2015 HKDSE Physics & Combined Science (Physics)

Report on Assessment

Y.T.SZETO
Manager (Physics), HKEAA

8 & 15 Oct 2015

Overview

Paper	Physics	CS(Phy)
1A (MC)	Mean: 17 out of 33 (i.e.52%) (2014: 18 out of 33)	Mean: 8.5 out of 22 (i.e.39%) (2014: 9 out of 22)
1B	~<50% (2014: ~>50%)	~30% (2014: ~40%)
2	~<50% (2014: ~>50%)	N.A.
SBA	~>70% (~2014)	~<70% (~2014)
Candidature	ALL: 13 184 SCH: 12 106	ALL: 1 063 SCH: 946

Marking & Grading

On-Screen Marking (OSM) panels	
Physics	**CS(Phy)**
1B-1: Q.1, 4, 5, 6 1B-2: Q.7, 8, 9 1B-3: Q.2, 3, 10	1B-1: Q.1, 2, 3, 4 1B-2: Q.5, 6, 7

2A: Astronomy (21%) 2B: Atomic World (66%) 2C: Energy (87%) 2D: Medical Physics (26%)	---

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

Marking & Grading

- Expert Panel (Chief Examiners etc.) 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/Exam Board

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

Results

Physics

Cut score difference = 43 marks

Level	5**	5+	4+	3+	2+	1+
Percentage	2.7%	27.1%	49.4%	72.7%	90.0%	97.9%
No. of MC	28	22	18/17	13	10	8/7

CS(Phy)

Cut score difference = 38 marks

Level	5**	5+	4+	3+	2+	1+
Percentage	0.8%	7.1%	19.2%	45.2%	73.5%	92.0%
No. of MC	17/16	14	12/11	9	7	5

Paper 1A

Physics (33 MC)

>70%	50%-70%	<50%
2	17	14

Easy ⟷ Difficult

CS (Phy) (22 MC)

>70%	50%-70%	<50%
0	4	18

Easy ⟷ Difficult

PHYSICS MC

Topic (No. of Qu.)	Average % correct	No. of Qu. < 50% correct
Heat & Gases (3)	66%	0
Force & Motion (8)	56%	3
Wave Motion (9)	53%	3
Electricity & Magnetism (10)	48%	6
Radioactivity (3)	44%	2

CS(PHY) MC

Topic (No. of Qu.)	Average % correct	No. of Qu. < 50% correct
Heat & Gases (3)	52%	2
Force & Motion (6)	28%	6
Wave Motion (8)	34%	7
Electricity & Magnetism (5)	37%	3

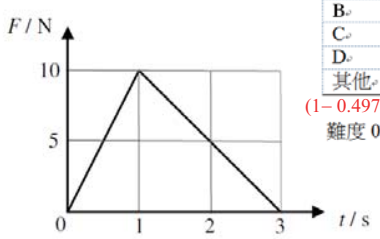
lower 27% top 27%

選項	全體	低分組	高分組
A	10.1	18.3	2.9
B	49.7	28.5	77.1
C	22.0	31.5	8.8
D	17.3	20.8	10.8
其他	.9	.9	.4

(1– 0.497) (0.771– 0.285)

難度 0.50，適中。區分度 0.49，很好。

6.



An object of mass 3 kg is initially at rest on a smooth horizontal ground. A force F is applied horizontally to the object such that the magnitude of F varies with time t as shown. What is the speed of the object at $t = 3$ s ? Neglect air resistance.

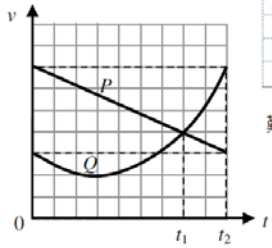
		PHY	CS(PHY)
A.	2.5 m s^{-1}	(10%)	(16%)
* B.	5 m s^{-1}	(50%)	(33%)
C.	10 m s^{-1}	(22%)	(31%)
D.	15 m s^{-1}	(18%)	(20%)

50% of the candidates managed to use the graph to find the final speed of the object.

選項	全體	低分組	高分組
A	17.6	24.1	9.2
B	30.1	37.7	17.8
C	12.3	22.2	2.6
D	39.8	15.7	70.3
其他	.3	.3	.2

難度 0.60，偏難。區分度 0.55，很好。

9.



The figure shows the velocity-time (v-t) graph of two cars P and Q travelling along the same straight road. At $t = 0$, the cars are at the same position. Which deductions about the cars between $t = 0$ and $t = t_2$ are correct ?

(1) P and Q are always travelling in the same direction.
(2) At $t = t_1$, the separation between P and Q is at a maximum.
(3) At $t = t_2$, Q lags behind P.

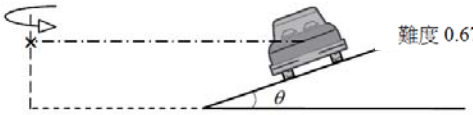
		PHY	CS(PHY)
A.	(1) and (2) only	(18%)	(23%)
B.	(1) and (3) only	(30%)	(34%)
C.	(2) and (3) only	(12%)	(21%)
* D.	(1), (2) and (3)	(40%)	(22%)

About one-third of the candidates did not realise that the separation between P and Q is at a maximum at $t = t_1$.

選項	全體	低分組	高分組
A	30.7	34.4	18.6
B	20.4	12.0	27.8
C	15.3	24.5	5.3
D	33.3	28.7	48.2
其他	.3	.4	.1

難度 0.67，偏難。區分度 0.19，差。

10.



The figure shows the rear view of a car of mass m which travels along a circular road banked with an angle θ to the horizontal. The car moves at a certain speed such that it experiences **no frictional force along the inclined surface**. Which of the following represents the centripetal force on the car ?

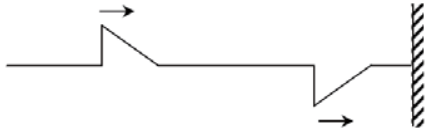
A.	$mg\sin\theta$	(31%)
B.	$mg\sin\theta\cos\theta$	(21%)
C.	$\dfrac{mg\cos\theta}{\sin\theta}$	(15%)
* D.	$\dfrac{mg\sin\theta}{\cos\theta}$	(33%)

About one-third of the candidates were able to find the centripetal force by resolving the components of the normal reaction.

選項	全體	低分組	高分組
A	29.7	44.8	11.2
B	13.5	15.0	11.1
C	15.5	18.9	10.1
D	41.2	21.1	67.4
其他	.2	.2	.1

難度 0.59，適中。區分度 0.46，很好。

14.



Two pulses of the same shape travel along a stretched string with one end fixed to the wall as shown above. Which of the following can be the resultant waveform at different instants later ?

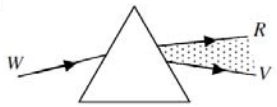
(1) (2) (3)

		PHY	CS(PHY)
A.	(1) only	(30%)	(42%)
B.	(3) only	(14%)	(14%)
C.	(1) and (2) only	(15%)	(18%)
* D.	(2) and (3) only	(41%)	(26%)

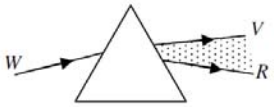
Almost 60% of candidates had difficulty with this question which suggests that a majority were not familiar with the reflection of wave pulses at a fixed end.

17. Which diagrams below correctly show the spectra formed from white light by a glass prism and a diffraction grating respectively ? It is known that red light travels faster than violet light in glass.
(*R* = red, *V* = violet, *W* = white)

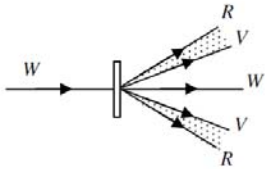
(1)



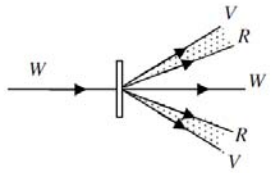
(2)



(3)



(4)



選項	全體	低分組	高分組	PHY	CS(PHY)
* A. (1) and (3) only	44.7	31.9	68.6	(45%)	(37%)
B. (1) and (4) only	27.6	31.7	16.7	(28%)	(31%)
C. (2) and (3) only	18.3	21.1	12.6	(18%)	(19%)
D. (2) and (4) only	9.3	15.1	2.1	(9%)	(13%)
其他	.1	.2	.0		

難度 0.55，適中。區分度 0.37，良好。

Less than half were able to identify the two correct spectra formed from white light in the diagrams.

選項	全體	低分組	高分組
A.	**38.9**	**28.2**	**53.1**
B.	30.1	36.1	23.7
C.	18.1	20.3	15.0
D.	12.4	14.9	8.0
其他	.5	.5	.2

難度 0.61，偏難。區分度 0.25，尚可。

20. Which of the following gives the order of magnitude of the wavelengths of ultra-violet radiation and microwave in a vacuum ?

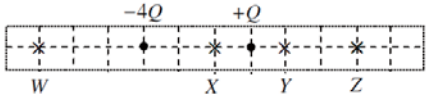
	ultra-violet radiation	microwave	PHY	CS(PHY)
* A.	10^{-8} m	10^{-2} m	(39%)	(31%)
B.	10^{-8} m	10^{-5} m	(30%)	(33%)
C.	10^{-10} m	10^{-2} m	(18%)	(20%)
D.	10^{-10} m	10^{-5} m	(13%)	(16%)

Over 40% of the candidates choose an incorrect answer with an order of magnitude of the wavelength of microwave at 10^{-5} m.

選項	全體	低分組	高分組
A.	7.8	15.3	1.7
B.	28.8	26.4	27.2
C.	30.1	36.8	14.3
D.	**33.2**	**21.4**	**56.8**
其他	.1	.1	.0

難度 0.67，偏難。區分度 0.35，良好。

22.



Two point charges $-4Q$ and $+Q$ are fixed as shown. At which point indicated in the figure is the resultant electric field due to these two charges zero ?

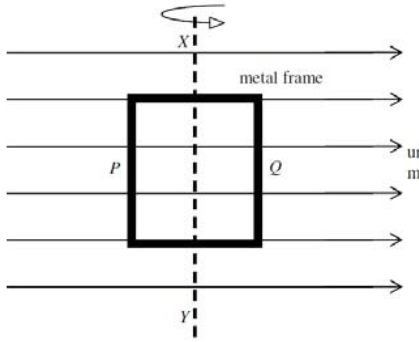
		PHY	CS(PHY)
A.	*W*	(8%)	(13%)
B.	*X*	(29%)	(31%)
C.	*Y*	(30%)	(26%)
* D.	*Z*	(33%)	(20%)

About 30% of the candidates choose '*Y*' which suggests they forgot to take into account the inverse square relationship between the electric field and the distance from the charge.

選項	全體	低分組	高分組
A.	17.0	20.8	10.5
B.	**44.4**	**21.7**	**74.7**
C.	25.5	34.9	10.3
D.	12.8	22.2	4.3
其他	.2	.3	.1

難度 0.56，適中。區分度 0.53，很好。

24.



A rectangular metal frame is made to rotate steadily about its axis *XY* in a uniform magnetic field. At the instant shown, the frame is in the plane of the paper and side *P* is moving out of the paper while side *Q* is moving into the paper. Which statement is **INCORRECT at this instant** ?

		PHY	CS(PHY)
A.	The induced e.m.f. in the frame is at a maximum.	(17%)	(13%)
* B.	The induced current produced in the frame is flowing in anti-clockwise direction.	(44%)	(31%)
C.	The magnetic force acting on side *P* is in a direction pointing into the paper.	(26%)	(26%)
D.	The magnetic forces acting on the frame produce a moment opposing the frame's rotation.	(13%)	(20%)

About 40% of the candidates may not have understood that the magnetic force as well as the resulting moment are opposing the frame's rotation.

