Specimen
mark scheme abbreviations

( ) the word, phrase or unit in brackets is not required but is in the mark scheme for clarification

accept accept the response

AND both responses are necessary for the mark to be allowed

c.a.o. correct answer only

e.c.f. error carried forward; marks are awarded if a candidate has carried an incorrect value forward from earlier working, provided the subsequent working is correct

ignore this response is to be disregarded and does not negate an otherwise correct response

NOT do not allow

note: additional marking guidance

/ OR alternative responses for the same marking point

owtte or words to that effect

underline mark is not allowed unless the underlined word or idea is used by candidate

units there is a maximum of one unit penalty per question unless otherwise indicated

any [number] from: accept the [number] of valid responses

max indicates the maximum number of marks
1 (a) speed \times time in any form, symbols, numbers or words
OR any area under graph used or stated
13 (m/s) OR 24 (s) seen or used in correct context
312 m (2 or 3 sig. figs.)

(b) rate of change of speed OR gradient of graph OR 18/12
18 (m/s) OR 12 (s) seen or used in correct context
1.5 m/s²

(c) same gradient / slope OR equal speed changes in equal times OR
allow graph symmetrical

2 (a) mgh OR 36 \times 10 \times 2.4
864 J OR N m (2 or 3 sig. figs.)

(b) (P =) \frac{E}{t} in any form, words, symbols or numbers OR \frac{864}{4.4}
196 W OR J/s (2 or 3 sig. figs.)

(c) evidence that candidate understands the principle of energy conservation, expressed in
words or as an equation (e.g. total energy is constant OR initial energy = final energy) or
implied by statement accounting for difference
some energy is dissipated into the surroundings OR difference due to increase in internal
energy/heating/thermal energy (of belt, motor, surroundings) owttt
note: do not accept kinetic energy / sound / friction if no mention of heating

(d) increase in potential energy of mass is greater
OR work done/energy used (to raise mass) is greater
\frac{t = E}{P} OR P = \frac{E}{t} in any form, words or symbols AND power is constant
speed reduced / time taken is longer

3 (a) p = mv in any form, words or symbols
0.16 \text{ kg m/s OR Ns}

(b) use of principle of conservation of momentum in words, symbols or numbers
use of combined mass 0.5(0) + 0.3(0) OR 0.8(0) (kg)
0.2(0)m/s
4 (a) three valid features listed without explanation

any three features explained from:

- copper/metal is a good conductor (of heat)
  NOT of electricity

- black is good absorber/bad reflector
  ignore emitter

- insulating material will reduce heat lost/conducted away (from pipes/sheet)
  NOT prevents heat loss owte

- glass/trapping of air reduces/prevents convection/warm air being blown away

- glass produces greenhouse effect/reference to far and near I.R. [max 3]

(b) \[38 - 16 \text{ OR } 22 \]

\[
mc\theta \text{ OR } 250 \times 4200 \times \text{candidate’s temperature difference} \quad \text{[1]}
\]

\[
2.31 \times 10^7 \text{ (J) e.c.f. from previous line} \quad \text{[1]}
\]

\[
9.24 \times 10^7 \text{ J OR e.c.f. from previous line } \times 4 \text{ correctly evaluated} \quad \text{[1]}
\]

no unit penalty if J seen anywhere in (b) clearly applied to an energy

(c) valid explanation relating to at least one of the reasons below:

note: if no explanation, this mark is not awarded even if more than three reasons are given

any three reasons from:

- which direction roof faces

- estimate output of panels

- household needs / whether household will use all hot water

- cost of panel / installation

- time to recoup cost

- whether roof is shaded

- relevant environmental consideration (e.g. not using wood or other fuel to heat water) [max 3]

(d) nuclei join together, accept hydrogen for nuclei

to produce a different element / helium (and energy) [2]

5 (a) (i) any one from:

- (molecules) move randomly / in random directions

- (molecules) have high speeds

- (molecules) collide with each other / with walls [max 1]

(ii) collisions with walls/rebounding causes change in momentum (of molecules)

- force is rate of change of momentum / force needed to change momentum [1]

(b) (i) \[p_1V_1 = p_2V_2 \text{ OR } 300 \times 100 (\times 0.12) = p_2 \times 0.40 (\times 0.12) \]

- \[750 \text{ kPa} \] [1]
(ii) (molecules) collide with walls more often or more collisions with walls per second or per unit time or greater force per unit area [1] 

6 (a) clear attempt at semi circles, at least 3 same wavelength as incoming wavefronts, by eye [1] 

(b) speed \( \div \) wavelength or \( 20 \div 2.5 \) or \( v = f\lambda \) 
8 Hz or \( 8 \text{ s}^{-1} \) or 8 waves/second [1] 

(c) candidate's (b) OR “the same” OR nothing [1] 

(d) low frequency signals have longer wavelength (than high frequency signals) OR high frequency signals have shorter wavelength [1] 
low frequency signals / long wavelength signals diffract more OR low frequency / short wavelength signals diffract less [1] 

7 (a) rheostat/variable resistor AND control/vary/change/limit the current /resistance/power/voltage across heater [1] 

(b) \( (I =) \frac{P}{V} \) any form, words or numbers 
\( (I =) 1.25 \) (A) seen anywhere [1] 
\( (V =) 6.0 – 3.6 \) OR \( 2.4 \) seen anywhere [1] 
\( (R =) \frac{V}{I} \) in any form words or numbers [1] 
1.92 \( \Omega \) (2 or 3 sig. figs.) [1] 
note: credit will also be given for alternative approaches [1] 

(c) battery running down/going flat/energy of battery used up OR \( V \) or e.m.f. less OR more/increasing resistance (of heater) NOT resistance of \( X \) increases use of relationship between \( I \) and \( V \) or \( R \) OR the current decreases [1] 

8 (a) output of A: 1, 1, 0, 0 c.a.o. [1] 
output of B: 0, 1, 0, 0 e.c.f. from candidate’s output of A [1] 

(b) dark AND hot orwte note: must be consistent with answer to (a) [1] 

(c) B cannot provide enough power / current for lamp, or equivalent OR allows remote lamp note: statement of function of a relay without reference to context gains 1 mark [2]
9 (a) electrons / negative charges *move* towards the rod / to R (ignore just “attracted”)
ignore any mention of positive charges moving
any mention of positive electrons = 0

(b) negative charges (are) close(r) (to the rod)
attraction between opposite charges greater than repulsion between like charges

(c) coulomb

10 γ rays
(γ rays) detected at B
(γ rays) not deflected by field / not charged
charged particles / β particles (accept α for charged particles)
β particles detected at C
reference to direction of deflection / LH rule
no α-particles OR only background detected at A

11 (a) top bent down to R of layer
middle straight on
bottom deflected back to left

(b) (i) deflection greater than 90°/the bottom one
(ii) positive  ignore numbers
(iii) nothing/vacuum/space/electrons

(c) 2 AND 2