2017 HKDSE Physics & Combined Science (Physics)

Report on Assessment

19 & 26 Oct 2017

Overview

Paper	Physics	CS(Phy)
1A (MC)	Mean: 21.5 out of 33 (i.e. 65%) (2016: 17.2 out of 32*)	Mean: 11.1 out of 22 (i.e. 51%) (2016: 8.5 out of 21*)
1B	>50% (2016: ~<50%)	>30% (2016: ~<30%)
2	~>50% (2016: ~<50%)	N.A.
SBA	~>70% (~2016)	~70% (~2016)
Candidature	ALL: 11 255 SCH: 10 615	ALL: 442 SCH: 433

* one item deleted

Marking & Grading

On-Screen Marking (OSM) panels	
Physics	**CS(Phy)**
1B-1: Q.1, 2, 4, 6 (32M) 1B-2: Q.7, 8, 9 (33M)	1B-1: Q.1, 2, 3, 4 (32M) 1B-2: Q.5, 6, 7 (24M)
1B-3: Q.3, 5, 10 (19M)	---
2A: Astronomy (20%) 2B: Atomic World (67%) 2C: Energy (86%) 2D: Medical Physics (27%)	---

SBA marks stat. moderated with both Mean and SD adjusted (outlining cases reviewed by Supervisors)

Marking & Grading

- Expert Panel (Chief Examiners, 4~5 persons) determine level boundaries/cut scores based on **Level descriptors / Group Ability Indicator (GAI) / Viewing student samples**.
- CS(Phy) graded by **Common items / Viewing student samples.**
- Endorsement by Senior Management/Public Exam Board

Note: GAI is calculated from Physics candidates' actual percentage awards obtained in 4 core subjects CEML.

Results

Physics

Cut score difference = 50 marks (4+ to 1+)

Level	5**	5+	4+	3+	2+	1+
Percentage	2.9%	28.6%	50.9%	72.2%	89.6%	97.8%

No. of MC	31/32	26/27	22	16/17	12	8

CS(Phy)

Cut score difference = 48 marks (4+ to 1+)

Level	5**	5+	4+	3+	2+	1+
Percentage	0.5%	6.3%	21.6%	45.7%	73.9%	91.9%

No. of MC	20/21	17/18	14/15	11/12	8	5

5

Paper 1A

Physics (33 MC)

>70%	50%-70%	<50%
11	18	4

Easy ⟷ Difficult

CS (Phy) (22 MC)

>70%	50%-70%	<50%
4	7	11

Easy ⟷ Difficult

6

PHYSICS MC

Topic (No. of Qu.)	Average % correct	No. of Qu. < 50% correct
Heat & Gases (4)	79%	0
Force & Motion (9)	69%	1
Wave Motion (8)	61%	1
Electricity & Magnetism (9)	60%	2
Radioactivity (3)	63%	0

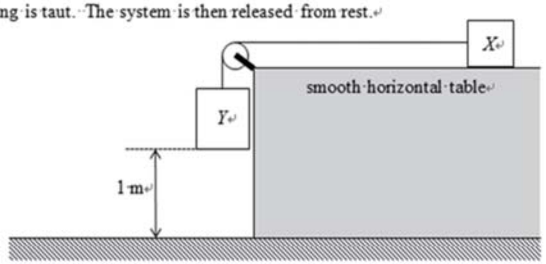
7

CS(PHY) MC

Topic (No. of Qu.)	Average % correct	No. of Qu. < 50% correct
Heat & Gases (3)	69%	0
Force & Motion (7)	54%	3
Wave Motion (6)	44%	4
Electricity & Magnetism (6)	45%	4

8

10. Blocks X and Y are connected by a light inextensible string passing over a fixed frictionless light pulley as shown. The mass of X and Y are 0.5 kg and 1 kg respectively. Initially, Y is 1 m above the ground and the string is taut. The system is then released from rest.

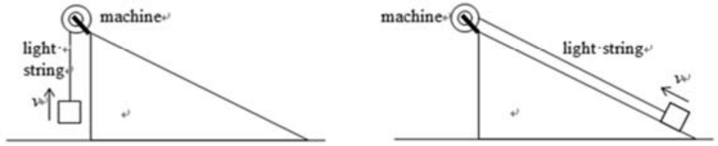


What is the speed of Y just before it reaches the ground ? (Take $g = 9.81\ \text{m s}^{-2}$)

			PHY	CS(PHY)
*A.	$3.62\ \text{m s}^{-1}$		(40%)	(21%)
B.	$4.43\ \text{m s}^{-1}$	favourable distractor	(40%)	(51%)
C.	$6.26\ \text{m s}^{-1}$		(12%)	(14%)
D.	$9.81\ \text{m s}^{-1}$		(8%)	(14%)

11. A machine is fixed at the top of a smooth inclined plane. Two methods, (I) and (II), are used to lift a block from the ground to the top of the inclined plane by the machine.

(I) Pull the block vertically upward at a uniform speed v.
(II) Pull the block up along the inclined plane at the same uniform speed v.

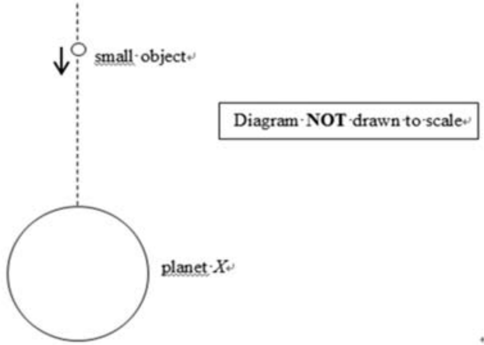


Which of the following statements correctly compare(s) the two methods ?

(1) The tension in the string is the same.
(2) The average output power of the machine is the same.
(3) The work done by the machine on the block is the same.

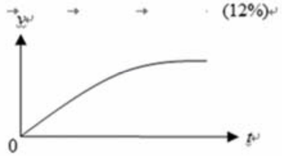
			PHY	CS(PHY)
A.	(1) only		(9%)	(17%)
*B.	(3) only		(57%)	(43%)
C.	(1) and (2) only		(9%)	(13%)
D.	(2) and (3) only	favourable distractor	(25%)	(27%)

13. A small object is released from rest at a point very far away from a planet X. The object then starts moving towards X. X does not have an atmosphere. Neglect the effect of other celestial bodies.

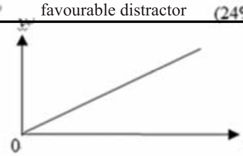


Which of the following graphs best shows the variation of the velocity v of the object with time t before it hits X ?

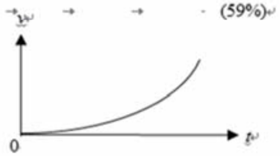
A. (12%)



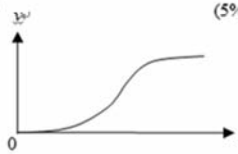
B. favourable distractor (24%)



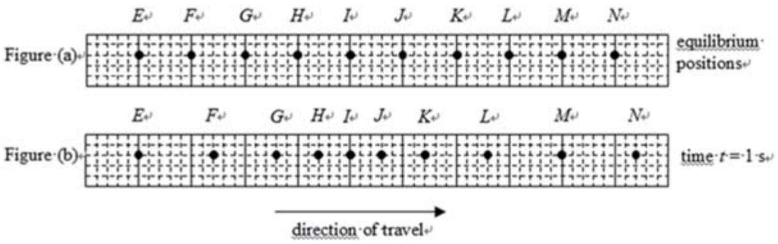
*C. (59%)



D. (5%)



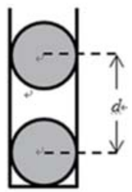
14. Figure (a) shows the equilibrium positions of particles E to N in a medium. At time $t = 0$, a longitudinal wave starts travelling from left to right. At time $t = 1$ s, the positions of the particles are shown in Figure (b).



Which of the following statements **MUST BE** correct ?

		PHY	CS(PHY)
*A.	The distance between particles F & N is equal to the wavelength of the wave.	(54%)	(32%)
B.	The period of the wave is 1 s.	(6%)	(11%)
C.	Particle E is always at rest.	(10%)	(14%)
D.	Particle I is momentarily at rest at $t = 1$ s. favourable distractor	(30%)	(43%)

22. In the figure, two charged conducting spheres of the same mass m are put in a vertical plastic cylinder. The inner wall of the cylinder is smooth. The spheres are separated by a distance d and remain in equilibrium.

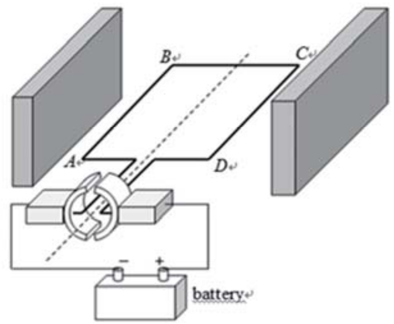


Which of the following statements **MUST BE** correct ?

(1) Both spheres carry positive charges.
(2) The amount of charges on the two spheres are the same.
(3) The separation d depends on m.

		PHY	CS(PHY)
A.	(1) only	(11%)	(17%)
*B.	(3) only	(63%)	(39%)
C.	(1) and (2) only	(9%)	(19%)
D.	(2) and (3) only favourable distractor	(17%)	(25%)

26. The figure shows a simple d.c. motor, the coil $ABCD$ is mounted between the poles of two slab-shaped magnets.

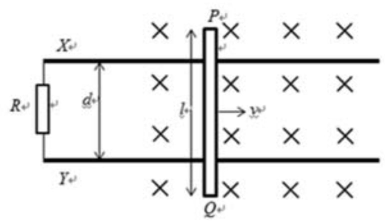


Which of the following statements is correct ?

		PHY	CS(PHY)
* A.	The turning effect is zero when the coil is vertical.	(46%)	(37%)
B.	The magnetic force acting on BC is the greatest when the coil is horizontal.	(16%)	(18%)
C.	The direction of the magnetic force acting on AB remains constant.	(14%)	(16%)
D.	The direction of the current in the coil remains unchanged.	(24%)	(29%)

favourable distractor

28. A metal rod PQ of length l is moving along smooth horizontal metal rails X and Y with constant speed v in a uniform magnetic field of magnetic field strength B pointing into the paper. The metal rails X and Y are separated by a distance of d and are connected to a resistor of resistance R as shown.



Which of the following descriptions about the induced current is correct ?

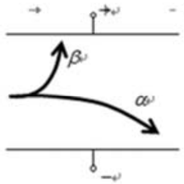
	magnitude	direction	
A.	$\frac{Blv}{R}$	from X to Y through R favourable distractor	(28%)
B.	$\frac{Blv}{R}$	from Y to X through R	(13%)
* C.	$\frac{Bdv}{R}$	from X to Y through R	(46%)
D.	$\frac{Bdv}{R}$	from Y to X through R	(13%)

30. The input terminal of a transformer is connected to the 220 V mains supply. Ten identical light bulbs are connected in parallel to the output terminal of the transformer. All the light bulbs are working at their rated values of '3 V, 1.5 W'. If the efficiency of the transformer is 70%, what is the current drawn from the mains supply ?

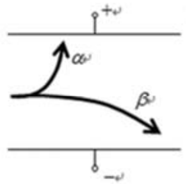
			PHY	CS(PHY)
A.	0.007 A		(8%)	(12%)
B.	0.048 A		(19%)	(26%)
$\boxed{\text{C.}}$	0.068 A	favourable distractor	(19%)	(29%)
*D.	0.097 A		(54%)	(33%)

31. Which of the following diagrams best shows the deflection of α and β particles in a uniform electric field in vacuum ?