Observations

- Most candidates were competent in handling calculations (e.g. Paper 1B Q.2 & 10). However, it seems that their grasp of fundamental physics concepts was not strong.
- Quite weak or careless in handling/converting units or scientific notations.
- Omitting subtle precautions / procedures of experiments even though they are simple but unfamiliar.
- Weaker candidates (Levels 1 & 2) tend to give up answering some of the questions. They also performed poorly in Paper 2.

Points to note

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

Points to note

- Equating Electives using Paper 1
  (Total = 40 (MC) + 40 (Qu.) = 80 each elective)
  Before equating: Mean 29 to 37 / SD 15 to 19
  After equating: Mean 37 to 41 / SD 15 to 16

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

Points to note

- From 2014 Exam onwards:
  PHY no. of MC = 33
  CS(PHY) no. of MC = 22

* *Syllabuses trimmed* with effect in *2016 Exam*

- Student samples of performance (Levels 1 to 5) available in October (HKEAA website).
- SBA Conference on 21 Nov 2015
- SBA Online Submission in Jan/Feb 2016
- All SBA tasks adopt 0 – 20 mark range.

2015 DSE Physics
1B1- Q.1,4,5,6

Mr. WONG KW
Mr. TAM YW

Q.1

- (a) (i) Well performed.
  (ii) unsatisfactory.
  (b) unsatisfactory.
    - Reasoning is not clearly shown.
    - confusion between experimental value and actual value.

$$\frac{140.51-102}{100-0}=\frac{R-102}{60-0}$$
$$R=38.51\times\frac{60}{100}+102$$
$$=125.1\ \Omega$$

(ii) 如果電阻溫度計的電阻現為 (a)(i) 部計算所得的值，那麼實際溫度是大於、小於還是等於 60°C？ (1 分)

是大於60°C

(b) 在一個測量水的比熱容 c_w 的實驗中，<u>表明</u>用該已校準的電阻溫度計量度水從 0°C 加熱至 60°C 的溫度。當該溫度計的電阻達到 (a)(i) 部所求得的值時便停止加熱。假設跟周圍環境的熱交換可忽略，而所量度的能量供應和水的質量亦沒有誤差，解釋所得的 c_w 實驗值比實際數值是較大、較小還是相同？ (2 分)

c_w實驗值比實際數值大，因為當溫度加熱至60°C時未到未溫度，水中的能量未均勻，所以溫度會繼續上升因此 c_w 比實際數值大。

As the measured temperature difference is smaller than that of the actual value, by energy = mcΔT, i.e. $c=\frac{E}{m\Delta T}$, the experimental value of c_w is higher than the actual value.

The experimental value of c_w found is lower than the actual value.

$C=\frac{Q}{m\Delta T}$ experimental: $C=\frac{Q}{m(60)}$ actual: $C=\frac{Q}{m(\Delta T<60)}$

experimental C < actual C

Q.4

- (a) Satisfactory.

  Description is not precise enough.

- moving forwards / moving forwards with acceleration / moving forwards with uniform acceleration(√).
- Moving with – 0.5 m s^-2 (×)

When t = 0.5s – 1.5 s, the block is moving in its original direction with decreasing velocity and stops at t = 1.5 s momentarily. When t = 1.5 s – 3.5 s, the block is moving in the opposite direction with increasing velocity. √

(a) 描述方塊從 *A* 至 *B* 的運動： (2分)

在A時，方塊向上移動但速率不斷下降，直至 t=1.5s 時瞬時靜止，然後開始向下滑，速率逐漸增加 √

(a) Describe the block's motion from *A* to *B*. (2 marks)

From t = 0.5 s to t = 1.5 s, the block moves upwards with uniform deceleration. For t = 1.5 s, the block reaches the highest point and is momentarily at rest. From t = 1.5 s to t = 3.5 s, the block moves down to the inclined plane with uniform acceleration. √

Q.4

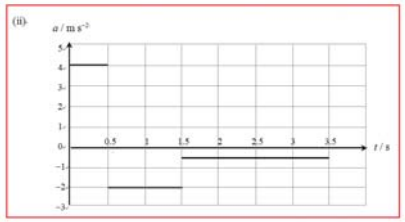
(b) (i) magnitude only.

$a = \frac{v}{t}$

$= \frac{-1}{3.5-1.5}$

$= -0.5\ m\ s^{-2}$ √

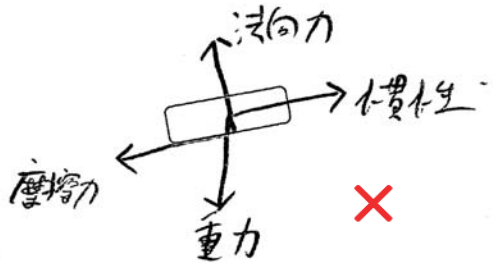
(ii) Well performed!

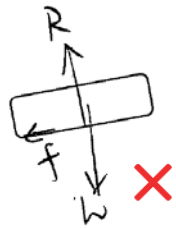


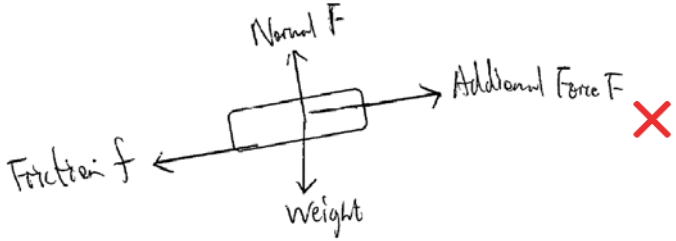
(c) Common mistakes:

direction of friction!

excess forces shown(inertia, upward force)







Q.4

- (d) Difficult question. Unsatisfactory.

  Concepts involved:

  F = ma

  resolution of *mg*

  direction of friction changes

$F - f_r = ma$

$f_r = 9.31\ N$ ×

$F = ma$

$F = (1)(0.5)$

$F = 0.5N$ ×

$T - f = ma$

For $t = 0s$ to $t = 1.5s$, $f + mg\sin\theta = ma$

$f + 9.8\sin\theta = 1(2)$ — ①

For $t = 1.5s$ to $t = 3.5s$, $mg\sin\theta - f = ma$

$9.8\sin\theta - f = 1(0.5)$ — ②

① − ②: $2f = 1.5$

$f = 0.75N$. √

Q.5

- Performance is satisfactory .
- Refer to the question: diagram/ equation / description are required, so marks are given to diagram / equation / description.
- Common mistakes:

  incorrect setup /

  using the diagram properly

Tie one end of the string to the metal ball and the other end through the centre/hole of the protractor.

When the train is at rest, held fixed the **protractor in the plane along the direction of motion** such that the string is on, say, the 90° mark.

When the train is accelerating with acceleration a, the string will make an angle, say θ, with the vertical. Measure the angle θ.

Let T be the tension of the string.

Vertically : $T\cos\theta = mg$ .....(1)

Horizontally : $T\sin\theta = ma$ .....(2)

where m is the mass of the ball.

(2) / (1):

$$\tan\theta = \frac{a}{g}$$

$$a = g\tan\theta$$

Q.6

- (a) (b) (i) Satisfactory!
- Part (c) Poor performance.

(a) - high temperature gradient; or
- long path lengths for light rays.

(b) (i) $n_1 \sin\theta_1 = n_2 \sin\theta_2 = n_3 \sin\theta_3 = n_4 \sin\theta_4$

$\sin\theta_1 = \frac{n_4}{n_1}\sin\theta_4$

$\theta_1 = \sin^{-1}\left(\frac{1.000221}{1.000261}\right)$

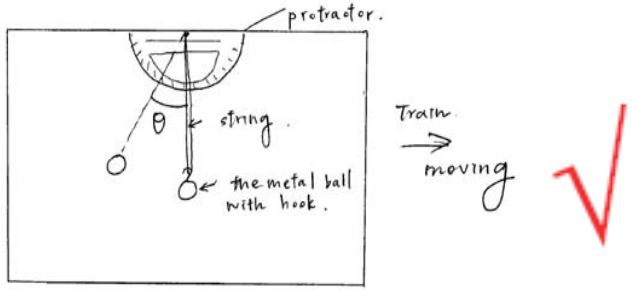
$= 89.5°$ (or 89.488°)

Common mistakes:

- (b) (ii) confusion between α and θ
- (c) explanation is not clear! Cannot relate the reasoning behind (b) (ii) and (c).

繩的一端繫上量角器的孔，另一端繫上金屬球的小鈎，然後把繩子垂直放開，使繩子在量角器上，然後紀錄火車移動時，繩子的擺動情況 √

Finally, measure the angle that the string marked on the metal ball when the track acuelerating, then jot down the angle for calculation (no diagram) √



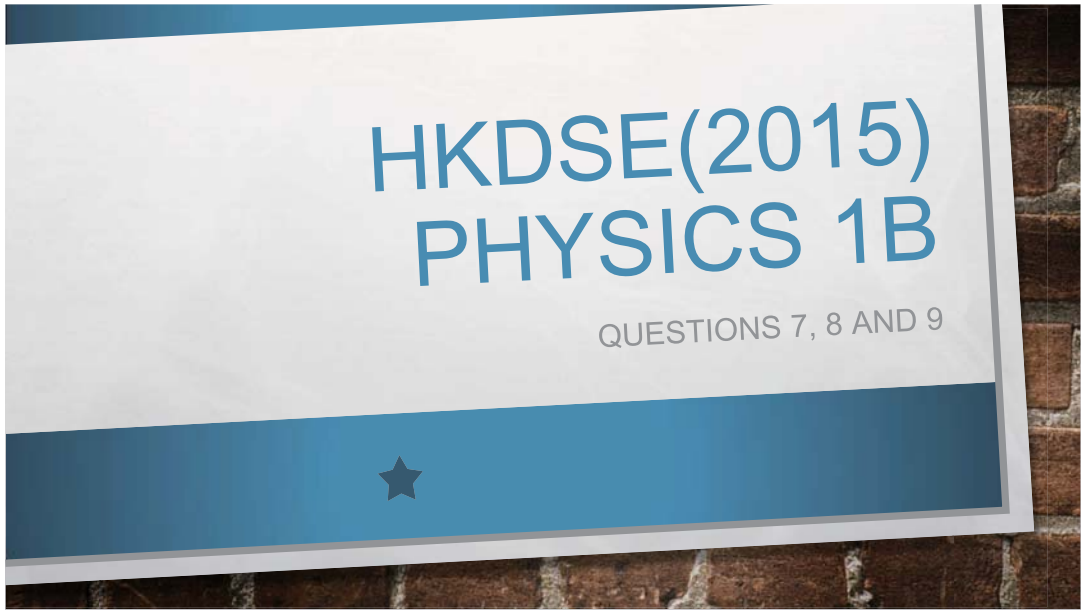
√

$\tan\theta_1 = \frac{h}{L}$ ×

$\tan 89.5° = \frac{1.5}{L}$

$L = 0.0131\ m$ //

The distance will still be L. This is because a mirage is still occured in the same way when he moves horizontally. 1 √



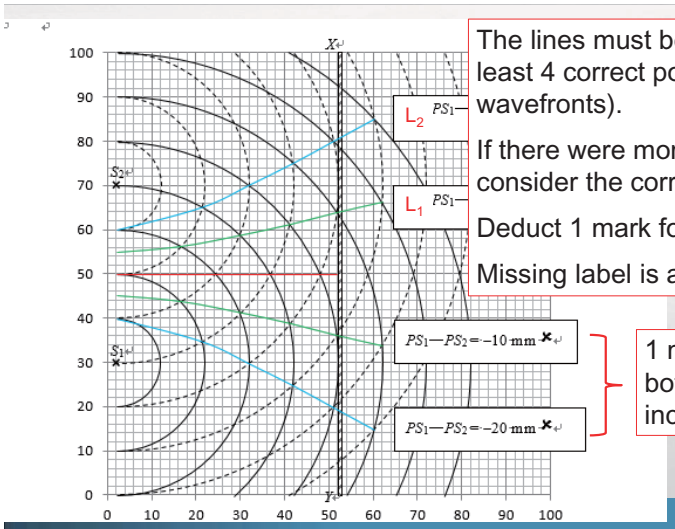
Solution	Marks
7. (a) $\Delta y = \frac{\lambda D}{a} = \frac{(650\times10^{-9})\times3.0}{0.325\times10^{-3}}$	1M
$\rightarrow$ $= 0.006\ \text{m}$ or $6\ \text{mm}$	1A
	2
(b) The screen is uniformly illuminated. (The interference patterns exist very briefly and change rapidly such that, to human eyes, they are averaged out).	1A
The light from the LEDs is incoherent (i.e. no fixed phase relationship between the light coming out from the two LEDs).	1A
	2
(c) path difference $PS_1 - PS_2 = 10\ \text{mm}$, L_1 correct.	1A
path difference $PS_1 - PS_2 = 20\ \text{mm}$, L_2 correct.	1A
Constructive interference (occurs at P)	1A
	3

1M for quoting formula

(a) Well answered. Some candidates made mistakes in converting units.

