Unit 5: Work, energy and power:

Subunit 5.1: Energy conservation:

Topical Question No: 1

17 The pump of a water pumping system uses 2.0 kW of electrical power when raising water. The pumping system lifts 16 kg of water per second through a vertical height of 7.0 m.

What is the efficiency of the pumping system?

A 1.8% **B** 5.6% **C** 22% **D** 55%
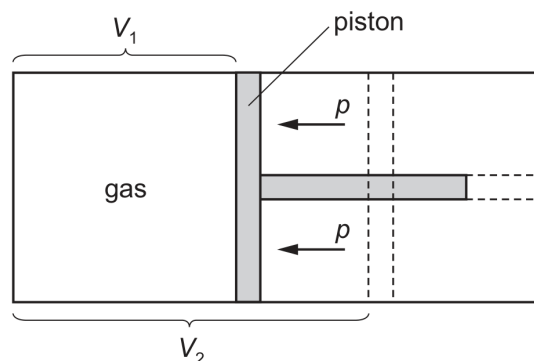
Topical Question No: 2

16 The total energy input E_{in} in a process is partly transferred to useful energy output U and partly transfered to energy that is wasted W.

What is the efficiency of the process?

A $\dfrac{U}{E_{in}} \times 100\%$

B $\dfrac{W}{E_{in}} \times 100\%$

C $\dfrac{U}{W} \times 100\%$

D $\dfrac{U+W}{E_{in}} \times 100\%$

Topical Question No: 3

17 A gas is enclosed inside a cylinder which is fitted with a frictionless piston.

Initially, the gas has a volume V_1 and is in equilibrium with the external pressure p. The gas is then heated slowly so that it expands at constant pressure, pushing the piston back until the volume of the gas has increased to V_2.

How much work is done by the gas during this expansion?

A $p(V_2 - V_1)$ **B** $\frac{1}{2}p(V_2 - V_1)$ **C** $p(V_2 + V_1)$ **D** $\frac{1}{2}p(V_2 + V_1)$

19 A car of mass 1400 kg is travelling on a straight, horizontal road at a constant speed of $25\,\text{m s}^{-1}$. The output power from the car's engine is 30 kW.

The car then travels up a slope at 2° to the horizontal, maintaining the same constant speed.

1400 kg

$25\,\text{m s}^{-1}$

$25\,\text{m s}^{-1}$

2°

What is the output power of the car's engine when travelling up the slope?

A 12 kW   **B** 31 kW   **C** 42 kW   **D** 65 kW

17 A small diesel engine uses a volume of $1.5 \times 10^4\,\text{cm}^3$ of fuel per hour to produce a useful power output of 40 kW. It may be assumed that 34 kJ of energy is transferred to the engine when it uses $1.0\,\text{cm}^3$ of fuel.

What is the rate of transfer from the engine of energy that is wasted?

A 102 kW   **B** 142 kW   **C** 182 kW   **D** 470 kW

15 Which statement best represents the principle of conservation of energy?

A Energy cannot be used faster than it is created.

B The supply of energy is limited, so energy must be conserved.

C The total energy in a closed system is constant.

D The total energy input to a system is equal to the useful energy output.

Topical Question No: 7

17 The data below are taken from a test of a petrol engine for a motor car.

power output	150 kW
fuel consumption	20 litres per hour
energy content of fuel	40 MJ per litre

What is the ratio $\dfrac{\text{power output}}{\text{power input}}$?

A $\dfrac{150 \times 10^3}{40 \times 10^6 \times 20 \times 60 \times 60}$

B $\dfrac{150 \times 10^3 \times 60 \times 60}{20 \times 40 \times 10^6}$

C $\dfrac{150 \times 10^3 \times 40 \times 10^6 \times 20}{60 \times 60}$

D $\dfrac{150 \times 10^3 \times 20}{40 \times 10^3 \times 60 \times 60}$

Topical Question No: 8

15 The total energy input E_{in} in a process is partly transferred to useful energy output U and partly transferred to energy that is wasted W.

What is the efficiency of the process?

A $\dfrac{U}{E_{in}} \times 100\%$

B $\dfrac{W}{E_{in}} \times 100\%$

C $\dfrac{U}{W} \times 100\%$

D $\dfrac{U + W}{E_{in}} \times 100\%$

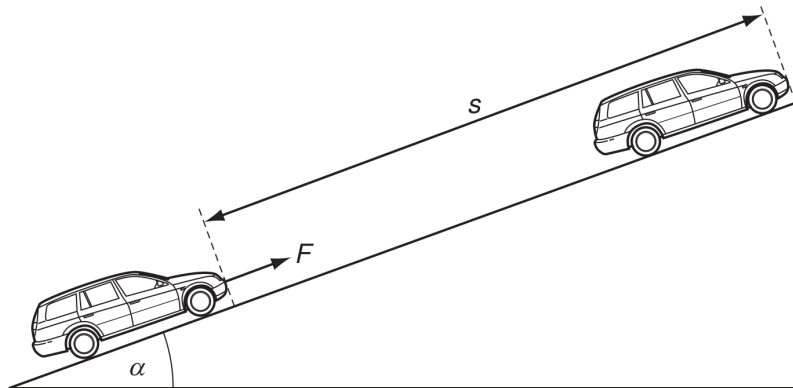*Topical Question No: 9*

16 A system with an efficiency of 74% wastes 230 W of power.

What is the useful output power of the system?

