MARK SCHEME for the March 2016 series

0625 PHYSICS

0625/42	Paper 4 (Extended Theory), maximum raw mark 80

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

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NOTES ABOUT MARK SCHEME SYMBOLS & OTHER MATTERS

M marks are method marks upon which further marks depend. For an M mark to be scored, the point to which it refers **must** be seen in a candidate's answer. If a candidate fails to score a particular M mark, then none of the dependent marks can be scored.

B marks are independent marks, which do not depend on other marks. For a B mark to scored, the point to which it refers must be seen specifically in the candidate's answers.

A marks In general A marks are awarded for final answers to numerical questions.
If a final numerical answer, eligible for A marks, is correct, with the correct unit and an acceptable number of significant figures, all the marks for that question are normally awarded.
It is very occasionally possible to arrive at a correct answer by an entirely wrong approach. In these rare circumstances, do not award the A marks, but award C marks on their merits. However, correct numerical answers with no working shown gain all the marks available.

C marks are compensatory marks in general applicable to numerical questions. These can be scored even if the point to which they refer are not written down by the candidate, **provided subsequent working gives evidence that they must have known it.**
For example, if an equation carries a C mark and the candidate does not write down the actual equation but does correct substitution or working which shows he knew the equation, then the C mark is scored
A C marks is not awarded if a candidate makes two points which contradict each other. Points which are wrong but irrelevant are ignored.

brackets ( ) around words or units in the mark scheme are intended to indicate wording used to clarify the mark scheme, but the marks do not depend on seeing the words or units in brackets.
e.g. 10 (J) means that the mark is scored for 10, regardless of the unit given.

underlining indicates that this <u>must</u> be seen in the answer offered, or something very similar.

OR / or indicates alternative answers, any one of which is satisfactory for scoring the marks.

e.e.o.o. means "each error or omission".

o.w.t.t.e. means "or words to that effect".

Ignore Indicates that something which is not correct or irrelevant is to be disregarded and does not cause a right plus wrong penalty.

Spelling Be generous about spelling and use of English. If an answer can be understood to mean what we want, give credit. However, beware of and do not allow ambiguities, accidental or deliberate: e.g. spelling which suggests confusion between reflection / refraction / diffraction / thermistor / transistor / transformer.

Not/NOT Indicates that an incorrect answer is not to be disregarded, but cancels another otherwise correct alternative offered by the candidate i.e. right plus wrong penalty applies.

ecf   means "error carried forward"
This is mainly applicable to numerical questions, but may occasionally be applied in non-numerical questions if specified in the mark scheme.
This indicates that if a candidate has made an earlier mistake and has carried an incorrect value forward to subsequent stages of working, marks indicated by ecf may be awarded, provided the subsequent working is correct.

Significant Figures   Answers are normally acceptable to any number of significant figures $\geqslant 2$. Any exceptions to this general rule will be specified in the mark scheme.

Units   Deduct one mark for each incorrect or missing unit from **an answer that would otherwise gain all the marks available for that answer: maximum 1 per question.** No deduction is incurred if the unit is missing from the final answer but is shown correctly in the working.
Condone wrong use of upper and lower case in symbols, e.g. pA, PA or Pa for Pa.

Arithmetic errors   Deduct one mark if the **only** error in arriving at a final answer is clearly an arithmetic one. Regard a power-of-ten error as an arithmetic one.

Transcription errors   Deduct one mark if the only error in arriving at a final answer is because given or previously calculated data has clearly been misread but used correctly..

Fractions   Only accept these where specified in the mark scheme.

Crossed out work   Work which has been crossed out **and not replaced but can easily be read,** should be marked as if it had not been crossed out.

Use of **NR**   (# key on the keyboard) Use this if the answer space for a question is completely blank or contains no readable words, figures or symbols.

1 (a) (i) 18 m/s   B1

(ii) (0.90 s is) driver's time to react   B1

(b) (i) (a =) $(v - u)/t$ OR $\Delta v/t$ OR either in words OR $(18 - 0)/3.1$ OR $18/3.1$ C1
$5.8 \, \text{m/s}^2$ A1
OR
Values from any correct points on graph   (C1)
Answer dependent on accuracy of chosen points   (A1)

(ii) Evidence of use of: (distance =) area under graph e.g. $1/2bh$ C1
$(18 \times 0.9) + (0.5 \times 3.1 \times 18)$ C1
44 m   A1

(c) (Without seat belt, driver:) e.g. keeps moving (forwards)/does not stop/has inertia/has momentum   B1

(Driver) hits steering wheel/windscreen/dashboard   B1

[Total: 9]

2 (a) $mv - mu$ OR $m(v - u)$ OR mv OR 0.15×8.0 C1
1.2 Ns or kg m/s   A1

(b) 1.2 Ns or kg m/s   B1

(c) $F = (mv - mu)/t$ OR $F = mv/t$ OR impulse/t OR $1.2/0.0015$ C1
800 N   A1
OR
(F =) ma OR $m[(v - u)/t]$ OR $0.15 \times 8/0.0015$ (C1)
800 N   (A1)