(b) Only a few candidates realized that interference did occur but was unobservable as the sources were incoherent.

(c) Many candidates wrongly sketched straight lines instead of curves for the antinodal lines.



The lines must be drawn to pass through at least 4 correct points (intersection of wavefronts).

If there were more than two lines drawn, only consider the correct one/two.

Deduct 1 mark for wrong labelling.

Missing label is accepted.

1 mark would be awarded if both lines were drawn incorrectly in this case.

(d)	(i)	$\Delta y = y_2 - y_1 = 31\ \text{mm} - 14\ \text{mm} = 17\ \text{mm} \pm 2.0\ \text{mm}$	1A
			1
	(ii)	Screen has to be far away from slits,	
		i.e. to satisfy $D >> a$ or $D >> y$, i.e. consider y to be close to the central maximum / makes use of the small angle approximation $\theta \approx \sin\theta \approx \tan\theta$	1A 1A
		Or screen is too close to slits, $D >> a$ or $D >> y$ not satisfied / small angle approximation $\theta \approx \sin\theta \approx \tan\theta$ cannot be applied.	
			2

(d)(i) Many candidates incorrectly read the value of Δy, they might overlook the scale given in Figure 7.3.

(d)(ii) Poorly answered. Most candidates did not know the geometrical constraints in estimating fringe separation.

Solution	Marks
8. (a) (i) $\rho = \frac{RA}{l}$	
$\frac{R}{l} = \frac{\rho}{A} = \frac{2.6\times10^{-8}}{1.3\times10^{-5}}$	1M
$\rightarrow$ $= 2.0\times10^{-3}\ \Omega\,\text{m}^{-1}$	
$\rightarrow$ $= 2.0\ \Omega\,\text{km}^{-1}$ or $2.0\ \Omega$	1A
	2
(ii) The strands of transmission lines are in parallel / The cross-sectional area of cable is larger than that of each single transmission line / Resistance is inversely proportional to the cross-sectional area of the wire	1A
$R_{\text{cable}} = \frac{R}{40} = 0.05\ \Omega\,\text{km}^{-1}$ or $0.05\ \Omega$	1M
$\left(\frac{1}{R_{\text{cable}}} = \frac{1}{R} + \frac{1}{R} + \ldots + \frac{1}{R} \rightarrow \frac{1}{R_{\text{cable}}} = \frac{40}{R}\right)$	1M
	2

It is not accepted as a final answer, 1M only.

1M

(a)(i) A significant number of candidates misunderstood the phrase 'per km' and therefore wrongly divided the resistance by 1000 m.

(a)(ii) Some candidates confused surface area with cross-sectional area.

(iii) A bird is in parallel with a short segment of an overhead cable. The potential difference across its feet is very small (very small resistance per km). 1A

OR

The resistance of the bird's body is much larger than that of a short segment of the overhead cable.

Hence, negligible current flows through the bird's body. 1A

2

(b) (i) $I = \frac{P}{V} = \frac{180\times10^6}{400\times10^3}$ 1M for substitution

$= 450\ \text{A}$ 1A

2

(ii) Percentage of power loss $= \frac{P_{loss}}{P_{total}} \times 100\%$ 1M

$= \frac{450^2\times0.05\times10}{180\times10^6} \times 100\%$

$= 0.05625\% < 0.1\%$ 1A

(a)(iii) Many candidates did not realise that electric shock is essentially due to the large amount of current passing through the body but not merely because of high voltage.

(b)(i) Well answered.

(b)(ii) A few candidates forgot to multiply the resistance per km (0.05 Ω km^{-1}) by 10 km.

(iii) (I) $N_p : N_s = V_p : V_s$

$12 : 1 = 400 : V_s$

$\rightarrow V_s = 33.3\ \text{kV}$ 1A

1

(II) Any **ONE** of the followings: 1A+1A

Resistance of coils + use thicker wire for the coils /

Magnetisation and demagnetisation of core + use soft iron core /

Induced eddy currents in core + laminated core /

Flux leakage + core design

2

The measure for improvement must be corresponding to the factor, otherwise the 2nd 1A mark would be withheld.

(b)(iii)(I) Well answered.

(b)(iii)(II) The terms stated by some candidates were not precise, for example, 'cable' was used instead of 'wire', 'sliced iron' was used instead of 'laminated core' etc.

Solution			Marks
9.	(a)	Right (current flowing down, B-field into paper)	1A
		When the rod reaches the highest point it falls. Then its lower end touches the conducting liquid again and the same magnetic force makes it 'kick' out from the liquid. The process is repeated, so the rod continually 'kicks' out and then returns.	1A 1A
			3
	(b) (i)	As moment $= F d$	1M
		$7.2\times10^{-4} = F(0.09)$	
		$F = \frac{7.2\times10^{-4}}{0.09} = 8.0\times10^{-3}\ \text{N}$	1A
			2
	(ii)	$F = BIl$	1M
		$8.0\times10^{-3}\ \text{N} = B(3.2\ \text{A})(0.06\ \text{m})$	
		$B = 0.042\ \text{T}$	1A
			2

(a) Some candidates tried to explain the direction of the electromagnetic force acting on the rod rather than to describe its subsequent motion.

(b)(i) Most were able to apply the definition of moment (F x d) to solve this problem but many of them failed to identify the correct value of d and ended up with an incorrect numerical answer.

(b)(ii) Incorrect equation

e.g. $B = \frac{\mu_o \ell}{2\pi r}$

or unit was quoted.

(c) (i) Correct sketch. 1A

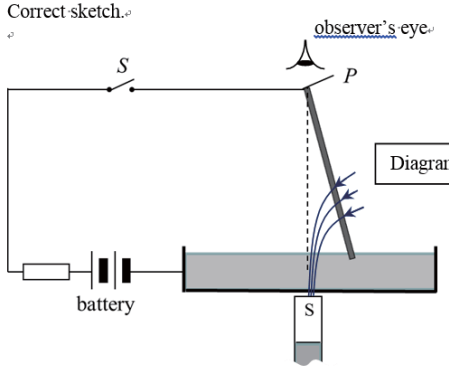


Diagram **NOT** drawn to scale

(ii) The wire will rotate anti-clockwise (as viewed from above). 1A

1

(c)(i) Some candidates treated the rod as a bar magnet and sketched the field pattern wrongly.
Common errors included incorrect direction of field lines, none of the field lines crossed the rod or uniform field patterns.

(c)(ii) Not many were able to state that the rod performs circular motion in an anti-clockwise direction.

Q7(a)

1

$\Delta y = \frac{\lambda D}{a}$

$\Delta y = \frac{(650\times10^{-9})(3)}{0.325}$

$\Delta y = 6\times10^{-6}$ m.

2

$\Delta Y_{2-1} = \frac{\lambda D}{d}$

$= \frac{650\times10^{-9}\times3}{0.325\times10^{-3}}$

$= 6\times10^{-3}$ //

3

$\Delta y = \frac{\lambda D}{a}$

$\Delta y = \frac{650^{nm}(3)}{0.000325}$

$= 6000000$ m

$= 600\times10^{13}$ m

4

By $\Delta y = \frac{\lambda D}{a}$,

Δy = separation between adjacent first - and second - order bright fringes

$= \frac{650\times10^{-9}\times3}{0.325\div1000}$

$= 6\times10^{-3}$ m. //

Q7(b)

$\Delta y = \frac{650(3)}{6.0006}$ 3

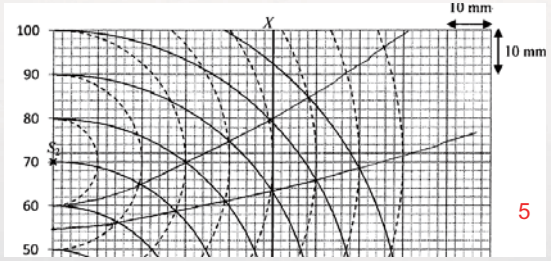
$= 325\times10^{13}$ m 4

There is a separate bright fringe of 325×10^{4} on the screen.

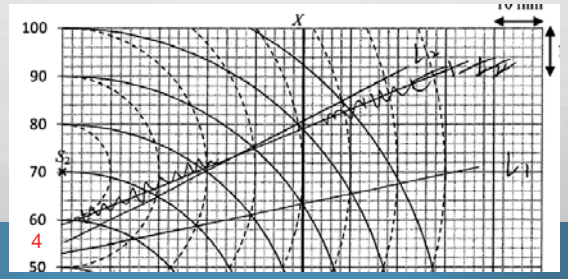
看見一個光圈，兩個LEDs的光會聚焦在同一點上。 4

Alternating bright and dark fringes are appeared on the screen. As the two are the coherent source, their path difference is changing on the positions of the screen. The bright fringes are the place where the constructive interference occurs and the dark fringes are the place where the destructive interference occurs. 5

Q7(c)



5



4

Q7(d)(ii)

因為節線間並非平行

∴ $\tan\theta = \theta$ 的假設並不成立

∴公式的計算有誤差。 5

As in fact, the formula: $\Delta y = \frac{\lambda D}{a}$ is just an estimation, since the fringe separation is in fact not a constant for two adjacent fringes. 5

Q8(a)(i)

$R = \frac{\rho l}{A}$ 5

$\frac{R}{l} = \frac{2.6 \times 10^{-8} \times 10^{-3}}{1.3 \times 10^{-5} \times 10^{-6}}$

$= 2\ \Omega$ per km.

$\frac{R}{l \times 1000} = \rho \frac{1}{A} \times \frac{1}{1000}$ 4

$= \frac{2.6 \times 10^{-8}}{1000} \times \frac{1}{1.3 \times 10^{-5}}$

$= 2 \times 10^{-6}\ \Omega\ km^{-1}$ //

Q8(a)(ii)

By $\frac{R}{l} = \frac{\rho}{A}$, the resistivity is constant. So, an overhead cable which has larger cross-sectional area leads to a smaller resistance per km.

$\frac{R}{l} = \frac{2}{40}$ 5

$= 0.05\ \Omega\ km^{-1}$

Since the cable consists of 40 strands of transmission line which are connected in parallel.

