Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

May 2019

Physics

Standard level

Paper 2

13 pages

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Subject Details: Physics SL Paper 2 Markscheme

Candidates are required to answer **all** questions. Maximum total = **50 marks**.

1. Each row in the "Question" column relates to the smallest subpart of the question.

2. The maximum mark for each question subpart is indicated in the "Total" column.

3. Each marking point in the "Answers" column is shown by means of a tick (✓) at the end of the marking point.

4. A question subpart may have more marking points than the total allows. This will be indicated by "**max**" written after the mark in the "Total" column. The related rubric, if necessary, will be outlined in the "Notes" column.

5. An alternative wording is indicated in the "Answers" column by a slash (*/*). Either wording can be accepted.

6. An alternative answer is indicated in the "Answers" column by "***OR***". Either answer can be accepted.

7. An alternative markscheme is indicated in the "Answers" column under heading ***ALTERNATIVE 1*** *etc*. Either alternative can be accepted.

8. Words inside chevrons **« »** in the "Answers" column are not necessary to gain the mark.

9. Words that are <u>underlined</u> are essential for the mark.

10. The order of marking points does not have to be as in the "Answers" column, unless stated otherwise in the "Notes" column.

11. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the "Answers" column then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by ***OWTTE*** (or words to that effect) in the "Notes" column.

12. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.

13. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. When marking, indicate this by adding **ECF** (error carried forward) on the script. "ECF acceptable" will be displayed in the "Notes" column.

14. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the "Notes" column.

Question			Answers	Notes	Total
1.	a	i	$F = \frac{\Delta mv}{\Delta t}$ / $m\frac{\Delta v}{\Delta t}$ / $\frac{0.058 \times 64.0}{25 \times 10^{-3}}$ ✓ $F = 148$ «N» ≈ 150 «N» ✓		2
1.	a	ii	***ALTERNATIVE 1*** $P = \frac{\frac{1}{2}mv^2}{t}$ / $\frac{\frac{1}{2} \times 0.058 \times 64.0^2}{25 \times 10^{-3}}$ ✓ $P = 4700 / 4800$ «W» ✓ ***ALTERNATIVE 2*** $P =$ average Fv / $148 \times \frac{64.0}{2}$ ✓ $P = 4700 / 4800$ «W» ✓		2

(continued…)

(Question 1 continued)

Question			Answers	Notes	Total
1.	b	i	horizontal component of velocity is $64.0 \times \cos 7^\circ = 63.52$ «m s^{-1}» ✓ $t = \text{«}\frac{11.9}{63.52}\text{=»}$ 0.187 / 0.19 «s» ✓	*Do not award BCA. Check working.* *Do not award ECF from using 64 m s^{-1}.*	**2**
1.	b	ii	***ALTERNATIVE 1*** $u_y = 64 \sin 7 / 7.80$ «m s^{-1}» ✓ decrease in height $= 7.80 \times 0.187 + \frac{1}{2} \times 9.81 \times 0.187^2 / 1.63$ «m» ✓ final height = «$2.80 - 1.63$» = 1.1 / 1.2 «m» ✓ «higher than net so goes over» ***ALTERNATIVE 2*** vertical distance to fall to net «$= 2.80 - 0.91$» = 1.89 «m» ✓ time to fall this distance found using «$1.89 = 7.8t + \frac{1}{2} \times 9.81 \times t^2$» $t = 0.21$«s» ✓ 0.21 «s» > 0.187 «s» ✓ «reaches the net before it has fallen far enough so goes over»	*Other alternatives are possible*	**3**

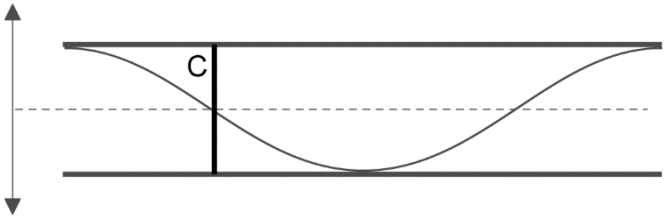
(continued…)

(Question 1 continued)

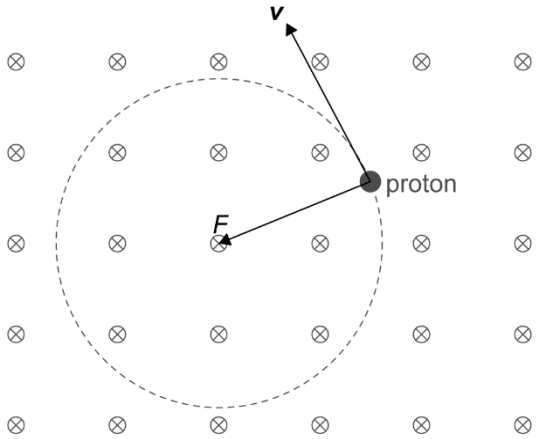
Question			Answers	Notes	Total
1.	b	iii	***ALTERNATIVE 1*** Initial KE + PE = final KE / $\frac{1}{2}\times 0.058\times 64^2 + 0.058\times 9.81\times 2.80 = \frac{1}{2}\times 0.058\times v^2$ ✓ $v = 64.4$ «m s^{-1}» ✓ ***ALTERNATIVE 2*** $v_v = \text{«}\sqrt{7.8^2 + 2\times 9.81\times 2.8}\text{»} = 10.8$ «m s^{-1}» ✓ «$v = \sqrt{63.5^2 + 10.8^2}$» $v = 64.4$ «m s^{-1}» ✓		**2**
1.	c		so horizontal velocity component at lift off for clay is smaller ✓ normal force is the same so vertical component of velocity is the same ✓ so bounce angle on clay is greater ✓		**3**

