GCSE
PHYSICS

Topic Paper: 3.1 & 3.2 Change of state, internal energy and energy transfers
Part 1 & 2 Mark Scheme

MARK SCHEME

76 Marks

M1. (a) loft insulation

1

energy saved in 10 years £600

1

net saving (600 – 110) £490

1

OR

hot water jacket

1

energy saved in 10 years £140

1

This is the highest percentage saving on cost

1

(b) transferred to environment / surroundings

1

as heat / thermal energy

1

[5]

M2. (a) conduction

1

(b) 35 000

1

(c) 500

*their (b) = 2 x c x 35 correctly calculated scores **2** marks*
*allow **1** mark for correct substitution,*
ie 35000 = 2 x c x 35
or
their (b) = 2 x c x 35

2

J / kg℃

1

(d) energy lost to surroundings
or
energy needed to warm heater

accept there is no insulation (on the copper block)
*do **not** accept answers in terms of human error or poor results or defective equipment*

1

[6]

M3. (a) air near freezer compartment is cooled or loses energy

accept air at the top is cold

1

cool air is (more) dense or particles close(r) together (than warmer air)

*do **not** allow the particles get smaller / condense*

1

so (cooler) air falls

1

air (at bottom) is displaced / moves upwards / rises

*do **not** allow heat rises*

accept warm air (at the bottom) rises

1

(b) if volume is doubled, energy use is not doubled

or

volume ÷energy not a constant ratio

1

correct reference to data, eg 500 is 2×250 but 630 not 2×800

1

(c) accept suitable examples, eg

advantage:

reduces emissions into atmosphere
lower input power or uses less energy or wastes less energy
costs less to run

cost of buying or installing new fridge is insufficient

ignore reference to size of fridge

1

disadvantage:

land fill
energy waste in production
cost or difficulty of disposal
transport costs

1

[8]

M4. (a) there are strong forces (of attraction) between the particles in a solid

accept molecules / atoms for particles throughout
accept bonds for forces

1

(holding) the particles close together

particles in a solid are less spread out is insufficient

1

or

(holding) the particles in a fixed pattern / positions

but in a gas the forces between the particles are negligible

accept very small / zero for negligible
accept bonds for forces

1

so the particles spread out (to fill their container)

accept particles are not close together
gas particles are not in a fixed position is insufficient

1

(b) (i) particles are (shown) leaving (the liquid / container)

accept molecules / atoms for particles throughout
accept particles are escaping
particles are getting further apart is insufficient

1

(ii) *accept molecules / atoms for particles throughout*
accept speed / velocity for energy throughout

particles with most energy leave the (surface of the) liquid

accept fastest particles leave the liquid

1

so the mean / average energy of the remaining particles goes down

1

and the lower the average energy (of the particles) the lower the temperature (of the liquid)

1

[8]

M5. (a) (i) the outlet mark

hot water rises **or** floats up

do not accept heat rises

the inlet mark

1

cold water replacing any drawn off comes in at the bottom and does not mix with hot **or** cool the hot water

do not accept descriptions of a convection current

1

(ii) only heats top (of tank) **or** a small volume

credit heats less water

1

no mixing occurs with cold because hot water is less dense **or** water is a poor conductor

no mixing because cold water is more dense

1

(b) radiation (losses from tank)

do not accept reflection of heat

1

lower from light **or** white **or** shiny surfaces

credit they are poor radiators for both marks

1

[6]

M6. (a) convection

air is heated by the burner / particles gain energy
air expands / particles move about more / particles move faster
air becomes less dense / particles are more spread out
air rises / particles rise - *not* heat rises
air from C moves into the heater / particles from C move into the heater to replace it / them

any four *for 1 mark each*

4

(b) (i) radiation

for one mark

1

(ii) black surface radiates / emits well
(*allow* absorbs and emits well) (*allow* comparison with shiny / white surfaces)

large surface area needed
high temperature (of the lumps)

any one for 1 mark

1

[6]

M7. (a) (i) refraction

accept refracted
reflection, diffraction and dispersion are incorrect

1

(ii) to check rise in temperature (of other thermometers) was due to the (different wavelengths of) light

accept as a control / comparison
to measure room temperature is insufficient

1

(iii) any **two** from three:

different colours produce different heating effects / (rises in) temperatures

red light produces the greatest heating effect / (rise in) temperature

or

violet produces the least heating effect / (rise in) temperature

all colours produce a greater heating effect than outside the spectrum

an answer

the longer the <u>wavelength</u> the greater the (rise in) temperature

or

the lower the <u>frequency</u> the greater the (rise in) temperature gains both marks