Resistance per km of an overhead cable

$= \left(\frac{1}{2 \times 10^{-1}} \times 40\right)^{-1} = 5 \times 10^{-8}\ \Omega\ km^{-1}$ 4 //

Q8(a)(iii)

By power $= I^2R$, the resistance is too small, so the power is small too. Thus, the bird will not easily get an electric shock. 5

Since their feet are so thin that the current flowing through is negligible. // 4

∵鳥兒雙腳間的電勢差接近0V 5,

因為鳥兒雙腳是絕緣體, 所以不會受到電擊 2

Q8(b)(iii)(II)

The resistance of the cable 3
To use a less resistance cable.

The resistance in the cable may lead to energy loss. It can be improved by using the cable which has a larger cross-sectional area. 2

變壓器能量損耗是因為部分的能量轉成為熱, 而改善方法是升壓壓, 令電流更小, 根據 $P = I^2R$, 因此功率損耗可大大降低。 2

Q9(a)

To the right. When the rod kicks, the circuit is incomplete, there is no current flowing through the rod, the rod returns to its original position, then the circuit is complete, the rod kicks again. The whole process repeats continuously. 4

Into the paper. When S is closed, electricity flow through the wire and direct to the rod, because the rod is inside the magnetic field, it will kick into the paper and downward to the liquid. 1

Q9(b)(i)&(ii)

$F = BIL$

$= (7.2 \times 10^{-4})(6)$

$= 4.32 \times 10^{-3}$ N

$B = \frac{\mu_0 I}{2\pi r}$

$= 2.13 \times 10^{-7}$ 3

$7.2 \times 10^{-4} = 9 \times 10^{-3} (F_b)$

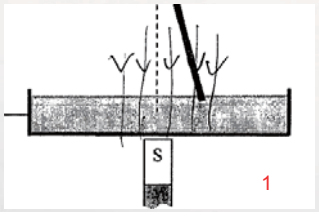
$F_b = 0.08$ N

$F_b = BIL$ 5

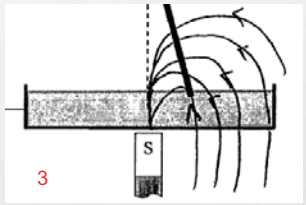
$0.08 = 3.2(B)(18)$

$B = 1.39 \times 10^{-3}$ T

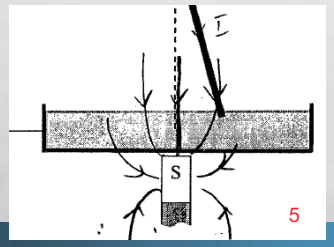
Q9(c)(i)



1

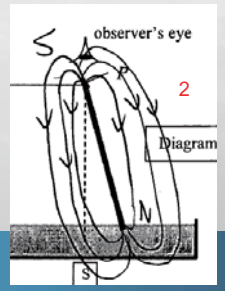


3



5

3



2

2015 DSE PHYSICS/ COMBINED SCIENCE (PHYSICS)

1B-3: Q.2, 3 & 10

Mr. Y.H. MUI

Mr. W.C. NG

QUESTION 2

Marking Scheme	Performance/Common Errors
(a) 210 atm × (1.0 × 10^4 cm^3) = 2.0 atm × V V = 1.05 × 10^6 cm^3 [1M] Volume available = 1.05 × 10^6 – 1.0 × 10^4 = 1.04 × 10^6 (cm^3) [1A] (b)(i) V_0 = 1.04 × 10^6 cm^3 ÷ 60 = 17333 ≈ 17300 (cm^3) (per minute) [1A/1M]	- Accept ans. without considering residual volume, i.e. 1.05 × 10^6 (cm^3) - If using $pV = nRT$, SI units must be used. - Applied the equation $pV = nRT$ without first converting the data into S.I. units, Accept ans. from (a) ÷ 60 for 1M V_0 = 17500 (cm^3) if residual volume not considered.

QUESTION 2

Marking Scheme	Performance/Common Errors
(ii) V' : total volume of air at this depth/in this situation $\frac{P_1V_1}{T_1} = \frac{P_2V'}{T_2}$ $\frac{210\times(1.0\times10^4)}{273+24} = \frac{4.5\times V'}{273+20}$ V' = 4.60 × 10^5 cm^3 [1M] Volume available = 4.60 × 10^5 - 1.0 × 10^4 = 4.50 × 10^5 (cm^3) Length of time : = $\frac{4.50\times10^5}{17333}$ [1M] = 26.0 (min.) [1A]	- Accept method/ans. without considering residual volume, i.e. V' = 4.60 × 10^5 cm^3 Length of time = 26.3 min - Did not change the temperature from Celsius scale to Kelvin scale.

QUESTION 2 (SAMPLE 1)

*2. 潛水員所用的水肺（裝有壓縮空氣的圓柱瓶）的容積為 1.0 × 10^4 cm^3，而當水肺注滿時其所載空氣的壓強於 24 °C 時為 210 atm（大氣壓強）。水肺內的空氣通過一減壓閥膨脹至其壓強等於周圍的水壓才供應予潛水員。設水肺內的空氣溫度恆等於周圍的水溫。

(a) 一潛水員於溫度 24 °C 和壓強 2.0 atm 的 10 m 水深處逗留。求於這水壓下水肺可供予潛水員的空氣總體積（單位：cm^3）。 (2 分)

$P_1V_1 = P_2V_2$

$(210)(1.0\times10^4) = (2)V_2$ ✓

$V_2 = 1.05\times10^6$ cm^3 ✓

1M

1A

QUESTION 2 (SAMPLE 2)

(b) 在 (a) 部求得的空氣供應量足夠讓潛水員在該水深逗留 1 小時。

(i) 假設潛水員吸氣時每分鐘都吸入相同體積 V_0（單位：cm^3）的空氣，求 V_0。 (1 分)

$V_0 = \frac{1.05\times10^6}{60}$

$= 1.75\times10^4$ cm^3 ✓ 1M

(ii) 如果潛水員潛至溫度 20 °C 和壓強 4.5 atm 的較深水處，估算一個注滿了的水肺所載的空氣可維持多久（以分鐘表示）。設潛水員每分鐘吸入的**空氣體積**跟 (b)(i) 部求得的**相同**。 (3 分)

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$\frac{(210)(1.0\times10^4)}{24+273} = \frac{(4.5)V_2}{20+273}$ ✓ 1M

$V_2 = 4.60\times10^5$ cm^3 1M

可維持時間 $= \frac{4.60\times10^5}{1.75\times10^4}$ ✓

$= 26.3$ 分鐘 1A

QUESTION 2 (SAMPLE 3)

*2. The aqua-lung (a cylinder containing compressed air) for divers has a capacity of 1.0×10^4 cm^3. When the aqua-lung is filled, the air inside has a pressure of 210 atm (atmospheric pressure) at 24 °C. The air in the aqua-lung is allowed to expand through a pressure-reducing valve until its pressure equals that of the surrounding water before it is supplied to divers. Assume that the temperature of the air inside the aqua-lung is always equal to that of the surrounding water.

(a) A diver stays in water of temperature 24 °C and pressure 2.0 atm at a depth of 10 m. Find the total volume of air (in cm^3) available for the diver from the aqua-lung at this water pressure. (2 marks)

$\frac{PV}{T} = \frac{PV}{T}$

$\frac{210(1\times10^4)}{24} = \frac{2(V)}{24}$ ✗

$V = \frac{210(1\times10^4)}{2}$

$= 105 \times 10^4$ cm^3 // ✓

∴ The total volum of air available for the diver = 105×10^4 cm^3

0M

1A

QUESTION 2 (SAMPLE 4)

(b) The supply of air in (a) is sufficient for the diver to remain at such a depth for 1 hour.

(i) If the diver breathed in the same volume V_0 (in cm^3) of air per minute, find V_0. (1 mark)

$V_0 = 105\times10^4 / f_0$

$= 1.75 \times 10^4$ cm^3 // ✓

1A

(ii) If the diver dives deeper where the water is of temperature 20 °C and pressure 4.5 atm, estimate how long (in minutes) the air in a fully-filled aqua-lung would last. Assume that the diver breathes in the **same volume of air** per minute as that found in (b)(i). (3 marks)

0 M

$\frac{P_2V_2}{T_2} = \frac{P_0V_0}{T_0}$

$\frac{210(1\times10^4)}{24} = \frac{4.5(V_2)}{20}$ ✗

$V_2 = 38.8889 \times 10^4$ cm^3 (correct to 6 sig. fig.) ✗

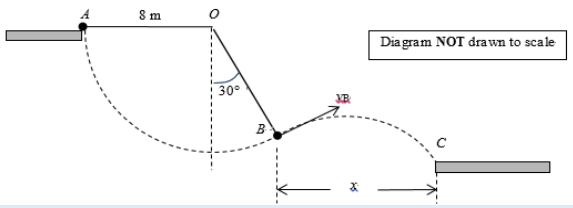
$\frac{V_2}{V_0} = \frac{38.8889\times10^4}{1.75\times10^4}$ ✓ $= 222222$ (correct to 6 sig. fig.)

1 M

0 A

∴ The air in a fully-filled aqua-lung would last for 222222 minutes (correct to 6 sig. fig.) ✗

QUESTION 3

Marking Scheme	Performance/Common Errors
(a)(i)  [1A]	- v_B correctly drawn with label (roughly ⊥ OB).
$\frac{1}{2}mv^2 = mgh$ $v_B^2 = 2gh = 2 \times 9.81 \times (8 \cos30°)$ [1M] $v_B = 11.7$ m s^{-1} (11.65) (or 11.77 for $g = 10$ m s^{-2}) [1A]	- Accept equation with incorrect h such as 8 m / 8 sin30°/ 8 ÷ cos30° - Solve the problem by using an equation of motion instead of conservation of energy to find v_B.

QUESTION 3

Marking Scheme	Performance/Common Errors
(b)(i) $x = v_x t$ $= 11.7 \cos30° \times 1.25$ [$v_x = v_B \cos30°$] [1M] $= 12.6$ m (12.74283) (or 12.7 to 12.8 m for $g = 10$ m s^{-2}) [1A]	- 1M for using $v_x = v_B \cos30°$
(ii) $y = ut - \frac{1}{2}gt^2$ $u = v_y = v_B \sin30° = 5.83$ m s^{-1} [1M] $y = v_y(1.25) - \frac{1}{2}(9.81)(1.25)^2$ $y = -0.38$ m (−0.414 to −0.352 m) [1M] (or −0.455 to −0.4375 m for $g = 10$ m s^{-2}) Platform C is 0.38 m below B. [1A] (c) Total mechanical energy is the same / unchanged. [1A]	- 1M for able to resolve v_B into $v_B \sin30°$ - Accept $ut \pm \frac{1}{2}gt^2$ - Most candidates were able to apply correct equations to find the answers to (b)(i)(ii) although a few got v_x, v_y and v_B mixed up. - Accept "No", "No change", "No energy lost", "PE → KE".

QUESTION 3 (SAMPLE 1)

3.

