中學文憑試　卷一甲部
DSE Paper 1 Section A

題號 Question No.	答案 Key	題號 Question No.	答案 Key
1.	D	26.	C
2.	B	27.	D
3.	A	28.	D
4.	D	29.	C
5.	A	30.	B
6.	C	31.	D
7.	B	32.	B
8.	D	33.	C
9.	B		
10.	A		
11.	B		
12.	A		
13.	C		
14.	C		
15.	A		
16.	C		
17.	B		
18.	A		
19.	D		
20.	A		
21.	D		
22.	A		
23.	A		
24.	C		
25.	B		

註：　括號內數字為答對百分率。
Note:　Figures in brackets indicate the percentages of candidates choosing the correct answers.

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香港考試及評核局
HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

2019 年香港中學文憑考試
HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2019

物理 香港中學文憑考試 試卷一乙
PHYSICS HKDSE PAPER 1B

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HKDSE Physics

General Marking Instruction

1. It is very important that all markers should adhere as closely as possible to the marking scheme. In many cases, however, candidates may have obtained a correct answer by an alternative method not specified in the marking scheme. In general, a correct answer merits ***the answer mark*** allocated to that part, unless a particular method has been specified in the question. **Markers should be patient in marking alternative solutions not specified in the marking scheme.**

2. In the marking scheme, answer marks or 'A' marks are awarded for a correct numerical answer with a unit. **In case the same unit involved is given incorrectly for more than once in the same question, the 'A' marks thereafter can be awarded even for correct numerical answers without units.** If the answer should be in km, then cm and m are considered to be wrong units.

3. In a question consisting of several parts each depending on the previous parts, **marks for correct method or substitution** are awarded to steps or methods correctly deduced from previous answers, even if these answers are erroneous or for inserting values of appropriate physical quantities into an algebraic expression **irrespective of their order of magnitudes**. However, 'A' marks for the corresponding answers should **NOT** be awarded (unless otherwise specified).

4. For the convenience of markers, the marking scheme is written as detailed as possible. However, it is still likely that candidates would not present their solution in the same explicit manner, e.g. some steps would either be omitted or stated implicitly. In such cases, markers should exercise their discretion in marking candidates' work. In general, marks for a certain step should be awarded if candidates' solution indicated that the relevant concept/technique had been used.

5. In cases where a candidate answers more questions than required, the answers to all questions should be marked. However, the excess answer(s) receiving the lowest score(s) will be disregarded in the calculation of the final mark.

6. OSM (On-screen marking) marking symbols:

✓	correct point
×	wrong point
═	point to highlight
〈_ _ _	incomplete answer
∧	missing point
文	entering text/comment

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<table>
<tr><th>Solution</th><th>Marks</th><th>Remarks</th></tr>
<tr><td>1. (a) (i) $(1.5)(4200)(60-10) = m(3.34\times10^5) + m(4200)(10-0)$
$m = 0.837766$ kg ≈ 0.838 kg
(Accept: $m = 0.83 \sim 0.84$ kg)</td><td>1M+1M
1A
3</td><td>All 3 terms correct 2 M
Any 2 terms correct 1 M
ΔT must be correct</td></tr>
<tr><td>(ii) More ice is needed
to cool the container as it will release heat/thermal energy as well.</td><td>1A
1A
2</td><td><table><tr><th>Reason</th><th>More ice</th><th>Less ice</th></tr><tr><td>✓</td><td>2</td><td>0</td></tr><tr><td>×</td><td>0</td><td>0</td></tr><tr><td>incomplete</td><td>1</td><td>0</td></tr></table>Key word: heat / energy</td></tr>
<tr><td>(b) (i) Conduction:
- Foam is a poor conductor (of heat) and it minimizes the transfer of heat/thermal energy from the surroundings to the cool contents/ice cream (inside the bag).
OR
Convection:
- The zipper prevents convection between the hot air outside and the cool contents/ice cream (inside the bag).
Any **ONE**</td><td>1A
1</td><td>One feature + corresponding reason

OR
Radiation:
- The shiny surface inside the bag reduces the transfer of heat/thermal energy from the surroundings to the cool contents/ice cream (inside the bag) through emission of radiation</td></tr>
<tr><td>(ii) (Radiation) Make the outer surface (of the bag) shiny.</td><td>1A
1</td><td>The answer must be related to the modification of the bag like 'thickening the bag'
Adding ice to the bag is **NOT** accepted</td></tr>
<tr><td>2. (a) $pV = nRT$
$(100\times10^3)(0.52) = n\,(8.31)(273+15)$
$n = 21.727504$ (mol) ≈ 21.7 (mol)</td><td>1M
1A
2</td><td>Accept: $n = 21 \sim 22$ mol</td></tr>
<tr><td>(b) (i) Since $pV = nRT \Rightarrow V = \dfrac{nRT}{p}$ / volume V of the balloon depends on both T and p,
the (fractional) decrease in pressure p (with height) is greater/faster than the (fractional) decrease in temperature T.</td><td>1A
1A
2</td><td>Accept: volume V decreases as temperature T decreases would be true only if pressure p is constant, however, p decreases with height.</td></tr>
<tr><td>(ii) (1) $\dfrac{pV}{T} = \text{constant}$
$\dfrac{(100)(0.52)}{(273+15)} = \dfrac{p(8)}{216}$
$p = 4.875$ kPa or 4875 Pa</td><td>1M
1A
2</td><td>Note: $p(8) = 21.7\times8.31\times216$
$p = 4869$ Pa</td></tr>
<tr><td>(2) $p = p_0 e^{-kx}$
$4.875 = 100\,e^{-0.138\,x}$
$x = 21.89166726$ (km) ≈ 21.9 (km)</td><td>1M
1A
2</td><td>e.c.f. from (b)(ii)(1)
Accept 21.8 km to 22.0 km</td></tr>
</table>