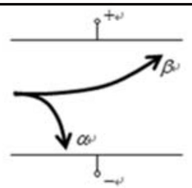
*A. (57%)



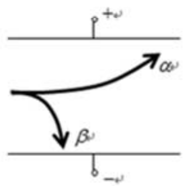
B. (7%)



C. favourable distractor (31%)



D. (5%)



Observations

- Although most candidates were competent in handling calculations, their misconceptions were revealed in various questions which require qualitative answers.
- Not quite understand some experimental procedures and precautions which are subtle.
- Weak or careless in handling/converting units or scientific notations.
- Weaker candidates ~20 – 25%.
- Performance better in Paper 1 than in paper 2.

Points to note

- ~70% of Paper 1 (Physics) with questions from core part.
- Accept using $g = 9.81$ or $10\ m\ s^{-2}$.
- Method marks 'M' awarded to correct formula / substitution / deduction
- In general, numerical ans. with 3 sig. fig. Answer marks 'A' awarded to correct numerical answer with correct unit within <u>tolerance range</u>.

Points to note

- Equating Electives (Total = 80 each) using Paper 1

  Before equating: Mean 38 to 45 / SD 17 to 22
  After equating: Mean 43 to 47 / SD 16 to 18

  2A Astronomy: ↑
  2B Atomic World: ↑↑
  2C Energy: unchanged
  2D Medical Physics: unchanged

Points to note

- Student samples of performance (Levels 1 to 5) available in late October (HKEAA website).
- SBA Conference on 4 Nov 2017
- SBA Online Submission in Jan/Feb 2018
- All SBA tasks adopt <u>0 – 20 mark range</u>.

THANK YOU

Paper 1B Q 1, 2, 4, 6

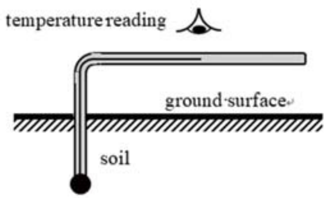
Question 1

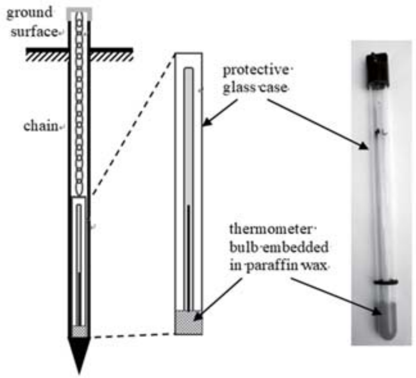
(a) As shown in Figure 1.1b, the bulb of the soil thermometer is very large compared to those of common thermometers. Suggest a reason for this design. (1 mark)

(a)	A larger bulb improves the <u>sensitivity</u> of the thermometer. OR A larger bulb minimizes the effect on the temperature reading due to the other parts of the thermometer stem that are exposed to different temperatures.	1A

ⓘComment:
Unfamiliar question. Performance was unsatisfactory.
Very few candidates mentioned the concept 'sensitivity'.

Question 1





(b) On a certain morning, the air temperature is 15°C. An observer takes a measurement of the soil temperature at 1 m deep. The thermometer reading is 20°C. It is given that the mass of the paraffin wax enclosing the thermometer bulb is 0.015 kg, and the specific heat capacity of paraffin wax is 2.9×10^3 J kg^{-1} °C^{-1}.

(i) Calculate the energy loss of the paraffin wax as it cools down to the air temperature. (2 marks)

(ii) It is known that the paraffin wax enclosing the bulb of the thermometer gains or loses energy at a constant rate of 0.5 J s^{-1}, estimate the time taken for the paraffin wax to reach the air temperature after the thermometer is lifted out of the soil. (2 marks)

(b)	(i)	$E = mc\Delta T$	
		$= \underline{0.015 \times (2.9 \times 10^3) \times (20 - 15)}$	1M
		$= 217.5$ J	1A
	(ii)	Time taken to reach air temperature = 217.5 / 0.5	1M
		= 435 s	1A

ⓘComment:
Well performed.

(iii) If there is no paraffin wax enclosing the bulb of the thermometer, explain how the thermometer reading as recorded by the observer is affected. (2 marks)

(iii) The thermometer would be in direct contact with the cooler air and would cool down quickly. 1A
The temperature reading would be less than the actual soil temperature. 1A

ⓘComment:

- Performance was unsatisfactory.
- Very few candidates gave a concise explanation of the function of paraffin wax.

Common mistake:

- Paraffin is a good conductor so that the thermometer absorbs energy effectively, if there is no paraffin…

Describe the procedures of the experiment. State the physical quantities to be measured and an equation for finding the speed of the bullet. Write down **ONE** precaution for getting a more accurate result. (5 marks)

2. Measure the mass of a bullet m and the mass of the trolley with plasticine M. 1A
Fire the bullet towards the plasticine. 1A
Read the speed of the trolley v immediately after the bullet hit the plasticine. 1A
The speed of the bullet u is given by $u = \frac{M+m}{m}v$. 1A
Precaution:
The bullet should be fired close to the plasticine.
The bullet should be fired along the direction of travel of the trolley.
The track must be horizontal / friction compensated.
(either one, or other reasonable answers) 1A

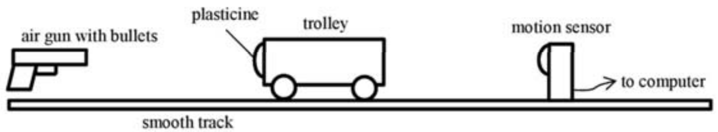
Question 2

2. The following experimental items are provided to set up an experiment to estimate the speed of a bullet fired from an air gun.

a smooth track
a trolley
a motion sensor used to measure the speed of the trolley
some plasticine
an air gun and bullets
an electronic balance

The set-up is shown in Figure 2.1.

Figure 2.1



Describe the procedures of the experiment. State the physical quantities to be measured and an equation for finding the speed of the bullet. Write down **ONE** precaution for getting a more accurate result. (5 marks)

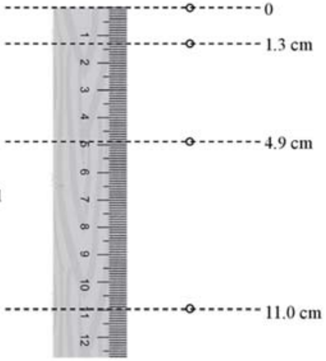
ⓘComment:

- General performance was poor.
- Many candidates failed to mention that the speed of the trolley immediately after the collision should have been taken.
- Some candidates did not know that the motion sensor registered the trolley's speed instead of its distance travelled.
- Not many were able to state the precautions for getting more accurate result.
- Some failed to write down the equation correctly, some just stated $m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

Question 4

4. (a) A steel ball bearing is released from rest at time t = 0. A stroboscopic photo is taken at 0.05 s time intervals. The results are shown in Figure 4.1. Neglect air resistance.

Figure 4.1



(i) Estimate the acceleration due to gravity using the data in Figure 4.1. (2 marks)

(a) (i)	By $s = ut + \frac{1}{2}gt^2$	
	$0.11 = \frac{1}{2}g(0.05 \times 3)^2$	1M
	$g = 9.79\ \text{m s}^{-2}$	1A

Accept other reasonable methods:

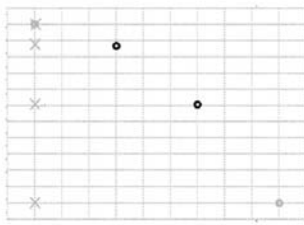
Remarks for (a)(i)

		"a" calculated	Marks for (a)(i)	v for(a)(ii)(2)
$s = ut + \frac{1}{2}gt^2$	s=1.3 cm	10.4 m s^{-2}	1M	1.85
	s=4.9 cm	9.8 m s^{-2}	1M+1A	1.78
	s=11.0 cm	9.78 m s^{-2}	1M+1A	1.78
$a = (v-u)/t$	u =0.26 m s^{-1} v=0.72 m s^{-1}	9.2 m s^{-2}	*1M	1.70
$\bar{v}_1$ =0.26 m s^{-1} $\bar{v}_2$ =0.72 m s^{-1} $\bar{v}_3$ =1.22 m s^{-1}	u =0.26 m s^{-1} v=1.22 m s^{-1}	9.6 m s^{-2}	*1M+1A	1.75
	u =0.72 m s^{-1} v=1.22 m s^{-1}	10.0 m s^{-2}	*1M	1.80
	Average value from calculated values from method 1	9.99 m s^{-2}		1.80
		9.79 m s^{-2}		1.78
		10.09 m s^{-2}		1.81
		10.1 m s^{-2}		1.82

ⓘComment: Performance was satisfactory.

*(ii) The bearing is now projected horizontally instead of released from rest. The bearing is projected at time t = 0, and a stroboscopic photo is taken at 0.05 s time intervals. The first and the last image of the stroboscopic photo are shown using circles (**o**) in Figure 4.2. For reference, the stroboscopic photo of the bearing released from rest is also shown in the figure using crosses (×).

(1) In Figure 4.2, mark the positions of the projected bearing in the stroboscopic photo using circles (**o**). (2 marks)

(ii) (1)			Accept other symbol
		1A	Correct horizontal positions
		1A	Correct vertical positions

ⓘComment:
Some candidates failed to distinguish the *horizontal uniform motion* and *vertical uniformly accelerated motion*.

(2) Given that the bearing is projected horizontally with an initial speed of 1 m s^{-1}, use the result of (a)(i) to calculate the speed of the projected bearing when the last image was taken. (3 marks)

(2) $v_x = 1$ m s^{-1} $v_y = u_y + gt$ $= 0 + 9.78 \times (0.05 \times 3)$ $= 1.47$ m s^{-1}	1M	Or $v^2 = u^2 + 2as$ $v^2 = 0 + 2(9.78)(0.11)$
$v = \sqrt{v_x^2 + v_y^2}$ $= \sqrt{1^2 + 1.47^2}$	1M	
$= 1.78$ m s^{-1}	1A	Award 1A only for correct answer deducted from other methods not using (a)(i) ans.

ⓘComment:

Common mistake: $v = u + gt$

$= 1 + 9.78 \times (0.05 \times 3)$

(b) If a small ball is released from rest from the top of a cliff, the speed of the ball becomes constant after a period of time. By considering the forces acting on the ball and using Newton's laws of motion, explain why the speed of the ball becomes constant. (3 marks)

(b) The air resistance acting on the ball increases as its speed increases.	1A
When the air resistance equals to the weight of the ball,	1A
net force acting on the ball becomes zero, by Newton's first law, the ball travels with constant speed. OR net force acting on the ball becomes zero, by Newton's second law, the ball will not accelerate further and travels with constant speed.	1A

Marking guideline for 3rd mark:

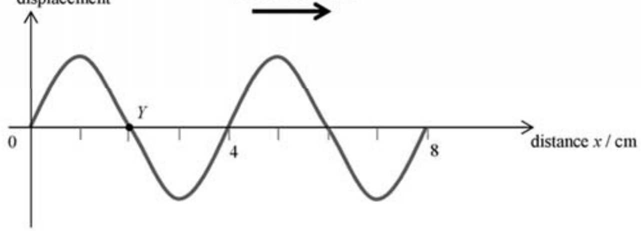
Using Newton's law (accept $F=ma$) + relationship between net force and motion.

ⓘMisconceptions:

'Weight' and 'air resistance' are an action-and-reaction pair.

Question 6

6. (a) A dipper vibrating with a frequency of 5 Hz is put in a water tank. Figure 6.1 shows the displacement-distance graph of the water wave at time $t = 0$. Y is a particle in the water tank.



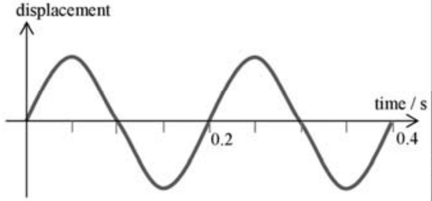
(i) Determine the wave speed of the water wave. (2 marks)

(a) (i) $v = f\lambda$ $= 5 \times 4$	1M
$= 20$ cm s^{-1}	1A

ⓘWell performed.