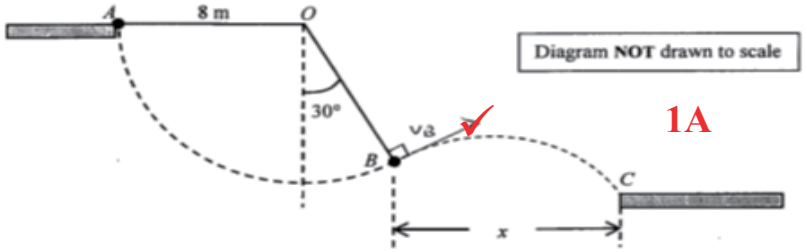


Figure 3.1

1A

Figure 3.1 shows two horizontal platforms with end points A and C. An acrobat tries to swing from A to C by using a light rope of 8 m long and with one end fixed at point O, which is at the same level as A. He leaves A by holding the end of the rope and then releases it when reaching point B at which the angle between the rope and the vertical is 30°. The acrobat can be treated as a point mass and the rope remains taut and not extended throughout the motion. Neglect air resistance. ($g = 9.81\ m\ s^{-2}$)

(a) Mark on Figure 3.1 the velocity v_B of the acrobat at B. If the speed of the acrobat when leaving A is zero, find the magnitude of v_B. (3 marks)

Loss in GPE = Gain in KE ✓ 1M

$m(9.81)(8\cos 30°) = \frac{1}{2}mv_B^2$ ✓ 1A

$v_B = 11.7\ m\ s^{-1}$

QUESTION 3 (SAMPLE 2)

*(b)(i) It takes 1.25 s for the acrobat to reach C after releasing the rope at B. By considering his horizontal motion, find the horizontal separation x between B and C. (2 marks)

$S = ut$

$x = v_B \cos 30° (1.25)$ ✓

$x = 12.6\ m$ ✓

1M

1A

QUESTION 3 (SAMPLE 3)

(ii) Calculate the vertical distance of C below B. (3 marks)

$u = v_B \sin 30°$, $t = 1.25$, $a = -9.81$

$S = ut + \frac{1}{2}at^2$

$S = v_B \sin 30°(1.25) + \frac{1}{2}(-9.81)(1.25)^2$ ✓ 1M

$S = -0.377\ m$ ✓ 1M

∴ The vertical distance is 0.377 m.

✓ 1A

(c) Before reaching the lower platform, is there any change to the acrobat's mechanical energy among the points A, B and C? (1 mark)

No. ✓ 1A

QUESTION 3 (SAMPLE 4)

3.

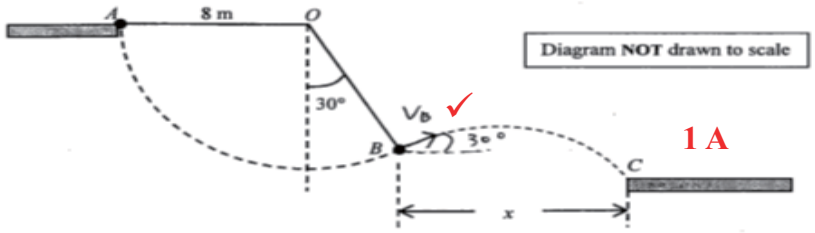


Figure 3.1

1 A

Figure 3.1 shows two horizontal platforms with end points A and C. An acrobat tries to swing from A to C by using a light rope of 8 m long and with one end fixed at point O, which is at the same level as A. He leaves A by holding the end of the rope and then releases it when reaching point B at which the angle between the rope and the vertical is 30°. The acrobat can be treated as a point mass and the rope remains taut and not extended throughout the motion. Neglect air resistance. ($g = 9.81\ m\ s^{-2}$)

(a) Mark on Figure 3.1 the velocity v_B of the acrobat at B. If the speed of the acrobat when leaving A is zero, find the magnitude of v_B. (3 marks)

Considering the vertical direction, By $v^2 = u^2 + 2as$ →

Take downward as negative

$(v_B \sin 30°)^2 = 0 + 2(-9.81)(-8\cos 30°)$ ✗ 0M

$v_B = 23.3\ m\ s^{-1}$ ✗ // 0A

∴ Magnitude of v_B is $23.3\ m\ s^{-1}$ //

QUESTION 3 (SAMPLE 5)

*(b)(i) It takes 1.25 s for the acrobat to reach *C* after releasing the rope at *B*. By considering his horizontal motion, find the horizontal separation *x* between *B* and *C*. (2 marks)

The x-component of v_B = $23.3 \cos 30°$ = a constant.

By $s = vt$,

$s = 23.3 \cos 30° \times 1.25$

$s = 25.2$ m //

∴ The horizontal separation x between B and C is 25.2 m. //

1M

0A

QUESTION 3 (SAMPLE 6)

(ii) Calculate the vertical distance of *C* below *B*. (3 marks)

Considering the vertical direction, by $s = ut + \frac{1}{2}at^2$,

$s = 1.25 \times v_B \sin 30° + \frac{1}{2}(-9.81)(1.25)^2$

$s = 1.25 \times 23.3 \sin 30° - \frac{1}{2}(9.81)(1.25)^2 = 6.90$ m

1M

∴ Vertical displacement of the person from B to C = 6.90 m.

1M

∴ Vertical distance of C below B is 6.90 m. //

0A

(c) Before reaching the lower platform, is there any change to the acrobat's mechanical energy among the points *A*, *B* and *C*? (1 mark)

Take C as the reference point,

Yes, from A to B, his/her potential energy partly changes to kinetic energy; from B to C, his/her potential energy all changes to kinetic energy.

1A

QUESTION 10

Marking Scheme	Performance/Common Errors
(a) Mass deficit = (2.014102 + 3.016049) u – (4.002602 + 1.008665) u [1M] = 0.018884 u Energy released = 0.018884 × 931 MeV = 17.58 (MeV) [1A] [Or Energy released = $0.018884 \times 1.661 \times 10^{-27} \times c^2$ = 2.823×10^{-12} J or 17.64 MeV]	- Candidates only did well in (a) - A few candidates had difficulty in dealing with the units eV and J
(b)(i) To overcome the (electrostatic) repulsion [1A] between the two (positive) nuclei and becomes electrical potential energy (of the two nuclei). [1A]	-Did not know that the energy used for overcoming the repulsion between the two positive nuclei became electrical potential energy. -Some wrongly thought that it turned into kinetic energy, heat or nuclear energy.

QUESTION 10

Marking Scheme	Performance/Common Errors
(b)(ii) High temperature enables them to have sufficient K.E. (to overcome electrical repulsion between their nuclei) [1A]	- Accept "high" KE/speed. Only "KE" **NOT** <u>accepted.</u>
(iii) Kinetic energy becomes electrical P.E.	-Accept without "×2"
$E_p = 2 \times \frac{1}{2} m (c_{rms})^2 = 2 \times \frac{3RT}{2N_A}$	0.4 MeV = 6.4×10^{-14} J
0.4 MeV = $2 \times \left(\frac{3 \times 8.31 \times T}{2 \times 6.02 \times 10^{23}}\right)$ [1M]	- Most candidates failed to relate the average kinetic energy of the nuclei to the large amount of work done needed. A few even wrongly employed E = 17.58 MeV in (a) in their calculations.
$T = 1.545 \times 10^9$ K i.e. order of magnitude 10^9 (K) [1A]	

QUESTION 10

Marking Scheme	Performance/Common Errors
(b)(iii) Alternative method: $\frac{1}{4\pi\varepsilon_0}\frac{e^2}{10^{-15}} = 2\times\frac{3RT}{2N_A}$ [1M] $T = 5.56\times10^9$ K i.e. order of magnitude 10^9 (K) [1A]	- correct equation with 10^{-15} - accept without "×2"

QUESTION 10 (SAMPLE 1)

10. Scientists had been experimenting controlled fusion in a nuclear reactor in which deuterium ($^2_1$H) and tritium ($^3_1$H) undergo the following nuclear fusion:

$$^2_1H + {}^3_1H \rightarrow {}^4_2He + {}^1_0n + \text{energy released}$$

Given: mass of a deuterium nucleus = 2.014102 u
mass of a tritium nucleus = 3.016049 u
mass of a helium nucleus = 4.002602 u
mass of a neutron = 1.008665 u

*(a) Calculate the energy released, in MeV, in the above nuclear fusion. (2 marks)

$E = (2.014102 + 3.016049 - (4.002602 + 1.008665)) \times 1.661\times10^{-27}\times(3\times10^8)^2$ ✓
$= 2.82\times10^{-12}$ J ✓
$= 17.6$ MeV

1M
1A

QUESTION 10 (SAMPLE 2)

(b) A deuterium nucleus and a tritium nucleus have to be within 10^{-15} m for nuclear fusion to occur and that a large amount of work done (about 0.4 MeV) is needed to bring two well separated nuclei to such a close distance.

(i) Explain why a large amount of work done is needed and state the kind of energy this work done has become. (2 marks)

As both deuterium and tritium are positively charged, a large amount of work done is needed to overcome the electric potential energy of the nucleus of the them. ✓ ✗

0 A
1 A

QUESTION 10 (SAMPLE 3)

(ii) Explain why a very high temperature is needed for nuclear fusion to occur. (1 mark)

As a very high temperature gives a very large kinetic energy of the atoms, which is used to overcome the repulsion force and start the reaction. ✓

1 A

*(iii) Estimate the order of magnitude of the minimum temperature at which fusion of deuterium and tritium nuclei would be possible if the plasma can be regarded as an ideal gas. (Hint: For an ideal gas, the gas molecules each is assumed to have an average kinetic energy $E_K = \frac{3RT}{2N_A}$) (2 marks)

$E_K = \frac{3RT}{2N_A}$
$2.82\times10^{-12} = \frac{3(8.31)T}{2(6.02\times10^{23})}$ ✗
$T = 1.36\times10^{11}$ K ✗
∴ The order of magnitude is 10^{11}.

0 M
0 A

QUESTION 10 (SAMPLE 4)

(b) A deuterium nucleus and a tritium nucleus have to be within 10^{-15} m for nuclear fusion to occur and that a large amount of work done (about 0.4 MeV) is needed to bring two well separated nuclei to such a close distance.

(i) Explain why a large amount of work done is needed and state the kind of energy this work done has become. (2 marks)

It is because there is a force between the Tons and if wanted to make the Tons become close, it required energy to overcome the force

0 A

0 A

QUESTION 10 (SAMPLE 5)

In the nuclear reactor, deuterium and tritium exist as plasma, which is a mixture of ions at a very high temperature.

(ii) Explain why a very high temperature is needed for nuclear fusion to occur. (1 mark)

It is because nuclear fusion requires large amount of energy to mix up the Tons and fight against the force between the bonding of the Tons.

0 A

THANK YOU!

Paper 2

Section A :Astronomy and Space Science

Mr. LEE WK & Mr. YING PC

Q.1 Multiple-choice questions

	A	B	C	D
1.1	**33.29%***	29.21%	22.73%	12.89%
1.2	14.73%	5.18%	**52.23%***	26.10%
1.3	6.51%	19.66%	15.13%	**56.66%***
1.4	12.37%	**46.18%***	26.20%	13.50%
1.5	33.29%	**40.19%***	15.25%	9.49%
1.6	8.32%	14.60%	**59.46%***	15.74%
1.7	**45.85%***	21.24%	15.48%	15.22%
1.8	10.88%	19.53%	16.22%	**51.36%***

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

MCQ 1.1

A satellite is orbiting the Earth at a distance *h* from the Earth's surface. What is the gain in gravitational potential energy of the satellite in the orbit with respect to the Earth's surface ?

m = mass of the satellite
R = radius of the Earth
g = acceleration due to gravity on the Earth's surface

A*	$mgh\left(\frac{R}{R+h}\right)$
B	$mgh\left(\frac{R}{R+h}\right)^2$
C	$mgh\left(\frac{R+h}{R}\right)$
D	$mgh\left(\frac{R+h}{R}\right)^2$

P.E $= -\frac{GMm}{R}$ *and* $g = \frac{GM}{R^2}$

MCQ 1.4

Which of the following observations by Galileo contradict with the geocentric model of the universe ?

