Candidates' Performance

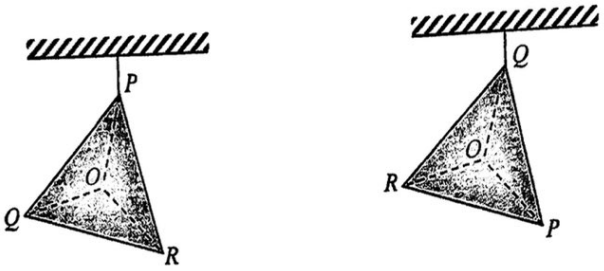
Paper 1

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 19. Items where candidates' performance was typically weaker will be presented below with mean percentage statistics.

4.

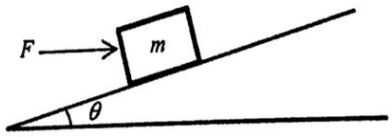


O is the centre of a metal plate PQR in the form of an equilateral triangle with **non-uniform** mass distribution. The plate is suspended from the ceiling at P and then at Q as shown. The centre of gravity of the metal plate is

A.	at O.	(14%)
B.	within the region POQ.	(19%)
C.	within the region ROQ.	(10%)
* D.	within the region POR.	(57%)

Just over half of the candidates were able to locate the centre of gravity of an object in the context given.

5.

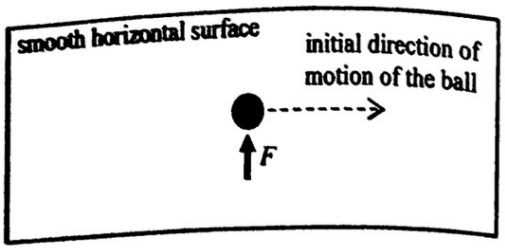


In the above figure, a horizontal force F is applied to a block of mass m so as to keep it at rest on a smooth incline making an angle θ with the horizontal. Find the magnitude of F.

* A.	$\dfrac{mg\sin\theta}{\cos\theta}$	**(50%)**
B.	$mg\sin\theta\cos\theta$	**(19%)**
C.	$\dfrac{mg\cos\theta}{\sin\theta}$	**(14%)**
D.	$mg\sin\theta$	**(17%)**

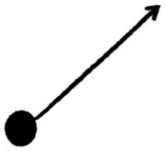
Half of the candidates were able to obtain the correct answer using resolution of forces.

10.



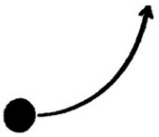
The above figure shows a ball moving with a constant speed along a straight line on a smooth horizontal surface. At a certain instant, the ball is acted on by a force F for a very short time as shown above. Which subsequent path below would the ball most closely follow ?

* A. (40%)

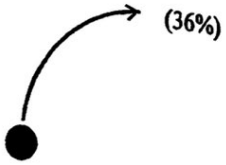


B. (6%)

C. (18%)

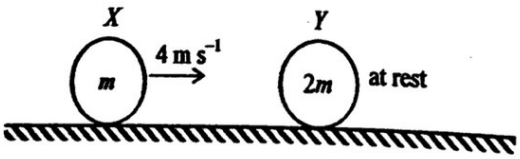


D. (36%)



More than half of the candidates did not have a good understanding of the inertial behaviour of objects, choosing instead options C and D.

11.



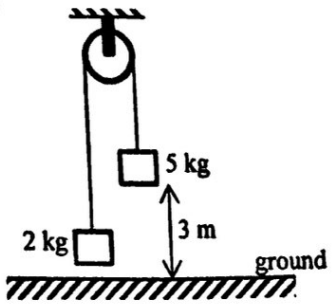
On a smooth horizontal surface, sphere X of mass m travels with speed 4 m s^{-1}. It collides head-on with another sphere Y of mass $2m$, which is at rest initially. Which of the following can be the speed of Y just after collision ?

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

A.	(1) only	(12%)
* B.	(2) only	(27%)
C.	(1) and (2) only	(41%)
D.	(2) and (3) only	(20%)

Just over one-quarter of the candidates were able to obtain the correct answer.

