Candidates' Performance

Paper 1

Paper 1 consists of two sections, multiple-choice questions in Section A and conventional questions in Section B. All questions in both sections are compulsory.

Section A (multiple-choice questions)

Section A consisted of 33 multiple-choice questions and the mean score was 18. Candidates' performance in the following items revealed some of their weaknesses:

6. Two small identical blocks slide down from rest on smooth incline planes from the same height H as shown in Figure (1) and Figure (2) below. Their respective speeds at the bottom of the incline planes are denoted by v_1 and v_2 and the respective times taken to reach the bottom are t_1 and t_2. Which of the following is correct ? Neglect air resistance.

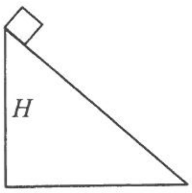


Figure (1)

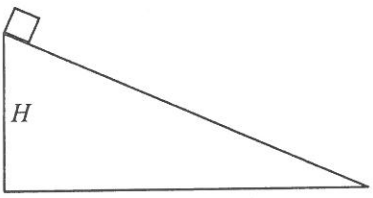
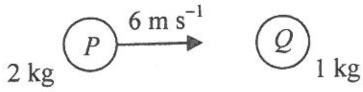


Figure (2)

A.	$v_1 > v_2$ and $t_1 = t_2$	(12%)
B.	$v_1 > v_2$ and $t_1 < t_2$	(33%)
C.	$v_1 = v_2$ and $t_1 = t_2$	(10%)
* D.	$v_1 = v_2$ and $t_1 < t_2$	(45%)

Nearly half of the candidates wrongly chose the options that a block on a steeper incline plane of the same height would reach the bottom faster.

7.



A sphere P of mass 2 kg makes a head-on collision with another sphere Q of mass 1 kg which is initially at rest. The speed of P just before collision is 6 m s^{-1}. If the two spheres move in the same direction after collision, which of the following could be the speed(s) of Q just after collision ?

(1) 2 m s^{-1}
(2) 4 m s^{-1}
(3) 6 m s^{-1}

A.	(1) only	(6%)
B.	(1) and (2) only	(36%)
* C.	(2) and (3) only	(26%)
D.	(1), (2) and (3)	(32%)

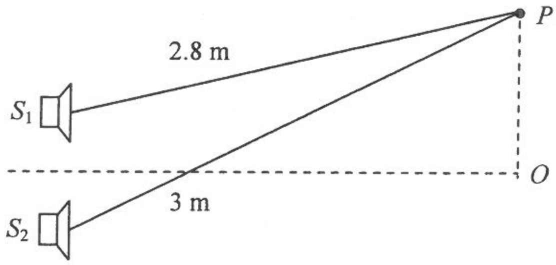
Only one quarter of the candidates were able to work out the correct speeds of Q which should not be smaller than that of P after collision.

11. An astronaut inside a spacecraft moving in a circular orbit around the Earth is apparently weightless because

A. the astronaut is too far from the Earth to feel the Earth's gravitational force. (25%)
* B. the astronaut and the spacecraft are both moving with the same acceleration towards the Earth. (29%)
C. the Earth's gravitational force on the astronaut is balanced by the reaction force of the spacecraft's floor. (9%)
D. the Earth's gravitational force on the astronaut is balanced by the centripetal force. (37%)

Over one third of the candidates attributed the astronaut's weightlessness to the Earth's gravitational force being balanced by the centripetal force.

18.

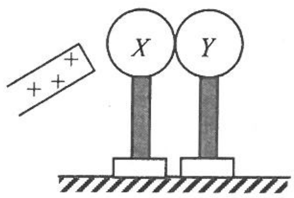


S_1 and S_2 are two loudspeakers connected to a signal generator but the sound waves produced by them are in anti-phase. Point O is equidistant from the loudspeakers while point P is at the distances shown in the figure from the loudspeakers. What type of interference occurs at O and P if the wavelength of the sound waves is 10 cm ?

	O	***P***	
A.	destructive	constructive	(14%)
B.	constructive	constructive	(31%)
* C.	destructive	destructive	(41%)
D.	constructive	destructive	(14%)

Surprisingly, more than half of the candidates failed to deduce the kind of interference which occurs at a certain point based on the overall phase difference.

