HKDSE Physics & Combined Science (Physics)

Report on Assessment

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Overview

Paper	Physics	CS(Phy)
1A (MC)	Mean: 19 out of 36 (i.e.54%) (2012: 21 out of 36)	Mean: 9 out of 24 (i.e.39%) (2012: 11 out of 24)
1B	~>45% (2012: ~>55%)	<40% (2012: ~45%)
2	~<50% (~2012)	N.A.
SBA	~>70% (~2012)	~<70% (~2012)
Candidature	ALL: 15 209 SCH: 14 087	ALL: 3 086 SCH: 2 946

Marking & Grading

On-Screen Marking (OSM) panels	
Physics	**CS(Phy)**
1B-1: Q.1, 3, 5, 6 1B-2: Q.7, 8, 10, 11 1B-3: Q.2, 4, 9	1B-1: Q.1, 2, 3, 4 1B-2: Q.5, 6, 7, 8

2A: Astronomy (26%) 2B: Atomic World (64%) 2C: Energy (81%) 2D: Medical Physics (29%)	---

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

Marking & Grading

- Expert Panel (Chief Examiners, 5 persons) determine level boundaries/cut scores based on
  1. Level descriptors
  2. Group Ability Indicator (GAI)
  3. Viewing student samples
- CS(Phy) graded by common items and viewing student samples
- Endorsement by Senior Management/Exam Board

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

Results

Physics

Cut score difference = 43 marks

Level	5**	5+	4+	3+	2+	1+
Percentage	2.6%	26.1%	49.9%	73.6%	90.5%	97.8%
No. of MC	32/31	25/24	19	14	10/9	7

CS(Phy)

Cut score difference = 36 marks

Level	5**	5+	4+	3+	2+	1+
Percentage	1.2%	12.1%	28.7%	52.9%	75.5%	92.6%
No. of MC	19/18	14	12	9	7	5

Paper 1A

Physics (36 MC)

>70%	50%-70%	<50%
3	17	16

Easy ← → Difficult

CS (Phy) (24 MC)

>70%	50%-70%	<50%
0	4	20

Easy ← → Difficult

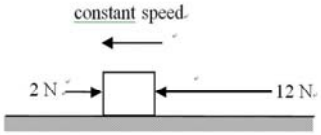
PHYSICS MC

Topic (No. of Qu.)	Average % correct	No. of Qu. < 50% correct
Heat & Gases (4)	54%	2
Force & Motion (11)	52%	5
Wave Motion (8)	56%	2
Electricity & Magnetism (10)	47%	7
Radioactivity (3)	65%	0

CS(PHY) MC

Topic (No. of Qu.)	Average % correct	No. of Qu. < 50% correct
Heat & Gases (2)	44%	2
Force & Motion (8)	37%	6
Wave Motion (6)	48%	4
Electricity & Magnetism (8)	33%	8

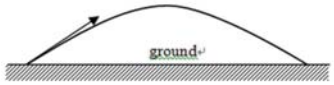
7.



A block on a rough horizontal surface is moving to the left with constant speed under two horizontal forces 2 N and 12 N indicated as shown. If the force of 12 N is suddenly removed, what is the net force acting on the block at that instant ?

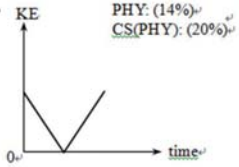
		PHY	CS(PHY)
* A.	12 N	(25%)	(12%)
B.	10 N	(15%)	(24%)
C.	8 N	(26%)	(22%)
D.	2 N	(34%)	(42%)

13.

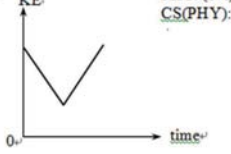


A particle is projected into the air at time $t = 0$ and it performs a parabolic motion before landing on the ground as shown. Which graph represents the variation of the kinetic energy (KE) of the particle with time before landing ? Neglect air resistance.

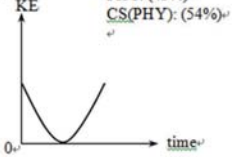
A. PHY: (14%) CS(PHY): (20%)



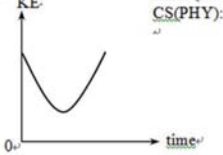
B. PHY: (8%) CS(PHY): (6%)



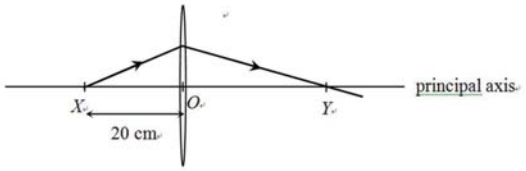
C. PHY: (43%) CS(PHY): (54%)



* D. PHY: (35%) CS(PHY): (20%)



22.

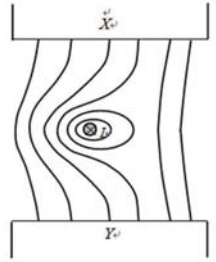


A point light source at X on the principal axis of a thin convex lens emits a ray of light. The ray passes through the lens and reaches the principal axis at point Y as shown. O is the optical centre of the lens such that $OX = 20$ cm and $OY > OX$. Which of the following statements is/are correct ?

(1) The focal length of the lens is shorter than 20 cm.
(2) If the point light source is shifted away from the lens, separation OY would increase.
(3) An object placed at Y would give a diminished image at X.

A.	(1) only	(23%)
B.	(2) only	(19%)
* C.	(1) and (3) only	(40%)
D.	(2) and (3) only	(18%)

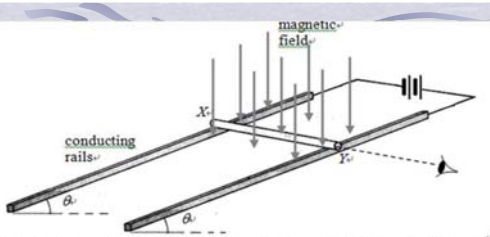
26.



A straight wire carrying current I pointing into the paper is placed in a magnetic field between pole pieces X and Y. The figure shows the resultant field line pattern. What is the polarity of pole piece X and in what direction is the magnetic force acting on the wire ? Ignore the effect of the Earth's magnetic field.

	polarity of X	direction of magnetic force	PHY	CS(PHY)
A.	N	to right	(14%)	(19%)
B.	N	to left	(29%)	(32%)
* C.	S	to right	(42%)	(30%)
D.	S	to left	(15%)	(19%)

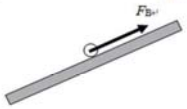
28.



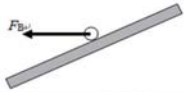
A copper rod XY is placed on a pair of smooth inclined conducting rails which are located in a magnetic field applied vertically downward. The rails make an angle θ to the horizontal and a battery is connected to the rails as shown above. Which diagram shown below represents the magnetic force F_B acting on the rod when viewed from end Y?