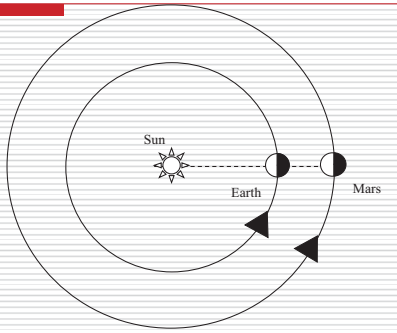
(1) the discovery of satellites of Jupiter
(2) the retrograde motion of Mars
(3) the changing phase of Venus

A	(1) and (2) only
B*	(1) and (3) only
C	(2) And (3) only
D	(1), (2) and (3)

(2) was not a discovery by Galileo.

MCQ 1.5

When the Earth lines up with the Sun and Mars as shown, how does Mars appear to move across the night sky as viewed from Earth ?



A	Mars moves from west to east against the background stars.
B*	Mars moves from east to west against the background stars.
C	Mars does not move against the background stars.
D	The movement of Mars cannot be determined because the east and west directions are not known.

MCQ 1.7

	absolute magnitude	apparent magnitude
star X	2.8	4.7
star Y	5.4	3.2

According to the information given above, which of the following about stars *X* and *Y* is/are correct ?

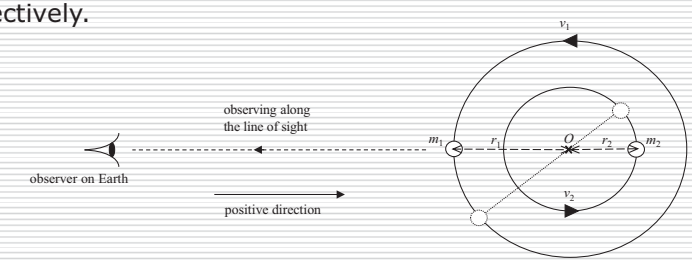
(1) Luminosity of star *X* is greater than that of star *Y*.
(2) A telescope collects more energy per unit area per unit time from star *X* than from star *Y*.

A*	Only (1) is correct
B	Only (2) is correct
C	Both (1) and (2) are correct
D	Both (1) and (2) are incorrect

The larger the value of magnitude, the fainter the star appears.

Q.1 Structured question

Figure 1.1 shows a distant binary star system viewed by an observer on Earth who is also on the orbital plane of the two stars. The system consists of stars 1 and 2 with masses m_1 and m_2 respectively orbiting in uniform circular motion about their centre of mass *O* under their mutual gravitational force. They move with **the same period** in two orbits of radii r_1 and r_2 with orbital speeds v_1 and v_2 respectively.



Q.1 Structured question

By finding the radial velocity v_r of the two stars inferred from the Doppler shift ($\Delta\lambda$) of the hydrogen-alpha line (H_α) observed on Earth, astronomers are able to deduce the masses of the stars. Assume that the centre of mass *O* of the binary system is stationary with respect to the observer. Figure 1.2 shows the radial velocity curves for the two stars. The direction moving away from the observer is taken to be positive velocity.

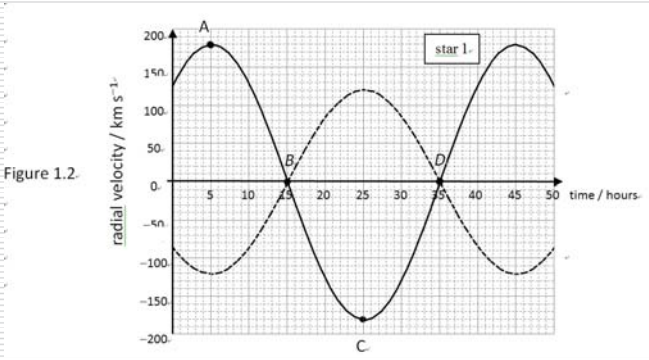


Figure 1.2

Q.1 Structured question

(a) (i) What does it mean by radial velocity v_r of a star observed on Earth ? (1 mark)

(ii) Identify which point, A, B, C or D, marked on the radial velocity curve corresponds to the orbital position of star 1 (in solid line) at the instant shown in Figure 1.1. (1 mark)

a(i) radial velocity is the component of the star's velocity along the observer's line of sight / velocity along the observer direction / the line joining the star and the observer.	1A

"Move away or toward" NOT accepted

(ii) Point D	1A

Candidates' performance in (a) was fair. Most of them failed to state the concise meaning of radial velocity of a star observed on Earth.

Q.1 Structured question

(b) Find, from Figure 1.2, the orbital speed v_1 of star 1 and calculate its orbital radius r_1. Using a similar method, or otherwise, find the orbital radius r_2 of star 2. (4 marks)

$v_1 = 180 \text{ km s}^{-1}$	1A
$v_1 = \frac{2\pi r_1}{T} = \frac{2\pi r_1}{40 \times 60 \times 60}$ (Period $T = 40$ hr)	1M
$r_1 = 4.125 \times 10^6$ km or 4.125×10^9 m	1A
From figure, $v_2 = 120 \text{ km s}^{-1}$; and by ratio or similar calculation gives $r_2 = 2.75 \times 10^6$ km or 2.75×10^9 m	1A

1M for the correct expression $v_1 = \frac{2\pi r_1}{T}$

For the calculation of orbital radii in (b), candidates were able to use the information given in the graph.

Q.1 Structured question

(c) By considering the circular motion of star 1, calculate the mass m_2 of star 2. (2 marks)

$\frac{Gm_1m_2}{(r_1+r_2)^2} = m_1(\frac{2\pi}{T})^2 r_1 = \frac{m_1v_1^2}{r_1}$ $[\omega = \frac{2\pi}{T}]$	1M
Therefore, $m_2 = 5.57 \times 10^{30}$ kg	1A

Many candidates had difficulties in understanding the binary stars system and therefore failed to set up a correct equation of motion in (c).
Some candidates even treated the circular motion of star 1 as if it was a single star.

Q.1 Structured question

(d) A spectrometer can only measure change of wavelength larger than 0.5 nm. Explain whether this instrument is suitable to measure the Doppler shift $\Delta\lambda$ of the hydrogen-alpha line (λ_0 = 656.28 nm) of the two stars. (2 marks)

$\frac{v_r}{c} = \frac{\Delta\lambda}{\lambda} = \frac{0.5 \text{ nm}}{656.28 \text{ nm}} \Rightarrow v_r = 228.3 \text{ km s}^{-1} > 180 \text{ km s}^{-1}$;	1M
Or $\frac{\Delta\lambda}{\lambda} = \frac{v_r}{c} = \frac{180 \times 10^3}{3 \times 10^8} \Rightarrow \Delta\lambda = 0.394 \text{ nm} < 0.5 \text{ nm}$; therefore **not** suitable.	1A
Accept using 120 km s^{-1} , $\Delta\lambda = 0.263 \text{ nm} < 0.5 \text{ nm}$	

Most candidates managed to give correct explanations concerning the suitability of using the spectrometer in (d).

Paper 2

Section B : Atomic World

Mr. LEUNG NC & Mr. LAW MW

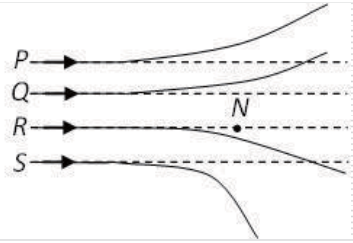
Q.2 Multiple-choice questions

	A	B	C	D
2.1	21.23	6.05	32.13	**40.05***
2.2	**41.69***	12.32	35.16	10.35
2.3	14.17	7.92	15.70	**61.73***
2.4	13.24	**66.01***	10.74	9.13
2.5	27.64	8.80	**47.39***	15.86
2.6	10.09	27.79	**43.30***	17.72
2.7	**42.10***	18.68	23.67	15.17
2.8	16.29	**35.29***	14.37	33.65

* : key ; Red colour : most favourable distractor

Q.2 Multiple-choice questions

2.1 A beam of α-particles with the same initial kinetic energy are scattered by a heavy nucleus N. In the figure, if P is a possible path for one of the α-particles, which of the paths, Q, R and S, is/are possible for these α-particles ?



A. Q and R only (21.23%)
B. R and S only (6.05%)
C. Q only (32.13%)
D. S only (40.05%)

* : key ; Red colour : most favourable distractor

Q.2 Multiple-choice questions

2.2 Which of the following provides experimental evidence for **discrete energy levels** in atoms ?

(1) the spectrum of a sodium discharge tube
(2) the spectrum of a tungsten filament lamp
(3) the diffraction of electrons by atomic spacing in crystals

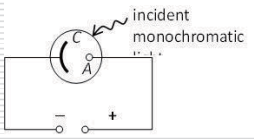
A. (1) only (41.69%)
B. (3) only (12.32%)
C. (1) and (2) only (35.16%)
D. (2) and (3) only (10.35%)

Q.2 Multiple-choice questions

2.5 A photocell is connected to a d.c. source as shown. Monochromatic light is incident on cathode C of the photocell so that photoelectrons are emitted. The maximum kinetic energy of photoelectrons reaching anode A depends on

(1) the kind of metal making the cathode surface.
(2) the voltage of the d.c. source.
(3) the intensity of the monochromatic light used.

A. (1) only (27.64%)
B. (3) only (8.80%)
C. (1) and (2) only (47.39%)
D. (2) and (3) only (15.86%)



Q.2 Multiple-choice questions

2.6 Aurora Borealis (Northern lights) are often observed in skies at high latitudes. When energetic electrons from outer space collide with the oxygen atoms in the upper atmosphere, the oxygen atoms are excited. The subsequent emission of light is usually green light of wavelength 558 nm. The minimum speed of these energetic electrons is of order of magnitude

A.	10^2 m s^{-1}	(10.09%)
B.	10^4 m s^{-1}	(27.79%)
*C.	10^6 m s^{-1}	(43.30%)*
D.	10^8 m s^{-1}	(17.72%)

$\frac{1}{2}mv^2 = \frac{hc}{\lambda}$

$v \approx 8.8\times10^5$

Q.2 Multiple-choice questions

2.7 Which of the following can increase the resolving power of a transmission electron microscope (TEM) ?

(1) increasing the anode voltage in the electron gun

(2) decreasing the aperture of the magnetic objective lens

(3) increasing the separation between the magnetic projection lens and the fluorescent screen

*A.	(1) only	(42.10%)*
B.	(2) only	(18.68%)
C.	(1) and (3) only	(23.67%)
D.	(2) and (3) only	(15.17%)

$\theta = \frac{1.22\lambda}{D}$

V increases → λ decreases → θ decreases.

Q.2 Structured question

The energy levels E_n of an electron in a hydrogen atom from the Bohr model can take the form below:

$$E_n = \frac{-13.6}{n^2} \text{ eV} \quad \text{where } n = 1, 2, 3, \ldots$$

(a) Bohr's idea was sometimes criticized by some physicists as semi-classical and semi-quantum. Point out **ONE classical aspect** in the Bohr model. (1 mark)

- the electron is considered as a particle revolving around the nucleus in definite orbits/circular motion; or
- the centripetal force is provided by the Coulomb force
- the electron's motion obeys Newton's laws of motion

Well answered !

Q.2 Structured question

(b) From the energy point of view, state the physical meaning of a hydrogen atom being in its **ground state**. Well answered! (1 mark)

- lowest energy level or most stable state
  State 13.6 eV only **NOT** accepted.
  Accept 13.6 eV is required to ionize hydrogen atom.

Most candidates understood the physical meaning of ground state.

(c) If the minimum energy required to ionize a hydrogen atom in the ground state is E, express the minimum momentum p of a photon for ionizing such a hydrogen atom in terms of E and another physical constant. (2 marks)

$p = \frac{h}{\lambda} = \frac{hc}{\lambda}\cdot\frac{1}{c}$ 1M

$p = \frac{E}{c}$ 1A

Some of the candidates managed to find the relation correctly but just wrote $E = pc$ instead of expressing p explicitly in terms of E and c.