20.

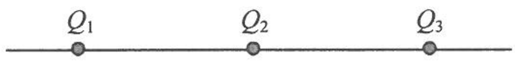


Two insulated uncharged metal spheres X and Y are placed in contact. A positively-charged rod is brought near X as shown. X is then touched by a finger momentarily and the two spheres are then separated by removing Y. The charged rod is removed afterwards. Which of the following describes the charges on X and Y ?

	sphere *X*	**sphere *Y***	
A.	uncharged	uncharged	(12%)
B.	uncharged	positive	(29%)
* C.	negative	uncharged	(44%)
D.	negative	negative	(15%)

Nearly half of the candidates did not adequately understand the movement of charges in the process concerned.

21.

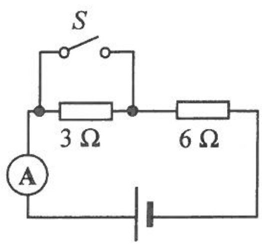


Three point charges Q_1, Q_2 and Q_3 are fixed on a straight line with Q_2 at the mid-point of Q_1 and Q_3. The resultant electrostatic force on each charge is zero. Which of the following can be the sign and magnitude (in the same arbitrary units) of Q_1, Q_2 and Q_3 ?

	Q_1	Q_2	Q_3	
A.	+2	+1	+2	(11%)
B.	+2	−1	+2	(28%)
C.	−4	+1	+4	(18%)
* D.	−4	+1	−4	(43%)

More than one third of the candidates overlooked the fact that the electrostatic force between two charges is inversely proportional to their separation.

24.



In the above circuit, the cell has constant e.m.f. and a fixed internal resistance. When S is closed, the ammeter reads 3.0 A. When S is open, which of the following is a possible reading of the ammeter ?

A.	1.6 A	(9%)
B.	2.0 A	(63%)
* C.	2.4 A	(20%)
D.	3.2 A	(8%)

It seems that over 60% of the candidates simply neglected the effects of the cell's internal resistance.

27.

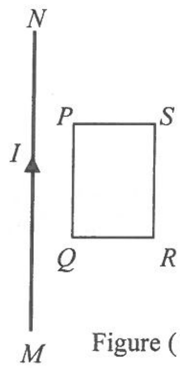


Figure (1)

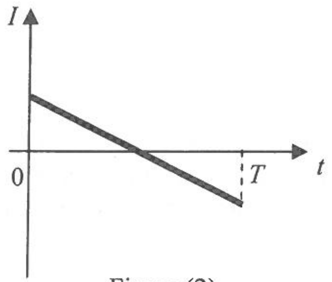


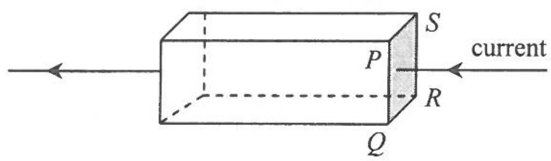
Figure (2)

A long straight current-carrying wire MN and a rectangular coil $PQRS$ are fixed in the same plane as shown in Figure (1). The current I is taken as positive when it flows from M to N and it varies with time t as shown in Figure (2). The direction of the induced current in the coil during the time interval $0 - T$ is

A.	first anti-clockwise and then clockwise.	(34%)
B.	first clockwise and then anti-clockwise.	(29%)
C.	anti-clockwise throughout.	(15%)
* D.	clockwise throughout.	(22%)

Not many candidates realised that the direction of induced current remains unchanged as the current in MN decreases uniformly with time.

29.



The figure shows a current flowing from right to left in a metal block with cross-section $PQRS$. When a uniform magnetic field is applied to the block, the electric potential of the side PQ is found to be higher than that of the side SR. In which direction can the magnetic field be applied ?

A.	from P to Q	(34%)
* B.	from Q to P	(28%)
C.	from P to S	(27%)
D.	from S to P	(11%)

Less than one third of the candidates were able to deduce the direction of the magnetic field based on the movement of negatively charged electrons.