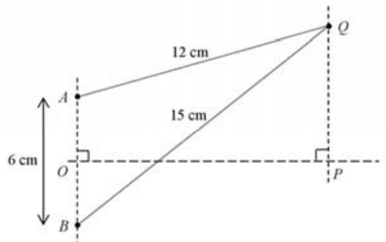
(ii) State the direction of motion of particle Y at $t = 0$. (1 mark)

(iii) Sketch the displacement-time graph of particle Y between $t = 0$ and $t = 0.4$ s in Figure 6.2. (2 marks)

(ii) Y is moving upwards at $t = 0$.	1A	
(iii) 	1A 1M	2 periods Correct waveform and correct phase ref. to ans in (a)(ii)

ⓘWell performed.

(b) In Figure 6.3, A and B are two dippers vibrating in phase in a water tank. The distance between A and B is 6 cm. OP is the perpendicular bisector of AB. Q is a second minimum from P, where AQ = 12 cm and BQ = 15 cm.



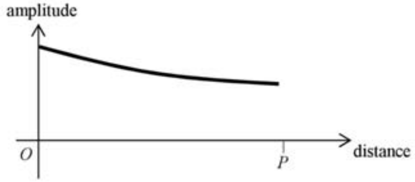
(i) Explain why a minimum occurs at Q. (2 marks)

(ii) Determine the wavelength of the water wave. (2 marks)

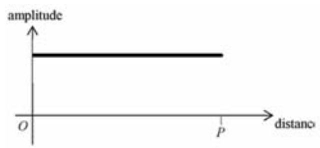
(b)	(i)	The water waves from A to B are in anti-phase at Q OR The path difference at $Q = (n + 1/2)\lambda$. Destructive interfere occurs to form a minimum.	 1M 1A	No mark: crest meets trough at Q accept ½λ, 1½λ…
	(ii)	Path difference at $Q = 1.5\lambda = 3$ cm $\lambda = 2$ cm	1M 1A	for $1.5\lambda = 3$, award 1M for $2.5\lambda = 3$

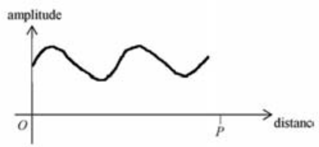
ⓘComment: some only stated 'crest meets trough at Q'

(iii) Sketch in Figure 6.4 how the **AMPLITUDE** of the water wave varies along the line OP. (1 mark)

(iii)		1A	Decreasing amplitude

ⓘUnsatisfactory performance.
Common answers:





2017 DSE PHYSICS/
COMBINED SCIENCE (PHYSICS
1B-3
Q. 3, 5 & 10)

QUESTION 3(a)

Marking Scheme		Performance/ Common Errors
$\dfrac{(c_{rms})_f}{c_{rms}} = \sqrt{\dfrac{T_f}{T}}$ 1M $\dfrac{(c_{rms})_f^2}{(c_{rms})^2} = \dfrac{T_f}{T}$ $\dfrac{c_{\text{r.m.s.}}\text{ at 350K}}{c_{\text{r.m.s.}}\text{ at 300K}} = \sqrt{\dfrac{350}{300}}$ $= 1.08$ 1A		Accept: 1.08:1, $\sqrt{\frac{7}{6}}$ Not accept: $\frac{18.7}{17.3}$ as answer Some candidates forgot to take square root of the ratio of temperatures.

QUESTION 3(a)

The average kinetic energy of one monatomic gas molecule at temperature T is given by

$$E_K = \frac{3}{2}\left(\frac{R}{N_A}\right)T ,$$

where R is the universal gas constant and N_A is the Avogadro constant. A monatomic gas is heated from 300 K to 350 K under fixed volume.

(a) Estimate the ratio of the root-mean-square speed ($c_{\text{r.m.s.}}$) of the gas molecules at the two temperatures ($\frac{c_{\text{r.m.s.}}\text{ at 350K}}{c_{\text{r.m.s.}}\text{ at 300K}}$). (2 marks)

QUESTION 3(a) (SAMPLE 1)

*3. The average kinetic energy of one monatomic gas molecule at temperature T is given by

$$E_K = \frac{3}{2}\left(\frac{R}{N_A}\right)T ,$$

where R is the universal gas constant and N_A is the Avogadro constant. A monatomic gas is heated from 300 K to 350 K under fixed volume.

(a) Estimate the ratio of the root-mean-square speed ($c_{\text{r.m.s.}}$) of the gas molecules at the two temperatures ($\frac{c_{\text{r.m.s.}}\text{ at 350K}}{c_{\text{r.m.s.}}\text{ at 300K}}$). (2 marks)

$E_k = \frac{1}{2} m c_{r.m.s}^2$

$c_{r.m.s} = \sqrt{\frac{2E_k}{m}}$

$\frac{c_{r.m.s}\text{ at 350k}}{300k} = \sqrt{\frac{2E_{k350}}{m}} : \sqrt{\frac{2E_{k300}}{m}}$

$= \sqrt{E_{k350}} : \sqrt{E_{k300}}$

$= \sqrt{\frac{3}{2}\left(\frac{R}{N_A}\right)(350)} : \sqrt{\frac{3}{2}\left(\frac{R}{N_A}\right)(300)}$

$= \sqrt{350} : \sqrt{300}$ ✓ 1A

$= 7:6$ ✗ 0A

QUESTION 3(a) (SAMPLE 2)

*3. The average kinetic energy of one monatomic gas molecule at temperature T is given by

$$E_K = \frac{3}{2}\left(\frac{R}{N_A}\right)T,$$

where R is the universal gas constant and N_A is the Avogadro constant. A monatomic gas is heated from 300 K to 350 K under fixed volume.

(a) Estimate the ratio of the root-mean-square speed ($c_{r.m.s.}$) of the gas molecules at the two temperatures ($\frac{c_{r.m.s.} \text{ at } 350\text{ K}}{c_{r.m.s.} \text{ at } 300\text{ K}}$). (2 marks)

$\frac{1}{2}m\bar{c}_1^2 = \frac{3}{2}\left(\frac{R}{N_A}\right)(350)$

$\frac{1}{2}m\bar{c}_2^2 = \frac{3}{2}\left(\frac{R}{N_A}\right)(300)$

$\frac{\bar{c}_1^2}{\bar{c}_2^2} = \frac{350}{300}$ ✓

c_{rms} at 350K : c_{rms} at 300K $= \sqrt{7} : \sqrt{6}$

$\frac{c_{rms} \text{ at } 350K}{c_{rms} \text{ at } 300K} = \frac{\sqrt{7}}{\sqrt{6}}$ ✓

1M

1A

QUESTION 3(b)

Marking Scheme	Performance/ Common Errors
The speed of the gas molecules increases. They collide more <u>frequently</u> and <u>violently</u> with the <u>wall</u> of the container. Thus, the pressure increase, Hit the wall more frequently/ with greater rate. 1A Hit the wall (more) violently/ vigorously/ with greater momentum/ with greater momentum change/ with greater speed/ with greater kinetic energy 1A	Any 2 correct 1A All correct 2A Misconception: The collisions among gas molecules themselves would contribute to the gas pressure.

QUESTION 3(b)

(b) Thus, using kinetic theory, explain why the gas pressure would increase. (2 marks)

QUESTION 3(b) (SAMPLE 1)

(b) Thus, using kinetic theory, explain why the gas pressure would increase. (2 marks)

The volume is unchanged but the average kinetic energy of the gas is increased. The number of collision of gas molecules hitting the inner surface of ✓ the container per unit time is increased ✓. Pressure is thus increased.

1A

0A

QUESTION 3(b) (SAMPLE 2)

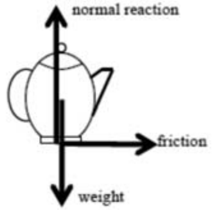
(b) Thus, using kinetic theory, explain why the gas pressure would increase. (2 marks)

When temperature increase, the molecules' speed inside increase, which they hit the inner ~~s~~ surface more frequently ~~Hence~~, pluse, ~~they~~ the collision of molecules increase as well. Hence, if the volume remain unchange, the pressure increase.

1A

0A

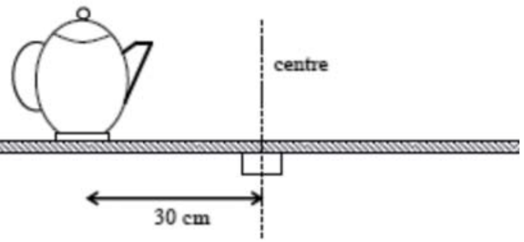
QUESTION 5(a)

Marking Scheme		Performance/ Common Errors
	Any 2 forces correct (direction and point of action) with label (can be in symbols) 1A All correct (including no additional forces and labels are not in symbols) 2A	Most candidates managed to indicate the forces acting on the teapot. A few of them labelled the frictional force as 'centripetal force'.

QUESTION 5(a)

A teapot of mass 1 kg is put 30 cm from the centre of a horizontal turntable, Figure 5.1 shows the side view. When the turntable is rotating, the teapot remains at the same position on the turntable.

Figure 5.1

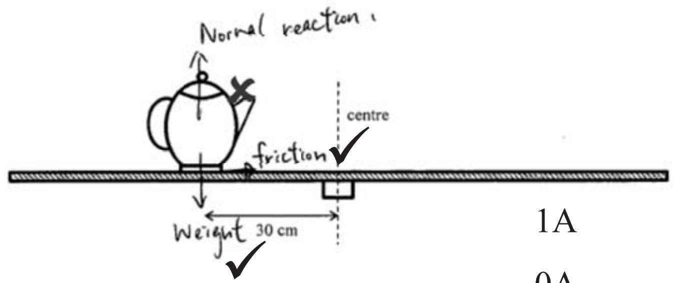


(a) On Figure 5.1, draw and label all the forces acting on the teapot when the turntable is rotating. (2 marks)

QUESTION 5(a) (SAMPLE 1)

A teapot of mass 1 kg is put 30 cm from the centre of a horizontal turntable, Figure 5.1 shows the side view. When the turntable is rotating, the teapot remains at the same position on the turntable.

Figure 5.1



1A

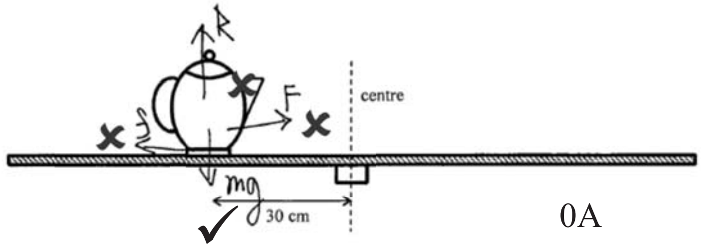
0A

(a) On Figure 5.1, draw and label all the forces acting on the teapot when the turntable is rotating. (2 marks)

QUESTION 5(a) (SAMPLE 2)

A teapot of mass 1 kg is put 30 cm from the centre of a horizontal turntable, Figure 5.1 shows the side view. When the turntable is rotating, the teapot remains at the same position on the turntable.

Figure 5.1



0A

0A

(a) On Figure 5.1, draw and label all the forces acting on the teapot when the turntable is rotating. (2 marks)

QUESTION 5(b)

Marking Scheme	Performance/ Common Errors
$\omega = \pi\ s^{-1}$ 1A $F = mr\omega^2$ $= (1)(0.3)(\pi)^2$ 1M $= 2.96$ N (towards the centre of the turntable) 1A OR $v = 0.3\pi\ m\ s^{-1}$ $F = m\frac{v^2}{r}$ $= 2.96$ N	A lot of candidates failed to work out the correct angular velocity from the rate of revolution given.