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Solution	Marks	Remarks
3. (a) (i) (1) $\frac{1}{2}mv^2 = mgh$	1M	
$v^2 = 2(9.81)(12)$		
$v = 15.344054 \text{ m s}^{-1} \approx 15.3 \text{ m s}^{-1}$ ($v = 15.491933 \text{ m s}^{-1} \approx 15.5 \text{ m s}^{-1}$ for $g = 10 \text{ m s}^{-2}$)	1A	Accept: $v = 15 \sim 15.5 \text{ m s}^{-1}$
	2	
(2) $s = \frac{1}{2}gt^2$	1M	
$12 = \frac{1}{2}(9.81)t^2$		
$t = 1.564124 \text{ s} \approx 1.56 \text{ s}$ ($t = 1.5491933 \text{ s} \approx 1.55 \text{ s}$ for $g = 10 \text{ m s}^{-2}$)	1A	Accept: $t = 1.5 \sim 1.6 \text{ s}$
	2	
(ii) $F - mg = ma$ $F = \frac{70 \times (15.3 - 0)}{0.3} + 70 \times 9.81$	1M+1M	$F = ma$ 1 M $F = ma + mg$ 2 M
$= 4266.9793 \text{ N} \approx 4270 \text{ N}$ ($F = 4314.7845 \text{ N} \approx 4310 \text{ N}$ for $g = 10 \text{ m s}^{-2}$)	1A	Accept: $F = 4180 \sim 4320 \text{ N}$
	3	
(iii) Elastic potential energy	1A	**MUST** have the word: 'Elastic'
	1	Accept: Elastic energy
(b) (i) (Velocity is too high, hence the force for deceleration is too large.) Any **ONE**: - The life net may be torn. - The falling person may be injured. - The firemen may not be able to hold the life net tight.	1A	The answer is related to the consequence due to limitation of any one of the following: (1) the net, (2) the falling person (3) the firemen NOT accept: - The force is too large which exceed the limit of the life net - The life net is not strong enough to withstand the force - The force is too large that the man cannot withstand
	1	
(ii) There exists a horizontal velocity when a person jumps and the horizontal displacement is very difficult to estimate as it depends on the time of fall, which is usually long.	1A 1A	1st mark: horizontal velocity / projectile motion 2nd mark: difficult to estimate the horizontal displacement / horizontal direction
	2	

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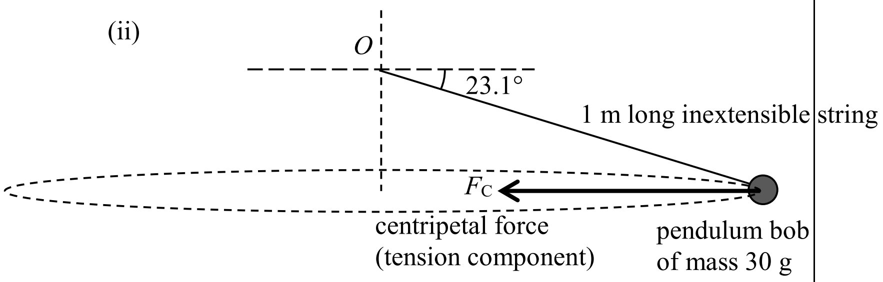
Solution	Marks	Remarks
4. (a) (i) Rotation rate $= \dfrac{\omega}{2\pi} = \dfrac{5.0}{2\pi}$ $= 0.795775$ (rev s^{-1}) ≈ 0.80 (rev s^{-1})	1M/1A	Accept: 0.79 ~ 0.80 (rev s^{-1})
	1	
(ii)		



Solution	Marks	Remarks
F_C correctly indicated.	1A	
$F_C = mr\omega^2$ $= (0.03)(1 \times \cos 23.1°)(5.0)^2$ $= 0.689866$ N ≈ 0.690 N ($F_C = 0.7033402$ N ≈ 0.703 N for $g = 10$ m s^{-2})	1M 1A	OR $T\cos\theta = F_C$ and $T\sin\theta = mg$ 1M $F_C = \dfrac{mg}{\sin\theta}\cos\theta = 0.689866$ N 1A Accept: $F_C = 0.70$ N
	3	
(iii) Horizontal component of tension provides the centripetal force, thus tension is larger than the centripetal force. OR $T\cos\theta = F_C \Rightarrow T > F_C$	1M 1A	$T\sin\theta = mg$ 1M $T = 0.750$ N $T > F_C$ 1A
	2	
(b) (i) The gravitational force is perpendicular to the moon's motion/displacement/velocity, thus no work is done on the moon by this force (k.e. unchanged)	1A 1A	
	2	
(ii) (The claim is incorrect) as, by Newton's third law of motion, gravitational force of the same magnitude (but in opposite direction) is acting on the Earth by the moon.	1A 1A	Accept: action and reaction pairs
	2	

