MARK SCHEME

GCSE
PHYSICS
AQA - TRIPLE SCIENCE

P1 - TEST 4
ENERGY
Intermediate

Mark schemes

1. (a) kinetic energy = 0.5 × mass × speed^2

allow $E_k = 1/2\ mv^2$

1

(b) $E_k = 0.5 \times 0.058 \times 5^2$

1

$E_k = 0.725$ (J)

*an answer of 0.725 (J) scores **2** marks*

1

(c) 0.725 (J)

allow ecf from (b)
allow the same amount of E_k as at A

1

(d) gravitational potential energy = mass × gravitational field strength × height

allow $Ep = mgh$

1

(e) $0.38 = 0.058 \times 9.8 \times h$

1

$$h = \frac{0.38}{(0.058 \times 9.8)}$$

1

$h = 0.67$ (m)

*an answer that rounds to 0.67 scores **3** marks*

1

[8]

2. (a) 80 (°C)

1

(b) **C**

1

temperature after 10 minutes was lowest
or
final temperature was lowest

*reason only scores if material **C** is chosen*
allow temperature after 10 minutes was lower

1

(c)   lower total temperature rise (for all materials)

allow lower final temperature (for all materials)

1

(because) the rate of temperature increase would be lower

allow lower gradient lines

1

(d)   higher resolution

1

reduced risk of misreading instrument

1

(e)   polyurethane foam

no marks if polyurethane foam not chosen

1

(because it has the) lowest rate of energy transfer

1

[9]

3.   (a)   (i)   kinetic

*do **not** accept movement*

1

(ii)   thermal sound

accept heat for thermal
*do **not** accept noise for sound*
***both** answers required in either order*

1

(b)   transferred to surroundings / surrounding molecules / atmosphere

'it escapes' is insufficient

or
becomes dissipated / spread out

accept warms the surroundings
accept degraded / diluted
accept a correct description for surroundings eg to the washing machine
*do **not** accept transformed into heat on its own*

1

(c)   (i)   3 (.0 p)

*allow **1** mark for correct substitution of correct values ie 0.2 x 15*
*allow **1** mark for calculating cost at 40°C (16.5p)*
or
cost at 30°C (13.5p)

2

(ii)   any **two** from:

- less electricity needed

    ignore answers in terms of the washing machine releasing less energy
    an answer in terms of the washing machine releasing CO$_2$ negates mark
    *do **not** accept less energy is produced*

- fewer power stations needed

- less fuel is burned

    accept a correctly named fuel
    *do **not** accept less fuel is needed*

2

[7]

4.   (a)

Level 2: Relevant reasons are identified, given in detail and logically linked to form a clear account.	3-4
Level 1: Relevant reasons are identified, and there are attempts at logically linking. The resulting account is not fully clear.	1-2
No relevant content	0

Indicative content

nuclear

- no carbon dioxide released (when generating electricity) **or** doesn't release greenhouse gases
- reliable
- high energy density
- power stations already built
- other power stations being built

wind

- no carbon dioxide released (when generating electricity) **or** doesn't release greenhouse gases
- renewable energy resource
- no fuel cost

4

(b)   wind power is unreliable

1

(so) will be unable to meet demand when wind speed is low
or
when there is no wind
or
unable to maintain base load at all times

1

(c)   electricity generation will need to increase (to meet higher demand)

1

(using)
nuclear power
or
wind power
or
other renewables

1

so that carbon dioxide emissions don't increase
or
reference to Paris Climate agreement

1

[9]

5. (a)   0.1 (°C)

1

(b)   power = energy transferred / time
allow P = E / t

1

allow E = P x t

(c)   1050 / 300

1

3.5 (W)

1

*accept 3.5 (W) with no working shown for **2** marks*

(d)   1050 = m × 4200 × 0.6

1

m = 1050 / (4200 × 0.6)

1

m = 0.417 (kg)

1

*accept 0.417 (kg) with no working shown for **3** marks*

(e) any **one** from:

- energy used to heat metal pan (as well as the water)
- energy transfer to the surroundings (through the insulation)
- angle of solar radiation will have changed during investigation
- intensity of solar radiation may have varied during investigation

1

[8]

6. (a) weight (lifted)

or

height (lifted)

1

(b) any **two** from:

- calculate a mean
- spot anomalies
- reduce the effect of random errors

2

(c) as speed increases, the efficiency increases

1

(but) graph tends towards a constant value

or

appears to reach a limit
   accept efficiency cannot be greater than 100%

1

(d) heating the surroundings

1

(e) 0 (%)

1

[7]

7. (a) (i) high levels of infrared radiation (from the Sun)

allow lots of (solar) energy (available)

do **not** accept 'heat' for infrared

'it is hot' is insufficient

'lots of sunlight' is insufficient

1

(ii) reflected

1

(iii) boiler

correct order only

1

turbine

1

transformer

1

(b) 2 100 000 (kWh)