QUESTION 5(b)

(b) Taking the teapot as a point mass, estimate the net force acting on the teapot when the turntable is rotating at a rate of 0.5 revolutions per second. (3 marks)

QUESTION 5(b) (SAMPLE 1)

(b) Taking the teapot as a point mass, estimate the net force acting on the teapot when the turntable is rotating at a rate of 0.5 revolutions per second. (3 marks)

$\cancel{\omega = \frac{2\pi}{T}}$ $F = m\omega^2 r$ $\cancel{=\omega r}$

$\cancel{= \frac{2\pi}{2s}}$ $= 1 \times 0.5^2 \times 0.3$

$\cancel{= \pi\ ra}$ $= 0.075$ N

0A

1M

0A

QUESTION 5(b) (SAMPLE 2)

(b) Taking the teapot as a point mass, estimate the net force acting on the teapot when the turntable is rotating at a rate of 0.5 revolutions per second. (3 marks)

$T = \frac{2\pi r}{v}$

$2 = \frac{2\pi(0.3)}{v}$

$v = 0.94\ ms^{-1}$

Net force $= \frac{mv^2}{r}$

$= \frac{1(0.94)^2}{0.3}$

$= 2.96N$

1A

1M

1A

QUESTION 5(c)

Marking Scheme	Performance/ Common Errors
The initial linear speed of the teapot = $r\omega = 0.3\pi$ m s^{-1} Deceleration of the teapot $a = \frac{f}{m} = \frac{10}{1} = 10$ m s^{-2} 1M Distance travelled s is given by $v^2 - u^2 = 2as$ $s = \frac{u^2}{2a} = \frac{(0.3\pi)^2}{2(10)}$ OR $0^2 - (0.3\pi)^2 = 2(-10)s$ 1M = 0.044 m (or 4.4 cm) 1A ALTERNATIVE The initial linear speed of the teapot = $r\omega = 0.3\pi$ m s^{-1} K.E. of the teapot is dissipated in work done against friction $\frac{1}{2}mu^2 = fd$ $d = \frac{mu^2}{2f} = \frac{(1)(0.3\pi)^2}{2(10)}$ 1M+1M = 0.044 m 1A	1M for using f = 10N $0^2 - (0.3\pi)^2 = 2(10)s$ 1M+1M s = -0.044 m 0A Accept: 0.04 m or 4 cm Some candidates wrongly applied the equation for circular motion to tackle the problem.

QUESTION 5(c)

(c) The turntable is suddenly stopped and the teapot slips. The turntable is rotating at a rate of 0.5 revolutions per second just before it stops, and the frictional force acting on the teapot is 10 N when it is slipping. Determine the distance travelled by the teapot after the turntable stops. (3 marks)

QUESTION 5(c) (SAMPLE 1)

(c) The turntable is suddenly stopped and the teapot slips. The turntable is rotating at a rate of 0.5 revolutions per second just before it stops, and the frictional force acting on the teapot is 10 N when it is slipping. Determine the distance travelled by the teapot after the turntable stops. (3 marks)

$F = ma$

$a = 10$

$v^2 - u^2 = 2as$

$0^2 - 0.94^2 = 2as$

$s = -0.0442\ m$

∴ Teapot travelled = 4.41cm

1M

1M

0A

QUESTION 5(c) (SAMPLE 2)

(c) The turntable is suddenly stopped and the teapot slips. The turntable is rotating at a rate of 0.5 revolutions per second just before it stops, and the frictional force acting on the teapot is 10 N when it is slipping. Determine the distance travelled by the teapot after the turntable stops. (3 marks)

deceleration of tea pot : $F = ma$

$a = -10 ms^{-2}$ ✓

v at stop $= 0.5 \times 0.3$ ✗

$= 0.15 ms^{-1}$

∴ distance ~~tra~~ travelled : $2as = 0^2 - (0.15)^2$ ✓ 1M

$-20s = -0.0225$ 1M

$s = 1.125 \times 10^{-3}$ m 0A

QUESTION 10(a)

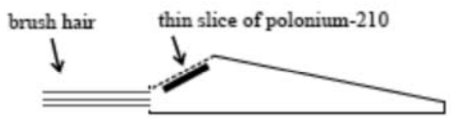
Marking Scheme	Performance/ Common Errors
$^{210}_{84}Po \rightarrow ^{206}_{82}Pb + ^{4}_{2}He$ 2A	Candidates did well in this part.

2A	1A	0A
$^{210}_{84}Po \rightarrow ^{206}_{82}Pb + \alpha$	$^{210}_{84}Po \rightarrow ^{206}_{82}Pb$	$^{210}_{84}Po \rightarrow Pb + \alpha$
$^{210}_{84}Po - ^{4}_{2}He \rightarrow ^{206}_{82}Pb$	$^{210}_{84}Po - ^{4}_{2}He = ^{206}_{82}Pb$	$^{210}_{84}Po \rightarrow Pb + ^{4}_{2}\alpha$
$^{210}_{84}Po - \alpha \rightarrow ^{206}_{82}Pb$	$^{210}_{84}Po - \alpha = ^{206}_{82}Pb$	
$^{210}_{84}Po \xrightarrow{\alpha} ^{206}_{82}Pb$	$^{210}_{84}Po \rightarrow ^{206}_{82}X + \alpha$	$^{210}_{84}Po \rightarrow ^{206}_{82}X$
	$^{210}_{84}Po \rightarrow ^{wrong}_{82}Pb + \alpha$	$^{210}_{84}Po \rightarrow ^{wrong}_{82}Pb$
	$^{210}_{84}Po \rightarrow ^{206}_{wrong}Pb + \alpha$	$^{210}_{84}Po \rightarrow ^{206}_{wrong}Pb$

QUESTION 10(a)

Dust may adhere to the surfaces of photos and films due to electrostatic attraction. To remove the dust effectively, a special brush with a thin slice of polonium-210 ($^{210}_{84}Po$) fixed near the brush hair as shown in Figure 10.1 may be used. Polonium-210 undergoes α decay and the daughter nucleus lead (Pb) is stable.

Figure 10.1



(a) Write a nuclear equation for the decay of polonium-210. (2 marks)

QUESTION 10(a) (SAMPLE 1, 2)

(a) Write a nuclear equation for the decay of polonium-210. (2 marks)

$^{210}_{84}Po \rightarrow ^{206}_{82}Pb + \alpha$ ✓ ✓ 1A

1A

(a) Write a nuclear equation for the decay of polonium-210. (2 marks)

$^{210}_{84}Po \rightarrow Pb + ^{4}_{2}He$ ✗ 0A

0A

QUESTION 10(b)

(b) Briefly explain how the α particles help clean the charged dust. (2 marks)

QUESTION 10(b) (SAMPLE 1, 2)

(b) Briefly explain how the α particles help clean the charged dust. (2 marks)

With the high ~~in~~ ironizing power, α could ~~attrac~~ ~~attrack~~ attrack with charged dust ~~of~~ on brush, and the dust remove

0A

0A

(b) 簡單解釋α粒子如何有助清除帶電的塵埃。 (2分)

因为α粒子会电离附近的空氣，令導片周圍的空氣帶电，吸走帶电的塵埃

1A

0A

QUESTION 10(b)

Marking Scheme	Performance/ Common Errors
The α particles ionize the air particles. 1A The ion neutralizes the charges on the dust/ photo or film surface. 1A	Quite a number of candidates wrongly thought that the α particles neutralized the charged dust directly.
α particles ionize the charge on the dust (×) and discharge the dust (✓). 0A+1A α particles discharge the charged dust (✓) so the dust is no longer attracted to the surface by the electrostatstic attraction. The dust can be removed. 0A+1A Charged dust removed by the ionized air molecules (✓). 1A+0A α particles attract the charged dust and dust removed (×). 0A+0A α particles ionize the surrounding air particles (✓), so the charged dust will be removed by the ionized air molecules and then cleaned by the brush (✓).1A+1A	

QUESTION 10(c)

(c) Briefly explain why the polonium-210 slice must be fixed near to the brush hair. (1 mark)

Marking Scheme	Performance/ Common Errors
α particles has a range of only a few centimeters in air. 1A	Candidates did well in this part.

QUESTION 10(c) (SAMPLE 1, 2)

(c) Briefly explain why the polonium-210 slice must be fixed near to the brush hair. (1 mark)

The range of α particle is very short ✓ 1A

(c) Briefly explain why the polonium-210 slice must be fixed near to the brush hair. (1 mark)

α particles has a very short range ✓ 1A

QUESTION 10(d)

Marking Scheme		Performance/ Common Errors
Activity after 1 year = $\left(\frac{1}{2}\right)^{\frac{365}{138}}$ = 0.160 unit	1M 1A	Accept: 0.16 unit Accept unit: Bq, s^{-1}
ALTERNATIVE $A = A_o e^{-\frac{ln2}{t_{1/2}}t}$ $A = 1 \times e^{-\frac{ln2}{138}(365)}$ A = 0.160 unit	 1M 1A	Most candidates knew how to calculate the activity in this part.
Initial activity is A_o. Activity after one year = $(1/2)^{(365/138)} = 0.160A_o$		1M+1A

QUESTION 10(d)

(d) The manufacturer recommends that the brush should be returned to the factory for replacement of the polonium-210 slice every year. Taking the activity of a newly replaced polonium-210 slice as 1 unit, find its activity after one year (365 days). Given: half-life of polonium-210 is 138 days. (2 marks)

QUESTION 10(d) (SAMPLE 1)

*(d) The manufacturer recommends that the brush should be returned to the factory for replacement of the polonium-210 slice every year. Taking the activity of a newly replaced polonium-210 slice as 1 unit, find its activity after one year (365 days). Given: half-life of polonium-210 is 138 days. (2 marks)

$A = 1 \times (\frac{1}{2})^{\frac{365}{138}}$ ✓

$= 0.160$ unit ✓

1A

1A

QUESTION 10(d) (SAMPLE 2)

*(d) The manufacturer recommends that the brush should be returned to the factory for replacement of the polonium-210 slice every year. Taking the activity of a newly replaced polonium-210 slice as 1 unit, find its activity after one year (365 days). Given: half-life of polonium-210 is 138 days. (2 marks)

$k = \frac{\ln 2}{138 \times 24 \times 3600}$

$= 5.81 \times 10^{-8}$ ✓

$A = A_0 e^{-kt}$

$A = 0.160$ ~~Bq~~ unit ✓

1A

1A

Thank You!

2017 HKDSE - PHYSICS

1B-2
Questions 7, 8 & 9

Q7(a)(i)

$n_p \sin\phi_p = n_a \sin\phi_a$

$\sin\phi_p = \dfrac{1}{1.36}$ 1 M

$\phi_p = 47.3°$ (47.332)

∴ the critical angle = 47.3°. 1 A

$n \sin c = n \sin\theta$

$1.36 \sin c = 1 \sin 90°$ 1 M

$\boxed{\sin c} = 47.3°$ (3.S.F) 0 A

QUESTION 7

Solution	Marks	Remarks
7. (a) (i) At the critical angle c,		Well answered
$\dfrac{\sin 90°}{\sin c} = n$		
$\dfrac{1}{\sin c} = 1.36$	1M	
$c = 47.3°$	1A	
	2	
(ii) Angle of refraction at $E = 90° - 47.33° = 42.67°$	1M	Well answered
By Snell's law		
$\dfrac{\sin\theta}{\sin 42.67°} = 1.36$	1M	
$\theta = 67.2°$	1A	
	3	

Q7(a)(ii)

$n_2 \sin\theta = n_1 \sin\phi$ 1 M

$\sin\theta = (1.36)\sin(90° - 47.3°)$ 1 M

$\theta = 67.2°$ 1 A

$n_1 \sin\theta_1 = n_2 \sin\theta_2$ 1 M

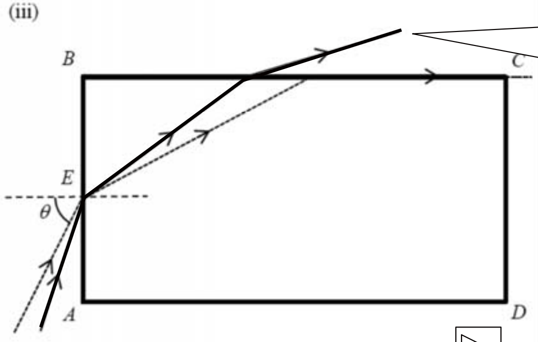
$1 \times 0.74 = 1.36 \sin\theta_2$ 0 M

∴ $\theta_2 = 32.96°$

$\theta = 90° - 32.96° = 57°$ 0 A

QUESTION 7

(iii)

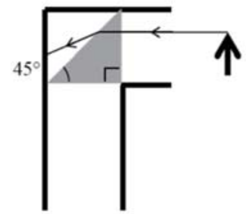


Some candidates failed to recognize that the light ray would eventually emerge from the plastic block as the incident angle within the block became smaller than the critical angle.