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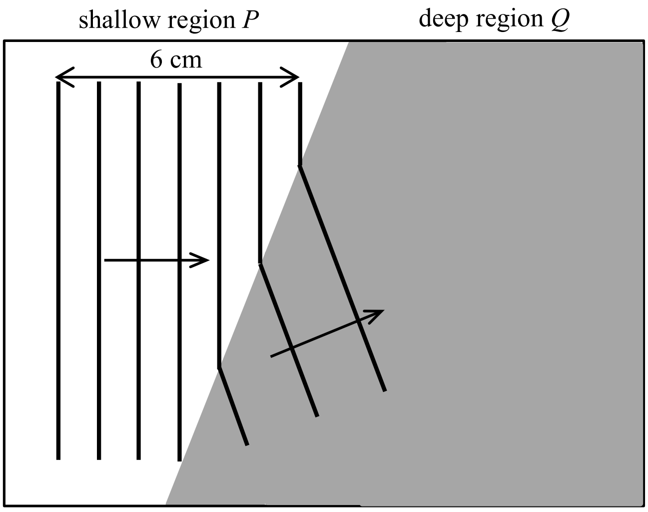
Solution	Marks	Remarks
5. (a) (i) wavelength $\lambda = \dfrac{0.06}{7-1}$ $= 0.01$ m (= 1 cm)	1A	
	1	
(ii) speed $v = f\lambda = 10 \times 0.01$ $= 0.1\ \text{m s}^{-1}$ (= 10 cm s^{-1})	1M/1A	e.c.f. from (a)(i)
	1	
(b) (i) frequency = 10 Hz	1A	'remain unchanged' is **NOT** accepted
	1	
(ii) 	1A 1A	Straight wavefronts *bend away from the normal* of the shallow-deep boundary. All correct with *double (longer) wavelength* having wavefronts *continuous at boundary*
	2	
(iii) Refraction. It is due to the change in wavelengths/wave speeds in different media/depth.	1A 1A	Correct spelling
	2	

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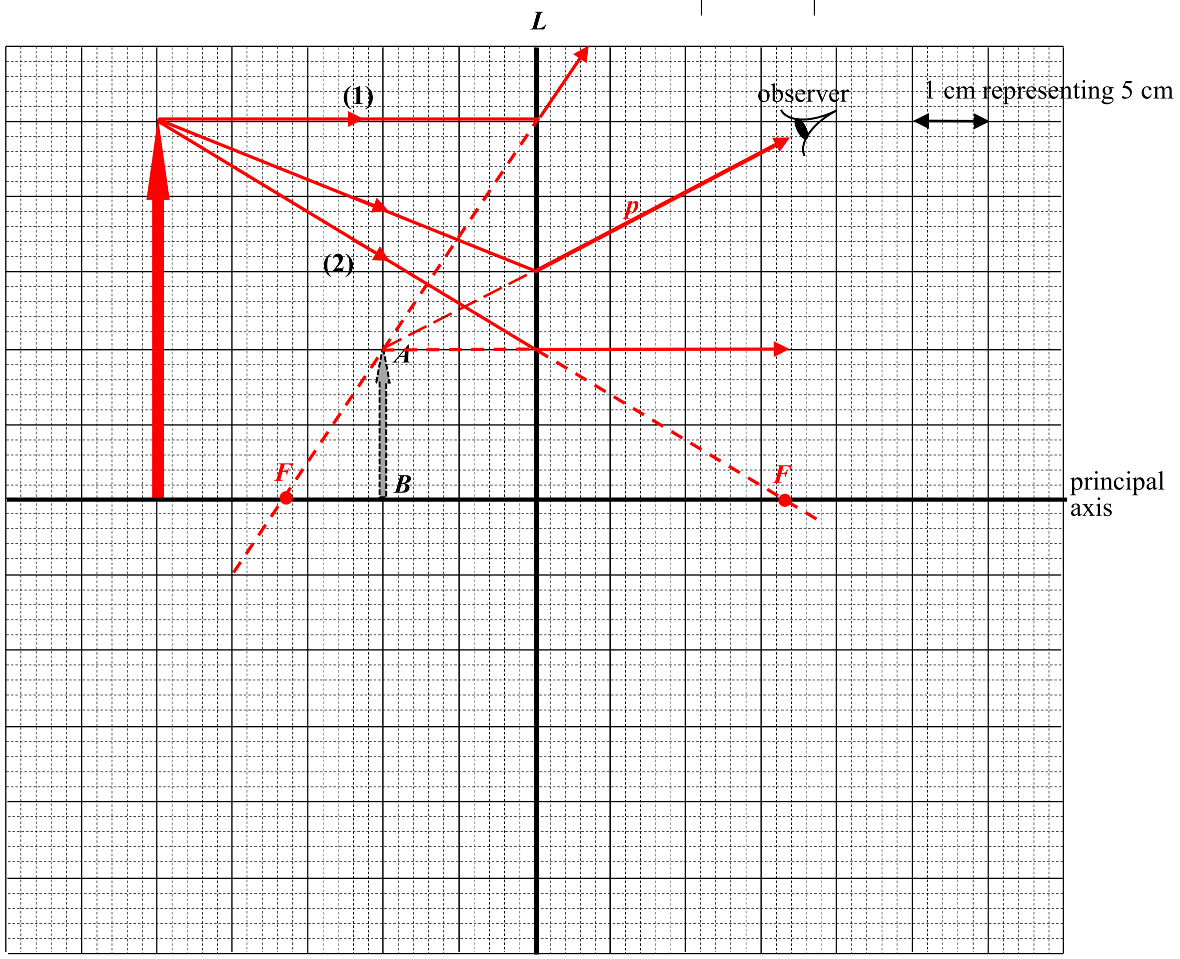
Solution	Marks	Remarks
6. (a) L is diverging/concave.	1A	
Only diverging/concave lens forms <u>diminished, virtual image.</u>	1A	This is the only accepted answer
	2	
(b) 		
Correct position and height of object	2A	Correct position 1st mark
	2	All correct: 2 marks
(c) Correct ray to locate F and focus F correctly marked.	2M	1st M mark: Ray (1) or (2) e.c.f. from (b)
Focal length = 16.5 cm (Accept 15.5 cm – 17.5 cm)	1A	2nd M mark: locate F
	3	1st A mark: Diverging ray from the tip of the object, and can reach the observer
(d) Correct ray p from tip of object	2A	
	2	2nd A mark: The ray entering the eye comes virtually from the tip of the image