Section B (conventional questions)

Question Number	Performance in General
1	This question was on an experiment to find the specific heat capacity of a metal. Parts (a) and (b) were well answered. Some weaker candidates mixed up the terms *heat* and *temperature* and failed to explain properly why the temperature of the block continued to rise after the heater was switched off. Some even confused the function of the heater and the power supply. In (c)(i), only the more able candidates identified the maximum temperature rise from the graph correctly and used the equation $mc\Delta T = IVt$ to work out the answer. Candidates' performance in parts (c)(ii) and (d) were satisfactory.
2	This question tested candidates' knowledge and understanding on gas laws and kinetic theory. The general performance was fair. In (a), many candidates did not fully understand the relationship between pressure and volume in the context of pumping a ball. Some were able to relate the pressure with the number of gas molecules in the basketball, but failed to work out their proportional relationship with the required volume of air originally at atmospheric pressure. In (b), few candidates were able to state that both temperature and volume were constant before they went on to explain the increase of pressure inside the basketball using kinetic theory.
3	This question was on the motion of two cars travelling along a straight horizontal road and was in general well answered. In (a), most candidates described the motion of car A along the whole journey correctly. Part (b) was well answered although some weaker candidates stated the unit of acceleration wrongly in (b)(i). In (c)(i), most candidates understood that the area under a velocity-time graph represents displacement and were able to find the separation between cars A and B. In (c)(ii), only the more able ones deduced correctly the time at which car B caught up with car A using the result of (c)(i). Candidates' performance in (d) was poor. Not many obtained the correct answer using the relation $P = Fv$. Weaker ones even confused *power* with *work done* and some failed to handle ratio properly.
4	This question was on force and acceleration. Candidates were required to comprehend a short passage on accelerometers as well as their use in smart phones. Candidates' performance was far from satisfactory. In (a), only the more able ones drew the free-body diagram correctly. Most failed to explain clearly that a net upward force was required when the box accelerated upward and thus the tension would be greater (than the weight) and the spring extended further (h decreased). Candidates did poorly in (b). Not many obtained the correct reading of the spring balance using the information given. Quite a number of them did not understand what quantity is being measured by a spring balance and wrongly gave their answers in metres. In (b), few candidates found the acceleration correctly using the equation $T - W = ma$. Some wrongly included mass $m = 5$ kg in their calculation. In (c), only the most able ones deduced the display mode correctly by considering the angle rotated by the phone or the component of the acceleration due to gravity along the y-axis of the phone. Many candidates were weak in resolving vectors and some were confused by the negative sign associated with the data.
5	This question was in general well answered. In (a), most candidates were able to apply Snell's law to find the refractive index of glass although some mistook 30° and 54° as the angles of incidence and refraction respectively. Quite a number of them did not explicitly calculate the critical angle for comparison in (b). Some even wrongly thought that the angle of incidence was 60°. In (c), some candidates were not aware that the angle of incidence should be equal to the angle of reflection at Q and thus drew the reflected light ray wrongly. Weaker candidates failed to draw the correct emergent ray. Common mistakes included drawing an internally reflected light ray at the boundary BC or a light ray straight through the boundary normally. In (d), some candidates confused *refraction* and *diffraction*, *visible light spectrum* and *line spectrum*, etc.