2

(b) move a thermometer into the infrared region / just beyond the red light

allow use an infrared camera / infrared sensor

1

the temperature increases beyond 24(℃)

accept temperature higher than for the red light

1

(c) $v = f \times \lambda$

9.4×10^{-6}

accept 9.375×10^{-6} or 9.38×10^{-6}

or

0.0000094

accept 0.000009375

***or** 0.00000938*

*allow **1** mark for correct substitution*

ie $3 \times 10^{8} = 3.2 \times 10^{13} \times \lambda$

2

(d) at night the surroundings are cooler

accept at night the air is colder

there is no heat from the Sun is insufficient

or

at night there is a greater temperature difference between people and surroundings

1

(so surroundings) emit less infrared (than in daytime)
accept camera detects a greater contrast

or

gives larger difference in infrared emitted (between people and surroundings)

1

[10]

M8. (a) (kinetic) energy (of the particles) is reduced
accept slow down
accept transfer energy to (cold) glass / surface
accept energy is lost
*do **not** accept vibrate less*

1

move closer together

1

(b) double glazing provides (better) insulation
accept double glazing has a lower U-value
accept less energy / heat transfer through double glazing

1

(inside of) glass is not as cold
accept window stays warm(er)

1

(c) (i) any **one** from:

to avoid bias

to make sure results are reproducible
accept repeatable / reliable for reproducible

1

(ii) any **three** from:
accept Superglaze or G-type for 'better insulating glass' throughout

the lower the U-value, the better the insulator
'better insulating glass' has a lower U-value is insufficient

better insulating glass costs more money

increasing the (width of) air gap increases cost

additional cost of better insulating glass offset by energy savings

3

[8]

M9. *accept atoms / particles for ions throughout*

(a metal has) free <u>electrons</u>
accept mobile for free
1

(kinetic) energy of (free) electrons increases
accept energy of ions increases
accept ions vibrate with a bigger amplitude
accept ions vibrate more
*do **not** accept electrons vibrate more*
1

(free) <u>electrons</u> move faster
1

or

electrons move through metal
accept electrons collide with other electrons / ions

(so) electrons transfer energy to other electrons / ions
accept ions transfer energy to neighbouring ions
1

[4]

M10. (a) any **two** from:

(air) particles / molecules / atoms gain energy

(air) particles / molecules / atoms move faster
*do **not** accept move more*
*do **not** accept move with a bigger amplitude / vibrate more*

(air) particles / molecules / atoms move apart

air expands
ignore particles expand

air becomes less dense
ignore particles become less dense

warm / hot air / gases / particles rise
*do **not** accept heat rises*
answers in terms of heat particles negates any of the mark points that includes particles
2

(b) (i) any **two** from

free / mobile electrons gain (kinetic) energy
accept free / mobile electrons move faster
accept vibrate faster for gain energy

free electrons collide with other (free) electrons / ions / atoms / particles

atoms / ions / particles collide with other atoms / ions / particles
answers in terms of heat particles negates this mark point

2

(ii) (faster) energy / heat transfer to room(s) / house
accept room(s) / house gets warm(er)
accept lounge / bedroom / loft for rooms

1

[5]

M11. (a) conduction
*do **not** accept conductor*

1

(b) the freezer
both parts needed

greater temperature difference (between freezer and room)
*do **not** accept because it is the coldest*

1

(c) any **two** from:

poor absorber of heat / radiation
accept does not absorb heat poor emitter of heat / radiation is neutral

reflects heat / radiation (from room away from fridge-freezer)

reduces heat transfer into the fridge-freezer

reduces power consumption of fridge-freezer
*do **not** accept it is a bad conductor / good insulator*

2

[4]

M12. (a) (i) £190
nb mention idea of cost per J in £ will come to an approx figure full credit given
*allow **1** mark for showing that the energy loss through the roof is ¼ of the total energy loss ie 150 / 600*

2

(ii) £142.50

allow ecf 50 % of their (a)(i) ×1.5 ie their (a)(i) ×0.75

1

(b) transferred to surroundings / atmosphere

or becomes spread out

1

[4]