A 170 W   **B** 310 W   **C** 650 W   **D** 880 W

16 A constant force F, acting on a car of mass m, moves the car up the slope through a distance s at constant velocity v. The angle of the slope to the horizontal is α.
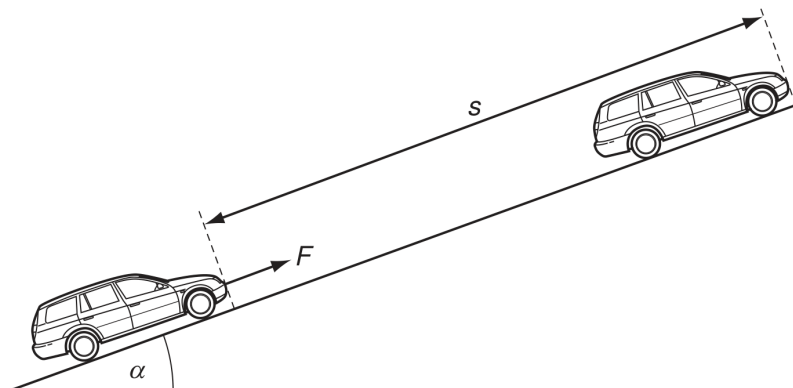

Which expression gives the efficiency of the process?

A $\dfrac{mgs \sin\alpha}{Fv}$ **B** $\dfrac{mv}{Fs}$ **C** $\dfrac{mv^2}{2Fs}$ **D** $\dfrac{mg \sin\alpha}{F}$

15 A constant force F, acting on a car of mass m, moves the car up the slope through a distance s at constant velocity v. The angle of the slope to the horizontal is α.

Which expression gives the efficiency of the process?

A $\dfrac{mgs \sin\alpha}{Fv}$ **B** $\dfrac{mv}{Fs}$ **C** $\dfrac{mv^2}{2Fs}$ **D** $\dfrac{mg \sin\alpha}{F}$

Space for working

18 Which process does **not** require energy to be supplied?

A boiling

**B** evaporation

C freezing

D melting

16 A parachutist is falling at constant (terminal) velocity.

Which statement is **not** correct?

    A   Gravitational potential energy is converted into kinetic energy of the air.

    B   Gravitational potential energy is converted into kinetic energy of the parachutist.

    C   Gravitational potential energy is converted into thermal energy of the air.

    D   Gravitational potential energy is converted into thermal energy of the parachutist.

17 A combined heat and power (CHP) station generates electrical power and useful heat. The diagram shows the input and output powers for a CHP station.
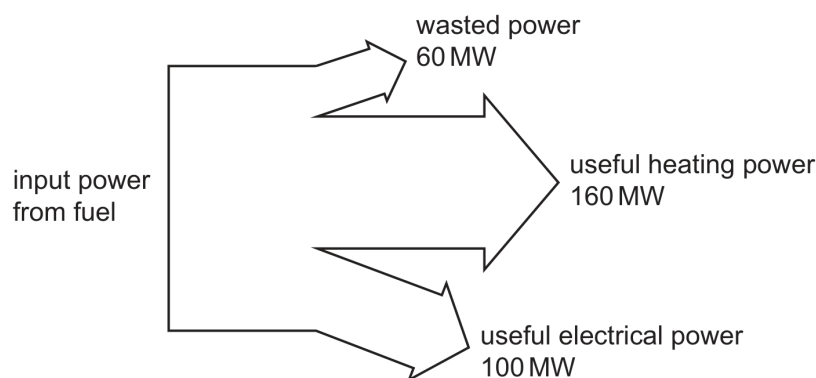
What is the efficiency of the CHP station for producing useful power?

    A   31%   **B**   38%   **C**   50%   **D**   81%

18 A lamp is switched on for 2.0 hours. The power input to the lamp is 1.0 W. The energy given out by the lamp as light is 7.0×10^3 J.

How much energy is converted to other forms by the lamp?

    A   120 J   **B**   200 J   **C**   3400 J   **D**   7200 J

Answer Key

1. N/A

2. N/A

3. N/A

4. N/A

5. N/A

6. N/A

7. N/A

8. A

9. C

10. N/A

11. N/A

12. N/A

13. N/A

14. N/A

15. B