A. PHY: (23%) CS(PHY): (25%)

B. PHY: (13%) CS(PHY): (19%)

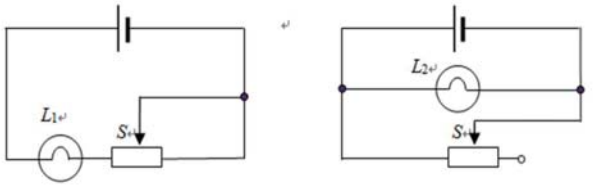


*C. PHY: (42%) CS(PHY): (27%)



D. PHY: (22%) CS(PHY): (29%)

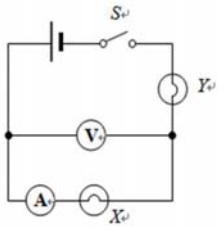
31.



In each of the above circuits, the cell has constant e.m.f. and negligible internal resistance. When the sliding contact S of each rheostat shifts from the mid-position to the right, how would the brightness of each bulb change?

	bulb L_1	bulb L_2	PHY	CS(PHY)
*A.	becomes dimmer	remains unchanged	(43%)	(35%)
B.	becomes dimmer	becomes brighter	(29%)	(26%)
C.	remains unchanged	becomes dimmer	(17%)	(24%)
D.	becomes brighter	remains unchanged	(11%)	(15%)

32.



In the above circuit, the cell has negligible internal resistance. When switch S is closed, both bulbs are not lit. The voltmeter has a reading but the ammeter reads zero. If only one fault has been developed in the circuit, which of the following is possible?

		PHY	CS(PHY)
A.	Bulb X has been shorted accidentally.	(15%)	(18%)
B.	Bulb Y has been shorted accidentally.	(15%)	(19%)
*C.	Bulb X is burnt out and becomes open circuit.	(46%)	(37%)
D.	Bulb Y is burnt out and becomes open circuit.	(24%)	(26%)

Observations

- Most candidates were competent in handling calculations
- Quite weak in handling units/converting units
- Some failed to identify which parameter(s) in an equation is/are constant/changing
- Weaker candidates (Level 1 and 2) tend to give up answering essay questions or parts that require description, which were effective in discriminating the wide ability spectrum of candidates.

Points to note

- About 70% of Paper 1 (Physics) with questions from core part.
- Formulae list provided for each written paper
- 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 (Total = 80 each) using Paper 1

Before equating: Mean 33 to 40 / SD 17 to 19
After equating: Mean 35 to 40 / SD 15 to 16

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

Points to note

- Student samples of performance (Levels 1 to 5) available in October (HKEAA website).
- SBA Conference on 2 Nov 2013
- SBA Online Submission in Jan/Feb 2014
- All SBA tasks adopt 0 – 20 mark range from 2014 Exam onwards.
- From 2014 Exam onwards:

  PHY no. of MC reduced from 36 to 33

  CS(PHY) no. of MC reduced from 24 to 22

THANK YOU

2013 DSE PHYSICS/ COMBINED SCIENCE (PHYSICS)

IB-2

H K LAU

W I TANG

QUESTION 7

Marking Scheme	Performance/Common Errors
(a) $c = f\lambda \Rightarrow 3\times10^8$ m s^{-1} $= f$ (0.02 m) [1M] 1M for correct substitution $\therefore$ $f = 1.5\times10^{10}$ Hz or 15000 MHz [1A]	- Mistook the speed of light (3×10^8 m s^{-1}) as the speed of sound (340 m s^{-1}). - Forgot to convert the unit of wavelength from cm to m.
(b)(i) Path difference of the diffracted waves from slits A and B to probe varies along XY. [1A] Constructive and destructive interference occur alternately to give maxima and minima. [1A]	- Failed to state the variation of path difference along XY.
(ii) $BP - AP = 1\frac{1}{2}\lambda$ [1M] $BP - AP = 3$ cm $= 0.03$ m $\therefore$ $BP = 1.24 + 0.03 = 1.27$ m [1A]	- Failed to realize that the path difference $= 1\frac{1}{2}\lambda$. - Mistook the path difference as $AP - BP$.

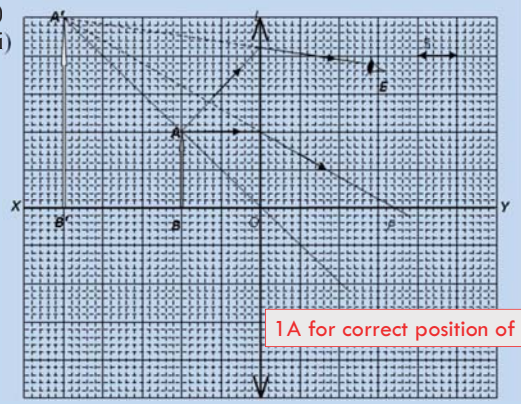
QUESTION 7

Marking Scheme	Performance/Common Errors
(iii) Path difference along $XY < AB$ $AB = 3\times2$ cm $= 3\lambda$ [1M] $\therefore$ path difference allowed $= 0\lambda, 1\lambda, 2\lambda$. Maximum number of maxima = 3 [1A]	- Failed to count the zeroth order maximum. - Incorrectly stated that the order corresponding to $\theta = 90°$ could still be observed. - The equation $d\sin\theta = n\lambda$ was incorrectly applied as the slit separation was not negligible in such a situation.
(c) Radio waves with lower frequencies (will have longer wavelengths and hence) have greater diffraction effect. [1A] Radio waves by-pass small obstacles / not to be reflected from small obstacles. [1A]	- Failed to mention how the reflection of waves from small obstacles would be affected as a result.

QUESTION 8

Marking Scheme	Performance/Common Errors
(a) (i) Virtual [1A]	well answered.
(ii) Convex. [1A] Only convex lens can form magnified (virtual, erect) images/ The image is formed behind the object. [1A] Correct spelling for "convex lens" Deduct 1 mark for wrong information, e.g. real, inverted, etc.	well answered.

QUESTION 8

Marking Scheme	Performance/Common Errors
(b) (i) (ii) (c)  1A for correct position of O or L	- Most candidates were able to find the position of the lens - Showed mistakes in drawing light rays, like incorrect use of dotted/solid lines or wrong direction of rays.

