



**Cambridge International Examinations**  
Cambridge International General Certificate of Secondary Education (9–1)

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**PHYSICS**

**0972/04**

Paper 4 Theory (Extended)

**For Examination from 2018**

MARK SCHEME

Maximum Mark: 80

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**Specimen**

From 2018 the mark scheme design/layout has improved.  
The content and marks remain the same.

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This document consists of **6** printed pages.



## 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                                                                                                                                         |
| <u>underline</u>   | 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 [1]  
 OR any area under graph used or stated [1]  
 13 (m/s) OR 24 (s) seen or used in correct context [1]  
 312 m (2 or 3 sig. figs.) [1]
- (b) rate of change of speed OR gradient of graph OR 18/12 [1]  
 18 (m/s) OR 12 (s) seen or used in correct context [1]  
 1.5 m/s<sup>2</sup> [1]
- (c) same gradient / slope OR equal speed changes in equal times OR  
 allow graph symmetrical [1]
- 2 (a)  $mgh$  OR  $36 \times 10 \times 2.4$  [1]  
 864 J OR Nm (2 or 3 sig. figs.) [1]
- (b) ( $P =$ )  $E/t$  in any form, words, symbols or numbers OR 864 / 4.4 [1]  
 196 W OR J/s (2 or 3 sig. figs.) [1]
- (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 [1]  
  
 some energy is dissipated into the surroundings OR difference due to increase in internal  
 energy/heating/thermal energy (of belt, motor, surroundings) owtte  
 note: do not accept kinetic energy / sound / friction if no mention of heating [1]
- (d) increase in potential energy of mass is greater  
 OR work done/energy used (to raise mass) is greater [1]  
 $t = E/P$  OR  $P = E/t$  in any form, words or symbols AND power is constant [1]  
 speed reduced / time taken is longer [1]
- 3 (a)  $p = mv$  in any form, words or symbols [1]  
 0.16 kg m/s OR N s [1]
- (b) use of principle of conservation of momentum in words, symbols or numbers [1]  
 use of combined mass 0.5(0) + 0.3(0) OR 0.8(0) (kg) [1]  
 0.2(0) m/s [1]

- 4 (a) three valid features listed without explanation [1]
- 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 owtte
- 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 OR 22 [1]  
 $mc\theta$  OR  $250 \times 4200 \times$  candidate's temperature difference [1]  
 $2.31 \times 10^7$  (J) e.c.f. from previous line [1]  
 $9.24 \times 10^7$  J OR e.c.f. from previous line  $\times 4$  correctly evaluated [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: [1]  
 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) [1]  
 force is rate of change of momentum / force needed to change momentum [1]
- (b) (i)  $p_1V_1 = p_2V_2$  OR  $300 \times 100 (\times 0.12) = p_2 \times 0.40 (\times 0.12)$  [1]  
 750 kPa [1]

- (ii) (molecules) collide with walls more often owtte  
OR more collisions with walls per second or per unit time owtte  
greater force per unit area [1]  
[1]
- 6 (a) clear attempt at semi circles, at least 3 [1]  
same wavelength as incoming wavefronts, by eye [1]
- (b) speed  $\div$  wavelength or  $20 \div 2.5$  or  $v = f\lambda$  [1]  
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 [1]  
control/vary/change/ limit the current /resistance/power/ voltage across heater
- (b) ( $I =$ )  $P/V$  any form, words or numbers [1]  
( $I =$ ) 1.25 (A) seen anywhere [1]  
( $V =$ ) 6.0 – 3.6 OR 2.4 seen anywhere [1]  
( $R =$ )  $V/I$  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
- (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 [1]  
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 owtte  
note: must be consistent with answer to (a) [1]
- (c) B cannot provide enough power / current for lamp, or equivalent  
OR allows remote lamp [2]  
note: statement of function of a relay without reference to context gains 1 mark

- 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 [1]
- (b) negative charges (are) close(r) (to the rod) [1]  
attraction between opposite charges greater than repulsion between like charges [1]
- (c) coulomb [1]
- 10  $\gamma$  rays [1]  
( $\gamma$  rays) detected at B [1]  
( $\gamma$  rays) not deflected by field / not charged [1]  
charged particles /  $\beta$  particles (accept  $\alpha$  for charged particles) [1]  
 $\beta$  particles detected at C [1]  
reference to direction of deflection / LH rule [1]  
no  $\alpha$ -particles OR only background detected at A [1]
- 11 (a) top bent down to R of layer [1]  
middle straight on [1]  
bottom deflected back to left [1]
- (b) (i) deflection greater than  $90^\circ$ /the bottom one [1]  
(ii) positive ignore numbers [1]  
(iii) nothing/vacuum/space/electrons [1]
- (c) 2 AND 2 [1]