1A	Larger i, larger r at E
1A	Ray escapes the block on side BC
	Withhold 1 mark for wrong direction of light ray (arrow).
2	

QUESTION 7

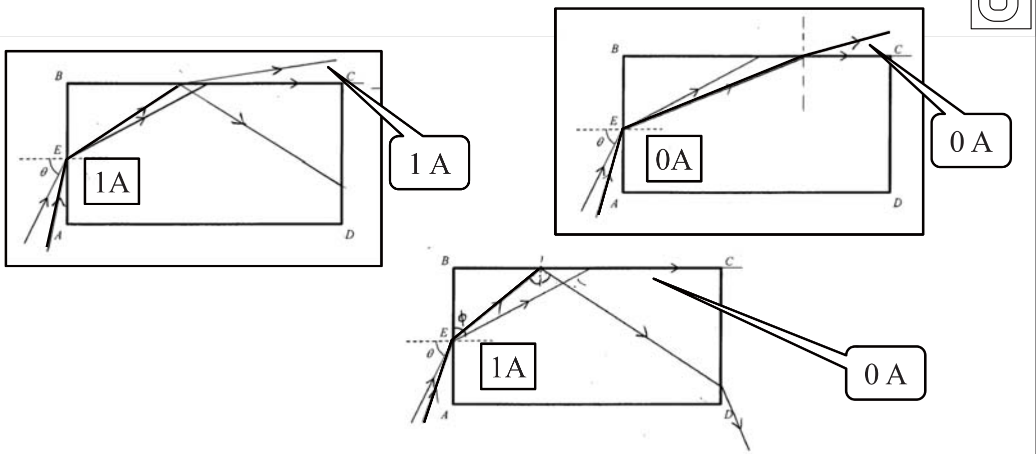
(b)



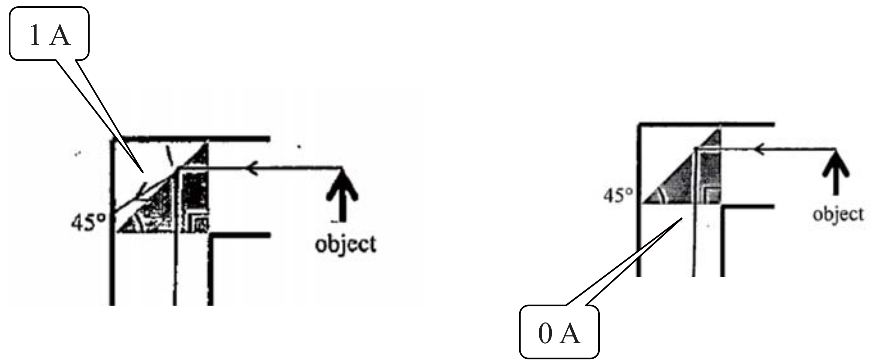
Well answered

(i)	1A	Light ray from object escapes the prism.
The angle of incidence of the light ray from the object is (45°, which is) less than the critical angle of the plastic prism.	1A	
Total internal reflection will not occur and the image may not be clear enough for observation.	1A	
	3	

Q7(a)(iii)



Q7(b)(i)



Q7(b)(i)

$1.36 \sin 45° = \sin \theta$ √ — 1 A

$\sin \theta = 0.96 < 1$

有折射光線出現 √ — 1 A

這使到達觀察者的光線強度下降

這或使到影像難以看見

故潛望鏡不能運作

As the ∧ angle is 45° < 47.3°, √ — 1 A

No total internal $\boxed{\text{refraction}}$ X ~~acc~~ occur. — 0 A

Light rays can't be reflected to the observer,

so the observer can't see the object.

Q7(b)(ii)

use two glass prisms instead of two plastic prisms. √ — 1 A

Glass prism $\boxed{\text{with a critical angle 45°}}$ X — 0 A

Materials of higher refractive index X — 0 A

兩塊$\boxed{\text{鏡片。}}$ X — 0 A

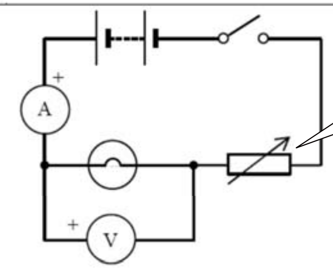
QUESTION 7

(ii) Glass prism (with critical angle less than 45°) OR Plane mirror (with coating on the front surface)	1A	
	1	

Well answered

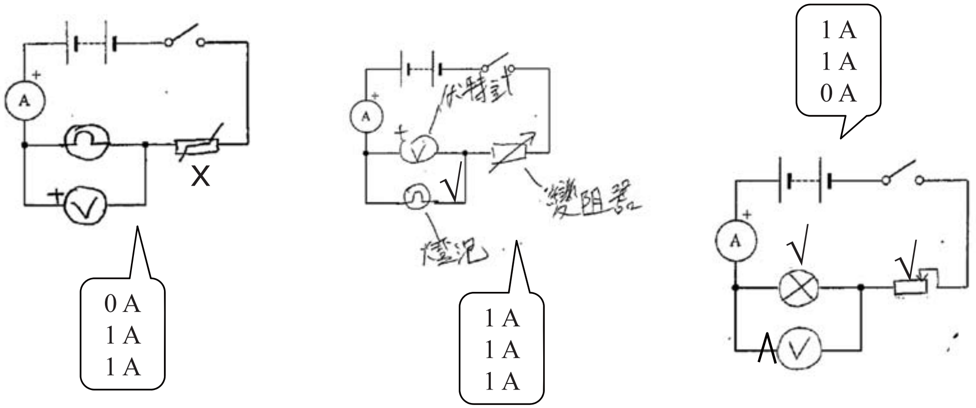
The most common error was to apply an incorrect symbol (e.g. or) for the variable resistor.

QUESTION 8

Solution	Marks	Remarks
8. (a) 	1A 1A 1A	Correct symbols of light bulb, variable resistor and voltmeter Correct positions Correct positive terminal connection for the voltmeter
	3	

Well answered.
The most common error was to apply an incorrect symbol (e.g. or) for the variable resistor.

Q8(a)



Q8(b)

When the voltage increases, the resistance of light bulb (and temperature rises) increases. This is because the filament in light bulb is heated up, the average velocity of charge flow reduces, hence the current reduce. The filament isn't an ohmic material, hence the resistance increases with voltage increases.

1 A

1 A

∵ $V = IR \Rightarrow I = \frac{1}{R} V$

∴ 不在線圖是斜系

0 A

由線圖，电压上升，电阻上升。

1 A

QUESTION 8

(b)	As the voltage across the light bulb increases, the temperature of the light bulb increases,	1A	
	thus the resistance of the light bulb increases.	1A	2
(c)	$R = V/I$ is the definition of resistance. It is applicable to all conductors.	1A	1

Many candidates only described how the resistance varies with the voltage according to the graph rather than to explain that the temperature increase led to the increase in resistance.

Not many candidates were able to point out that by definition R = V/I

Q8(c)

By $V = IR$, $R = \frac{V}{I}$ which is suitable to calculate the resistance no matter the resistant is constant or not. X

不遵從歐姆的电阻器才不能使用方程 $V = IR$

並非取決於电阻是否為常數 X

QUESTION 8

(d) At $V = 0.1$ V $R = \frac{V}{I} = \frac{0.1}{76 \times 10^{-3}} = 1.32\ \Omega$	1A	
At $V = 2.5$ V $R = \frac{V}{I} = \frac{2.5}{250 \times 10^{-3}}$	1A	for reading correct values (ignore the order of magnitude) from the graph
$= 10\ \Omega$	1A	
	3	

Accept the answer (1.33 Ω) from I = 75 mA

Well answered

QUESTION 8

(e) $R = \rho \frac{l}{A}$ $l = \frac{RA}{\rho}$ $= \frac{1.32 \times (1.66 \times 10^{-9})}{5.6 \times 10^{-8}}$	1M+1M	1M for suitable resistance from (d) 1M for correct substitutions
$= 0.039$ m	1A	
	3	

Not many candidates realised that the one corresponding to room temperature should be employed to find the length of the tungsten filament.

For I = 75 mA
l = 0.0395 m

Q8(d)

At $v = 0.1$ V, $I = \boxed{76\text{mA}}$

$R = \frac{0.1}{76 \times 10^{-3}} = \boxed{1.32\ \Omega}$ (1.3159)

At $v = 2.5$V, $I = \boxed{250\text{mA}}$

$R = \frac{2.5}{250 \times 10^{-3}} = \boxed{10\ \Omega}$

∴ resistance of light bulb at V=0.1V and 2.5V are 1.32Ω and 10Ω respectively.

1 A
1 A
1 A

$V = 0.1$V, $R = \frac{V}{I}$ $R = \boxed{\frac{0.1}{76}}$ $R = \boxed{1.32 \times 10^{-3}\ \Omega}$

$V = 2.5$V, $R = \frac{V}{I}$ $R = \boxed{\frac{2.5}{250}}$ $R = \boxed{0.01\ \Omega}$

0 A
1 A
0 A

Q8(e)

$\frac{1.66 \times 10^{-9}}{5.6 \times 10^{-8}} \times \boxed{10}$

$= 0.296$ m

長度是 0.296米

0 M

1 M

0 A

At 0.1 V, $R = \rho \frac{l}{A}$

$1.32 = 5.6 \times 10^{-8} \frac{l}{1.66 \times 10^{-9}}$

$l = 0.039$ m

At 2.5 V $R = \rho \frac{l}{A}$

$10 = 5.6 \times 10^{-8} \frac{l}{1.66 \times 10^{-9}}$

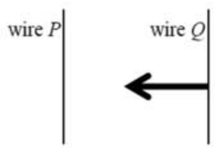
$l = 0.296$ m

1 M

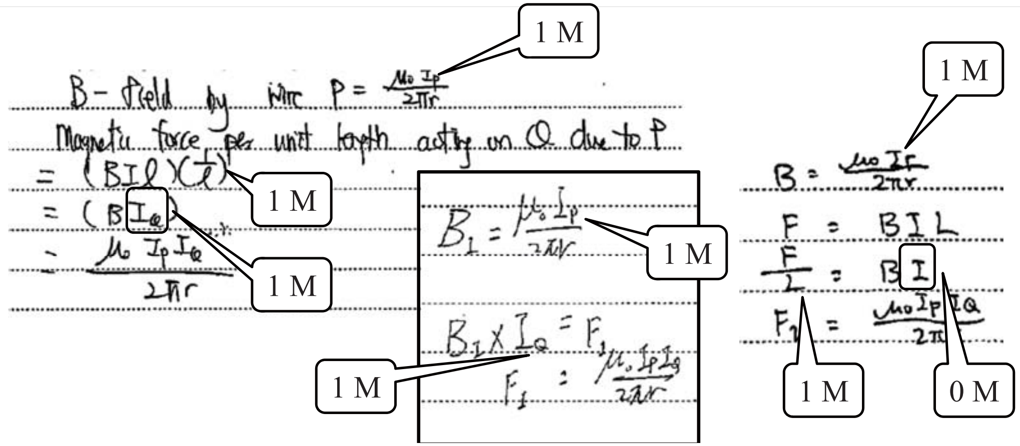
0 M

0 A

QUESTION 9

Solution	Marks	Remarks
9. (a) (i) The magnetic field at Q due to P points out of the paper.	1A	
	1	Well answered
(ii) 		Well answered
	1A	force to the left
	1	

