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)

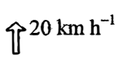
Section A consisted of 33 multiple-choice questions (of which one item was deleted) and the mean score was 17. Items where candidates' performance was typically weaker will be discussed below.

2. 0.3 kg of water at temperature 50 °C is mixed with 0.2 kg of ice at temperature 0 °C in an insulated container of negligible heat capacity. What is the final temperature of the mixture ?
Given: specific heat capacity of water = 4200 J kg^{-1} $°C^{-1}$
specific latent heat of fusion of ice = 3.34×10^5 J kg^{-1}

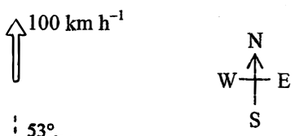
A.	−1.8 °C	(26%)
* B.	0 °C	(39%)
C.	1.8 °C	(22%)
D.	3.0 °C	(13%)

About one quarter of the candidates chose option A which is physically not possible.

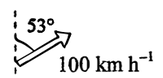
5. A car travelling at 80 km h^{-1} due east changes direction and travels at 60 km h^{-1} due north. Which diagram represents the change in velocity of the car ?

A. 

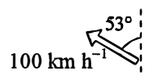
(4%)

B. 

(2%)

C. 

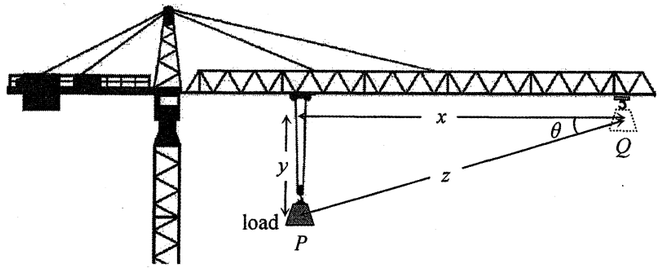
(76%)

* D. 

(18%)

Many candidates mistook the resultant velocity as the change in velocity.

9. A crane moves a load of weight W steadily from point P to point Q as shown.

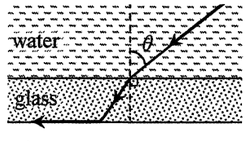


The work done on the load by the crane is

* A.	Wy.	(25%)
B.	$W(x+y)$.	(13%)
C.	Wz.	(17%)
D.	$Wz\cos\theta$.	(45%)

In this context, the work done by the crane turns into gain in gravitational potential energy. Only one quarter of the candidates were able to choose the correct answer.

17.

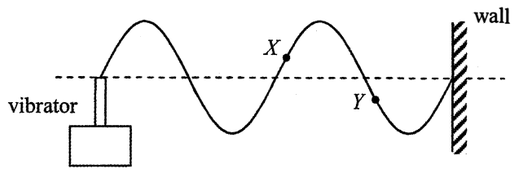


A parallel-sided glass sheet separates water from air. A ray of light in water is incident at an angle θ on the glass sheet and finally emerges into air along the glass-air interface as shown. Find θ.
Given: refractive index of water is 1.33.

A.	41.2°	(7%)
* B.	48.8°	(48%)
C.	53.1°	(8%)
D.	It depends on the refractive index of glass.	(37%)

More than one-third of the candidates thought that θ depends on the refractive index of glass (option D).

18. A string is tied to a vibrator while the other end is fixed to a wall. A stationary wave is formed as shown.

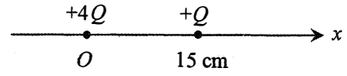


Which statement is correct when the frequency of the vibrator doubles ?

A.	The wavelength will double.	(4%)
B.	The wave speed will double.	(33%)
C.	The amplitude will be halved.	(14%)
* D.	Particles X and Y will become vibrating in phase.	(49%)

About one-third of the candidates thought that the wave speed will double as the frequency doubles (option B).

24.



Point charges $+4Q$ and $+Q$ are fixed on the x-axis with $+4Q$ at the origin O and $+Q$ at $x = 15$ cm as shown. The respective electric fields due to the two charges are equal at

A.	$x = 10$ cm.	(34%)
B.	$x = 12$ cm.	(20%)
C.	$x = 20$ cm.	(16%)
* D.	$x = 30$ cm.	(30%)

Only 30% of the candidates were able to find the point at which the respective electric fields have the same magnitude and direction.

26. Two filament light bulbs X and Y are connected in parallel to a dry cell. X is brighter than Y. Which statements are correct ?

(1) In 1 s, the number of charges flowing through X is greater than that flowing through Y.
(2) In 1 s, the electrical energy dissipated by X is greater than that dissipated by Y.
(3) For every unit charge passing, the electrical energy dissipated by X is equal to that dissipated by Y.

A.	(1) and (2) only	(37%)
B.	(1) and (3) only	(17%)
C.	(2) and (3) only	(13%)
* D.	(1), (2) and (3)	(33%)

It seemed that some candidates did not fully understand the definition of 'potential difference' as more than one-third of them wrongly held that statement (3) is incorrect.

