www.megalecture.com · www.youtube.com/@megalecture

Online tutoring for Cambridge IGCSE, O Level & A Level Physics

IGCSE PHYSICS 0625 · TOPICAL PAST PAPERS

Transfer of Thermal Energy — Paper 1

Worked Answer Key (Multiple Choice)

Fahad H. Ahmad

Contact: +92 323 509 4443

M.Eng NUS Singapore · B.Eng NUST · 15+ years of teaching experience in Singapore, UAE & Pakistan · 60,000+ subscribers and 20 million+ video lecture views.

Fahad H. Ahmad · **+92 323 509 4443**

Transfer of Thermal Energy — Paper 1 · Worked Answer Key

These are **Megalecture worked answers** for the topical multiple-choice compilation on **Transfer of Thermal Energy (IGCSE Physics 0625, Paper 1)**. Every answer below was reasoned out from first principles by the Megalecture team — there are no formulae to crunch in this topic, so each line gives the one-step physics that fixes the correct letter. Keep three ideas at your fingertips throughout: **conduction** (lattice vibrations everywhere, plus fast-moving free electrons in metals), **convection** (warm fluid becomes less dense and rises, cool fluid is denser and sinks), and **radiation** (infra-red, travels through a vacuum at the speed of light; *dull black* surfaces are the best emitters and absorbers, *shiny silver* surfaces the worst). The questions are grouped by mechanism below; the *Exam reference* column shows the original Cambridge paper for each item.

Part A · Conduction

Q #	Exam reference	Answer	Brief working / reason
1	5054/11 M/J/12 Q17	**C**	In a metal the dominant path is the fast-moving **free electrons**: they gain energy at the hot end, travel along the rod and hit atoms further along, passing energy down the metal.
2	5054/12 M/J/12 Q17	**C**	Conduction in a metal happens by **both** the movement of free electrons **and** the vibration of atoms — the electron contribution makes metals such good conductors.
5	5054/11 M/J/13 Q15	**D**	In a solid (non-metal) bar, heated molecules **vibrate more vigorously** and pass energy to neighbouring molecules by collisions — they do not travel along the bar.
14	5054/12 M/J/18 Q24	**C**	"All heat transferred by vibration of molecules only" means a solid non-metal (no free electrons, no convection). Of the four, **rubber** is the insulating solid → **C**.
19	5054/11 M/J/21 Q15	**B**	Heating one end of copper gives its **free electrons** extra energy; they move from the **hotter end to the cooler end**, carrying thermal energy with them.
21	5054/11 M/J/22 Q13	**B**	Wood (non-metal) conducts only by vibration of particles; steel (metal) conducts by **both** vibration of particles **and** movement of free electrons → row **B**.
29	5054/12 O/N/13 Q15	**A**	Aluminium pan (metal): free electrons + vibration of atoms. Plastic handle (non-metal): vibration of molecules only → row **A**.
30	5054/12 O/N/13 Q16	**B**	The outside of the cup gets hot quickly because **silver is a good conductor of heat**, so energy passes rapidly through the metal wall.

Q #	Exam reference	Answer	Brief working / reason
31	5054/11 O/N/14 Q15	**B**	Same idea as Q19: in heated copper the **energetic free electrons move from the hotter end to the cooler end** → **B**.
32	5054/12 O/N/14 Q11	**D**	Copper beats glass as a heat conductor because copper contains **free (delocalised) electrons** that transport energy quickly; glass has none → **D**.
36	5054/11 O/N/17 Q16	**C**	Conduction "mainly due to the movement of electrons" only happens in metals. Of air, ice, iron, water, the metal is **iron** → **C**.
39	5054/11 O/N/18 Q17	**B**	Heat flowing through a solid from hot to cold is conduction: **energy is passed from one molecule to the next** by collisions of vibrating particles → **B**.

Part B · Convection

Q #	Exam reference	Answer	Brief working / reason
3	5054/11 M/J/13 Q13	**B**	Convection current: water heated at the base **expands, becomes less dense and rises** to the surface → **B**.
7	5054/12 M/J/15 Q15	**B**	The heater warms the oil at X; warmed liquid **becomes less dense and rises** → **B**.
10	5054/12 M/J/16 Q16	**D**	Air near the cooling unit is cooled, so its molecules **move closer together** and its **density increases** (it then sinks) → row **D**.
12	5054/11 M/J/18 Q20	**A**	The candle warms the air, which rises and circulates, dragging the smoke round the box. Moving fluid carrying energy is **convection** → **A**.
33	5054/12 O/N/14 Q12	**B**	Air at 5 °C lies **above** the colder ice. Heat reaches the ice by conduction (contact) and radiation. Convection cannot carry heat *downward* to the ice, so it is **conduction and convection only** is wrong → **conduction and radiation only** = **B**.
35	5054/12 O/N/16 Q24	**B**	Convection needs particles free to move and change places, i.e. fluids: **gases and liquids only** → **B**.
40	5054/12 O/N/20 Q17	**A**	The loop is B(top-left)–C(top-right)–D(bottom-right)–A(bottom-left). A downward current at P (right side) means the water rises on the left side (A→B). Water rises where it is heated, so the tube is heated at **A**.
41	5054/11 O/N/21 Q12	**D**	Same physics as Q10: cooled air molecules **move closer together** and the air **density increases** → row **D**.

