

Biomedical Admissions Test (BMAT)

Section 2: Thermal Physics
Questions by Topic

P4: Thermal Physics

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P4: Thermal Physics - Question by Topic

Mark scheme and explanations at the end

1 The following statements are about thermal physics.

- 1 Atoms, molecules and ions are microscopic particles.
- 2 Only solids and liquids are made from microscopic particles.
- 3 Microscopic particles in solids vibrate on the spot.
- 4 Microscopic particles in liquids are more mobile than the particles in solids.
- 5 Thermal energy and temperature are the same thing.

Which of these statements are correct?

- A 1, 2, 3 and 4
- B 1, 2, 3 and 5
- C 1, 2 and 4
- D 1, 3 and 4
- E 1, 2 and 5
- F 1 and 2
- G 1 and 3
- H 2 and 5

2 The following statements are about thermal physics.

- 1 The thermal energy of a substance increases as the temperature of a substance increases.
- 2 Heat transfers from regions of low temperature to regions of high temperature.
- 3 Conduction involves kinetic energy in the particles that make up the substance.
- 4 Conduction can only transfer heat between substances that are in the same state.
- 5 Conduction mainly occurs in solids and liquids.

Which of these statements are correct?

- A 1, 2, 3 and 4
- B 1, 2, 3 and 5
- C 1, 3 and 5
- D 1, 4 and 5
- E 2, 4 and 5



- F** 1 and 2
- G** 1 and 3
- H** 2 and 5

3 The following statements are about thermal physics.

- 1** During conduction in solids the temperature rises from regions closest to furthest away from the heat.
- 2** Energy is transferred through liquids by vibrations.
- 3** Metals are good conductors.
- 4** Wood is a good conductor.
- 5** Materials that contain a lot of air are good insulators.

Which of these statements are correct?

- A** 1, 2, 3 and 4
- B** 1, 2, 3 and 5
- C** 1, 2 and 4
- D** 1, 3 and 5
- E** 1, 2 and 5
- F** 1 and 2
- G** 1 and 4
- H** 2 and 3

4 The following statements are about thermal physics.

- 1** Heat transfers fastest through a vacuum.
- 2** Gases are not as good thermal conductors as solids and liquids.
- 3** Liquids are not as good thermal conductors as solids.
- 4** When a metal becomes hot only the electrons gain kinetic energy.
- 5** Metals are not very good conductors.

Which of these statements are correct?

- A** 1, 2, 3 and 4
- B** 1, 2, 3 and 5
- C** 1, 2 and 4
- D** 1, 3 and 4
- E** 1, 2 and 5
- F** 1 and 2



- G** 1 and 4
H 2 and 3

5 The following statements are about thermal physics.

- 1** Double glazed windows are better insulators than one layered glass windows.
- 2** A higher temperature difference between two objects increases the rate of conduction.
- 3** The shorter the distance between the objects the faster the rate of conduction.
- 4** The larger the area touching the heat the slower the rate of conduction.
- 5** Rate of conduction is reduced when a layer of insulation surrounds the object.

Which of these statements are correct?

- A** 1, 2, 3 and 4
B 1, 2, 3 and 5
C 1, 2 and 4
D 1, 3 and 4
E 2, 3 and 5
F 1 and 2
G 1 and 5
H 2 and 4

6 The following statements are about thermal physics.

- 1** When a fluid's temperature increases it expands.
- 2** As the temperature of a fluid increases the particles expand.
- 3** Density of a fluid increases as the temperature of the fluid increases.
- 4** The air inside a hot air balloon is less dense than the air surrounding it.
- 5** Particles get closer to each other as the temperature of a fluid increases.

Which of these statements are correct?

- A** 1, 2, 3 and 4
B 1, 2, 3 and 5
C 1, 2 and 4



- D** 1, 3 and 4
- E** 2, 3 and 5
- F** 1 and 2
- G** 1 and 4
- H** 2 and 4

7 The following statements are about thermal physics.

- 1** In convection the colder fluid rises.
- 2** Convection takes place when a region within a solid is heated.
- 3** The colder fluid takes the hotter fluids place in convection.
- 4** The warmer fluid sinks back down again.
- 5** A convection current will develop straight away.

Which of these statements are correct?

- A** 1, 2, 3 and 4
- B** 1, 2, 3 and 5
- C** 1, 2 and 4
- D** 1, 3 and 4
- E** 2, 3 and 5
- F** 1 and 2
- G** 1 and 4
- H** 3 and 4

8 The following statements are about thermal physics.

- 1** If the fluid at the top of container is heated a convection current is set up.
- 2** Heat is transferred slower by convection in fluids.
- 3** Conduction and convection can occur at the same time.
- 4** A room heater and air conditioner work by convection.
- 5** Foam insulation is present between walls reduces the rate of heat loss.

Which of these statements are correct?