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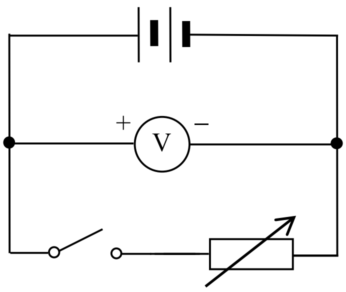
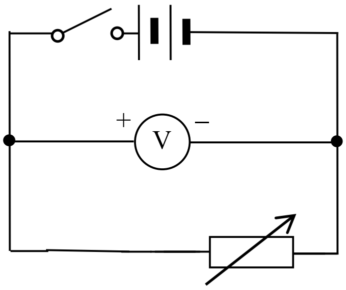
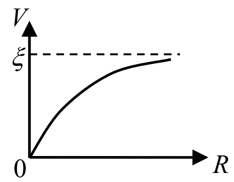
Solution	Marks	Remarks
. (a) 	1A 1A	Correct circuit with correct symbol Correct polarity Alternative circuit 
Close the switch and record corresponding V and R readings Adjust the resistance R to lower/other value(s) and repeat the experiment	1A 1A	
Precaution: - First set the variable resistor to its maximum / a large value - Open the switch after each measurement - Any reasonable answer Any **ONE**	1A	NOT accept Change of apparatus e.g. Using thicker connecting wires etc.
	5	
(b) Terminal voltage V delivered increases with increasing (loading) resistance R (or graphical representation)	1A	Accept 
$V = \xi \dfrac{R}{R+r}$ <u>OR</u> $V = \xi - \dfrac{\xi}{R+r} r$	1A	NOT accept V is directly proportional to R V varies linearly with R
	2	

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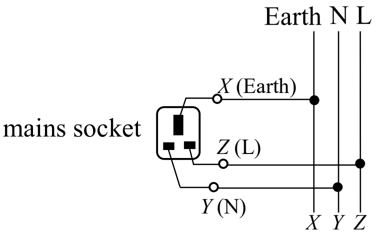
Solution	Marks	Remarks
8. (a) 	1A	
	1	
(b) (i) - If one of the lighting sets/circuits fails, the other (in parallel) can still operate, i.e. both work independently. - Both can work at the rated power. - Any reasonable answer Any **ONE**	1A	
	1	
(ii) $P = IV$		
$(300 + 450) = I(220)$	1M	1M for substitution
$I = 3.409091\ \text{A} \approx 3.41\ \text{A}$	1A	The unit of current can be omitted
Thus 5 A fuse should be used.	1A	Correct deduction
	3	
(c) Electrical energy used per day		
= 0.500 kW × 8 h + 2 kW × 0.5 h + 3 kW × 2 h	1M	
= 11 kW h		
Cost = \$0.9 / kW h × 11 kW h	1M	
= \$9.9	1A	
	3	