Part C · Radiation, Emitters & Absorbers

Q #	Exam reference	Answer	Brief working / reason
4	5054/11 M/J/13 Q14	**A**	A **dull black** surface is the best **absorber** and the best **emitter**, so it absorbs more energy and emits more → "black, black" = **A**.
6	5054/11 M/J/15 Q16	**A**	Solar panels are painted black because **black surfaces absorb radiation well**, gathering the Sun's energy efficiently → **A**.
8	5054/11 M/J/16 Q18	**A**	Thermal (infra-red) radiation is an electromagnetic wave, so in a vacuum it **travels at the speed of light** → **A**. (It is transverse, not longitudinal; black surfaces, not white, emit best.)
9	5054/12 M/J/16 Q15	**D**	Heat from a red-hot grill above the bread crosses the air gap as infra-red **radiation only** (air conducts poorly and convection carries heat upward, away from the bread) → **D**.
11	5054/12 M/J/17 Q25	**D**	Emission ranking: best emitter = dull black, worst = shiny silver. So the surface emitting **least** is shiny silver and the one emitting **most** is dull black → row **D**.
13	5054/11 M/J/18 Q21	**A**	The coolest water is in the can that loses heat fastest = best emitter with no lid. Can **A** is dull black and open (no lid), so it cools most and holds the coolest water → **A**.
15	5054/11 M/J/19 Q16	**D**	Infra-red radiation is electromagnetic, so it can travel **in a vacuum and in gases** → **D**.
16	5054/11 M/J/20 Q21	**A**	A dull black surface is a **good emitter, good absorber and poor reflector** of radiation → **A**.
17	5054/12 M/J/20 Q23	**A**	Water cools fastest where most heat is radiated away: the **largest** exposed face painted **black** (best emitter, biggest area) → container **A**.
22	5054/12 M/J/22 Q16	**C**	Space is a vacuum, so only **radiation** can carry the Sun's energy to the Moon → **C**.
23	5054/12 M/J/22 Q17	**A**	The hottest reading is near the face that emits most radiation = best emitter = **dull black** → **A**.
24	5054/11 O/N/11 Q15	**D**	A vacuum has no particles, so neither conduction nor convection works; heat crosses it **by radiation only** → **D**.
26	5054/11 O/N/12 Q17	**D**	The vacuum/space between the walls stops conduction and convection but *not* radiation. Radiation is cut by making the surfaces shiny, so **painting surface S silver** reduces the radiated loss → **D**.
28	5054/11 O/N/13 Q13	**A**	The 54 MJ shown is not the whole story; the heater must also replace energy lost **by other means** (e.g. draughts/air changes), so it supplies more than 54 MJ → **A**.
34	5054/11 O/N/16 Q20	**A**	**Transfer by radiation does not require a medium** — it is the only mechanism that works through a vacuum → **A**. (Heat flows hot→cold; transfer up in fluids is mainly convection; solids transfer by conduction, not density changes.)

Q #	Exam reference	Answer	Brief working / reason
37	5054/11 O/N/17 Q17	**B**	Most radiation absorbed by the best absorber = **dull black**; most reflected by the best reflector = **shiny white** → row **B**.
38	5054/12 O/N/17 Q18	**D**	To **reduce** the radiation emitted, make the surface a poorer emitter, i.e. **shinier** → **D**. (A higher temperature or larger area would increase emission.)
42	5054/12 O/N/21 Q15	**B**	The best absorber of infra-red radiation is **black and dull** → **B**.

Part D · Molecular Behaviour & Cooling

Q #	Exam reference	Answer	Brief working / reason
18	5054/12 M/J/20 Q24	**C**	Boiling at a constant 100 °C: liquid→gas. The molecule **separation increases** (3) and the intermolecular **forces decrease** (1); the speed does *not* increase because the temperature is unchanged (2 is false) → **1 and 3 only = C**.
20	5054/12 M/J/21 Q18	**C**	The only process that needs **no medium** is radiation (conduction and convection both need particles), so "does not require a medium" = **radiation only** = **C**.
25	5054/11 O/N/12 Q16	**D**	The drink is kept cool because **water evaporating from the wet cloth** takes latent heat (energy) from the bottle, cooling the drink → **D**.
27	5054/12 O/N/12 Q17	**A**	The water cools most rapidly in the can that radiates best = dull (rough) black surface → **"black, rough" = A**.

Note from Megalecture. A few items recur across this compilation (the refrigerator-cooling-unit pair Q10/Q41, and the copper-rod conduction pair Q19/Q31); they are answered consistently above. Remember the core rules: in metals conduction is dominated by free electrons; convection only occurs in fluids and is driven by density changes; radiation alone crosses a vacuum, and dull black surfaces are the best emitters and absorbers while shiny silver are the worst. These are original Megalecture worked solutions prepared for revision use.