- A** 1, 2, 3 and 4
- B** 1, 2, 3 and 5
- C** 1, 2 and 4



- D** 1, 3 and 4
- E** 2, 3 and 5
- F** 1 and 2
- G** 1 and 4
- H** 3 and 4

9 The following statements are about thermal physics.

- 1** Both convection and conduction need particles.
- 2** Only convection occurs in fluids.
- 3** Conduction and convection occur in solids.
- 4** In conduction kinetic energy is passed on from one particle to another.
- 5** In convection the heat is transferred through carrying kinetic energy.

Which of these statements are correct?

- A** 1, 2, 3 and 4
- B** 1, 2, 3 and 5
- C** 1, 2 and 4
- D** 1, 4 and 5
- E** 2, 3 and 5
- F** 1 and 2
- G** 1 and 4
- H** 3 and 4





Solutions

1 D is the answer

1 is correct - it is true that **atoms, molecules and ions** are **microscopic particles**.

2 is incorrect - it is true that **solids and liquids** are made up of **microscopic particles**, however **gases** are also made up of microscopic particles.

3 is correct - the microscopic particles that make up solids are **in motion**, and they **vibrate** on the spot.

4 is correct - it is true that the microscopic **particles in liquids are more mobile** than the microscopic particles that make up solids. This is because although the microscopic particles in both solids and liquids are in motion, the particles in liquids **move from place to place** but in solids they just **vibrate** and do not move places.

5 is incorrect - this is because thermal energy and temperature are different things. **Thermal energy** is the energy that a substance has **due to the motion of microscopic particles** that make up the substance. Whereas **temperature** is **how hot** the substance is.

Since **1, 3** and **4** are the only correct statements, **D** must be the correct answer.

2 C is the answer

1 is correct - it is true that as the temperature of a substance increases the thermal energy of the substance also increases. This is because the increase in temperature causes the microscopic particles to **gain more kinetic energy** and thus the **particles move around more**.

2 is incorrect - this is because heat transfer from regions of **high temperature to regions of low temperature**.

3 is correct - it is true that **conduction/thermal conduction involves kinetic energy**. This is because heat is transferred from one place to another through the **movement of the particles** that make up the substance, i.e. the kinetic energy.

4 is incorrect - this is because although it is true that conduction transfer heat between substances that are in the **same state**, it can also transfer heat from a **substance in one state to a substance in a different state**, only if they are in **contact**.



5 is correct - it is true that conduction mainly occurs in solids and liquids, as the particles are in **close proximity**.

Since **1**, **3** and **5** are the only correct statements, **C** must be the correct answer.

3 D is the answer

1 is correct - it is true that during conduction in solids the temperature will rise from regions that is **closest to the heat source**, and then **move to areas further away** from the heat.

2 is incorrect - this is because energy is transferred through liquids by **collisions between particles that are moving around**, not due to vibrations of the particles.

3 is correct - it is true that **metals are good conductors**. This means that heat will conduct through the metal quickly.

4 is incorrect - this is because **wood is a good insulator** not a good conductor. This means that wood does not conduct heat well, it does it slowly.

5 is correct - it is true that materials that contain a lot of **trapped air** are **good insulators**.

Since **1**, **3** and **5** are the only correct statements, **D** must be the correct answer.

4 H is the answer

1 is incorrect - this is not true, as **heat cannot transfer through a vacuum by conduction**. This is because in conduction heat is transferred through particles, and there are **no particles in a vacuum**.

2 is correct - it is true that **gases are not as good conductors as solids and liquids** are. This is because during conduction heat is passed on due to **transfer of kinetic energy** between particles. In gases the **particles are too far away** for collisions to occur frequently enough, therefore heat is transferred slowly, in comparison to solid and liquids.

3 is correct - it is true that **liquids are not as good thermal conductors as solids**, this is because the **particles are further away in liquids** in comparison to solids. The particles are not held tightly together in liquids therefore **kinetic energy is transferred slower** than in solids.





4 is incorrect - this is because it is true that when a metal gets hot that the **free electrons present gain kinetic energy**, however the **ions also gain kinetic energy**.

5 is incorrect - this is because **metals are very good conductors**. Metals have ions, which gain kinetic energy when hot and thus transfer it on to nearby ions, this is done relatively slowly. However the **free electrons** in metals are **very mobile**, and can transfer kinetic energy a lot faster as they **move through the metal lattice** and collide with each other and well as the ions throughout the lattice.

Since **2** and **3** are the only correct statements, **H** must be the correct answer

5 **B is the answer**

1 is correct - it is true that double layered windows (double glazed) are better insulators than single glazed windows. This is because in double-glazed windows have a **layer of air** that is trapped between the two glasses, the **air acts as an insulator** slowing down the loss of heat.

2 is correct - it is true that a **higher temperature difference** between two objects **increases the rate of conduction**.

