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## Answers

# Practice exam questions

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## The acoustics of the Royal Albert Hall

- 1  $S\alpha = 40.3 \text{ m}^2 \text{ sabins}$
- 2  $T = 1.21 \text{ s}$
- 3  $L = 63.0 \text{ dB}$
- 4 Increased absorption reduces reflections / echoes / reverberation.  
Reduced reverberation time prevents overlap of sounds.  
Speech sounds become clearer and more distinct.  
Less background noise from reflected sound waves.  
Direct sound dominates over reflected sound.

## Power from wind turbines

- 1 **a**  $A = 5.03 \times 10^3 \text{ m}^2$   
**b**  $P_{\text{wind}} = 3.02 \times 10^6 \text{ W}$
- 2  $P_{\text{turbine}} = 1.21 \times 10^6 \text{ W}$
- 3 **a**  $P_{\text{max}} = 1.79 \times 10^6 \text{ W}$   
**b** Air must continue moving after passing the turbine  
Not all kinetic energy can be extracted from the wind.  
Energy losses due to turbulence, drag or sound.  
Mechanical losses in the turbine / generator.  
Betz limit assumes ideal conditions not met in practice.
- 4 **a**  $P_{\text{new}} = 5.21 \times 10^6 \text{ W}$   
**b** Power output increases by the same factor as  $P_{\text{wind}}$ .  
Output increases by a factor of 1.73 if  $C_p$  remains the same.  
Small increase in wind speed gives a large increase in power.

## Dishwasher physics

1 a Plastic:

$$E = 4.18 \times 10^4 \text{ J}$$

Ceramic:

$$E = 2.25 \times 10^4 \text{ J}$$

b Plastic stores more thermal energy because it has a higher specific heat capacity and the mass and temperature increase are the same for both items.

2 Plastic dries more quickly because in this example it has a higher heat capacity. The heat capacity of the plastic is  $835 \text{ J K}^{-1}$ , whereas that of the ceramic is  $450 \text{ J K}^{-1}$ . Therefore, if both items lose energy at the same rate to the surroundings, the plastic remains hotter for longer resulting in more water evaporating from the surface.

3 The lighter plastic item only stores about  $2.5 \times 10^4 \text{ J}$ , and the heat capacity is only  $50.1 \text{ J K}^{-1}$ . Therefore it will cool very quickly, resulting in only a small amount of water evaporating from the surface. In this case, the ceramic object dries faster.

4 Examples include:

- Automatic door opening at the end of the cycle.
- Fan-assisted drying.

Explanation points:

- Allows moist air to escape.
- Reduces humidity inside the dishwasher.
- Encourages evaporation.
- Improves air circulation.

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