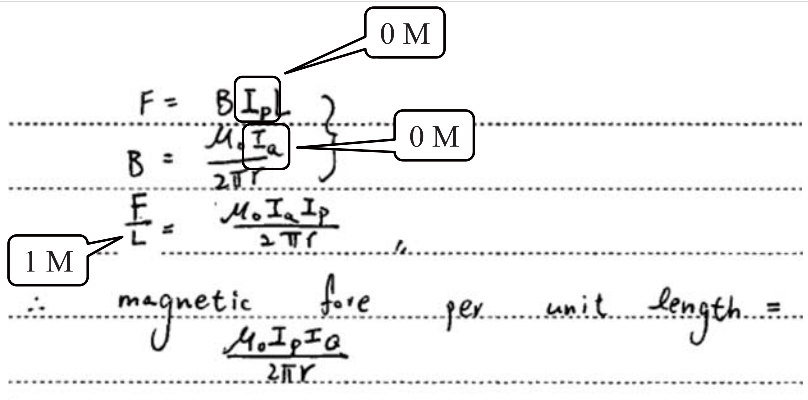
Q9(a)(iii)



QUESTION 9

Solution	Marks	Remarks
(iii) The magnetic field at Q due to P is $B_Q = \frac{\mu_o I_P}{2\pi r}$	1M	I_p and I_Q must be clearly indicated in the formulae
For a certain length segment l of wire, the magnetic force is $F = B_Q I_Q l \sin\theta$ $= \frac{\mu_o I_P}{2\pi r} I_Q l$	1M	Many candidates lost marks for not specifying the current I_P or I_Q in the formulae for calculating magnetic field or magnetic force respectively.
The magnetic force per unit length is $F_l = \frac{F}{l} = \frac{\mu_o I_P I_Q}{2\pi r}$	1M	1M for $F_l = \frac{F}{l}$
	3	

Q9(a)(iii)



QUESTION 9

(iv) The two forces is an action and reaction pair, Thus the two forces are equal in magnitude.	1A 1A 2	"The force acting on P due to Q is $F_l = \frac{\mu_o I_P I_Q}{2\pi r}$, thus the two forces are equal in magnitude" (0A)

A significant number of candidates were not able to explain why the two magnetic forces, which are a pair of action and reaction, were equal in magnitude.

QUESTION 9

(b) (i) As current passes in the same direction between neighboring wire segments, the wire segments attract each other, and the solenoid is compressed.	1A 1A 2	"As current passes in the <u>opposite</u> direction between neighboring wire segments, the wire segments <u>repel</u> each other, and the solenoid is <u>stretched</u>." (1A)
(ii) Current is still flowing in the same direction between neighboring wire segments at each instant, thus the solenoid will be compressed due to magnetic force.	1A 1	

Only the more able candidates referred to the direction of currents in <u>neighbouring wire segments</u> in explaining the origin of magnetic forces.

Many answers were too vague to award a mark

Q9(a)(iv)

The forces are equal In magnitude √ as they are the action and reaction pair √ their magnitude must be same.

1 A
1 A

Both for are calulate = $\frac{\mu_o I_P I_Q}{2\pi r}$. X
The magneti force acting on both P and Q are equal in ~~magneti~~ magnitude since both I_P and I_Q are taken into measuremeT.

0 A
0 A

Q9(b)(i)

Compressed. Since the curret of adjacent coil are in same direction. They attract each other. Thus, the coil compressed.

1 A
1 A

The spring will be compresied. In each turn of the coil, North pole and South pole are induced on each side. The magnetic attraction force between the alternating north pole and south pole will compress the spring.

1 A
1 A

Q9(b)(i)

The spring will be compressed. When a direct current passes through the spring, magnetic field will be created. A north pole will be induced on one end and a south pole will be induced on the other end. The two ends attract each other and the spring will be compressed due to magnetic force.

0 A
0 A

Q9(b)(ii)

It is because when an alternating current passes through, the current in each coil at every instant still have the same direction, thus the magnetic force acting on the spring is unchanged, hence the spring will be compressed all the time. It will not be compressed and stretched alternately.

1 A

when an alternating current passes through. Briefly explain why he is wrong. (1 mark)

Although the current is alternating, the direction of current flow are still the same X

0 A

Paper 2

Section A: Astronomy and Space Science

Summary of candidates performance (MC)

- 7 of 8 questions only need qualitative analysis.
- The correct percentage about 50% to 60%.
- The Discrimination Index about 0.52 to 0.64.
- Top 10% candidates ALL questions are correct.
- Most favourable distractor about 16% to 26%.

Q.1 Multiple-choice questions

	A	B	C	D
1.1	17.25	10.72	**54.54***	16.02
1.2	9.96	**51.55***	11.24	25.82
1.3	13.11	21.16	**54.42***	8.21
1.4	24.58	**50.92***	12.07	10.72
1.5	16.25	9.76	10.84	**61.20***
1.6	7.49	9.28	21.04	**60.40***
1.7	**52.39***	18.57	19.28	7.93
1.8	**64.30***	9.28	16.02	8.84

*** : key** ; Red colour : most favourable distractor

MC 1.2

Two astronauts are experiencing 'weightlessness' in a space station. The mass of the astronauts are 50 kg and 70 kg respectively. Which of the following statements is/are correct ?

(1) No gravitational force is acting on the two astronauts by the Earth.

(2) The net forces acting on the two astronauts are the same.

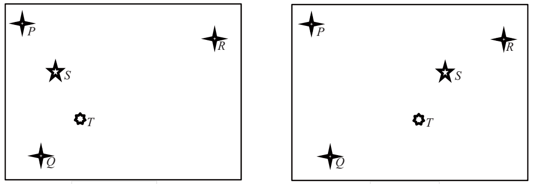
(3) The two astronauts have the same acceleration.

A. (1) only
B. (3) only* 55.55%
C. (1) and (2) only
D. (2)and (3) only 25.82%

There are still 45% of the candidates did not understand the meaning of weightlessness

MC 1.4

The following shows two pictures of the same region of the sky taken in January and May of a certain year. *P*, *Q*, *R*, *S* and *T* are five stars.



January view   May view

Which of the following statements MUST BE correct ?

(1) Stars *P*, *Q* and *R* are equidistant from the Earth.
(2) The parallax of star *S* is smaller than that of star *T*.
(3) Star *S* is closer to the Earth than star *T*.

A. (1) Only 24.58%
B. (3) only* 50.92%
C. (1) and (2) only
D. (2)and (3) only

About half of the candidates did not know the closer the star to the observer is, the greater the parallax results

Q1 Structured question

(a) Figure 1.1 shows an object of mass m orbiting around a star of mass M with a radius of r. The velocity of the object is v.

(i) Using Newton's law of gravitation, show that

$$v^2 = \frac{GM}{r},$$

where G is the universal gravitational constant.

(ii) Hence, or otherwise, show that

$$T^2 = \frac{4\pi^2}{GM} r^3,$$

where T is the period of the motion of the object.

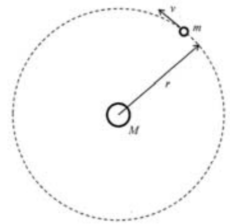


Figure 1.1

MC 1.7

It is known that the Sun is a class G star, and the star Zeta Puppis is a class O supergiant. Which of the following is correct ?
Given: the sequence of the spectral classes is O B A F G K M.

	higher surface temperature	greater luminosity
A.* 52.39%	Zeta Puppis	Zeta Puppis
B.	Zeta Puppis	the Sun
C. 19.28 %	the Sun	Zeta Puppis
D.	the Sun	the Sun

Spectral classification and the luminosity of star depend on the its temperature and size

- a(i)

$$\frac{GMm}{r^2} = \frac{mv^2}{r}$$

$$v^2 = \frac{GM}{r}$$

1 M gravitational force = centripetal force

- (ii)

$$T = \frac{2\pi r}{v}$$ or $T=2\pi/\omega$ 1 M

$$T^2 = \frac{4\pi^2 r^2}{v^2}$$

$$= \frac{4\pi^2 r^2}{\left(\frac{GM}{r}\right)}$$ from (i) 1M

$$= \frac{4\pi^2}{GM} r^3$$

Candidates' performance in (a) was satisfactory.
Just some of them employed incorrect formula or made mistakes in manipulating equations using ratio.

(b) Stars and gases orbit around the centre of the M33 Galaxy. At a position *X* near the edge of the galaxy (3.98×10^{20} m from the centre of the galaxy), the orbital velocity of the hydrogen gas is about 1.23×10^5 m s^{-1}. You may assume that the hydrogen gas at *X* orbits with a circular orbit.

(i) One of the spectral lines of hydrogen gas (the H I line) has a wavelength of 21.106 cm. If the hydrogen gas at *X* is moving towards the Earth along the line of sight, what would be the observed wavelength of the H I line ? (2 marks)

(ii) How long would it take for the hydrogen gas at *X* to complete one orbit around the M33 Galaxy ? (1 mark)

By $\frac{\Delta\lambda}{\lambda_o} \approx \frac{v}{c}$

$$\Delta\lambda \approx \frac{v}{c}\lambda_o = \frac{1.23\times10^5}{3\times10^8}\times 21.106$$

$= 8.65346 \times 10^{-3}$ cm

Or correct sub. of $\frac{\lambda-\lambda_o}{\lambda_o} = \frac{v}{c}$ or $\frac{\lambda_o-\lambda}{\lambda_o} = \frac{v}{c}$ 1M

no need to consider the blue or red shift

$\lambda = \lambda_o - \Delta\lambda$

$= 21.106 - 8.65346 \times 10^{-3}$

$= 21.097$ cm (21.09 ~ 21.1 cm) 1A

Quite a number of the candidates failed to relate blue shift with the decrease in the wavelength of the spectral line observed.

b(ii)

$$T = \frac{2\pi r}{v}$$

$$= \frac{2\times3.14\times(3.98\times10^{20})}{1.23\times10^5}$$

$= 2.03 \times 10^{16}$ s (6.42×10^8 yr) 1A

Some candidates arrived at answers with wrong orders in the calculation in (b)(ii).

(iii) Using the result of (a)(ii), or otherwise, estimate the mass of the M33 Galaxy in solar mass.

Given: 1AU = 1.50×10^{11} m, and 1 year = 3.16×10^7 s. (3 marks)

(iv) Astronomers estimated that the total mass of luminous objects in the M33 Galaxy is 7×10^9 solar mass. Compare this to your answer in (b)(iii) and suggest a reason to explain the difference, if any. (1 mark)

For the hydrogen gas orbiting the M33 Galaxy at X,

$$T^2 = \frac{4\pi^2}{GM} r^3 \quad \ldots\ldots(1)$$

where T is the answer in (b)(ii), M is the mass of the M33 Galaxy and r is the distance between position X and the centre of the galaxy.

Consider the Earth orbiting around the Sun,

$$T_S^2 = \frac{4\pi^2}{GM_S} r_S^3 \quad \ldots\ldots(2)$$

where T_S = 1 year, r_S = 1 AU and M_S is the solar mass 1M

(1) & (2) and we have

$$\frac{T^2}{T_S^2} = \frac{M_S r^3}{M r_S^3}$$ 1M

$$M = \frac{T_S^2 r^3}{T^2 r_S^3} M_S$$

$$= \left(\frac{3.16\times10^7}{2.03\times10^{16}}\right)^2 \left(\frac{3.98\times10^{20}}{1.50\times10^{11}}\right)^3 M_S$$

$= 4.526 \times 10^{10}\ M_S \sim 4.53 \times 10^{10}\ M_S$ 1A

(iv) Dark matter / a (super) massive black hole / non luminous object exists in the galaxy. 1A

ALTERNATIVE:

Use $T^2 = \frac{4\pi^2}{GM} r^3$ to find the mass of M33 1M

$$M = \frac{4\pi^2 (3.98\times10^{20})^3}{G(2.03\times10^{16})^2} = (9.055 \sim 9.06) \times 10^{40} \text{ kg}$$

Use $T_S^2 = \frac{4\pi^2}{GM_S} r_S^3$ to find solar mass 1M

$$M_S = \frac{4\pi^2 (1.5\times10^{11})^3}{G(3.16\times10^7)^2} = 2.0 \times 10^{30} \text{ kg}$$

Then $M = (4.526 \sim 4.53) \times 10^{10}\ M_S$ 1 A

Some candidates arrived at answers with wrong orders in the calculation in (b)(iii).

