Oxford Cambridge and RSA

GCSE Physics A (Gateway)

J249/04 Physics A P5-P8 and P9 (Higher Tier)

Question Set 20

20 A student has two radiators in her home. They are filled with different liquids and have different power ratings.

The diagram shows information about the two heaters.

Oil radiator	Water radiator
 Heater contains 10 kg of **oil**	 Heater contains 10 kg of **water**
400 W heater **Specific heat capacity for oil = 1 680 J/kg°C**	**1000 W heater** **Specific heat capacity for water = 4 200 J/kg°C**

(a) The radiators are turned on and both radiators increase in temperature by 40 °C in 1 680 seconds.

Show, by calculation, that the heaters take the same time to heat up.

$q = mc\Delta T$ $E = q = Pt$

Oil Radiator

$q = 10 \times 1680 \times 40$

$= 672{,}000$

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

$\frac{672{,}000}{400}$

$= 1680$ seconds

water radiator

$q = 10 \times 4200 \times 40$

$= 1{,}680{,}000$

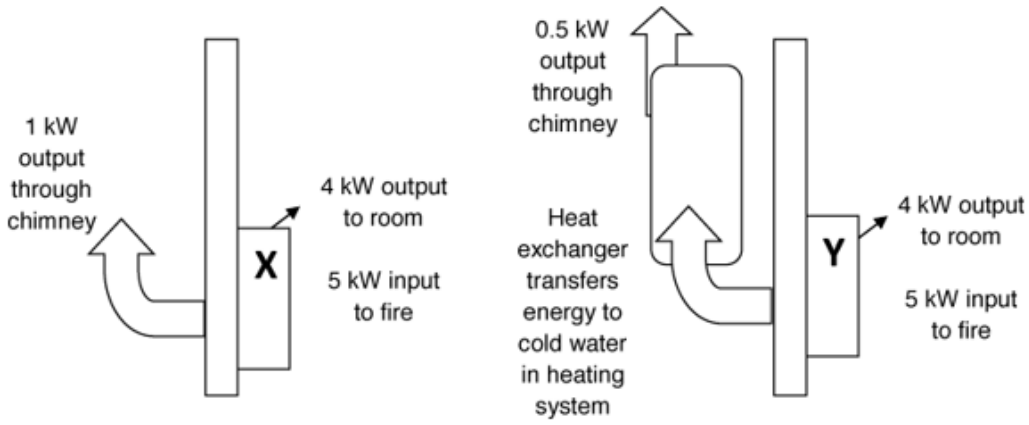
$\frac{1680000}{1000}$

$= 1680$ seconds

∴ heaters take the same time to heat up.

[4]

(b) The student has two fires in her home (**X** and **Y**) shown in the diagrams below.



Why does fire **Y** help to save money on the energy bills for her home?

Use calculations of efficiency in your answer.

[4]

X efficiency

$\frac{4,000}{5,000} \times 100 = 80\%$

Y efficiency

$\frac{4,500}{5000} \times 100$

$= 90\%$

Y is 90% efficient while X is only 80% efficient. This is because even though they both output 4 KW to the room, Y also uses 0.5 KW to heat up cold water, this means only 0.5 KW is wasted through chimney, unlike X which is 1 KW wasted through the chimney instead.

Total Marks for Question Set 20: 8