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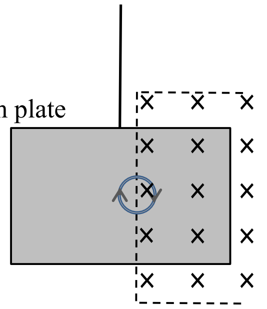
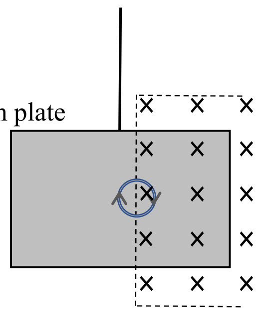
	Solution	Marks	Remarks
9.	(a) (i) By Lenz's law, an e.m.f. would be induced such that it opposes the change, i.e. decrease of magnetic flux (into the paper) by driving an induced current (clockwise) in the coil/circuit (complete).	1A 1A	1A for induced e.m.f. 1A for the change of magnetic flux
	(ii) $N\Delta\Phi = NBA$ $= (20)(0.3)(0.005)$ $= 0.03\text{ Wb}$ $\xi = \frac{N\Delta\Phi}{\Delta t} = \frac{0.03}{0.5}$ $= 0.06\text{ V}$ (or 60 mV)	1M/1A 1M 1A	Accept equivalent unit : T m^2, V s
	(b) (i) The change of (magnetic) flux linkage is double that in (a)(ii), i.e. 0.06 Wb.	1M	e.c.f. from (a)(ii)
	(ii) Direction of current : *PQRS*	1A	NOT accept clockwise/anticlockwise
	(c) (i) 	1A 1A 2	Correct position (accept just within the magnetic field) Correct direction (clockwise) with complete circular path inside the aluminium plate
	(ii) Move/swing to the right initially/momentarily/briefly.	1A 1	

Attachment of 9 (c)(i)



Correct position (accept just within the magnetic field) **1A**
Correct direction (clockwise) with complete circular path inside the aluminium plate **1A**

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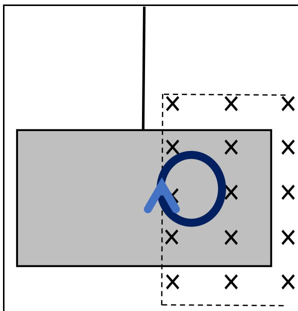
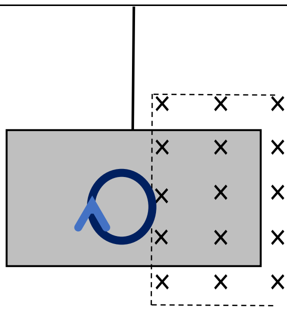
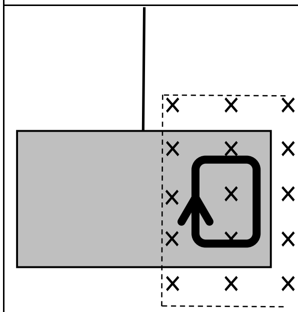
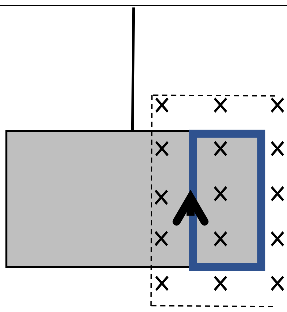
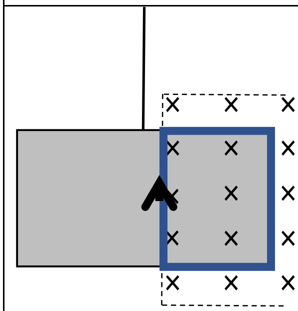
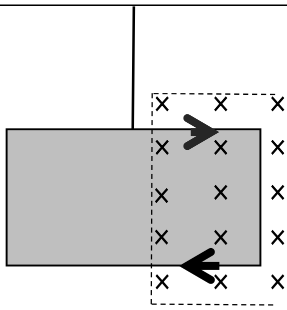
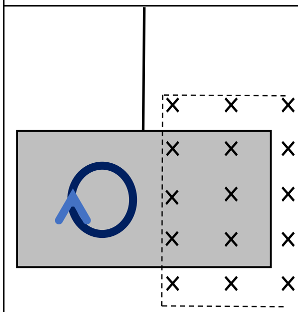
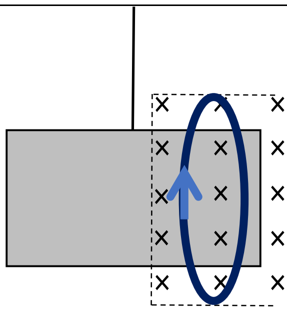
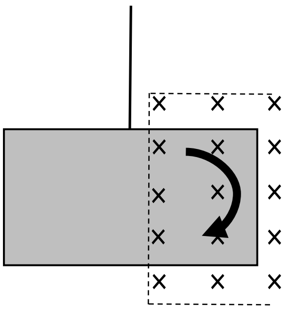
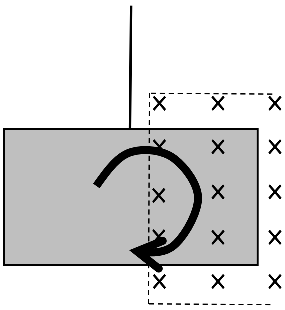
Examples:

	1A 1A		1A 1A
	0 1A		0 0
	1A 0		0 0
	0 1A		0 0
	0 0		1A 0

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Solution	Marks	Remarks
10. (a) (i) $x = 3$	1A	
	1	
(ii) More neutrons are produced in each fission for triggering further fissions, i.e. $x > 1$.	1A	Accept: exceed critical mass, suitable concentration of U-235
	1	
(b) (i) $m = m_0 e^{-kt}$ $k = \dfrac{\ln 2}{t_{1/2}} = 9.846\times10^{-10}\ \text{yr}^{-1}$ $0.06 = m_0\ e^{-\ln 2\times\left[\frac{2\times10^9}{7.04\times10^8}\right]}$	1M	OR $0.06 = m_0\ (\frac{1}{2})^{2\times10^9/7.04\times10^8}$
$m_0 = 0.429882832\ \text{(kg)} \approx 0.430\ \text{(kg)}$	1A	
	2	
(ii) $\dfrac{0.430}{13.556+0.430} = 0.03073691 \approx 3.1\ \% > 3\%$ Thus natural nuclear fission was possible.	1M/1A	e.c.f. from (b)(i)
	1	
(c) Underground water might run dry. OR Energy released by fission drys up the underground water.	1A	
Therefore, fission might stop without slow neutrons.	1A	
	2	

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2019 年香港中學文憑考試
HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2019

物理　香港中學文憑考試　試卷二
PHYSICS　HKDSE　PAPER 2

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HKDSE Physics

General Marking Instruction

1. It is very important that all markers should adhere as closely as possible to the marking scheme. In many cases, however, candidates may have obtained a correct answer by an alternative method not specified in the marking scheme. In general, a correct answer merits ***the answer mark*** allocated to that part, unless a particular method has been specified in the question. **Markers should be patient in marking alternative solutions not specified in the marking scheme.**

2. In the marking scheme, answer marks or 'A' marks are awarded for a correct numerical answer with a unit. **In case the same unit involved is given incorrectly for more than once in answering the same question, the 'A' marks thereafter can be awarded even for correct numerical answers without units.** If the answer should be in km, then cm and m are considered to be wrong units.

3. In a question consisting of several parts each depending on the previous parts, method marks or 'M' marks are awarded to substitutions or methods correctly deduced from previous numerical answers, even if these answers are erroneous or appropriate physical quantities of incorrect order of magnitudes are inserted into an algebraic expression. However, 'A' marks for the corresponding answers should **NOT** be awarded (unless otherwise specified).

4. For the convenience of markers, the marking scheme is written as detailed as possible. However, it is still likely that candidates would not present their solution in the same explicit manner, e.g. some steps would either be omitted or stated implicitly. In such cases, markers should exercise their discretion in marking candidates' work. In general, marks for a certain step should be awarded if candidates' solution indicated that the relevant concept/technique had been used.

5. In cases where a candidate answers more questions than required, the answers to all questions should be marked. However, the excess answer(s) receiving the lowest score(s) will be disregarded in the calculation of the final mark.

6. OSM (On-screen marking) marking symbols:

✓	correct point
×	wrong point
═	point to highlight
〈_ _ _	incomplete answer
∧	missing point
文	entering text/comment

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Section A : Astronomy and Space Science

1. D (%)	2. B (%)	3. B (%)	4. A (%)
5. D (%)	6. A (%)	7. C (%)	8. C (%)

Solution	Marks	Remarks
1. (a) (i) $\frac{1}{2}m(v_B^2 - v_A^2) = GMm(\frac{1}{r_B} - \frac{1}{r_A})$		
$v_B^2 - 8.02^2 = 2(4\times10^5)(\frac{1}{6400+400} - \frac{1}{6400})$	1M	Correct sub. for v_A , r_A and r_B
$v_B = 7.547679036 \text{ km s}^{-1} \approx 7.55 \text{ km s}^{-1}$	1A	
	2	
(ii) $T = \frac{2\pi a}{v}$ and $\frac{GMm}{a^2} = \frac{mv^2}{a}$ $\therefore T^2 = \frac{4\pi^2 a^3}{GM}$	1M	Correct expression/derivation for Kepler's 3rd law
$T = 2\pi\sqrt{\frac{a^3}{GM}}$ where $a = \frac{r_A + r_B}{2}$ for elliptical orbit		
$a = \frac{r_A + r_B}{2} = \frac{(6400) + (400 + 6400)}{2} = 6600 \text{ km}$ $T_{AB} = \frac{T}{2} = \frac{1}{2}\left\{2\pi\sqrt{\frac{6600^3}{4\times10^5}}\right\} = 2663.3962 \text{ s} \approx 2663 \text{ s}$	1M	Correct semi-major axis
	2	
(iii) Any ONE: - The gravitational force acting on the astronaut is (all) used for accelerating the astronaut. - The astronaut and the spacecraft are under the same acceleration due to gravity, i.e. free falling. - The gravitational force (weight) acting on the astronaut is (all) used for centripetal force.	1A	NOT accept: -They have the same acceleration - The acceleration of gravity is used for centripetal force - No normal reaction to the astronaut in the spacecraft
	1	
(b) (i) $\theta = \frac{\frac{5570}{2} - 2663}{5570} \times 360°$	1M	OR $\frac{2663}{5570} = \frac{180° - \theta}{360°}$
$= 7.8850987° \approx 7.89°$ Accept : 7.8° ~ 7.9°	1A	OR $\frac{2\pi(6800)}{7.67} \times \frac{180° - \theta}{360°} = 2663$ OR $\theta = \omega\Delta t = \frac{2\pi}{5570}(\frac{5570}{2} - 2663)$ $= (1.128\times10^{-3} \text{ rad s}^{-1})(122 \text{ s})$
	2	
(ii) If the launching speed at A is slightly higher (or lower), the length of the elliptical orbit's major axis will be longer (or shorter), i.e. the orbit changed.	1A	Accept: The shape of the spacecraft's orbit will be changed. Thus the two orbits cannot meet at B.
Thus the two orbits will no longer touch at B.	1A	
	2	
(iii) The spacecraft has to fire its rocket briefly at B so as to boost up its speed to the required speed. (i.e. from 7.55 km s^{-1} to 7.67 km s^{-1})	1A	E.c.f. from a(i),. if it is greater than 7.67 km s^{-1}, then the spacecraft should be slowed down by reverse firing of rocket.
	1	