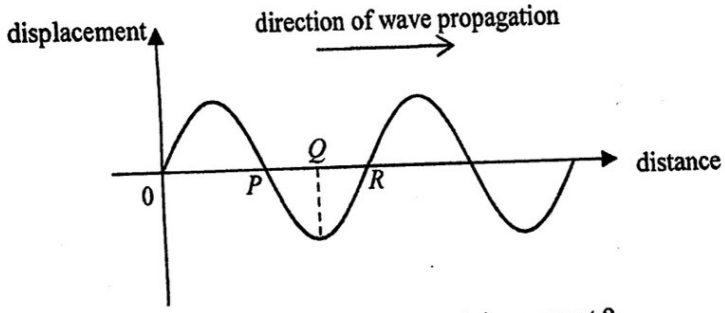
13. Two blocks of respective masses 2 kg and 5 kg are connected by a light inextensible string which passes over a smooth fixed light pulley as shown. The system is released from rest when the 5-kg block is 3 m above the ground. What is the speed of the 5-kg block just when reaching the ground ? Neglect air resistance. ($g = 9.81\ m\ s^{-2}$)



* A.	$5.0\ m\ s^{-1}$	(34%)
B.	$6.0\ m\ s^{-1}$	(20%)
C.	$6.5\ m\ s^{-1}$	(15%)
D.	$7.7\ m\ s^{-1}$	(31%)

Almost one-third of the candidates chose option D only considering the 5 kg block as a free falling object.

14. The figure shows the displacement-distance graph at a certain instant of a longitudinal wave which travels to the right. Displacement to the right is taken to be positive.



At the instant shown, which of the following statements is/are correct ?

(1) P is a centre of compression.
(2) A particle with its equilibrium position at Q is at rest.
(3) A particle with its equilibrium position at R is moving downwards.

A.	(1) only	(18%)
B.	(3) only	(17%)
* C.	(1) and (2) only	(35%)
D.	(2) and (3) only	(30%)

Judging from the percentage of candidates choosing (3), nearly half of the candidates wrongly thought that the particle at R would move downwards for a longitudinal wave.

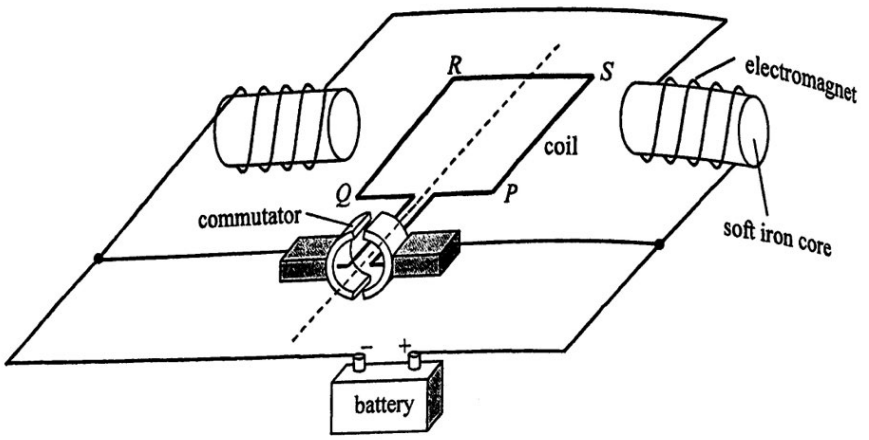
23.

In the above figure, point charge Y is placed in the middle of two identical positive point charges X and Z, with Z being fixed. Both X and Y are in equilibrium and at rest initially. What would happen to X if Y is slightly pushed towards Z?

* A.	It moves towards the left.	(34%)
B.	It moves towards the right.	(25%)
C.	It remains at rest.	(23%)
D.	It cannot be determined as the sign of Y is not known.	(18%)

About a third of candidates demonstrated a correct understanding of Coulomb's law.

27.



The figure shows the structure of a motor. The coil $PQRS$ and the two electromagnets are connected to a battery so that the coil rotates continuously. If a sinusoidal a.c. source of frequency 50 Hz is used instead of a battery, the coil will

A.	remain at rest.	(13%)
B.	oscillate at a frequency 50 Hz.	(23%)
C.	rotate to a vertical position and then stop.	(20%)
* D.	rotate continuously.	(44%)

Less than half of the candidates realised that the direction of the torque always remains the same in this set-up when a sinusoidal a.c. source is used.

30. The power consumption of the heating element of an electric heater connected to an a.c. mains can be increased by

(1) increasing the electrical resistance of the heating element.
(2) increasing the frequency of the a.c. voltage.
(3) increasing the r.m.s. value of the a.c. voltage.

A.	(1) only	(26%)
* B.	(3) only	(45%)
C.	(1) and (2) only	(13%)
D.	(2) and (3) only	(16%)

About 40% of the candidates wrongly thought that the power consumption would increase when the heating element's resistance is larger and therefore chose options A and C.