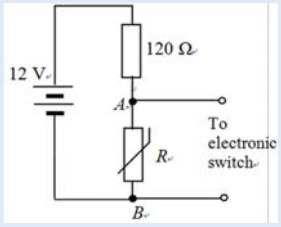
QUESTION 8

Marking Scheme	Performance/Common Errors
(b) (ii) Correct light ray to locate F. [1M] Focal length f = 17 cm [1A] (16.0 to 17.5 cm)	- Finding the focal length using lens formula rather than using the ray diagram - Misreading the focal length from the ray diagram
(c) Correct ray from A' or lens to E. [1A] All correct. [1A]	- Drawing light rays randomly - Failed to attempt this part.
(d) Magnifying glass / Glasses for long-sighted eyes / Simple microscope [1A]	- Well answered - Unable to spell correctly the name of the optical instrument

QUESTION 10

Marking Scheme	Performance/Common Errors
(a) (i) 80 Ω [1A]	- Well answered
(ii) $V_{AB} = \frac{120}{(80+120)}12$ [1M] = 7.2 V [1A]	- Well answered
(b) As R_v and 120 Ω resistor are in parallel, R_{eq} across AB is smaller than 120 Ω, [1A] $\frac{1}{R_{eq}} = \frac{1}{120} + \frac{1}{1000}$ $\Rightarrow R_{eq}$ = 107 Ω therefore voltage shared across AB is reduced / smaller than expected. [1A] V = 6.87 V Use a voltmeter with resistance much larger than the resistance in that part of the circuit. (e.g. 10 MΩ in some digital voltmeter) [1A]	- Many candidates attempted to tackle this part in terms of current passing through the voltmeter rather than the voltage across AB and hence failed to explain precisely how the reading was affected.

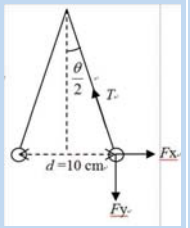
QUESTION 10

Marking Scheme	Performance/Common Errors
(c) (i) $V_{AB} = \frac{120}{(R+120)} \times 12 = 6.0\,\text{V}$ R = 120 Ω [1A] corresponds to temperature at 16 °C. [1A]	- For those who were able to find the resistance of R by considering the potential difference across the resistors, most managed to work out the correct answer.
(ii) 	

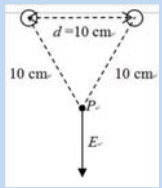
QUESTION 10

Marking Scheme	Performance/Common Errors
(c) (ii) Correct circuit (i.e. interchange thermistor R and 120 Ω resistor). [1A] As the temperature drops, the thermistor resistance increases. [1A] When the resistance increases to a value such that $V_{AB} = 6.0$ V or above, the electronic switch is on and it turns on the heating device. [1A]	- Some candidates did not attempt this part which involved unfamiliar situation. - For those who did attempt the question, not many were able to explain the action of the circuit.

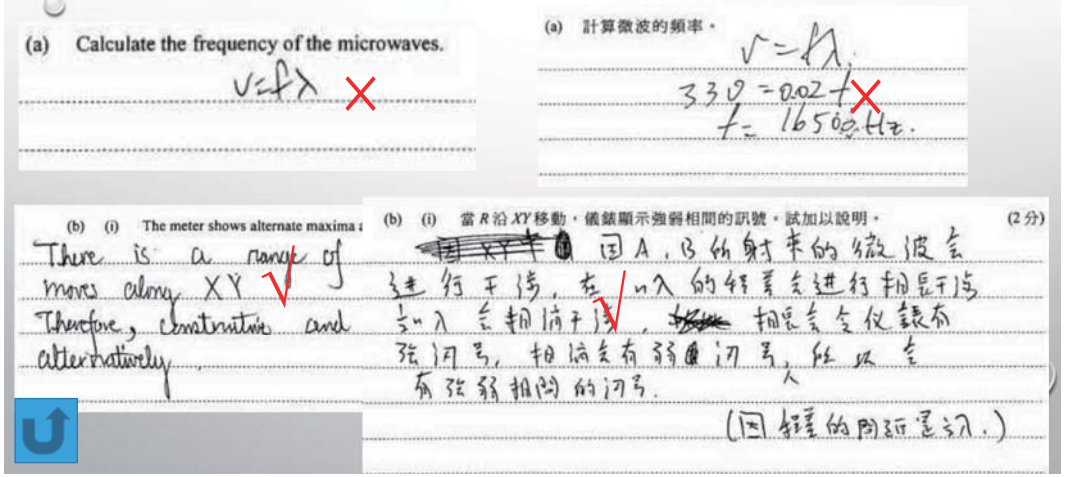
QUESTION 11

Marking Scheme	Performance/Common Errors
(a) $T\cos\frac{\theta}{2} = F_y = mg$ [1M] $T\sin\frac{\theta}{2} = F_x = \frac{Q^2}{4\pi\varepsilon_0 d^2}$ [1M] $\tan\frac{\theta}{2} = \frac{Q^2}{4\pi\varepsilon_0 d^2}\left(\frac{1}{mg}\right)$ $= 9\times10^9 \times \frac{(3.1\times10^{-9})^2}{0.1^2} \times \frac{1}{(1.0\times10^{-5})(9.81)}$ $\frac{\theta}{2} = 5.0°$ i.e. $\theta = 10.1°$ [1A] 	- Many candidates were able to quote the formula for calculating the electrostatic force - Wrongly halving the electrostatic force, - Wrongly taking $4\pi\varepsilon_o = 9 \times 10^9$ N m^2 C^{-2} or r = 5 cm in substitution, - Drawing incorrect free-body diagrams 1M for calculating electrostatic force 1M for calculating θ 1A for correct answer

QUESTION 11

Marking Scheme	Performance/Common Errors
(b) (i)  [1A]	- Quite a number of candidates omitted this part. - Some sketched the whole electric field pattern - Wrongly identified the resultant field was pointing upwards to the positive charges.
(ii) Potential at $P = \frac{Q}{4\pi\varepsilon_0 d} + \frac{Q}{4\pi\varepsilon_0 d} = \frac{2Q}{4\pi\varepsilon_0 d}$ [1M] $= (9\times10^9)\frac{2\times3.1\times10^{-9}}{0.1}$ $= 558$ V [1A]	- Mistook the electric potential as a vector quantity
(iii) Separation d decreases. [1A]	- Failed to understand the induction of charges on a conductor, and the effect of nearby charges or an electric field.

QUESTION 7 (SAMPLE 1)



QUESTION 7 (SAMPLE 2)

(iii) When R is moved along XY from X towards Y and beyond, explain whether or not it is possible to detect more than three maxima. (2 marks)

$d\sin\theta = n\lambda$

$(0.06)\sin 90° = n(0.02)$

$n = 3$

the maximum order is 3 which mean the third maxima along ~~at the edge of the~~ metal

∴ it is not possible - maxima.