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Section B : Atomic World

1. C (%)	2. D (%)	3. A (%)	4. B (%)
5. A (%)	6. D (%)	7. B (%)	8. A (%)

Solution	Marks	Remarks
2. (a) (i) Most alpha particles passed (straight) through the foil, some were only slightly deflected.	1A	If the candidate does not show a difference in quantity of the particles in these two cases, at most 1A is awarded.
A small number of alpha particles were scattered at large angles and a few even rebounded backward.	1A	
	2	
(ii) Since the charge and mass of an atom in Thomson's atomic model are evenly distributed, the alpha particles should not be deflected (by large angles).	1A	Accept explanation for the expt. result supporting Rutherford model (Mass and charge concentrated at a small nucleus so that alpha particles can be deflected / deflected by large angles.)
	1	
(b) (i) The electron is bounded by the nucleus, i.e. energy/work must be supplied in order to remove the electron from the atom/ionize the atom. (either)	1A	NOT accept using PE instead of the total energy. NOT accept E_n is lower than E_∞ and $E_\infty = 0$ so $E_n < 0$.
An electron at E_∞ is not bounded by the attractive force from the nucleus, i.e. free.	1A	Accept the electron is free / is not bounded / escapes / is infinite from the atom / nucleus / ionized. NOT accept: the electron is delocalized.
	2	
(ii) $\Delta E = E_7 - E_1$ $= -13.6\left(\frac{1}{8^2} - \frac{1}{2^2}\right)$ $= 3.1875\text{eV} \approx 3.1875 \times (1.60 \times 10^{-19})$ J	1M	Accept $\pm 13.6\left(\frac{1}{8^2} - \frac{1}{2^2}\right)$ NOT accept $13.6\left(\frac{1}{8^2} + \frac{1}{2^2}\right)$.
$\lambda = \frac{hc}{\Delta E} = \frac{(6.63\times10^{-34})(3\times10^8)}{3.1875 \times (1.60 \times 10^{-19})}$	1M	Need to check substitution of h, c and ΔE for 1M. 1.60×10^{-19} C not required for 1M.
$= 3.9 \times 10^{-7}$ m ≈ 390 nm	1A	Accept using de Broglie formula to find the wavelength: $\Delta E = mc^2$ and $\lambda = h/p = h/mc$ $\therefore\ \lambda = hc/\Delta E$ …
	3	
(iii) $E_3 = -\frac{13.6}{4^2} = -0.85\text{eV}$	1M	Accept $E_3 = +\frac{13.6}{4^2}$ for 1M. I.E. $= E_3 = 0.85$ eV $\Rightarrow$ 1M only
Energy required $= 0 - (-0.85)$ $= 0.85\text{eV}$ or 1.36×10^{-19}J	1A	I.E. $= \frac{13.6}{4^2} = 0.85$ eV $\Rightarrow$ 1M + 1A NOT accept I.E. $= -\frac{13.6}{3^2}$ for 1M. NOT accept I.E. $= -0.85$ eV for 1A.
	2	

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Section C : Energy and Use of Energy