*allow **1** mark for correct substitution i.e. 140 000 × 15 provided no subsequent step*

2

(c) (i) only 1 wind turbine was considered

accept only one location is considered

1

or
other wind turbines may have generated more electricity

accept insufficient sample size

only 1 week's weather was reported on
or
wind speed varies from one week to another

'wind speed varies' is insufficient

1

(ii) any **one** from:
• wind speed is too high / low

allow no wind
allow too windy
• wind is unreliable.

allow wind is variable

1

(iii) any **one** from:
- wind is a renewable energy source
- do not use fuel
- energy source is free
- do not release carbon dioxide
- do not release greenhouse gases
- do not release sulfur dioxide
- do not cause acid rain
- do not cause climate change
- do not cause global warming
- do not cause global dimming.

answer must be an advantage of wind, converse answers in terms of fossil fuels are insufficient

accept do not release pollutant gases

'no pollution' is insufficient

1

[11]

8. (a) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

0 marks
No relevant information

Level 1 (1-2 marks)
There is a relevant statement about an energy saving method

Level 2 (3-4 marks)
There is at least one clear comparison of energy saving methods and their cost effectiveness with an appropriate calculation

Level 3 (5-6 marks)
There is a comparison of energy saving methods and their cost effectiveness with appropriate calculations. Comparison to include further detail.

examples of physics points made in the response

examples of relevant statements
- energy efficient boiler saves the most (energy / money) per year
- loft insulation costs the least to install
- double-glazing costs the most to install

examples of statements that include cost effectiveness
- loft insulation is the most cost effective in the long term
- double-glazing is the least cost effective
- loft insulation has the shortest payback time
- double-glazing has the longest payback time
- payback time calculated for any method

> *payback times:*
>
> *energy efficient boiler: 6.25 years*
>
> *loft insulation: 2 years*
>
> *double glazing: 100 years*
>
> *cavity wall insulation: 2.86 years*

examples of further detail
- for cost effectiveness install in the following order: loft, cavity wall, boiler, double-glazing
- for reducing energy use install in the following order: boiler, loft, cavity wall, double glazing
- don't install double-glazing for insulation purposes
- double-glazing won't pay for itself in your lifetime
- justified choice of best / worst method

6

(b) (i)   how effective a material is as an insulator

> *accept 'heat' for energy*
>
> *accept how effective a material is at keeping energy in*
>
> *accept the lower the U-value the better the insulator*
>
> *accept the lower the U-value the lower the rate of energy transfer*

1

(ii)   (the U-value) decreases

1

[8]

9. (a) (i)   5(.0)

1

(ii)   35 **or** their (a)(i) × 7 correctly calculated

> *allow **1** mark for correct substitution, ie 5 **or** their (a)(i) × 7 provided no subsequent step shown*

2

(iii) 525(p)
or
(£) 5.25
or
their (a)(ii) × 15 correctly calculated

> *if unit p or £ given they must be consistent with the numerical answer*

1

(iv) decreases

1

temperature difference (between inside and outside) decreases

> *accept gradient (of line) decreases*
> *do **not** accept temperature (inside) decreases*
> *do **not** accept graph goes down*

1

(b) air (bubbles are) trapped (in the foam)

> *do **not** accept air traps heat*
> *foam has air pockets is insufficient*

1

(and so the) air cannot circulate / move / form convection current

> *air is a good insulator is insufficient*
> *no convection current is insufficient*
> *answers in terms of warm air from the room being trapped are incorrect and score no marks*

1

[8]

10. (a) (matt) black is a good <u>emitter</u> of infrared / radiation

> *accept heat for infrared / radiation*
> *ignore reference to good absorber*
> *attracts heat negates this marking point*

1

to give maximum (rate of) energy transfer (to surroundings)

> *accept temperature (of coolant) falls fast(er)*
> *accept black emits more radiation for **1** mark*
> *black emits most radiation / black is the best emitter of radiation for **2** marks*

1

(b) the fins increase the surface area

> *accept heat for energy*

1

so increasing the (rate of) energy transfer
or
so more fins greater (rate of) energy transfer

1

(c)   114 000

*allow **1** mark for correct temperature change, ie 15 (°C)*

or

*allow **2** marks for correct substitution, ie 2 × 3 800 × 15*

*answers of 851 200 **or** 737 200 gain **2** marks*

or

*substitution 2 × 3800 × 112 **or** 2 × 3800 × 97 gains **1** mark*

*an answer of 114 kJ gains **3** marks*

3

(d)   increases the efficiency

1

less (input) energy is wasted

accept some of the energy that would have been wasted is (usefully) used

or

more (input) energy is usefully used

accept heat for energy

1

[9]