29. A student uses a search coil to study the strength of the magnetic field inside a long solenoid which is connected to an a.c. signal generator set at a certain frequency. Which of the following can improve the accuracy of this experiment ?

(1) Ensure the plane of the search coil is perpendicular to the field lines.
(2) Increase the signal generator's frequency and use the same current as before.
(3) Set the axis of the solenoid along an east-west direction to avoid the effects of the Earth's magnetic field.

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

This item was deleted due to inadequate discrimination power. Candidates might have different understandings of the effects of increasing the signal generator's frequency on the accuracy of the experiment.

30. A sinusoidal a.c. of a certain frequency delivers a r.m.s. voltage $V_{\text{r.m.s.}}$. If its frequency is doubled and its peak voltage is halved, what would be the r.m.s. voltage ?

* A.	$\frac{1}{2}V_{\text{r.m.s.}}$	(33%)
B.	$\frac{1}{\sqrt{2}}V_{\text{r.m.s.}}$	(22%)
C.	$\frac{1}{2\sqrt{2}}V_{\text{r.m.s.}}$	(33%)
D.	$V_{\text{r.m.s.}}$	(12%)

Many candidates had difficulty in relating the r.m.s. voltage and the peak voltage in this question.

Section B (conventional questions)

Question Number	Performance in General
1	In (a), many candidates failed to figure out how to raise the temperature of the sphere to 80 °C by using the water bath given. Some mistook the towel for insulation of the polystyrene cup rather than drying the sphere. Candidates' performance in (b) was satisfactory though some of them failed to point out that the temperature rise of water is lower than it should be.
2	This question tested candidates' knowledge and understanding on gas laws. The general performance was fair. In (a), most candidates were able to find the number of moles though some of them failed to get the final answer which is the number of gas molecules. Some had a misconception in (b)(i) that the gas temperature could be kept constant by wrapping the syringe with an insulator. In (b)(ii), quite a number of them wrongly thought that V_0 is the volume of gas at absolute zero or under infinite pressure. Part (b)(iii) was well answered.
3	This was a typical question on kinematics involving apparent weight. Candidates' performance was satisfactory. Parts (a) and (b) were well answered. In (c)(i), some candidates failed to verify the result as they made mistakes in the sign of acceleration in the calculation. Most were able to obtain the answer in (c)(ii).
4	This question tested candidates' knowledge and understanding of Newton's laws of motion via an unfamiliar situation. Candidates' performance was poor. In (a), few candidates knew that the momentum change of water requires a net force from the jetpack and as a result of an action-and-reaction pair an equal and opposite supporting force is produced. Many had a misconception that this force comes from the interaction between the water ejected from the jetpack and the water surface. More than half of the candidates managed to draw the correct free-body diagram in (b). Some had difficulty in applying $F = \frac{\Delta p}{\Delta t}$ to find F in (c)(i) as the directions of water flow needed to be considered. In (c)(ii), a few candidates did not know what mechanical energy consists of. Candidates' performance in (c)(iii) was unsatisfactory. Quite a number of them suggested that a greater power is required for the person to stay at a higher position.
5	Candidates performed well in (a)(i). In answering (a)(ii), many candidates merely memorized the image formed by a convex lens without considering the observer's position. Part (b) was in general well answered. Some candidates made mistakes in reading the distance D from the graph. Quite a number of them did not realize that the object and image distances could be interchanged in (b)(iv). Many mistook the magnification of the new image as the height ratio regarding the two situations involved.
6	Although most candidates applied the correct formula to find λ in (a)(i), many made mistakes in getting the fringe separation from the pattern given or in converting the units. In (a)(ii), quite a number of the candidates confused slit width with slit separation. Not many pointed out explicitly that the diffracted waves from the slits have to overlap for interference to occur. Some candidates wrongly applied $\Delta y = \frac{\lambda D}{a}$ to find the separation between bright spots in (b)(i). Candidates' performance in (b)(ii) was poor. The patterns drawn were either with uniform separation between bright spots, not symmetrical about the centre or without the central bright spot.
7	This question tested candidates' understanding of the loading effect of meters in simple circuits. Candidates' performance in (a) was satisfactory. In (a)(i), some candidates took the product of the total current and the resistance of the resistor concerned as the voltmeter reading. Most candidates knew that the finite internal resistance of the voltmeter introduced error to the measurement but few understood how to work out the problem mathematically. Some candidates in (a)(ii) failed to state explicitly that the resistance of the voltmeter should be 'much higher' than that of the part under measurement. In (b)(i), many candidates wrongly held that both voltmeter and ammeter readings are not true values for the resistor concerned. Not many obtained the correct percentage error in R in (b)(ii).