1. B (%)	2. B (%)	3. A (%)	4. D (%)
5. D (%)	6. A (%)	7. C (%)	8. C (%)

Solution	Marks	Remarks
3. (a) (i) The radiant power coming from the Sun on unit area is given by		Note: The total (spherical) area irradiated at the Earth's orbit is $4\pi R_0^2 = 2.8274334 \times 10^{23}$ m^2
$P_0 = \dfrac{P_S}{4\pi R_0^2} = \dfrac{3.86\times10^{26}\ \text{W}}{4\pi(1.50\times10^{11})^2\ \text{m}^2}$	1M	Correct sub. of P_S and R_0
$= 1.365195734 \times 10^3$ W m^{-2} ≈ 1365 W m^{-2}	1A	Accept: 1360 – 1370 W m^{-2}
	2	
(ii) Loss due to <u>absorption</u> by the <u>atmosphere</u>.	1A	Accept: absorption / reflection / scattering by ozone layer <u>OR</u> some are blocked by the atmosphere
	1	
(b) (i) Solar energy $\rightarrow$ electrical energy $\rightarrow$ chemical energy 1A only for solar energy $\rightarrow$ chemical energy	1A 1A	Accept: light energy $\rightarrow$ electric energy NOT accept: light and heat energy $\rightarrow$ electrical energy; light $\rightarrow$ electricity
	2	
(ii) $\eta = \dfrac{\text{power output}}{\text{solar power input}} \times 100\%$		
$= \dfrac{300}{1000\times1.65}\times100\%$	1M	Correct sub. of input & output powers
$= 18.1818\ \% \approx 18.2\ \%$	1A	Accept: 18.0 – 18.2 %
	2	
(iii) $t = \dfrac{\text{total energy stored}}{\text{power input}}$		
$= \dfrac{100\ \text{Ah}\times12\ \text{V}}{300\ \text{W}\times0.8}$	1M	1M for $\dfrac{100\ \text{Ah}\times12\ \text{V}}{300\ \text{W}}$ 1A for 5 h / 300 min / 18000 s
$= 5$ hours	1A	
The sun rays are (always) normal to the panel <u>Or</u> Clear sky / not cloudy.	1A	
	3	

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Section D : Medical Physics

1. C (%)	2. B (%)	3. A (%)	4. D (%)
5. A (%)	6. C (%)	7. D (%)	8. B (%)

Solution	Marks	Remarks
4. (a) (i) $\sin c = \dfrac{1.45}{1.5}$ $c = 75.2°$	1A	
	1	
(ii) For α larger than α_{max}, subsequently the light ray incident angle at the **core-cladding boundary** would be less than c, thus total internal reflection fails to occur.	1A 1A	When $\alpha > \alpha_{max}$, incident angle at core-cladding boundary $< c$, no total internal reflection occurs.
*For α less than α_{max}, subsequently the light ray incident angle at the **core-cladding boundary** would be greater than c, thus total internal reflection occurs.*	1A 1A	When $\alpha < \alpha_{max}$, incident angle at core-cladding boundary $> c$, total internal reflection occurs.
*Correct description, but without mentioning **core-cladding boundary***	1A	Note: $\alpha_{max} = 22.6°$
	2	
(iii) When comparing to X-rays radiographic imaging: Advantage: (Any **ONE**) - direct <u>view</u> of the stomach <u>lining / inside / wall</u> - perform <u>biopsy (getting a tissue)</u> during examination if necessary - without exposure to <u>ionizing radiation</u> by X-rays	1A	NOT accept: Endoscope does not 'radioactive' / is clear / has higher resolution / produce real-time image / produce colour image.
Disadvantage: (Any **ONE**) - requires fasting (for a few hours) prior to examination - endoscopy is an invasive procedure *or* having a risk of causing patient internal bleeding or discomfort / unwell - anesthetic may be needed - X-rays imaging is non-invasive	1A	*Barium meal enables visualization of soft tissue using X-ray imaging. In such case, soft tissue has low contrast in X-rays radiographic image is not accepted as a correct answer.*
	2	
(b) (i) $Z_B = \rho c$ $7.15 \times 10^6 = \rho(3780)$ $\rho = 1891.534392 \text{ kg m}^{-3} \approx 1890 \text{ kg m}^{-3}$	1M/1A	Accept: $\rho = 1890 \sim 1900 \text{ kg m}^{-3}$
	1	
(ii) $\alpha_b = \dfrac{(Z_2 - Z_1)^2}{(Z_2 + Z_1)^2}$ $= \dfrac{(7.15 - 1.65)^2}{(7.15 + 1.65)^2}$	1M	Correct sub., the powers of Z's can be omitted.
$\alpha_b = \dfrac{I}{I_0} = 0.390625 \approx 0.391 = 39.1\%$	1A	Accept: $\alpha_b = \left(\frac{5.5}{8.8}\right)^2 = \frac{25}{64}$ Accept: $0.39 \sim 0.391$
	2	
(iii) The <u>difference in acoustic impedances</u> of a muscle-bone boundary is greater than that of a muscle-fat boundary (*or vice versa*), therefore giving a <u>larger intensity reflection coefficient</u> α_b (~39%) / <u>larger intensity reflection ratio</u> (*or vice versa*), <u>*so more clear / easier to be distinguished*</u>.	1A 1A	Accept: $\alpha_{(muscle\text{-}fat)} = 0.00859 = 0.86\%$ as a supporting statement that $\alpha_{(muscle\text{-}fat)}$ is less than $\alpha_{(muscle\text{-}bone)}$ *The underlined statement repeats the question stem, hence NOT accepted.*

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