1M only

(iii) 當 R 沿 XY 從 X 移向 Y 並繼續外移，解釋可否偵測到超過三個最大訊號。 (2分)

不能，因為當 θ 為 90 時，

$n = \frac{d}{\lambda}$

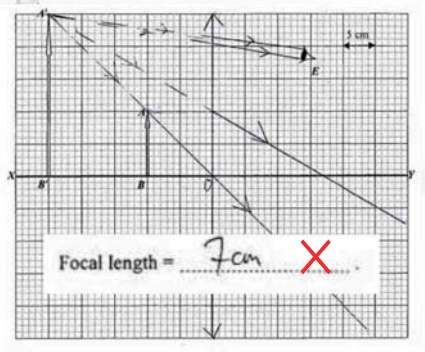
$= \frac{0.06}{0.02}$

$= 3$

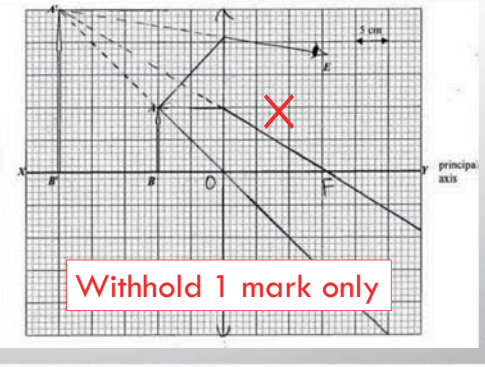
∴ 最大級數為 3，並不能偵測超過3個最大訊號

1M only

QUESTION 8 (SAMPLE)



Focal length = 7cm ✗



Withhold 1 mark only

(d) State an application of lens L in the situation as shown above. (d) 指出透鏡 L 如以上所示情況中的一項用途。

To magnify the object ✓

放大雲素的物件 ✓

QUESTION 10 (SAMPLE)

The ~~no~~ the total ~~reci~~ resistance ~~of the circuit is~~ or ~~the~~ across AB is change because the resistance of voltmeter ~~we~~ is not significantly large.

$\frac{1}{R_{AB}} = \frac{1}{120} + \frac{1}{1000}$

$R_{AB} = 107$ Ω ✓

∴ Resistance ~~are~~ across AB is lower than the ~~o~~set up in fig. 10.1. ~~it~~ is the ~~voltage~~ V_{AB} is lower.

Accuracy can be ~~imp~~ higher resistance.

因為伏特計的电阻還不夠大，所以仍有少量电流流經伏特計 ✗ 以致偏差

將伏特計換上一個起高电阻的伏特計。

原本

QUESTION 11(SAMPLE)

(a) Find the angle between the threads.

$F_E = \frac{(3.1\times10^{-9})^2}{0.1^2} \cdot 9\times10^9$

$= 8649\times10^{-6}$ N

At X, $T = mg + F_E$ ✗

$T\cos\frac{\theta}{2} = mg$

$T\sin\frac{\theta}{2} = F_E$

(2) ÷ (1) ✓

$\tan\frac{\theta}{2} = \frac{F_E}{mg}$

$\tan\frac{\theta}{2} = \frac{8.649N}{1\times10^{-3}\times g}$

$\theta = 10.108°$

∴ the angle is 10

*(ii) Calculate the electric potential at point P. The electric potential a

$\angle XPY = 60°$

$E = 9\times10^9 \times \frac{3.1\times10^{-9}}{0.1^2} \times \cos 30° \times 2$ ✗

$= 4832$ N C^{-1}

THANK YOU!

Paper 2

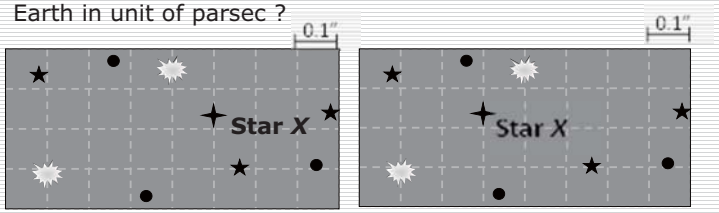
Section A : Astronomy and Space Science

Q.1 Multiple-choice questions

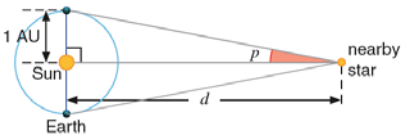
	A	B	C	D
1.1	10.1	**77.55**	6.35	5.75
1.2	14.99	12.55	29.03	**43.04**
1.3	**43.44**	16.31	21.11	18.47
1.4	5.50	17.92	43.42	**32.69**
1.5	**42.72**	9.56	38.54	8.49
1.6	20.71	**55.96**	9.24	13.52
1.7	11.73	8.24	**61.02**	18.37
1.8	24.12	19.17	**44.20**	9.91

Q.1 Multiple-choice questions

1.4 The following are two pictures of the same region of the sky taken six months apart. Gridlines are overlaid on the pictures. Each grid square corresponds to an angular scale of 0.1 arc second. What is the distance of Star *X* from the Earth in unit of parsec ?



A. 0.1 pc (5.50%)
B. 0.2 pc (17.92%)
C. 5 pc (43.42 %)
D. 10 pc (32.69%)



Q.1 Structured question

Given: $GM = 4.0 \times 10^{14}$ N m^2 kg^{-1}, where G is the universal gravitational constant and M is the mass of the Earth.

Mean radius of the Earth = 6400 km.

Radius of the geostationary orbit is about 42400 km, i.e. 36000 km above Earth's surface.

The following describes a way to launch a satellite into the geostationary orbit:

- The satellite is first launched by a rocket to a circular near-Earth orbit (1) at 300 km above the Earth's surface.
- At *A*, the satellite's engine is fired for a short period of time to give it a boost needed to enter the elliptical transfer orbit (2), with *AB* as the ellipse's major axis.
- At *B*, the satellite's engine is fired again briefly to boost it into the geostationary orbit (3)

Q.1 Structured question

Assume that the three orbits are coplanar such that the elliptical orbit touches the two circular orbits at *A* and *B* respectively. During the period when the satellite travels from *A* to *B* along the transfer orbit, its engine is shut.

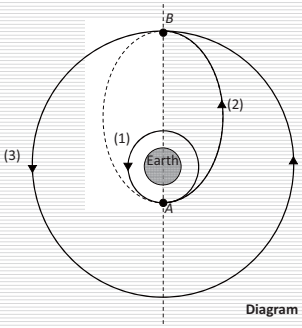


Diagram NOT drawn to scale

(a) Communications satellites are usually launched into the geostationary orbit. State and explain the advantage of such an arrangement.