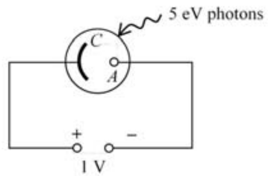
Part (b)(iv) was in general well answered.

HKDSE 2017
Physics Paper 2

Section B : Atomic World

Q.2 Multiple-choice questions

2.2



A photocell is connected to a 1 V d.c. source as shown. A monochromatic light beam with each photon of energy 5 eV is incident on cathode C of the photocell so that photoelectrons are emitted. If the work function of cathode C is 2 eV, what is the maximum kinetic energy of the photoelectrons reaching anode A ?

A. 2 eV (29.85%)*
B. 3 eV (51.34%)
C. 4 eV (15.75%)
D. 6 eV (2.61%)

Common mistakes:
Most candidates calculated the KE of the photoelectrons just emitted from the cathode

Q.2 Multiple-choice questions

	A	B	C	D
2.1	7.69	**69.70**	8.41	13.87
2.2	**29.85**	51.34	15.75	2.61
2.3	10.45	16.58	**56.83**	14.56
2.4	15.86	10.39	**59.91**	13.31
2.5	10.93	**51.90**	16.11	20.07
2.6	**63.10**	6.94	18.02	11.05
2.7	**69.79**	12.19	8.05	9.48
2.8	4.02	14.83	10.34	**70.31**

Bold : Key ; Red colour : Most favorable distractor

Q.2 Multiple-choice questions

2.3 When monochromatic light of wavelengths λ and $\frac{3}{4}\lambda$ are incident on the cathode surface of a photocell separately, the stopping potentials are in the ratio of 1 : 2. What is the longest wavelength of monochromatic light that can cause photoelectrons to be emitted from the photocell ?

A. λ (10.45%)
B. $\frac{4}{3}\lambda$ (16.58%)
C. $\frac{3}{2}\lambda$ (56.83%)*
D. $\frac{5}{3}\lambda$ (14.56%)

Remarks:

By $eV_s = \frac{hc}{\lambda} - \Phi$

$$eV_s = \frac{hc}{\lambda} - \frac{hc}{\lambda_o} \quad ......(1)$$

$$e(2V_s) = \frac{hc}{\frac{3}{4}\lambda} - \frac{hc}{\lambda_o} \quad ......(2)$$

$$\lambda_o = \frac{3}{2}\lambda$$

Q.2 Multiple-choice questions

2.4 A parallel beam of yellow light from a sodium discharge tube is directed to a glass tube filled with sodium vapour. Which of the following would happen after the sodium vapour absorbs the yellow light ?

A. No more yellow light can be seen. (15.86%)
B. The sodium vapour emits yellow light in the direction of the incident beam. (10.39%)
C. The sodium vapour emits yellow light in all directions. (59.91%)*
D. The sodium vapour emits white light in all directions. (13.31%)

Common Mistakes:
Some candidates thought that sodium vapour absorbed all the yellow light.

Q.2 Multiple-choice questions

2.5 A beam of 8 keV electrons is directed towards a crystal to observe the diffraction of electrons. What is the de Broglie wavelength of a 8 keV electron ?

A.	4.34×10^{-10} m	(10.93%)
B.	1.37×10^{-11} m	(51.90%)*
C.	1.74×10^{-19} m	(16.11%)
D.	5.49×10^{-21} m	(20.07%)

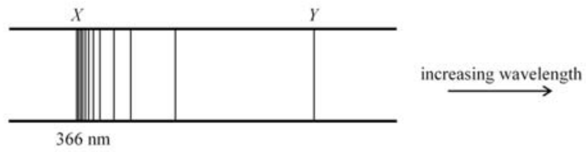
Remarks:
By $\lambda = \frac{h}{mv}$
$= \frac{h}{\sqrt{2m(K.E)}}$

Common mistakes:
Some candidates did not convert 8 keV into joule in their calculation.

Q.2 Structured question

Figure 2.1 shows part of the line spectrum of hydrogen.

Figure 2.1



It contains a series of spectral lines with wavelength λ given by

$$\frac{1}{\lambda} = R\left(\frac{1}{2^2} - \frac{1}{n^2}\right) ,$$

where R is a constant and $n = 3, 4, 5, \ldots$ There are no spectral lines in the series with wavelength less than that of line X (366 nm) nor greater than that of line Y.

Q.2 Structured question

(a) Use Bohr's model of the hydrogen atom to explain why the spectral lines are discrete but not continuous. (2 marks)

Marking Guide

(a)	When an atom transits from a higher energy level to a lower one, a photon with energy equals to the energy difference between the levels is emitted. (1A) Since energy levels are quantized, the energy (and thus wavelength) of the photons emitted can take some discrete values only. (1A)

Common mistakes:
Many candidates failed to point out the energy levels are quantized and they also failed to state that the energy (wavelength) of the photons depends on the energy difference in the transition.

Q.2 Structured question

(b)(i) Which region of the electromagnetic spectrum does line X belong to ? (1 mark)

(ii) What is the energy of a photon of line X ? Express your answer in eV. (2 marks)

Marking Guide

(b) (i) Line X belongs to the ultraviolet region. (1A)

(ii)

$$\text{energy} = \frac{hc}{\lambda e}$$

$$= \frac{(6.63\times10^{-34})(3\times10^{8})}{(366\times10^{-9})(1.60\times10^{-19})} \quad \text{(1M)}$$

= 3.40 eV [3.39 eV] (accept 3.39 – 3.41) (1A)
(do not accept -3.40ev)

Remarks:
(b) ii

1M Accept :

1. Energy = +/- $\frac{13.6}{4}$
2. E= $\frac{hc}{\lambda e}$ = $5.43\text{x}10^{-19}$J

Q.2 Structured question

(c) (i) State the transition in a hydrogen atom that can produce line Y. (1 mark)

Marking Guide

(c)	(i)	The transition from n = 3 to n = 2. Or from 2nd to 1st excited state

Remarks:
Accept: n=2 to n=3 or
from 1st to 2nd excited state

Common mistakes:
Some candidates stated 'from 3rd to 2nd excited state' or 'from n=2 to n=∞'

Q.2 Structured question

b. (iii) What would happen when a beam of radiation having the same wavelength as line X is incident on hydrogen atoms in the first excited state (n = 2) ? Briefly explain. (2 marks)

Marking Guide

(iii) The radiation would be absorbed, (1A)
and the hydrogen atoms ionized. (1A)

Remarks:

(b)(iii) The 1st 1A accept
1.Proving n = ∞ 2.E_2 = –3.4 eV. 3.4 eV is required to ionize the atom.

Q.2 Structured question

(c) (ii) Determine the wavelength of line Y. (2 marks)

Marking Guide

From line X, we have

$$\frac{1}{366} = R(\frac{1}{2^2} - 0) \quad \text{(1M)}$$

$R \approx 0.0109$ (nm^{-1}) (1.09×10^{7} m^{-1})

For line Y,

$$\frac{1}{\lambda} = R(\frac{1}{2^2} - \frac{1}{3^2})$$

λ = 658.8 nm (654 nm – 661 nm) (1A)

Common mistakes:
Some candidates wrongly used

$$\frac{1}{366} = R(\frac{1}{2^2} - \frac{1}{3^2})$$

to find R.

Q.2 Structured question

ALTERNATIVE

$E = E_2 - E_3$
$hf = 13.6\ (1/2^2 - 1/3^2)$ eV (1M)
$h\frac{c}{\lambda} = 13.6\left(\frac{1}{2^2} - \frac{1}{3^2}\right) \times 1.6\text{x}10^{-19}$

$= 6.58 \times 10^{-7}$ m (1A)

Common Mistakes:
-some candidates did not converted eV into joule
-some just found the frequency of the line instead of its wavelength

The End

Paper 2

Section C : Energy and Use of Energy

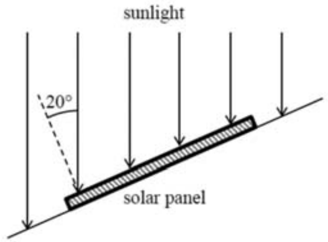
Q.3 Multiple-choice questions

	A	B	C	D
3.1	20.67	**63.19***	9.75	5.72
3.2	4.30	2.08	**88.98***	4.53
3.3	2.19	**75.35***	11.73	10.59
3.4	19.31	1.97	5.82	**72.83***
3.5	7.38	28.81	**57.01***	6.63
3.6	23.17	31.58	7.09	**38.04***
3.7	10.10	65.98	**19.05***	4.59
3.8	**52.07***	14.08	18.74	15.08

*** : key** ; Red colour : most favourable distractor

MCQ 3.5

3.5 A solar panel of area 3 m^2 is installed on a roof. Sunlight makes an angle of 20° to the normal of the panel at noon. The solar constant is 1366 W m^{-2} and 40% of the radiation power is absorbed by the atmosphere.



If the efficiency of the solar panel is 10%, what is the electrical power generated by it at noon ?

A. 84 W
B. 154 W favourable distractor 28.81%
*C. 231 W 57.01%
D. 246 W

A B C D

$$1366 \times \boxed{0.6} \times 3 \times \cos 20° \times 0.1 = 231\ \mathrm{W}$$

MCQ 3.6

3.6 The figure shows a wind turbine.

Which of the following statements explain why the wind turbine is **NOT** 100% efficient in converting the kinetic energy of the wind to electrical energy ?

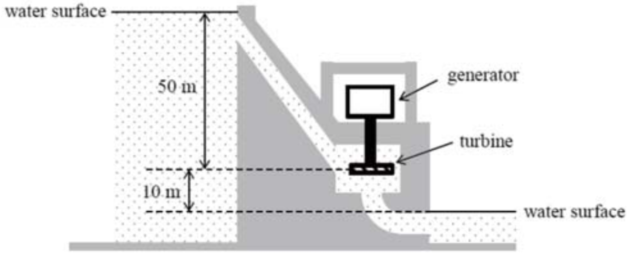
(1) There are mechanical energy losses in the moving parts.
(2) Wind does not stop completely after passing through the rotor.
(3) The direction of wind changes irregularly.

A. (1) and (2) only
B. (1) and (3) only favourable distractor 31.58%
C. (2) and (3) only
* D. (1), (2) and (3) 38.04%

A B C D

MCQ 3.7 (deleted)

3.7 The hydroelectric power plant shown has an efficiency of 40% in electricity generation. If the flow rate of the water is 300 $m^3\ s^{-1}$, what is the power output of the plant ?
Given: density of water is 1000 kg m^{-3}. Take $g = 9.81$ m s^{-2}.



A. 11.8 MW
B. 58.9 MW favourable distractor 65.98%
*C. 70.6 MW 19.05%
D. 88.3 MW

A B C D

$$\frac{m}{t}gh\times\eta = \frac{300\times1000}{1}\times9.81\times\boxed{60}\times0.4 = 70.6\text{ MW}$$

MCQ 3.8

3.8 Energy is released in the following nuclear fission of uranium-235.

$${}^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{94}_{40}Zr + {}^{139}_{52}Te + 3{}^{1}_{0}n$$

Which of the following statements concerning the reaction is/are correct ?

(1) The rate of the reaction can be controlled by absorbing some of the neutrons produced.
(2) Mass is conserved in the reaction.
(3) The binding energy per nucleon of ${}^{235}_{92}U$ is higher than that of ${}^{94}_{40}Zr$ or ${}^{139}_{52}Te$.

