

Question number	Answer	Marks	Guidance
GCSE Physics only			
1 a i	temperature variations cause roofing material to deteriorate due to expansion and contraction, if temperature variations great enough, develop small cracks	1 1	
1 a ii	smooth shiny surface: reflects sunlight and therefore does not get as hot in sunlight, also radiates less energy to surroundings at night	1 1	
1 b	any four from: <ul style="list-style-type: none"> • panel with transparent cover reflects sunlight and fluid in panel absorbs some radiation so less radiation absorbed by matt black surface, • but matt black surface heats fluid in panel directly, • matt black cover absorbs sunlight very effectively so becomes warmer in sunlight, • effective conductor needed to heat fluid effectively, • this also emits radiation into surrounding air, • matt black cover probably more effective further from equator as Sun lower in sky 	4	
2 a i	conduction through plate	1	
2 a ii	radiation (and convection) through air	1	
2 b	fins increase surface area of heat sink, larger surface area means more energy lost due to radiation and convection from plate	1 1	

2 c	any three from: <ul style="list-style-type: none"> • greater density of material → larger mass of heat sink for same volume • greater mass and specific heat capacity of material → lower temperature increase for given amount of energy transfer • copper therefore better choice • unless mass of aluminium much greater than mass of copper 	3	
3 a	wool good insulator as fibres trap dry air which is good insulator inside of clothing becomes warm due to radiation from body body stays warm because clothing does not conduct heat energy away	1 1 1	
3 b	in cold weather, radiation from exposed skin causes energy transfer from head hair is insulator containing trapped air so reduces energy transfer by conduction wearing hat reduces radiation from exposed parts of scalp and reduces conduction by providing extra insulation	1 1 1	
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3 c	normally radiation from ears = radiation received from surroundings by ears in very cold weather significantly less energy received so more energy radiated than received surface area of ear relatively large in relation to its mass so they cool down quickly	1 1 1	
4 a	infrared radiation	1	

4 b	reflective coating traps infrared radiation in space between body and blanket so air in space becomes warmer warm air keeps body warm	1 1	
5 a	for each kg: $\Delta E = 1\%$ of 60 MJ = 600 000 J $\Delta E = mc\Delta\theta$ gives 600 000 J = 1.0 kg \times 400 J/kg $^{\circ}\text{C}$ \times $\Delta\theta$ $\Delta\theta = \frac{600\,000\text{ J}}{1.0\text{ kg} \times 400\text{ J/kg/}^{\circ}\text{C}}$ 15 000 $^{\circ}\text{C}$	1 1 1 1	Must have unit to gain mark.
5 b	yes: surface material vaporised at this temperature and small objects burn up before reaching ground meteorites don't burn completely so only part of their mass vaporised	1 1	
6 a	In 1 s, $m_{\text{water}} = 1.5\text{ kg} / 60\text{ s} = 0.025\text{ kg}$ $\Delta E = 0.025\text{ kg} \times 4200\text{ J/kg }^{\circ}\text{C} \times (40 - 15)^{\circ}\text{C} = 2625\text{ J}$	1 1	Must have unit to gain mark.
6 b	useful energy transferred in 1 s = 2625 J, energy supplied in 1 s = $Pt = 5000\text{ W} \times 1\text{ s} = 5000\text{ J}$ efficiency = $= \frac{2625\text{ J}}{5000\text{ J}} \times 100\%$ = 53%	1 1 1	

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7	any five from: compare cooling of several cans of hot water as near as possible to each other with a single can on its own, containing same amount of hot water at same temperature, measure and record temperature of water in central can of group of cans every 2 minutes for 20 minutes, repeat test for can on its own with same amount of hot water as before at same initial temperature, record measurements and plot temperatures on same graph and label each curve, compare curves and use them to draw conclusions about effect of huddling together	5	
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