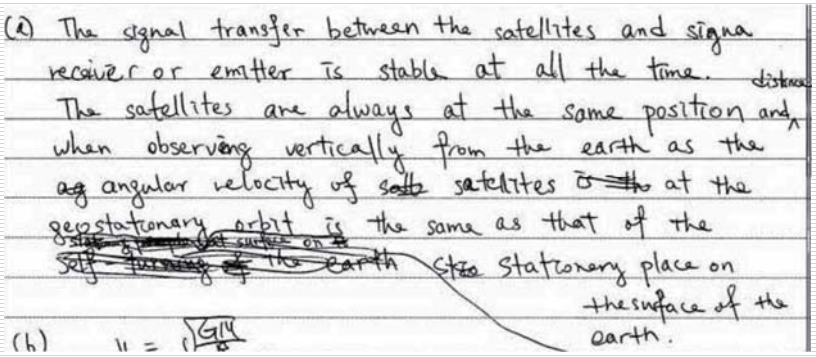
Q.1 Structured question

- Satellites will be directly above a certain location on the equator of the Earth, with period = 24 hrs same as that of the Earth, ✓ 1A
- thus enables easy transmitting / receiving signals from the Earth / no altering of aerial for tracking the satellite is required. ✓ 1A

Accept: Vertically above the Earth and stay from some spot
Appear to be stationary from Earth

NOT accept: Stable orbit
Constant distance from the Earth
On top of some place

Q.1 Structured question


(a) The signal transfer between the satellites and signa receiver or emitter is stable at all the time. distance
The satellites are always at the same position and when observing vertically from the earth as the ag angular velocity of satte satellites ~~o~~ at the geostationary orbit is the same as that of the ~~self-turning of the earth~~ Sta Stationary place on the surface of the earth.

(b) $v = \sqrt{\frac{GM}{r}}$

Some candidates were not familiar with the geostationary orbit and the applications of the satellites in it.

Q.1 Structured question

(b) Find the speed of the satellite in the near-Earth orbit (1)

- $\frac{mv^2}{r} = \frac{GMm}{r^2}$ or
- $v = \sqrt{\frac{GM}{r}} = \sqrt{\frac{4.0\times10^{14}}{(6.4\times10^6 + 0.3\times10^6)}}$ ✓ 1M
- = 7727 m s^{-1} ✓ 1A

It was well answered although mistakes like substituting incorrect radii, missing square roots or using wrong units were common.

Q.1 Structured question

(c)(i) Show that for a satellite of mass *m* moving in a circular orbit of radius *r* around the Earth, its total mechanical energy is, where *M* is the mass of the Earth. Take the gravitational potential energy of the satellite at infinity to be zero

- Total energy = $\frac{1}{2}mv^2 + (\frac{-GMm}{r})$ ✓ 1M
- $= \frac{GMm}{2r} + (\frac{-GMm}{r}) = \frac{-GMm}{2r}$ ✓ 1M

Less able candidates did not demonstrate they understood that total mechanical energy is the sum of kinetic energy and potential energy.

Q.1 Structured question

(c)(ii) U… …ergy re… = 2000 kg… *A* to the ge…

- $\Delta E =$ …10^{-3} ✓ 1M
- ✓ 1A

They f… attemp…

$\Delta E = \frac{-GMm}{2}\left(\frac{1}{r_2 - r_1}\right)$.

(c)(ii) The energy required

$= \frac{-GMm}{2r_A} + \left(\frac{-GMm}{2r_B}\right)$

$= \frac{-GM(2000)}{2(300)} + \left(\frac{-GM(2000)}{2(36000)}\right)$

$= -\frac{10}{3}GM - \frac{1}{36}GM$

$= -\frac{121}{36}GM$

$= 1.34\times10^{15}$ J

寫於邊界以外的答案，將不予評閱。

Q.1 Structured question

(c)(iii) How long does it take for the satellite to travel from *A* to *B* along the transfer orbit (2) ?

- Kepler's third law for elliptical orbit $T^2 = \frac{4\pi^2 a^3}{GM}$

or

$a = [r_A + r_B]\div 2 = \frac{6.7\times10^6 + 42.4\times10^6}{2}$

= 2.455 x 10^7 m ✓ 1M

Time from *A* to *B* $= \frac{T}{2} = \frac{1}{2}\sqrt{\frac{4\pi^2 a^3}{GM}} = \frac{2\pi}{2}\sqrt{\frac{a^3}{GM}}$

=19107 s = 318.5 min / 5.3 hrs ✓ 1A

Quite a number of candidates failed to find the semi-major axis while they forgot that only half of the period was required for the transfer orbit (2).

Paper 2

Section C : Energy and Use of Energy

Q.3 Multiple-choice questions

	A	B	C	D
3.1	**54.78**	27.90	4.10	13.06
3.2	10.68	**75.15**	10.28	3.65
3.3	11.33	4.70	**77.51**	6.39
3.4	8.58	17.14	18.18	**55.68**
3.5	18.73	**59.26**	15.40	5.86
3.6	10.26	7.35	51.93	**30.34**
3.7	**70.52**	8.59	12.17	8.52
3.8	17.33	10.22	**55.13**	17.28

Q.3 Multiple-choice questions

3.6 The Overall Thermal Transfer Value (OTTV) of a building can be reduced by making its glass windows smaller because

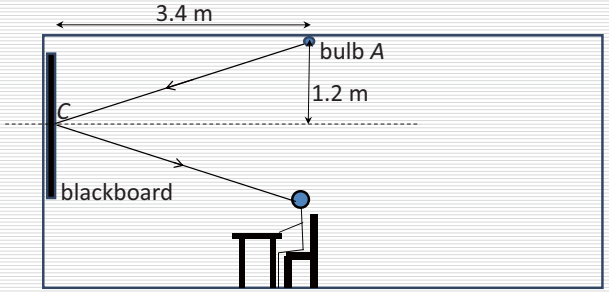
(1) glass has a much higher thermal conductivity than concrete.

(2) heat can be transferred by convection if windows are open.

(3) glass allows heat transfer by radiation.

A.	(1) only	(10.26%)
B.	(2) only	(7.35%)
C.	(1) and (3) only	(51.93%)
D.	(2) and (3) only	(30.34%)

Q.3 Structured question

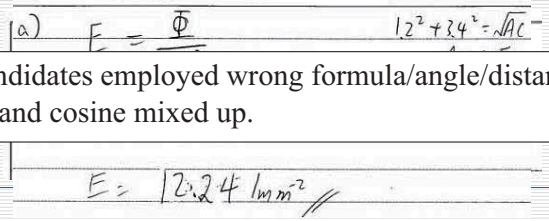


The classroom shown in Figure 3.1 has an incandescent light bulb A of luminous flux 2000 lm (lumens). You may treat the light bulb as a point light source.

Q.3 Structured question

(a) Find the illuminance, in lm m^{-2}, by bulb A around the blackboard's centre C. Neglect any reflection of light. (2 marks)

- $2000[\frac{1}{4\pi(3.4)^2}\cos^3(\tan^{-1}(\frac{1.2}{3.4}))]$ ✓ 1M
- = 11.5 (lm m^{-2}) ✓ 1A



Most candidates employed wrong formula/angle/distance or got sine and cosine mixed up.