Question Number	Performance in General
6	Candidates did well in part (a). In (b), many candidates overlooked the fact that the parallel rays all came from a point and wrongly drew and labelled an arrow sign as the image. A few candidates misread the focal length as 10 cm from the ray diagram. In (c), only the more able ones knew that the light rays coming from the same point should intersect at the corresponding position of the image after passing through the lens. Some candidates did not follow the requirement stated in (d) and employed an experimental method using a ray box ,instead of a distant object, to determine the focal length f according to the lens formula $1/f = 1/u + 1/v$.
7	Candidates performed well in parts (a)(i) and (ii) involving the calculations of diffraction grating. Many did not have a clear concept of percentage error in x or θ and therefore failed to score marks in (a)(iii). It seems that most candidates did not understand what part (b) asked for and gave answers like using a grating with more lines per mm.
8	Part (a) was well answered. In (b), some weaker candidates failed to identify the resistance network involved in mode X. In (c), many candidates were able to identify *overall resistance least* for parallel connections but did not state that the power dissipation is inversely proportional to the resistance under the same voltage. In (d)(i), quite a number of them failed to identify the mode that corresponds to the largest operating current. In (d)(ii), most candidates knew that the switch S should be installed in the live wire, however, not many were able to point out the hazards of not doing so. Part (d)(iii) was well answered.
9	In (a), very few candidates scored full marks. Many of them omitted that the ring would fall back to the coil when the current as well as the resulting magnetic field are constant and eddy currents no longer flow. It seems that some candidates did not understand Lenz's law and were not able to express their answer clearly. Some even confused the apparatus with the Lenz's law apparatus – a small magnet falling through a metal tube – and wrongly stated that the law could be demonstrated by comparing the falling speed of the aluminum ring along the retort stand under different conditions, with the switch on or off. In (b)(i), quite a number of them confused the words *flow* and *float*. A few candidates failed to give precise answers and stated *no change* or *no observation* etc in (b)(ii).
10	Parts (a) and (b)(i) were well answered. It revealed that most candidates had a good understanding of the properties of α-particles and the meaning of activity. In (b)(ii), only the more able ones knew that the power is given by the product of energy per decay and the activity found in (a)(i). Some wrongly used the total number of plutonium atoms in their calculation instead of the activity. In (b), for those who considered the number of half-lives elapsed in order to find the decrease in number of active atoms or activity, many obtained the correct numerical answer.

The mean percentage correct achieved by the candidates was slightly higher than 50%. Most markers agreed that there was an appropriate balance between questions testing basic knowledge and those testing higher-order skills.

Paper 2

Paper 2 consisted of four sections. Each section contained eight multiple-choice questions and one structured question which carried 10 marks. Section A contained questions on 'Astronomy and Space Science', Section B on the 'Atomic World', Section C on 'Energy and Use of Energy' and Section D on 'Medical Physics'. Candidates were required to attempt all questions in two of the four sections.

Question	Popularity (%)	Performance in General
1	21	Candidates' performance in (a) was fair. In (a)(i), some candidates confused the effective area πr^2 with the spherical surface area of the planet $4\pi r^2$. Weaker ones did not realise that the power per unit area at the planet is given by $\frac{L}{4\pi d^2}$ and confused the area of the star with the area of the sphere of the planet's orbit. Some candidates failed to equate the power absorption and power radiation of the planet according to the hint stipulated in (a)(ii). Quite a number of them failed to obtain the correct surface temperature in (b)(i), however, most were still able to make a logical deduction in (b)(ii). Part (b)(iii) was in general well answered.
2	68	Part (a) revealed that many candidates were not familiar with the structure of TEM. Candidates performed well in (b). In (b)(i), most were able to derive the formula, however, some of them did not state conservation of energy explicitly. Most candidates substituted correct values into the formula to obtain the answer in (b)(ii) except for some careless mistakes, such as wrong or missing units. In (b)(iii), many candidates knew that the wavelength of an electron is smaller than that of visible light. Weaker ones misunderstood that a larger value of θ implied higher resolving power. In fact θ is the angular separation between objects such that a smaller value means that it is possible to distinguish objects of smaller separation, and thus a higher resolving power. Candidates' performance in (c) was poor. Many mixed up the features and principles of TEM and STM.
3	85	Part (a) was well answered. In (b)(i), many candidates did not fully understand the regenerative breaking system and the energy conversion involved. They failed to use concise scientific terms in their answers and common misconceptions like stating that work done against friction/internal energy/heat energy were collected and then changed to electrical/chemical energy. Less than half of the candidates answered (b)(ii) correctly. Even for those who opted for high speed being more effective, most explanations were incorrect. In (b)(iii), quite a number of them wrongly thought that the vehicle could not be stopped when the rechargeable battery was used up or the regenerative breaking system was not effective at high speed. Part (c) was well answered although a few candidates did not work out the overall efficiencies and jumped to conclude that mode 2 was the most efficient. Some candidates just stated that mode 2 was not the one with minimum emission without giving explanations.
4	26	The overall performance was satisfactory. Many candidates failed to give concise answers in (a)(i) and stated that a *current* or *electricity* was required to distort a crystal instead of a *voltage*. Some did not realise that the *change* of voltage instead of the voltage itself makes the crystal vibrate. Part (a)(ii) was well answered although some careless candidates thought that the question asked for the advantage and disadvantage of ultrasound compares with other medical imaging methods. Parts (b)(i) and (ii) were well answered. However, some had difficulties in manipulating radian and made wrong or unnecessary conversion of angles. Part (b)(iii) was poorly answered. Many candidates had no idea about the approximation $\tan\theta \approx \theta$ when θ is small. Not many were able to apply the formula of arc length ($s = r\theta$) correctly, which should be $r = L\theta$ here. Some confused r in the first formula and the r in the question and used it in place of L. Some candidates wrongly used $r/2$ instead of r.