Q.2 Structured question

(d) Hydrogen atoms in the ground state are bombarded by electrons each with kinetic energy 12.9 eV.

(i) Show that these hydrogen atoms can be excited at most to the third excited state (i.e. $n = 4$). (2 marks)

$$E_4 = -\frac{13.6}{4^2} = -0.85 \text{ eV}$$

$\Delta E = E_4 - E_1 = -0.85 - (-13.6) = 12.75$ eV

1M : **Finding ΔE**

$$E_5 = -\frac{13.6}{5^2} = -0.544 \text{ eV}$$

$\Delta E = E_5 - E_1 = -0.544 - (-13.6) = 13.056$ eV

1A : **Both ΔE and with conclusion correct.**

12.75 eV < 12.9 eV < 13.06 eV,

therefore at most to the 3rd excited state ($n = 4$).

Q.2 Structured question

(d) (i) was well answered!

Quite a lot of candidates showed that the energy was large enough to excite the hydrogen atoms to the third excited state but not why there was not enough energy to excite it to the fourth excited state.

Some candidates arrived at negative ΔE by using $E_1 - E_4$.

Q.2 Structured question

(ii) For a hydrogen atom excited to the third excited state ($n = 4$), what is the de Broglie wavelength of the orbiting electron in the atom ? Given: the orbital radius r_n of the electron in a hydrogen atom from the Bohr model is equal to 0.053 n^2 (unit: nm), where $n = 1, 2, 3, ...$ (2 marks)

$$mvr_n = \frac{nh}{2\pi} \Rightarrow 2\pi r_n = \frac{nh}{mv} = n\lambda$$

1M : deduce/apply $n\lambda = 2\pi r_n$

When $n = 4$, $2\pi(0.053)(4^2) = 4\lambda$

Therefore, $\lambda = 1.33$ nm

Alternative method

1M : Using centripetal force to find v or mv.

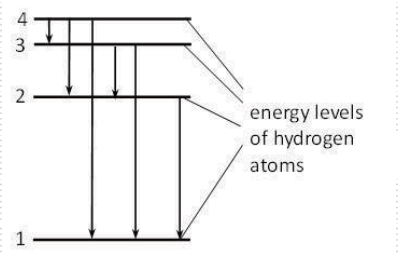
$$\frac{1}{4\pi\varepsilon_0}\cdot\frac{e^2}{r^2} = \frac{mv^2}{r} \Rightarrow v = 5.49\times10^5 \text{ m s}^{-1}$$

Few candidates were able to apply $n\lambda = 2\pi r$ to find the wavelength.

Some assumed that the K.E. of the electron equals to its P.E. at $E4$ but actually K.E. = –P.E.

Q.2 Structured question

(iii) **Copy the energy level diagram below to your answer book** and draw arrow(s) to illustrate all possible transitions leading to emission of photons by these excited hydrogen atoms. (2 marks)



Most of them only drew 4 to 5 lines and some with incorrect arrows.

Deduct 1A each for

- wrong or incomplete arrows
- omitting any one transition

Accept more than 6 correct transitions

Paper 2

Section C : Energy and Use of Energy

Mr. LEE WK & Mr. YING PC

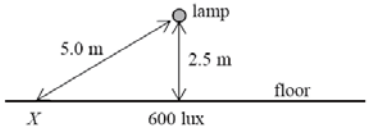
Q.3 Multiple-choice questions

	A	B	C	D
3.1	**32.99***	14.56	25.30	26.87
3.2	7.67	22.04	19.53	**50.29***
3.3	16.32	**67.00***	12.05	4.09
3.4	58.51	4.99	**20.61***	15.60
3.5	19.61	**28.08***	26.21	25.75
3.6	39.55	20.66	**28.42***	10.98
3.7	15.53	18.29	**46.62***	18.75
3.8	**31.90***	39.98	23.80	4.05

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

MCQ 3.1

3.1 A lamp is fixed on the ceiling of a room as the only light source. The illuminance on the floor directly under the lamp is 600 lux. Assuming that the lamp emits light uniformly in all directions, what is the illuminance on the floor around point *X* as indicated in the diagram ? Neglect any reflections of the walls and the ceiling.



* A. 75 lux
B. 130 lux
C. 150 lux
D. 300 lux favourable distractor

A B C D

$$\frac{P}{4\pi(2.5)^2} = 600$$

$$\frac{P}{4\pi(5.0)^2}\cos 60° = \frac{P}{4\pi(2.5)^2}\cos^3 60°$$

$$= 600\cos^3 60°$$

$$= 75 \text{ lux}$$

MCQ 3.4

3.4 A coal-fired power plant generates and transmits electrical energy to consumers a long distance away. When a consumer connects an incandescent lamp to the mains supply, the following data illustrates what happens per 1000 J of energy in coal converted to electrical energy which is then supplied to the lamp.

Loss during generation process in the power plant	600 J
Loss during transmission before reaching the lamp	100 J
Heat generated by the lamp	250 J
Visible light generated by the lamp	50 J

What is the **end-use energy efficiency** of this incandescent lamp ?

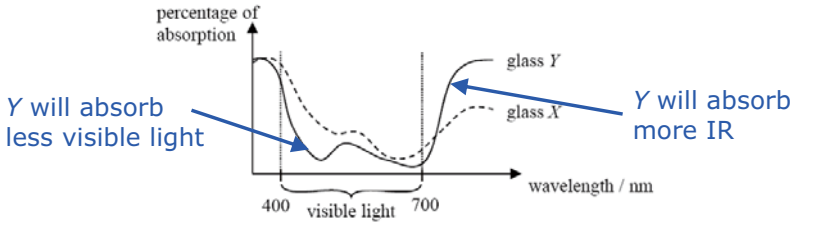
A. 5 % favourable distractor
B. 12.5 %
* C. 16.7 %
D. 30 %

A B C D

$$\frac{50}{250+50} = 16.7\%$$

MCQ 3.5

3.5 The following graph shows the percentage of absorption of different electromagnetic radiations when passing through two types of glasses *X* and *Y*. One of them is to be chosen for windows of buildings in Hong Kong. With the consideration of energy efficiency of buildings, which statement is correct ?



A. *X* should be chosen as it is better than *Y* in reducing the need of air conditioning and the amount of lighting.

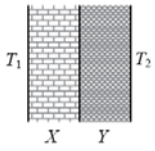
* B. *Y* should be chosen as it is better than *X* in reducing the need of air conditioning and the amount of lighting.

C. *X* should be chosen as it can greatly reduce the need of air conditioning although it needs a bit more amount of lighting than *Y*. favourable distractor

D. *Y* should be chosen as it can greatly reduce the need of air conditioning although it needs a bit more amount of lighting than *X*.

MCQ 3.6

3.6 The diagram shows a wall composed of two layers *X* and *Y* of equal thicknesses. The thermal conductivity of the material of *X* is higher than that of *Y*. The two sides of the wall are maintained at different temperatures T_1 and T_2. Which of the following statements is/are correct ?



(1) The thermal transmittance of layer *X* is higher than that of layer *Y*.
(2) The energy flowing through layer *X* per second is greater than that through layer *Y*.
(3) The temperature drop across layer *X* is smaller than that across layer *Y*.

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

A ○ B ○ C ○ D ○

(1) $U = \frac{\kappa}{d}$ $\kappa_X > \kappa_Y \Rightarrow U_X > U_Y$

(2) $\frac{Q}{t} = U_X A \Delta T_X = U_Y A \Delta T_Y$

(3) $U_X > U_Y \Rightarrow \Delta T_X < \Delta T_Y$

MCQ 3.8

3.8 What is the function of the **moderator** in a nuclear fission reactor ?

* A. It slows down neutrons and this helps increase the rate of nuclear fission.

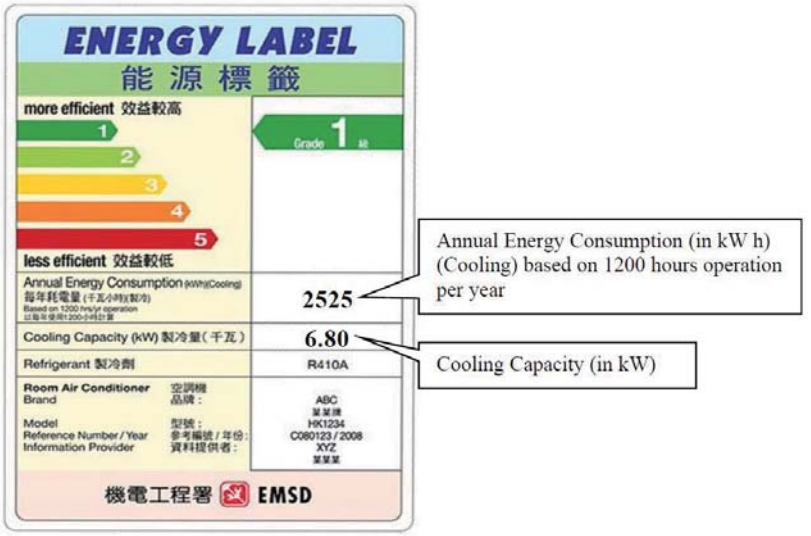
B. It slows down neutrons and this helps reduce the rate of nuclear fission. favourable distractor

C. It absorbs neutrons and this helps reduce the rate of nuclear fission.

D. It generates neutrons for nuclear fission.

A ○ B ○ C ○ D ○

Q.3 Structured question



Q.3 Structured question

(a) This air-conditioner is installed in a room of floor area of 20.0 m^2 and height of 3.0 m.
Given: density of air = 1.2 kg m^{-3}, specific heat capacity of air = 1000 J kg^{-1} $°C^{-1}$

(i) Estimate the time required to cool the room from 33°C to 25°C. Assume that the density and specific heat capacity of air remain constant throughout. (2 marks)

(a) (i) Time required $= \frac{\text{heat to remove } (mc\Delta T)}{\text{cooling capacity}}$

$= \frac{[(20.0 \times 3.0) \times 1.2] \times 1000 \times (33 - 25)}{6.80 \times 1000}$

$= \frac{576000}{6800} = 85$ s (1.42 min. or 0.0236 hr)

1M

1A

2

Accept in text form / sub. with incorrect order of magnitude

Accept 84 to 85 s

Part (a)(i) was well answered.

Q.3 Structured question

(ii) Suggest a reason why the actual time for cooling from 33°C to 25°C is longer than the result found in (a)(i). (1 mark)

(ii) **ANY ONE**:
Heat has to be removed from wall, furniture etc. / Heat transferred from outside to the room has to be removed / Other reasonable factors such as bad air ventilation for air-conditioner / Doors or windows are not closed properly / Installation position is facing west or exposed to sunlight directly, etc. / Heat gain from surroundings / Poor conductor (air) lengthens the time for heat transfer

1A

1

NOT accept:
- Heat generated from the air-conditioner
- There are people / electrical appliances / furniture without mentioning heat / heat capacities

(a)(ii) revealed that many candidates were weak in explaining principles of physics.

Quite a number of them stated that longer cooling time was due to 'heat lost to surroundings' but not the fact that thermal energy is being removed.

Q.3 Structured question

(b) (i) Find the average electrical power input (in kW) of air-conditioner *X* during operation. (1 mark)

(b) (i) $P_{in} = \frac{2525}{1200} = 2.1$ (kW) or 2100 W

1A

1

Most were able to work out the average electrical power input.