Q.3 Structured question

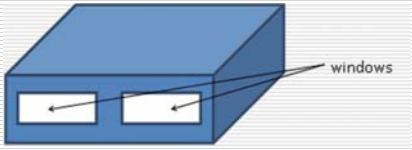
(b) Bulb A is mainly for illuminating the student's desk, however, the light ray reflected back into the student's eyes is undesirable (see the figure). Explain the type of surface that should be used for the blackboard so as to reduce such a problem. (2 marks)

- Rough surface should be used such that ✓ 1A
- reflection becomes diffuse to reduce glare. ✓ 1A
- To reduce reflection ✗

Candidates were in general weak in their understanding of the concept of 'glare'.

Q.3 Structured question

(c) Figure 3.2 shows the appearance of the classroom. The average rate of heat gain of the classroom from outside is 14.5 kW.



The classroom is designed to accommodate a maximum of 15 persons at the same time and each person produces on average 100 J of heat per second. There are altogether 6 identical incandescent light bulbs installed to illuminate the classroom and each bulb produces 80 J of heat per second.

Q.3 Structured question

(c)(i) Estimate the cooling capacity, in kW, (due to heat produced inside the classroom and heat gain from outside) required for the classroom's air-conditioning system. Assume that there is no other equipment producing heat in the classroom. (2 marks)

- 14.5 kW + 15 × 0.1 kW + 6 × 0.08 kW ✓ 1M
- = 16.48 (kW) (accept 16.48 kW or 16.5 kW) ✓ 1A

Many calculated the heat produced inside the room only.

Q.3 Structured question

(c)(ii) The power rating of each light bulb is 100 W. The air-conditioning system consumes 0.5 J of electrical energy for removing 1 J of heat from the classroom. Estimate the total monthly cost of electricity for lighting and air-conditioning if the classroom operates 8 hours a day and 20 days a month. Given: cost of electricity = $1.0 / kW h (3 marks)

- (6 × 0.1 kW + 16.48 kW × 50%) ✓ 1M
  × 8 × 20 × 1.0 ✓ 1M
- = $ 1414.4 (accept $ 1414.4 or $1416) ✓ 1A

Quite a number of the candidates wrongly stated 16.48 kW × 2 rather than 16.48 kW × 50%.

Q.3 Structured question

(c)(iii) Suggest one way of changing either the building structure or the electrical appliance so as to reduce the electricity bill through lower consumption of energy. (1 mark)

Any 1:

- Windows with low-e coating.
- Thicker walls / shading fins.
- Replace light bulb by fluorescent lamp.
- Replace air-conditioner with higher cooling capacity / COP. ✓ 1A

- Solar panel on the roof ×

Well answered !

Paper 2

Section B : Atomic World

Q.2 Multiple-choice questions

	A	B	C	D
2.1	25.19	15.78	9.18	**49.68**
2.2	25.79	20.39	**41.97**	11.72
2.3	18.35	9.76	**48.84**	22.65
2.4	9.27	18.87	27.90	**43.50**
2.5	**63.47**	4.28	10.99	21.10
2.6	3.52	**72.66**	6.50	17.26
2.7	33.70	**21.48**	20.62	23.37
2.8	**43.56**	9.98	10.36	35.86

Q.2 Multiple-choice questions

2.2 According to classical electromagnetic theory, what deductions about Rutherford's atomic model can be made ?

A. Atoms are stable and atomic spectra are continuous spectra. (25.79%)

B. Atoms are stable and atomic spectra are line spectra. (20.39%)

C. Atoms are unstable and atomic spectra are continuous spectra. (41.97%)

D. Atoms are unstable and atomic spectra are line spectra. (11.72%)

Q.2 Multiple-choice questions

2.4 The energy level of an electron in a hydrogen atom is given by $E_n = -E_o/n^2$, where E_0 is a constant and n = 1, 2, 3, …. What is the maximum wavelength of a photon that can ionize a hydrogen atom in its first excited state ?

A. $3hc/4E_o$ (9.27%)

B. hc/E_o (18.87%)

C. $4hc/3E_o$ (27.90%)

D. $4hc/E_o$ (43.50%)

Q.2 Multiple-choice questions

2.7 The minimum resolvable length of a typical transmission electron microscope (TEM) is about 0.2 nm. If a particle has the same charge of an electron and its mass is four times that of an electron, and a beam of such particles is accelerated through the same voltage in a TEM, the minimum resolvable length becomes

A. 0.05 nm (33.70%)

B. 0.1 nm (21.48%)

C. 0.4 nm (20.62%)

D. 0.8 nm (23.37%)

Q.2 Multiple-choice questions

2.8 A cube with 1 mm per side is divided into nano-scale cubes, each side measuring 1 nm. How many times has the total surface area of the cube been increased ?

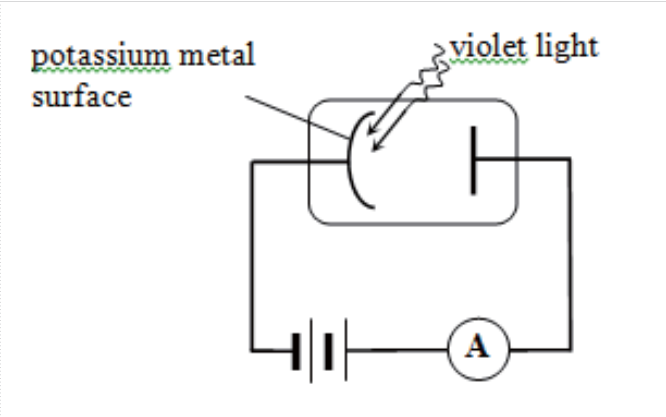
A. 10^6 (43.56%)

B. 10^8 (9.98%)

C. 10^{10} (10.36%)

D. 10^{12} (35.86%)

Q.2 Structure question



Q.2 Structure question

Maximum kinetic energy of the electrons emitted from the metal surface is 0.81 eV.
The work function of potassium is 2.30 eV.

(a) (i) Find the energy of a violet light photon in unit of eV. (1 mark)

$E = hf$ = work function + KE_{max}
= 2.30 eV + 0.81 eV = 3.11 (eV) ✓ 1A

Q.2 Structure question

- Well answered !
- Some candidates used
  $6.63\times10^{-34} f$ = work function + KE_{max}
  to find the threshold frequency first.
  Then find the energy by hf .