3 is correct - it is true that the **shorter the distance** between objects means that there is a **faster rate of conduction**.

4 is incorrect - this is because the **larger the area** that is in contact with the heat source the **faster the rate of conduction**.

5 is correct - it is true that if there is a **layer of insulation** surrounding the object then the **rate of conduction is slowed down**. This is because conduction occurs slowly through the insulation thus taking longer.

Since **1**, **2**, **3** and **5** are the only correct statements, **B** must be the correct answer.

6 **G is the answer**

1 is correct - it is true that **when a liquids' temperature increases it expands** if it is not confined. This is because as the temperature increases, the microscopic particles making up the liquid **gain more kinetic energy** and **move further apart** from each other, so there is more space between the particles.



2 is incorrect - this is because the particles themselves **do not expand** when the temperature of a liquid increases, the particles gain more kinetic energy.

3 is incorrect - this is because when a **fluids' temperature increases it becomes less dense**. This is because the particles gain more kinetic energy, and move further away from each other. Thus there is increased separation between the particles and therefore there are fewer particles in a given space - therefore **less mass is present per unit volume**.

4 is correct - it is true that the **air in a hot air balloon is less dense than the air surrounding it**. The air inside is heated using a flame and therefore as the gas particles gain more kinetic energy and therefore move further apart, thus **less particles are present per unit volume**. The lower density allows the balloon to float up, carrying the weight of the balloon and the people.

5 is incorrect - this is because **particles get further away from each other** as the temperature of a fluid increases. This is because as mentioned before the particles get hotter and thus **gain kinetic energy**, therefore they **move around more** and the particles therefore move further away from each other.

Since **1** and **4** are the only correct statements, **G** must be the correct answer.

7 **H is the answer**

1 is incorrect - this is because when convection occurs it is the **hot fluid that rises** and the cold fluid moves in order to take the place of the hotter fluid. The hot fluid rises as its density is lower than the surrounding colder fluid.

2 is incorrect - this is because convection is a process that takes place when a **region within a fluid is heated**, not within a solid.

3 is correct - it is true that in convection the **colder fluid will take the place of the hotter fluid**, once the hotter fluid has risen.

4 is correct - it is true that the fluid that was previously warmer and had risen, will **eventually sink back down again**. This is because the risen warmer fluid will eventually **get cooler**. It gets cooler as the warmer fluid will **transfer heat to colder fluid** around it through **conduction**. As the hot fluid becomes colder it will be **more dense** than fluid surrounding, therefore will sink again.

5 is incorrect - it is true that a convection can occur, however not all the time. A convection current will only occur if the **heat source continues to supply heat to the fluid**. This is



because the fluid near the heat source will be continuously heated and therefore will rise and the colder fluid will take its place. Once the hotter fluid has transferred its heat to colder fluid surrounding it, it will sink back down and this cycle will continue.

Since **3** and **4** are the only correct statements, **H** must be the correct answer.

8 **H is the answer**

1 is incorrect - this is because if the **heat source is at the top of the fluid** then the top fluid will get warmer and therefore become less dense, and it will **remain at the top** as there is no more space to rise. Therefore a **convection current will not be set up**.

2 is incorrect - it is true that heat is transferred **quicker by convection** than by conduction in fluids, not slower.

3 is correct - it is true that in a fluid **both convection and conduction can occur at the same time**. E.g. when the warm fluid that has risen it will transfer heat to the surrounding colder fluid by conduction, whilst convection is still going on.

4 is correct - it is true that both **room heater and air conditioners work by convection**. An air conditioner is placed at the top of a ceiling, so the colder air will sink down and circulate to cool the room. A room heater is placed on the floor as the hot air will rise and circulate to heat the room.

5 is incorrect - it is true that a convection can occur, however not all the time. A convection current will only occur if the **heat source continues to supply heat to the fluid**. This is because the fluid near the heat source will be continuously heated and therefore will rise and the colder fluid will take its place. Once the hotter fluid has transferred its heat to colder fluid surrounding it, it will sink back down and this cycle will continue.

Since **3** and **4** are the only correct statements, **H** must be the correct answer.

9 **D is the answer**

1 is correct - it is true that **both convection and conduction require particles**, as heat is transferred from particle to particle.

2 is incorrect - this is because **convection and conduction can both occur in fluids**, even at the same time.



3 is incorrect - this is because it is true that conduction can occur in solids, however **convection cannot occur in solids**, this is because convection requires particles that move from one place to another.

4 is correct - it is true that in conduction **kinetic energy is passed on from one particle to another**, as the heat is transferred through the substance by the motion of microscopic particles.

5 is correct - it is true that in convection heat is transferred by the **moving particles carrying kinetic energy**. Heat is transferred by the motion of a large number of microscopic particles.

Since **1**, **4** and **5** are the only correct statements, **D** must be the correct answer.

