m/s. Explain what happens to its kinetic energy. **[3 marks]**

speed is SQUARED in the equation
$2^2 = 4$
so double the speed gives 4 times the energy

Answer: it becomes four times bigger

9. A cyclist has 900 J of kinetic energy and a mass of 72 kg. Work out their speed. **[4 marks]**

$900 = \frac{1}{2} \times 72 \times v^2$
$900 = 36v^2$
$v^2 = 25$
$v = 5$ m/s

Answer: 5 **m/s**

10. Write down the equation for gravitational potential energy. **[1 mark]**

mass × gravitational field strength × height

Answer: $E_p = mgh$

11. A 3 kg bag is lifted 1.5 m. Take $g = 9.8$ N/kg. Work out the energy transferred. **[3 marks]**

$3 \times 9.8 \times 1.5$
$= 44.1$ J

Answer: 44.1 **J**

12. A 60 kg climber gains 2 000 J of gravitational potential energy. Take $g = 10$ N/kg. Work out the height climbed. **[3 marks]**

$2000 = 60 \times 10 \times h$
$2000 = 600h$
$h = 3.33$ m

Answer: 3.33 **m**

13. Write down the equation for work done. **[1 mark]**

force × distance moved along the force

Answer: $W = Fs$

14. A force of 250 N pushes a crate 6 m. Work out the work done. **[2 marks]**

$250 \times 6 = 1500$ J

Answer: 1500 **J**

15. That work is done in 10 s. Work out the power. **[3 marks]**

power = work done ÷ time
$1500 \div 10 = 150$ W
1 watt is 1 joule per second

Answer: 150 **W**

16. A motor is rated at 2 kW. Work out the energy it transfers in 5 minutes. **[4 marks]**

2 kW = 2000 W
5 min = 300 s
both units must be SI before you multiply
$2000 \times 300 = 600\,000$ J

Answer: 600 000 **J**

17. Write down the equation for efficiency. **[1 mark]**

× 100 for a percentage

Answer: useful output ÷ total input

18. A lamp takes in 60 J and gives out 9 J of light. Work out its efficiency as a percentage. **[3 marks]**

$\frac{9}{60} \times 100$
$= 15\%$

Answer: 15 %

19. Explain why no device can be 100% efficient. **[2 marks]**

friction and resistance heat the surroundings
it is not lost -- it is dissipated

Answer: some energy is always dissipated

20. A kettle transfers 250 000 J to water and wastes 50 000 J.

(a) Work out the total energy supplied. **[2 marks]**

250 000 + 50 000
= 300 000 J

(b) Work out the efficiency as a percentage. **[3 marks]**

$\frac{250\,000}{300\,000} \times 100$
$= 83.3\%$

Answer: 300 000 J ; 83.3%

21. A student heats 0.5 kg of water. The specific heat capacity of water is 4 200 J/kg°C.

(a) Write down the equation linking energy, mass, specific heat capacity and temperature change. **[1 mark]**

$E = mc\Delta\theta$

(b) Work out the energy needed to raise it by 20°C. **[3 marks]**

$0.5 \times 4200 \times 20$
$= 42\,000$ J

Answer: $E = mc\Delta\theta$; 42 000 J

22. A house loses heat through its walls.

(a) Name two ways to reduce unwanted energy transfer from a house. **[2 marks]**

loft insulation, cavity wall insulation
double glazing, draught excluders

(b) Explain how cavity wall insulation reduces heat loss. **[3 marks]**

it traps air in the gap
air is a poor conductor
and the foam stops convection currents forming

Answer: insulation / glazing ; traps air, a poor conductor

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