School-based Assessment

All school candidates sitting for HKDSE Physics have to participate in School-based Assessment (SBA). For the 2014 examination, 12944 students from 434 schools submitted their SBA marks this year. The schools were divided into 24 groups and the implementation of SBA by the teachers in each group was monitored by a District Coordinator (DC). The DCs were also responsible for reviewing the submitted samples of students' work.

It must be stressed that students should complete the assessment tasks honestly and responsibly in accordance with the stipulated requirements. They will be subject to severe penalties for proven malpractice, such as plagiarizing others' work. The HKDSE Examination Regulations stipulate that a candidate may be liable to disqualification from part or the whole of the examination, or suffer a mark penalty for breaching the regulations. Students can refer to the information leaflet *HKDSE Examination - Information on School-based Assessment* (http://www.hkeaa.edu.hk/DocLibrary/Media/Leaflets/SBA_pamphlet_E_web.pdf) for guidance on how to properly acknowledge sources of information quoted in their work.

A statistical moderation method was adopted to moderate the SBA scores submitted by schools. Outlier schools after statistical moderation were identified for further follow-up by the SBA Supervisor. 61.3% of schools fall into the 'within the expected range' category, with 21.4% of schools having marks slightly higher than expected, and 17.3% of schools having marks slightly lower than expected. This is encouraging as the data shows that the majority of the teachers do have a good understanding about the SBA implementation, and hence the marking standards are generally appropriate.

Some schools were visited by the DCs to gather first-hand information on the implementation of SBA in schools. From the feedback of teachers and the DC's reports, the assessment process was smooth and effective in general. SBA marks were submitted on time and all requirements of SBA were met. The major observations for this year's SBA are:

1. This was the first time that students were required to write up a detailed report or conduct an Investigative Study as mandatory requirement of SBA. Most schools opted for the former. Nevertheless, it is encouraging to find that a certain number of schools did implement Investigative Study for SBA, in which students were asked to plan and design an experiment to come up with possible solutions to an "open-ended" task. The goal of a detailed report is to help students develop the skills to handle tasks with less structure. The design, format and tasks of those experiments were diverse and most of them were appropriate. There were just a few cases that students should have been provided opportunities for more demanding tasks such that they could demonstrate their science process skills.

2. The experiments selected for assessment were of an appropriate level of difficulty for students and relevant to the curriculum. The majority of teachers submitted 4 to 5 experiments each year for assessment, which was more than the minimum requirement. It was encouraging that some teachers provided extended questions to stretch high-tier students to experience a full range of science process skills.

3. Most reports were satisfactorily marked. Besides indicating marks awarded to different parts of the reports, teachers are advised to provide assessment criteria and written feedback in the reports wherever appropriate in order to enhance assessment for learning.

4. Based on the SBA submission, teachers selected a diverse range of experiments as the practical tasks. Similar to last year, the popular list includes measurement of resistance of a wire, focal length of a lens, refractive index and critical angle of a glass block, wavelength of visible light, projectile motion and magnetic flux of a current-carrying solenoid. Some experiments involve the verification of Boyle's Law, Ohm's Law, inverse square law, centripetal force and interference of waves. It is worth to note that some teachers designed some SBA experiments such as measuring luminance, luminous flux and efficacy of an electric light source to support the learning and teaching of the elective part of the curriculum.

5. In general, most of these tasks are suitable for SBA as well as for students' learning. However, there were a few cases in which the experiments chosen were too trivial for assessment (e.g. measurement of mass by a lever). These tasks are simple activities that require limited science process skills. The assessment aims and skills required were reiterated in the SBA Conference and follow-up by respective DCs was done. Teachers are expected to exercise professional judgment in selecting and devising tasks/worksheets that allow students to demonstrate their science process skills and competencies.