Q.2 Structure question

(a) (ii) Not all the electrons emitted can have maximum kinetic energy. Explain.
(1 mark)

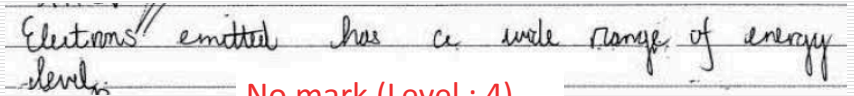
Q.2 Structure question

Any one :

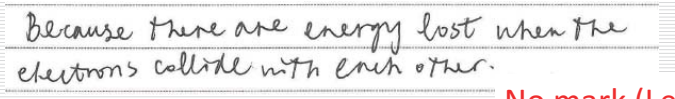
- Only those conduction / free electrons at the surface can have the maximum kinetic energy.
- Or The work function of a metal is only the minimum energy required to eject an electron.
- Or The conduction / free electrons in metal have different energies.
- Less energetic electrons are tightly bound to the nuclei and require more energy to break free of its attraction to the nuclei.
- Some electrons are not at the surface of metal so don't have maximum k.e. ✓ 1A

Q.2 Structure question

- Some candidates thought that the electrons emitted from metal surface will lose energy because they will collide with the particles/electrons.



No mark (Level : 4)



No mark (Level : ?)

Q.2 Structure question

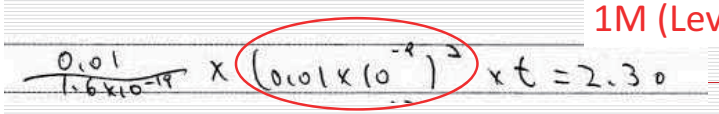
(b) (i) According to classical wave theory, an atom has to absorb enough energy from light waves to eject an electron. Estimate the minimum time required for a potassium atom to absorb energy so as to eject an electron. Take the effective area of a potassium atom in absorbing energy as 0.01 nm^2 (2 marks)

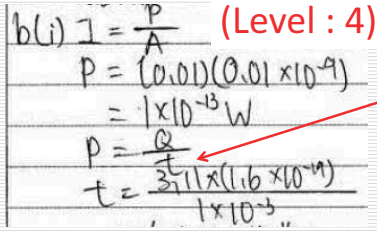
$(0.01) \times [0.01 \times (10^{-9})^2] \times t = 2.30 \times (1.60 \times 10^{-19})$ ✓1M

(RHS all correct, LHS at least 2 terms.)

$t = 3680$ s $= 61.3$ min. ✓ 1A

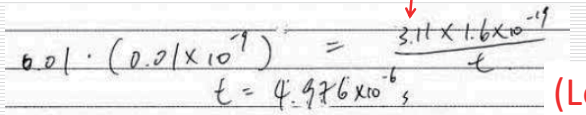
1M (Level : 5*)





(Level : 4)

No mark (incorrect work function used)



(Level : 3)

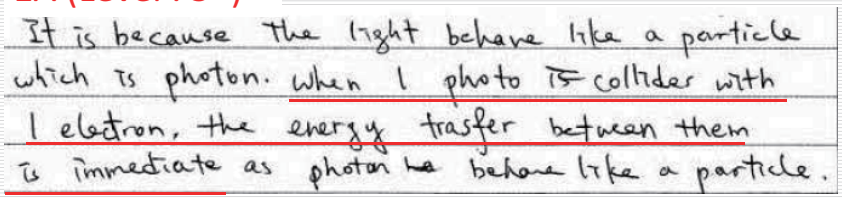
Q.2 Structure question

(b) (ii) Explain why in experiments almost no time delay is observed for electrons to be ejected from the metal surface even though the intensity of light is very weak. (1 mark)

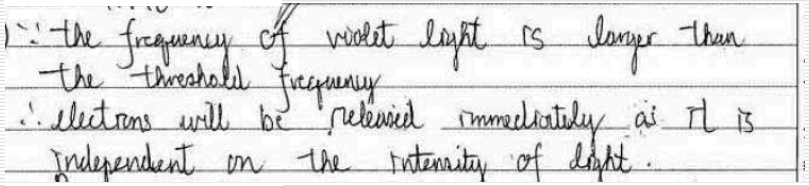
Any One:

- ☐ If a single photon has sufficient energy to knock out an electron, the electron gains enough energy in just one collision to eject an electron.
- ☐ An electron can be ejected instantaneously if it accepts a photon. ✓1A

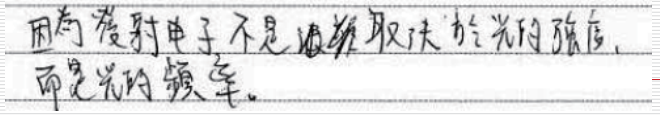
1A (Level : 5*)



0 M (Level : 4)



0 M (Level : 1)



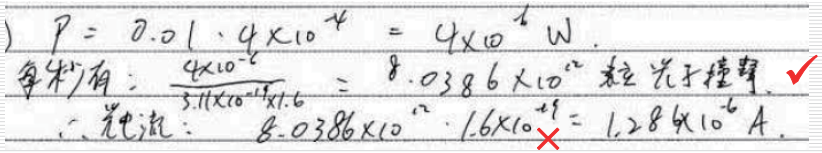
Q.2 Structure question

(c) If the area of the potassium metal surface receiving violet light is 4.00×10^{-4} m^2, how many photons hit the surface per second ? Find the maximum photoelectric current if one electron is emitted for every 10 photons hitting the surface. (3 marks)

Q.2 Structure question

No. of photons hit the surface
$= (0.01\ W\ m^{-2}) \times (4.00\times10^{-4}\ m^2) \div [3.11 \times (1.60 \times10^{-19})\ J]$
$= 8.04 \times10^{12}$ (photons per second) ✓ 1A

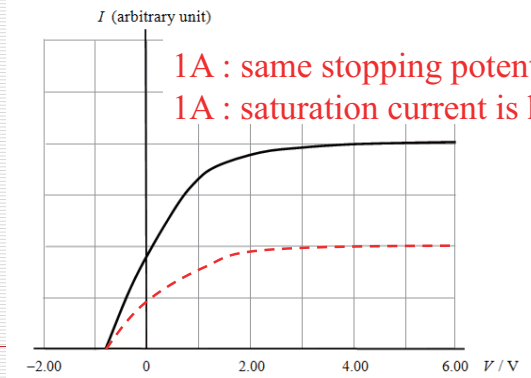
Max. photoelectric current
$= (8.04 \times10^{12}) \times 0.1 \times (1.60 \times 10^{-19})$ A ✓ 1M
$= 1.29 \times 10^{-7}$ A $= 0.13$ μA ✓ 1A



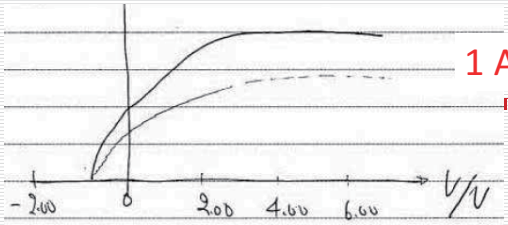
1 M (Level : 3)

Q.2 Structure question

(d) The curve of the photoelectric current I against the potential difference across the cathode and the anode V is shown in the graph below. (3 marks)