[Total: 5]

3 (a) (i) Straight line through origin   B1

(ii) Strain (energy) OR elastic (energy)   B1

(b) Use of $1/2mv^2$ C1
$0.5 \times 2.5 \times v^2 = 0.48$ C1
$v^2 = 0.48/(0.5 \times 2.5)$ OR $v^2 = 0.384$ C1
$v = 0.62$ m/s   A1

[Total: 6]

4 (a) Coal, hydroelectric and wind boxes ticked   B2

(b) (i) Copper is a good conductor of thermal energy / heat   B1
Black surface is a good / the best absorber <u>of radiation</u> / <u>infra red</u>   B1

(ii) (Temp rise =) 72 – 20 = 52 (°C)   C1
(Q =) $mc\Delta\theta$ OR $0.019 \times 4200 \times 52$ C1
4100 J   A1

(iii) Efficiency = (power) output / (power) input ($\times$ 100)
OR $70 = \dfrac{(4100 / 5) \times 100}{\text{power input}}$ OR $\dfrac{(4100 \times 100)}{\text{power input}}$ OR rearranged   C1
Power input = 1200 W   A1

[Total: 9]

5 (a) (i) $P \times V$ values are 7500 or about 7500
OR If P / pressure doubles, V / volume halves OR vice versa   B1
(so) PV = constant OR $P \alpha 1/V$ OR either in words   B1

(ii) temperature   B1

(b) (i) P = hdg OR $5.0 \times 10 \times 1000$ C1
50 000 Pa or 50 kPa   A1

(ii) Volume of bubble <u>increases</u>
Mass of gas <u>stays the same</u>   B2
Density of gas <u>decreases</u>

[Total: 7]

6 (a) (i) 1. Mark amplitude with **X**   B1
2. Mark wavelength with **Y**   B1

(ii) 1. Amplitude increases <u>and</u> wavelength stays the same   B1
2. Amplitude stays the same <u>and </u> wavelength decreases   B1

(b) v = (total) distance / time OR d / t OR 2d / t in any form   C1
d = $1500 \times 0.054 / 2$ C1
40 m OR 41 m   A1

[Total: 7]

7 (a) (i) Reflection <u>in a more dense material</u> where there is no refracted ray or wtte
OR All light <u>in a more dense material</u> is reflected or wtte   **B1**

(ii) e.g. The greatest angle of incidence (in the material) at which refraction occurs
OR The angle of incidence (in the material) at which the refracted ray travels along the boundary / angle of refraction is 90°   **B1**
OR The angle of incidence / (in the material) above which total internal reflection occurs

(b) (i) (refractive index =) speed of light in air / speed of light in glass
OR $3.0 \times 10^8 / 2.0 \times 10^8$ **M1**
= 1.5   **A1**

(ii) sin c = 1 / n OR 1 / 1.5 seen
(c = 42°)   **B1**

(iii) No change of direction at first face   **B1**
Total internal reflection at hypotenuse with i = r by eye   **B1**
Refraction with r greater than i at lower face   **B1**

[Total: 8]

8 (a) (i) P = IV OR 40 = 220 × I OR (I =) P / V OR 40 / 220   **C1**
0.18 A   **A1**

(ii) [3 × 0.18(2)] = 0.54 A OR 0.55 A   **B1**

(iii) 2 / 0.182 = 10.99 OR 2 / 0.18 = 11.1   **C1**
10 lamps OR 11 lamps   **A1**

(b) (i) Resistance <u>increases</u>   **B1**

(ii) Power (of lamp) decreases   **B1**
P = IV <u>and</u> current in lamp decreases. OR $P = V^2 / R$ **B1**

[Total: 8]

9 (a) (i) . . . . .direction of the force on a positive charge   **B1**

(ii) Straight parallel lines from upper to lower plate   **B1**
At least 3 lines drawn. All lines drawn equally spaced,
approximately symmetrical with respect to plates   **B1**
Arrows downwards   **B1**

(b) (i) Upward force (on drop) due to electric field / charge on plates   **B1**
= weight of drop   **B1**
Upward force on drop = downward force on drop
OR no resultant / net force on drop
OR forces are balanced   **(B1)**

    (ii) Drop moves upwards   **B1**

Weight / mass of drop decreases **OR** downward force decreases

OR Upward force (due to electric field) > weight of drop   **B1**

[Total: 8]

10 (a) (i) Protons: 53 neutrons: 78 electrons: 53   **B2**

      (ii) $^{131}_{54}$Xe   **B1**

                                                                            B1

    (b) Points plotted at 3 of: 0 s, 50 s, 100 s, 150 s   **B1**

3 corrected counts/minute plotted at any from :

(0,   280)

(50, 140)

(100, 70)

(150, 35)   **M1**

Graph drawn as curve through correct points   **A1**

[Total: 7]

11 (a) AND (gate)   **B1**

    (b) 0 0 1   **B2**

1 0 0

0 1 0

1 1 0

    (c)

A	B	C	D	E	F
1	1	0	1	1	1

                                                                                          B3

[Total: 6]