Question Number	Performance in General
8	Candidates' performance in this question was fair. Most were able to comprehend the given passage on lightning and answered part (a) correctly. In (b)(i), some candidates confused the magnetic field due to the lightning current with that due to the induced current flowing in the square coil. For those who had attempted (b)(ii), most were able to point out that the induced current would oppose the changing magnetic field, but some forgot to explain why there is such a decreasing/increasing magnetic field in the first place. Many overlooked the hint 'fore-warning' in (b)(iii) and thus failed to distinguish which quantity could be measured 'before' lightning takes place.
9	This question tested candidates' understanding of radioactivity. Part (a) was well answered. Most candidates employed a correct formula in (b)(i) to find the age of the sample but not many were able to work out the correct ratio $\frac{N}{N_0} = \frac{3}{5}$ from the information given. In (b)(ii), the reasons stated by the candidates for the age found being an underestimate were mostly far from concise. In sketching the graph in (b)(iii), few candidates realized that the number of Pb-206 atoms is non-zero at $t = 0$.

The mean percentage correct achieved by the candidates was slightly lower 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	20	Candidates had difficulty in explaining the relationship of absolute magnitude, apparent magnitude and luminosity of a star in (a). Most of them just simply stated the meaning of each of the terms. Part (b) was well answered although not many mentioned the correct assumption that both celestial bodies are taken as black bodies. In (c)(i), stronger candidates were able to relate the terms of the equation given with those of an equation of a straight line $y = mx + c$. Most performed well in (c)(ii).
2	68	In (a)(i), many candidates were not aware that the current saturates at a voltage of 1.0 V (which is larger than 0 V) for the photocell concerned. Candidates did not fully understand what (a)(ii) asked for and very few obtained the correct answer using the information from the graph. In answering (b)(i), some mistook the result found in (a)(ii) as the work function and a lot of them failed to differentiate maximum kinetic energy, work function and stopping potential. Candidates were able to apply $\lambda = \frac{hc}{\Phi}$ to find λ but some forgot to convert the unit eV to J or just found the threshold frequency instead of wavelength. In (b)(ii), most candidates knew that the larger the wavelength, the smaller the energy of the source and thus, were able to deduce a correct conclusion. Part (c) was well answered though some candidates thought that a greater saturation current is the result of increased frequency.
3	85	In (a)(i), most candidates mentioned that the turbine will not move when the wind speed is too low, but few of them pointed out that it is due to the friction between the contact surfaces. Some candidates knew that the turbine will be damaged when the wind speed is high, however, not many went on to elaborate that the turbine is actually shut down to prevent such damage. Part (a)(ii) was well answered. In (b)(i), many took it for granted that the efficiency of the wind turbine remained the same at different wind speeds. Instead of finding the required wind speed from the graph provided, they tried to calculate the 'expected' wind speed by using an incorrect efficiency. In (b)(ii)(I), most candidates were able to find the total output power of the wind farm, but some failed to relate it precisely with the time period within which the pumped hydroelectric storage system needs to generate electricity. In (b)(ii)(II), quite a number of them mixed up the pump's input power and output power, and as a result employed an incorrect expression of efficiency in the calculation.
4	27	Most candidates were able to identify the correct picture for radionuclide imaging in (a)(i) and mentioned that the patient needs taking in a radionuclide. However, many failed to point out that the image is formed by the accumulation of radionuclide at the target organ. They simply stated that an image is formed as there is radionuclide and ignored the crucial fact that its contrast is caused by the difference in concentration of radionuclide in the body. Some candidates mixed up the working mechanism with that of X-ray photography and wrongly reasoned by the attenuation through the body. In answering (a)(ii), many stated the advantages of other methods such as 'less harmful' and 'high resolution'. Part (b)(i) was well answered. Although most candidates knew the meaning of half-life, a lot of them failed to point out that the radionuclide is being removed by a *biological process* in (b)(ii). In (b)(iii), not many were able to get the correct effective half-life. Some of them simply used either physical or biological half-life in the calculation even though they knew how to apply the formula of exponential decay.

School-based Assessment

All school candidates sitting for HKDSE Physics have to participate in School-based Assessment (SBA). For the 2016 examination, 11280 students from 427 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.

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. 53.8% of schools fall into the 'within the expected range' category, with 29.9% of schools having marks slightly higher than expected, and 16.3% 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. Most schools opted for the write-up of a detailed report while an increasing 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 science process skills to handle tasks without detailed instruction. The design, format and tasks of those experiments on various topics 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 through which they could demonstrate their higher ability skills.

2. Based on the SBA submission, the majority of teachers submitted a total of 4 to 5 experiments for assessment, which was more than the minimum requirement. Teachers selected a diverse range of experiments as practical tasks, and these tasks were of an appropriate level of difficulty and relevant to the curriculum. The popular list includes projectile motion, refractive index and critical angle of a glass block, focal length of a lens, wavelength of visible light and diffraction grating, measurement of resistance of a wire 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 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. Common errors made by students in areas, such as measurements and observations, presentation of results, graphical works and analysis can be highlighted by teachers, together with what is acceptable or what is not acceptable in the work assessed, so that students can learn from these errors.

4. In general, most of the tasks selected or devised are suitable for SBA as well as for students' learning. However, there were a few cases in which the experiments chosen for assessment just involved limited science process skills. Teachers are advised to exercise professional judgment in selecting and devising tasks/worksheets that allow students to demonstrate their science process skills and competencies.

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.