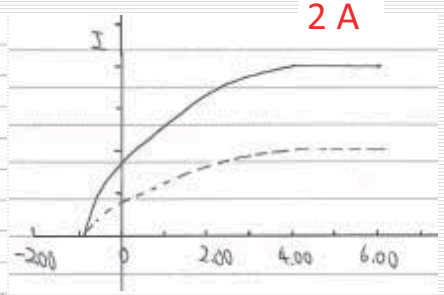


1A : same stopping potential
1A : saturation current is half of the original



1 A

0 mark



2 A

Paper 2

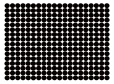
Section D: Medical Physics

HKDSE 2013

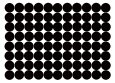
Multiple Choice

Qn.	1	2	3	4	5	6	7	8
A	47.0%	8.3%	3.6%	40.7%	11.3%	14.1%	5.3%	7.3%
B	17.6%	24.3%	30.1%	26.2%	37.9%	36.1%	52.8%	4.1%
C	30.2%	59.1%	37.9%	11.0%	13.6%	23.8%	8.5%	12.1%
D	4.8%	7.9%	28.3%	22.0%	36.9%	25.8%	33.6%	77.6%

Qn. 4.3



X



Y

The diagram represents two coherent optical fibre bundles *X* and *Y* used in endoscopes. Their cross-sections have the same dimensions but *X* has more and finer fibres. Which statements are correct ?

(1) *X* gives a much brighter image than *Y*.
(2) *X* can be bent more than *Y*.
(3) *X* gives an image of higher resolution than *Y*.

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

Qn. 4.5

A speaker is connected to an amplifier to produce sound. When the power supplied to the speaker is 50 W, the resulting sound intensity level at a certain location is 100 dB. Assume that there is no other sound source and the speaker has a fixed efficiency of converting electrical energy to sound. What is the power required to produce a sound intensity level of 110 dB at the same location ?

A. 52 W
B. 55 W
C. 100 W
D. 500 W

Qn. 4.6

1 hour after intake

3 hours after intake

6 hours after intake

(1) The darker part of the images corresponds to the part of the liver causing a greater attenuation of γ-rays.
(2) This series of images provides functional information about the liver of the patient.
(3) The difference between the images is solely due to the decay of technetium-99m.

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

Q.4 Structural question

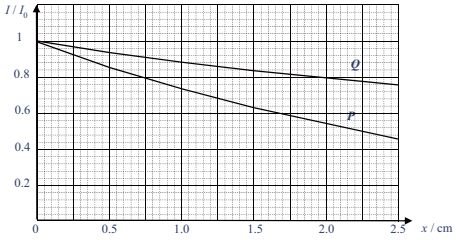
(a) Figure 4.1 shows how the intensity of an X-ray beam changes as it travels through a distance x in two media P and Q respectively. The initial intensity of the X-ray beam is I_0.

(i) What is the half-value thickness of medium P ? (1 mark)

(ii) Find the linear attenuation coefficient of medium P. (2 marks)

(iii) Does medium Q have a density higher than, equal to or lower than that of medium P ?

(1 mark)



Comment

(a)(i) was well answered although a few candidates made mistakes in the units of half-value thickness.

More than half of the candidates correctly found the linear attenuation coefficient in (a)(ii).

Overall: satisfactory

Q.4 Structural question

(b) Figure 4.2 shows an X-ray radiographic image of the chest.

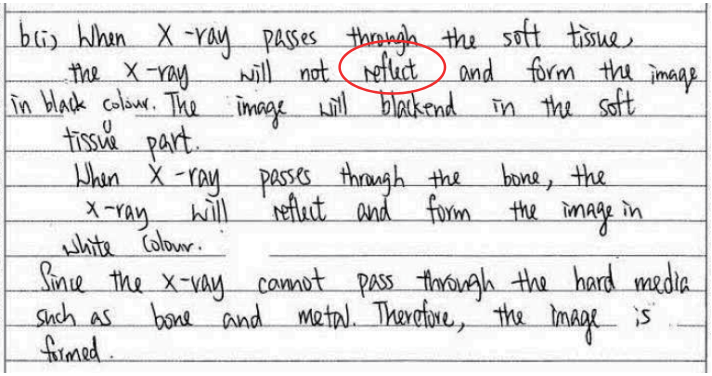
(i) Explain how the image is formed in terms of the effects on the passage of X-rays through different media including soft tissue and bone. (2 marks)
(ii) Briefly explain why a computed tomography (CT) image provides more detailed structural information of the body than an X-ray radiographic image. (2 marks)
(iii) Although CT images have the advantage mentioned above, give **TWO** reasons (other than CT scanners are more expensive) why conventional X-ray radiographic imaging has not been completely replaced by CT imaging. (2 marks)

Comment

- Part (b)(i) was in general well answered. Some weaker ones mentioned that the soft tissue or bone would 'change' the colour to black or white without referring to the X-ray film. A few wrongly thought that the weakening of X-rays was due to reflection rather than attenuation.

Overall: satisfactory

Sample – wrong concept



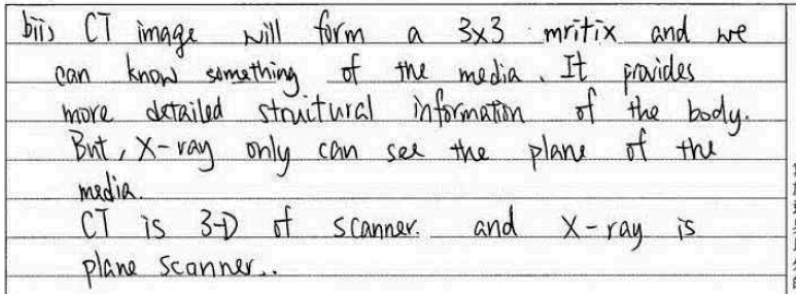
b(i) When X-ray passes through the soft tissue, the X-ray will not reflect and form the image in black colour. The image will blackend in the soft tissue part.
When X-ray passes through the bone, the x-ray will reflect and form the image in white colour.
Since the x-ray cannot pass through the hard media such as bone and metal. Therefore, the image is formed.

Comment

- In (b)(ii), most candidates just simply pointed out that the CT scan provided 3D images while X-rays radiographic image was 2D only. Only the more able ones made reference to how the CT images were formed using appropriate terms like ‘back projection’ or ‘reconstruction’.

Overall: poor

Sample – too generic


bii) CT image will form a 3x3 mritix and we can know something of the media. It provides more detailed structural information of the body. But, X-ray only can see the plane of the media.
CT is 3-D of scanner. and X-ray is plane scanner..

Comment

- Candidates’ performance in (b)(iii) was satisfactory except for misconceptions like CT scan let patients receive more ‘radioactive substances’.

Overall: good to satisfactory

The End