Q.3 Structured question

(ii) Find the value of $\frac{\text{cooling capacity}}{\text{electrical power input}}$ for this air-conditioner. A student comments that this ratio having a value greater than 1 violates the principle of conservation of energy because the amount of heat removed by the air-conditioner is greater than the electrical power input. Discuss the student's comment. (3 marks)

(ii) $\frac{\text{cooling capacity}}{\text{electrical power input}}\ (\text{COP}) = \frac{6.80}{2.1} = 3.24$

Conservation of energy is not violated.
For each joule of electrical energy consumed by the air-conditioner/compressor, 3.24 J of heat will be transferred/removed, but not created, by the air-conditioner.

1M/1A

1A

1A

3

1M for the ratio $\frac{6.80}{\text{Ans from (b)(i)}}$

1A for the working principle of heat pump / the meaning of Q_C AND W / heat flow vs work done by the air-conditioner

1A for Q_C not necessarily equal to W / small W can lead to large Q_C

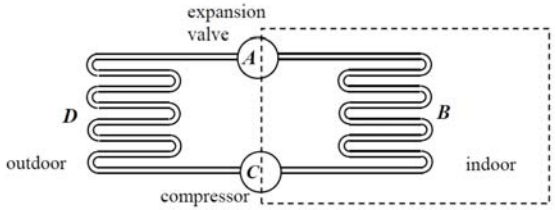
Most were able to work out the COP.

However, many did not fully understand the concept that 1 J of electrical energy consumed by the air-conditioner/compressor can remove 3.24 J of thermal energy from the room.

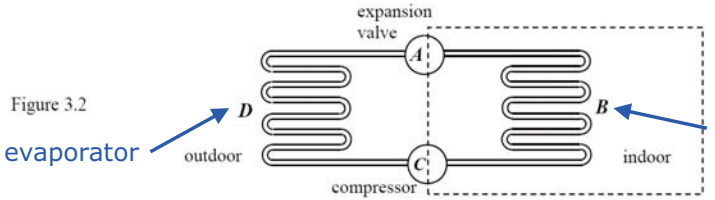
Q.3 Structured question

(c) *X* is a cool-only air-conditioner as it can only cool air. Nowadays, 'reverse-cycle air-conditioners' (RCAC) that can either cool or warm air are available in the market and they have the same major components of *X*. Figure 3.2 shows a simplified schematic diagram of an RCAC with four components *A*, *B*, *C* and *D*, in which *A* is the expansion valve and *C* is the compressor.

Figure 3.2



Q.3 Structured question



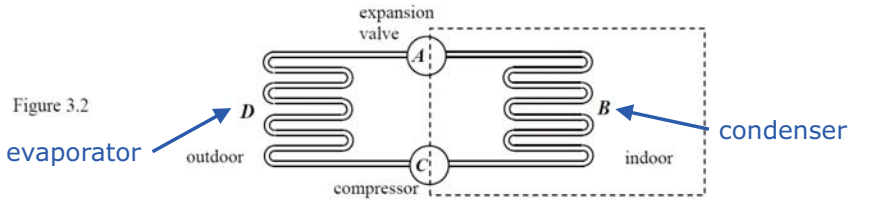
(i) If the RCAC operates in a mode **to warm air** during winter time, give the direction of the flow of refrigerant starting from compressor *C* using the letters *A*, *B*, *C* and *D*. State in which component, *A*, *B* or *D*, the refrigerant has the highest temperature. (2 marks)

(c)	(i)	$(C \rightarrow) B \rightarrow A \rightarrow D$ component *B* (or condenser)	1A 1A 2

In (c)(i), quite a number of the candidates made mistakes in the direction of the flow of refrigerant. They were not familiar with the working principle of a RCAC and the functions of different components in it.

As a result, many failed to state in which component the refrigerant had the highest temperature.

Q.3 Structured question



(ii) Suggest **ONE** modification that can convert a cool-only air-conditioner into an RCAC. (1 mark)

(ii)	reverse the direction of flow of refrigerant Or interchange/swap the positions of *B* (condenser) and *D* (evaporator) or *A* (expansion valve) and *C* (compressor)	1A	1

Part (c)(ii) was generally well answered despite some wrong statements such as reversing the direction of electric current could convert a cool-only air-conditioner into an RCAC.

Paper 2

Section D: Medical Physics

Mr. LEUNG NC & Mr. LAW MW

HKDSE 2015

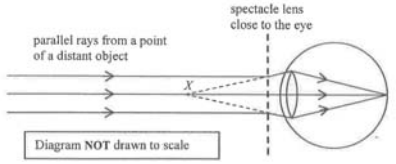
Multiple Choice

Qn.	1	2	3	4	5	6	7	8
A	18.2%	13.1%	21.5%	23.9%	17.9%	8.2%	50.1%	60.2%
B	47.0%	14.5%	21.5%	13.4%	63.8%	16.0%	15.7%	7.4%
C	11.2%	27.5%	30.6%	33.8%	12.1%	57.6%	15.1%	8.0%
D	23.3%	44.6%	26.2%	28.7%	6.1%	18.0%	18.9%	24.4%

Qn. 4.1

4.1 Peter suffers from a certain eye defect and needs to wear spectacles. The diagram shows the spectacle lens for correcting this defect. Which statements are correct ?

0251801088



(1) Peter is suffering from short sightedness.
(2) Point X is the near point of his unaided eye.
(3) If X is 0.8 m from the spectacle lens, the power of the lens should be −1.25 D.

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3) ⟸ best distractor

A B C D

Answer : B (47.0%)
Best distractor: D (23.3%)
Mix up *far point* and *near point*.

Qn. 4.2

4.2 Which of the following are disadvantages of a fibre optic endoscope ?

(1) Anesthesia is sometimes required.
(2) It can only be used for viewing the inner surface of an organ with cavity.
(3) It may cause internal bleeding.

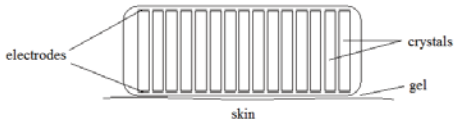
A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only ⟸ best distractor
D. (1), (2) and (3)

A B C D

Answer : D (44.6%)
Best distractor: C (27.5%)
May have problem in the word *anesthesia*.

Qn. 4.3

4.3 The following diagram shows an ultrasound scanner with an array of crystals. A pair of electrodes is connected across each crystal. Which of the following statements is/are correct ?



(1) The gel is used to reduce the attenuation of ultrasound when passing the gap between the scanner and the skin.
(2) When a crystal receives ultrasound, an electrical signal is generated between the electrodes by piezoelectric effect.
(3) This scanner is designed for taking B-scan images.

A. (1) only
B. (2) only
C. (1) and (3) only ⟸ best distractor
D. (2) and (3) only

A B C D

Answer : D (26.2%)
Best distractors: C (30.6%)
Tricky option (1). Poor understanding in (2) & (3) on theory of piezoelectric effect.

Qn. 4.4

4.4 Ultrasound scanning is **NOT** suitable for the lungs because air in the lungs

A. has a high attenuation coefficient and can absorb almost all the ultrasound.
B. has a low attenuation coefficient and can absorb almost all the ultrasound.
C. has high acoustic impedance compared to soft tissue and can reflect almost all the ultrasound.
D. has low acoustic impedance compared to soft tissue and can reflect almost all the ultrasound.

A B C D

best distractor

Answer : D (28.7%)

Best distractor: C (33.8%)

Mix up acoustic impedance and reflection coefficient.

Q.4 Structural question

(a) (i) Match the letters *A*, *B*, *C* and *D* in Figure 4.1 with the parts of the ear, namely, **eardrum**, **oval window**, **semi-circular canals** and **cochlea**. State the function of *C*. (2 marks)

(ii) The ratio of area of *A* to that of *D* is 20. If the ear amplifies the pressure of a sound signal by 25 times totally after passing *D*, find the gain of pressure contributed by the lever action of the ossicles. (1 mark)

(a) (i) *A*: eardrum — 1A
B: semi-circular canals
C: cochlea
D: oval window

C (cochlea) is for discriminating different frequencies of incoming sound waves / convert sound waves to nerve signals / auditory sensor cells inside send signals to brain. — 1A

2

(ii) $25 \div 20 = 1.25$ (i.e. 25% increase) — 1M/1A

Part (a)(i) was well answered. Many failed to deduce the gain of pressure in (a)(ii). May not understand the meaning of the ratio of area.

Q.4 Structural question

(b) Figure 4.2 shows an equal loudness curve of people with normal hearing.

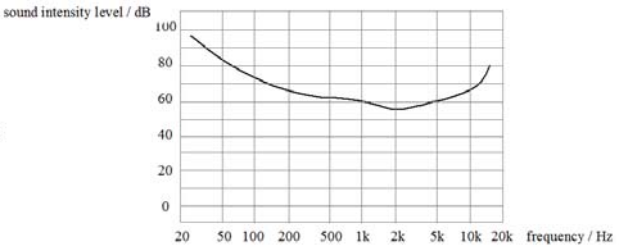


Figure 4.2

(i) State the loudness, in phons, represented by this curve. State the physical significance of the curve being higher up at both ends. (2 marks)

Q.4 Structural question

(b) (i) 60 (phons) — 1A
The ear is less sensitive (compared to 1–2 kHz frequency) to sound of low or high frequencies / more sensitive to middle frequencies / need a higher sound intensity to give the same loudness at high and low frequencies. — 1A

2

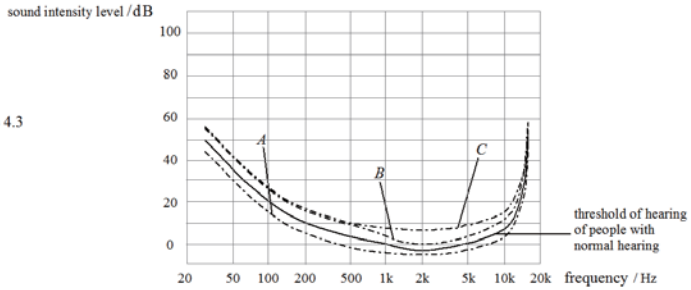
(ii) Curve *C*. — 1A

In (i), a significant number of candidates do not know how to read 60 phons from the graph. Some candidates were unable to state concisely the *physical significance* of the loudness curve being higher at both low and high frequencies. Some simply describe the graph (e.g. higher dB in higher and lower frequency ends).

Q.4 Structural Question

(ii) A worker has suffered from hearing loss due to prolonged exposure to a noisy environment and the loss is most severe for sounds around kHz frequencies. If the worker is tested for the threshold of hearing, which of the equal loudness curves, *A*, *B* and *C*, in Figure 4.3 best represents his response ? Explain your choice. (2 marks)

Figure 4.3



Q.4 Structural question

(ii) Curve *C*. 1A

Curve shifted upwards such that a greater intensity level for threshold of hearing (or giving the same loudness sensation), especially significant in kHz range. 1A

2

Not many candidates managed to identify the correct loudness curve in (b)(ii) with appropriate explanations. Many candidates know that it is curve *C*, but the explanation is not appropriate. Some simply say that the *curve C is higher than the normal ear*, which is also correct for the curve *B*. They do not use the information *especially significant in kHz range*.

Q.4 Structural Question

(c) An engineer working near an operating engine is exposed to noise of sound intensity 80 W m^{-2}. After putting on earmuffs, the sound intensity of the noise heard is reduced to 2.5×10^{-5} W m^{-2}. Estimate the decrease in sound intensity level of the noise, in dB, heard after wearing the earmuffs. (3 marks)

(c) Change in sound intensity level

$$L_1 = 10 \log \frac{80}{I_0}$$ 1M

$$L_2 = 10 \log \frac{2.5 \times 10^{-5}}{I_0}$$

$$L_2 - L_1 = 10 \log \frac{80}{2.5 \times 10^{-5}}$$ 1M

$$= -65 \text{ (dB)}$$ 1A

Part (c) was in general well answered although a few of them were not familiar with logarithmic operations.