Question			Answers	Notes	Total
2.	a		$m = \frac{4.0\text{x}10^{-3}}{6.02\times10^{23}}$ «kg» ***OR*** 6.64×10^{-27} «kg» ✓		1
2.	b		$\frac{1}{2}mv^2 = \frac{3}{2}kT$ / $v = \sqrt{\frac{3kT}{m}}$ / $\sqrt{\frac{3\times1.38\times10^{-23}\times320}{6.6\times10^{-27}}}$ ✓ $v = 1.4\times10^3$ «ms^{-1}» ✓		2
2.	c		$N = \frac{pV}{kT}$ / $\frac{5.1\times10^5\times3.2\times10^{-6}}{1.38\times10^{-23}\times320}$ ***OR*** $N = \frac{pVN_A}{RT}$ / $\frac{5.1\times10^5\times3.2\times10^{-6}\times6.02\times10^{23}}{8.31\times320}$ ✓ $N = 3.7\times10^{20}$ ✓		2
2.	d	i	«$\frac{4\times10^{20}\times4.9\times10^{-31}}{3.2\times10^{-6}}$ =» 6×10^{-5} ✓		1

2.	**d**	**ii**	**«**For an ideal gas**»** the size of the particles is small compared to the distance between them/size of the container/gas ***OR*** «For an ideal gas» the volume of the particles is negligible/the volume of the particles is small compared to the volume of the container/gas ***OR*** **«**For an ideal gas**»** particles are assumed to be point objects ✓ calculation/ratio/result in (d)(i) shows that volume of helium atoms is negligible compared to/much smaller than volume of helium gas/container «hence assumption is justified**»** ✓		**2**

Question			Answers	Notes	Total
3.	a		Expression or statement showing acceleration is proportional to displacement ✓ so «$7.9 \times \frac{2.3}{3.2}$» $= 5.7$ «m s^{-2}» ✓		2
3.	b		$\sin\theta = \frac{340}{6010} \times \sin 54^0$ ✓ $\theta = 2.6^0$ ✓		2
3.	c	i	$f = 250$ «Hz» ***OR*** Same ***OR*** Unchanged ✓		1
3.	c	ii	$\lambda =$ «$\frac{340}{250}$ =» $1.36 \approx 1.4$ «m» ✓		1
3.	d		any point labelled C on the vertical line shown below ✓ *eg:* displacement to the right  displacement to the left		1

Question			Answers	Notes	Total
4.	a		total resistance of circuit is 8.0 «Ω» ✓ $P = \frac{12^2}{8.0} = 18$ «W» ✓		2
4.	b	i	«a resistor is now connected in parallel» reducing the total resistance ***OR*** current through YZ unchanged and additional current flows through X ✓		1
4.	b	ii	evidence in calculation or statement that pd across Y/current in Y is the same as before ✓ so ratio is 1 ✓		2

Question			Answers	Notes	Total
5.	a	i	*F* towards centre ✓		1
5.	a	ii	*v* tangent to circle and in the direction shown in the diagram ✓		1
5.	b		$\text{«}qvB = \frac{mv^2}{R} \Rightarrow \text{»}\ R = \frac{mv}{qB}\ /\ \frac{1.673\times10^{-27}\times2.16\times10^{6}}{1.60\times10^{-19}\times0.042}$ ✓ $R = 0.538$ «m» ✓ $R = 0.54$ «m» ✓		3

Question			Answers	Notes	Total
6.	a		proton / ${}^{1}_{1}\mathrm{H}$ / p ✓		1
6.	b	i	«$3 \times 2.78 - 2 \times 2 \times 1.12$» See $3 \times 2.78 / 8.34$ ***OR*** $2 \times 2 \times 1.12 / 4.48$ ✓ 3.86 «MeV» ✓		2
6.	b	ii	the deuterium nuclei are positively charged/repel ✓ high KE/energy is required to overcome «Coulomb/electrostatic» repulsion /potential barrier ***OR*** high KE/energy is required to bring the nuclei within range of the strong nuclear force ✓ high temperatures are required to give high KEs/energies ✓		2 max
6.	c	i	–1 / -e ✓		1
6.	c	ii	–3 ✓		1

Question			Answers	Notes	Total
7.	a		$5.67 \times 10^{-8} \times 289^4$ ***OR*** $= 396$ «$\mathrm{W\,m^{-2}}$» ✓ «$\approx 400\,\mathrm{W\,m^{-2}}$»		1
7.	b		«most of the radiation emitted by the oceans is in the» infrared ✓ «this radiation is» absorbed by greenhouse gases/named greenhouse gas in the atmosphere ✓ «the gases» reradiate/re-emit ✓ partly back towards oceans/in all directions/awareness that radiation in other directions is also present ✓		3 max