*A. (1) only 52.07%
B. (3) only
C. (1) and (2) only favourable distractor 18.74%
D. (2) and (3) only

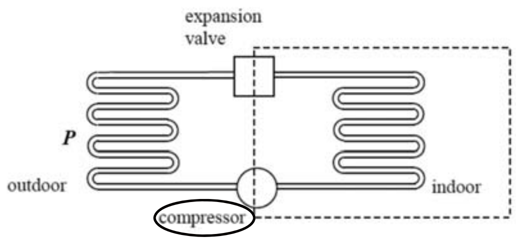
A B C D

Q.3 Structured question

A refrigerated truck is used for transporting frozen goods. A refrigerator is installed in the refrigerated compartment.

(a) Figure 3.1 shows a simplified schematic diagram of a refrigerator.

Figure 3.1



Q.3 Structured question

(i) In which direction does the refrigerant flow through the compressor (from indoor to outdoor or from outdoor to indoor) ? (1 mark)

(ii) Describe the change of state of the refrigerant and the heat exchange when it flows through component *P*. (2 marks)

The refrigerant flows from indoor to outdoor through the compressor.	1A

The refrigerant condenses / changes from gas to liquid.	1A
It releases the heat/internal energy to the environment.	1A

1+1

Q.3 Structured question

- Part (a) was in general well answered although a few candidates wrongly described the change of state of the refrigerant and the heat exchanged resulted.

Q.3 Structured question

(ii) On a sunny afternoon, the **AIR TEMPERATURE** is 35°C. By using the refrigerator with cooling capacity calculated in (b)(i), briefly explain why the temperature inside the compartment **CANNOT** be maintained at –15°C. (2 marks)

The compartment absorbs heat by radiation,	1A
the exterior surface temperature of the refrigerated compartment is higher than 35°C.	1A

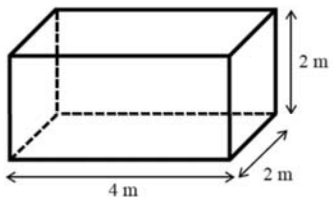
The 2nd 1A can be granted only if extra heat gained is mentioned above.
Accept:
- Due to extra heat gained, the cooling capacity calculated in (b)(i) is not enough to maintain ΔT = 50°C
- Heat gained > Heat removed if ΔT = 50°C

NOT accepted:
- The refrigerator is not 100% efficiency
- Energy lost / gained from surroundings

Q.3 Structured question

(b) Figure 3.2 shows the dimensions of the refrigerated compartment. The compartment is insulated using 0.08 m thick polystyrene. The thermal conductivity of polystyrene is 0.03 W m^{-1} K^{-1}.

Figure 3.2



(i) If a temperature difference of 50°C is maintained between the exterior and the interior surfaces, estimate the minimum cooling capacity required for the refrigerator. (Hint: consider all the surfaces of the compartment.) (3 marks)

Total surface area = (4 × 2) × 4 + (2 × 2) × 2 = 40 m^2	1A
Cooling capacity = rate of heat gain	
$= \kappa \dfrac{A(T_H - T_C)}{d} = 0.03\,\dfrac{40(50)}{0.08}$ correct subst. of κ, $(T_H - T_C)$ and d	1M
=750 W	1A

Q.3 Structured question

- In (b), many candidates did not realise that the calculation involving thermal conductivity only dealt with heat transfer by conduction and thus failed to answer part (b)(ii) in which *radiation* had a part to play.

Q.3 Structured question

(c) Light emitting diodes (LED) are installed inside the refrigerated compartment for illumination. State **TWO** advantages of using LED over other common types of lighting. (2 marks)

Light emitting diode (LED) has a <u>long life time</u>	1A
and <u>very high efficacy</u>.	1A

2A from 2 different aspects below:
- long life-time
- high efficiency / less heat / less electricity cost
- environmental friendly/less disposal problem <u>BECAUSE</u> no/less toxic substance inside

NOT accepted:
- long time usage (使用時間長)
- cheap / low cost
- small in size / low voltage
- environmental friendly without reason
- no mercury without mentioning disposal problem

Q.3 Structured question

- Candidates' performance in (c) was satisfactory though some of their answers were far from concise.

Paper 2

Section D: Medical Physics

HKDSE 2017

Q.4 Multiple-choice questions

4.2 Which of the following statements about human hearing are correct ?

(1) The ear bones in the middle ear convert sound waves into vibrations of the ear drum.
(2) Pressure is amplified because of the difference in area between the ear drum and the oval window.
(3) Mechanical vibrations are converted into electrical signals in the inner ear.

A. (1) and (2) only (16.91%)
B. (1) and (3) only (15.76%)
C. (2) and (3) only (40.32%)*
D. (1), (2) and (3) (26.35%)

Remarks:
The sound waves are converted into vibrations of the ear drum. The ear bones act as a lever system only.

Multiple Choice

	A	B	C	D
4.1	**69.25**	15.45	8.63	6.08
4.2	16.91	15.76	**40.32**	26.35
4.3	8.97	**71.74**	15.01	3.86
4.4	6.21	3.52	32.01	**58.05**
4.5	8.42	**57.23**	29.34	4.83
4.6	**71.49**	8.26	15.09	5.14
4.7	5.26	20.93	**64.42**	9.30
4.8	12.47	15.56	19.46	**52.51**

Bold : Key ; Red colour : Most favorable distractor

Q.4 Multiple-choice questions

4.4 The acoustic impedances of various tissues and that of air are listed in the following table.

	acoustic impedance ($\times 10^6$ kg m^{-2} s^{-1})
fat	1.34
liver	1.65
muscle	1.71
bone	7.8
air	0.0004

Which of the following interface will give the largest intensity reflection coefficient in ultrasound scans ?

A. liver – muscle (6.21%)
B. fat – muscle (3.52%)
C. muscle – bone (32.01%)
D. muscle – air (58.05%)*

Remarks:
intensity reflection coefficient $\propto = \frac{(Z_2-Z_1)^2}{(Z_2+Z_1)^2}$

Q.4 Multiple-choice questions

4.5 An ultrasound transducer is used to scan the eye (Figure 4.5.1) and the echoes received are shown in Figure 4.5.2. The velocity of the ultrasound waves in the eye is 1550 m s^{-1}.

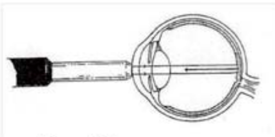


Figure 4.5.1

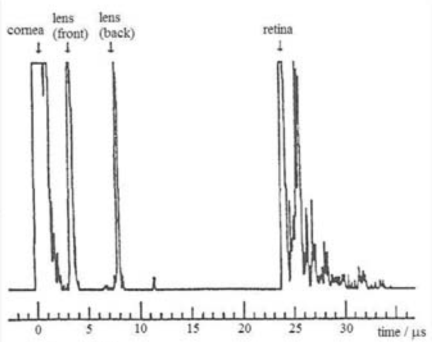


Figure 4.5.2

The thickness of the lens is about

A. 1.6 mm. (8.42%)
B. 3.5 mm. (57.23%)*
C. 7.0 mm. (29.34%)
D. 18.6 mm. (4.83%)

Remarks:

The time lapse between pulses (from front and back of the lens) is equal to $2d/v$

Q.4 Multiple-choice questions

4.8 Which of the following statements about radionuclide imaging is correct ?

A. Due to the decay of the tracer, images should be taken immediately after the tracer is injected. (12.47%)
B. The gamma camera emits gamma radiation to irradiate the tracer. (15.56%)
C. Radionuclide imaging can clearly reveal the structure of a failed organ. (19.46%)
D. For a period of time after injecting the tracer, excretion of the patient may be radioactive. (52.51%)*

Remarks:

- The resolution of the image is poor.
- The image reveals the radionuclide uptake by the organ.

Q.4 Multiple-choice questions

4.7 A certain tracer Y has a biological half-life of 3 days and a physical half-life of 4 hours. What is the effective half-life of Y ?

A. 0.24 hours (5.26%)
B. 1.71 hours (20.93%)
C. 3.79 hours (64.42%)*
D. 4.23 hours (9.30%)

Remarks:

*1/(effective half-life) = 1/(biological half-life) +1/(physical half-life)
*biological half-life should be expressed in hours.

Q.4 Structured question

X-ray radiographic imaging and computed tomography (CT) scans are used for medical purposes.

(a) Briefly describe how X-ray is produced. (1 mark)

(b) State an advantage of a CT scan over X-ray radiographic imaging. (1 mark)

Q.4 Structured question

Marking Guide

(a) X-ray is produced when fast electrons hit a heavy metal target. (1A)

(b) CT scan is better at mapping soft tissues / differentiating between overlying structures in the body / making 3D images (1A)

Remarks:

(b)

•do not accept vague answers such as "higher resolution" and "clearer image"

Q.4 Structured question

Marking Guide

(c) (i) The effective dose of CT scan is much higher because multiple X-ray images are taken for a CT scan. 1A

(ii) Equivalent background radiation dose

$= 1.85 \times \dfrac{1.5}{0.02}$ 1A

= 138.75 days (accept 139 days)

Common mistakes:

(i) do not accept vague answer such as
'take more time'
'come from all directions or 360°'

(ii) Some candidates did not use correct unit for the equivalent background radiation dose

Q.4 Structured question

(c) The effective dose of radiation absorbed can be measured in millisieverts (mSv) or expressed as the time taken to receive the equivalent dose from background radiation. The effective doses for a chest X-ray radiographic imaging and a chest CT scan are shown below.

	effective dose (mSv)	**equivalent background radiation dose** (days)
chest X-ray radiographic imaging	0.02	1.85
chest CT scan	6.6	610.5

(i) Briefly explain why the effective dose of a CT scan is much higher. (1 mark)

(ii) A head CT scan has an effective dose of 1.5 mSv. Based on the information from the table, estimate its equivalent background radiation dose. (1 mark)

Q.4 Structured question

(d) In a CT scan, a narrow X-ray beam of initial intensity I_0 transmits through lung cavity, soft tissue and bone along its path. The table below shows the linear attenuation coefficients of the tissues, and the path lengths of the X-ray in the tissues.

	linear attenuation coefficient (cm^{-1})	**path length** (cm)
lung cavity	0.1	19.8
soft tissue	0.18	8.8
bone	0.48	4.4

(i) Briefly explain the large difference in linear attenuation coefficient between lung cavity and bone. (1 mark)

(ii) Determine the value of $\dfrac{\text{transmitted intensity } I}{\text{initial intensity } I_0}$ of the X-ray after transmitted through lung cavity, soft tissue and bone. (3 marks)

Q.4 Structured question

Marking Guide

(d) (i) The lung cavity is filled with air. / There is a large difference in density between the lung cavity and bone.

(ii) The total attenuation is

$I = I_o e^{-(\mu_1 x_1 + \mu_2 x_2 + \mu_3 x_3)}$ 1M+1M

$\frac{I}{I_o} = e^{-(0.1 \times 19.8 + 0.18 \times 8.8 + 0.48 \times 4.4)}$

$= e^{-5.676} = 3.43 \times 10^{-3}$ 1A

Remarks:

(i) well answered.

(ii) Some candidates just calculated the attenuations for the X-rays passing though lung cavity, soft tissue and bone respectively instead of the overall attenuation.

1M for $I = I_o e^{-ux}$ (at least one correct substitution)

1M for calculating the overall attenuation

Q.4 Structured question

(e) A student suggests that a CT scan can be used for checking a foetus. Briefly explain whether you agree or not. If you do not agree, suggest a suitable medical imaging method for checking a foetus. (2 marks)

Marking Guide

	I do not agree because a CT scan may cause ionization (changes) in cells / damage DNA of the foetus. (1A) An ultrasound scan can be used for checking a foetus. (1A)

Remarks:

1st 1 A

Accept: ionizing radiation/ killing of cells/ cancer/ heritable effects / mutation;

The End