Section B (conventional questions)

Question Number	Performance in General
1	This question was in general well answered. In (a)(i), most candidates obtained the correct answer though a few omitted the term for the heat gained by the melted ice to reach the final temperature of 10 °C. Although most candidates realised that more ice was needed in (a)(ii), some wrongly stated that more energy should be 'absorbed' by the container if its heat capacity was not negligible. In (b), the heat transfer processes were well understood by candidates, however, quite a number of them mistook the direction of heat flow and stated that the inner silvery surface was a poor absorber of radiation in (b)(ii).
2	The question was in general well answered. Most managed to obtain the answer in (a) despite some forgetting to convert the temperature given in Celsius to an absolute temperature on the Kelvin scale or mixed up number of molecules with the number of moles. In (b)(i), many candidates knew that the decrease in pressure would in effect increase the volume of the balloon. However, few were able to compare the change in pressure with the change in temperature while some wrongly thought that the volume remained unchanged. Candidates did well in the calculation in (b)(ii) although some considered the temperature to be constant and wrongly used Boyle's law to estimate the pressure. A few made mistakes when converting units or wrongly took the base of the exponential function as an electronic charge.
3	This question tested candidates' knowledge and understanding in Mechanics in the context of life nets. The overall performance was fair. Part (a)(i) was well answered. Many candidates omitted the falling person's weight in finding the average force acting on the person by the net in (a)(ii). In (b)(i), some candidates failed to point out the possible consequences for a person falling from a great height. Not many realised that in (b)(ii) the determining factors for reaching the life net's central part are the initial horizontal velocity and the time of fall of the projectile motion, not air resistance or wind, which were neglected.
4	Candidates' performance was fair. Quite a lot of them had difficulties relating the angular velocity with the rotation rate in (a)(i). Most candidates were able to find the centripetal force F_C in (a)(ii). However, a few did not indicate F_C in the figure or mistook the length of the string to be the radius. In (a)(iii), a majority of the candidates tackled this part by finding out the value of the tension. Weaker candidates held that the tension was the resultant of the bob's weight and the centripetal force. In (b)(i), some candidates failed to point out that no work is done by the gravitational force acting on the Moon while weaker ones failed to realise that the centripetal force is actually the gravitational pull and stated that the net force acting on the Moon was zero. In (b)(ii), most were able to mention an action-and-reaction pair or use $F = \frac{GMm}{r^2}$ to explain.
5	This question was in general well answered. Most obtained the correct answers in (a) although a few wrongly counted the number of wavelengths in the shallow region. In (b)(i), the less able candidates struggled to find the frequency of the water wave in the deep region, which should remain unchanged (at 10 Hz). Quite a number of the candidates failed to sketch the refracted wavefronts properly in (b)(ii). Common mistakes included wavefronts bending towards instead of away from the normal or not continuing across the boundary. Part (b)(iii) was well answered except for a few who confused refraction with diffraction.

6	This question tested candidates' knowledge and understanding on image formation by a concave lens. Candidates' performance was fair. Most realised that the lens was a concave one and gave valid explanation in (a). However, some made mistakes in the position and height of the object in (b) and thus failed to locate the correct position of the focus in (c). Part (d) was poorly answered. Not many were able to draw a correct light ray from the object so as to illustrate how the image's tip could be observed.
7	Part (a) was in general well answered. Most candidates were able to draw the circuit diagram correctly though some failed to mark the polarities of the voltmeter or wrongly connected it across the switch. Quite a number of the candidates suggested precautions that were not relevant to accuracy or safety of the experiment like 'using a voltmeter (assumed ideal) of a very high resistance'. In (b), not many gave a correct expression of V in terms of ξ, r and R. A significant number of them mistook that V varied linearly with R or they had a directly proportional relationship.
8	The question tested candidates' knowledge and understanding on domestic circuits. The overall performance was good. Most answered part (a) correctly though some drawings of the connecting wires were quite messy. In (b)(i), many candidates knew the advantage of connecting L_1 and L_2 in parallel, however, some gave incomplete or wrong answers like 'both can work under the same voltage' or 'when one lighting set failed to work due to a short circuit, the other can still work'. Although most managed to find the working currents of the two lighting sets in (b)(ii), a few wrongly thought that the fuse value should be greater than either currents but not the total. Part (c) was well answered.
9	Candidates' performance was poor. In (a)(i), most candidates employed Lenz's law to explain and stated that there was a change of magnetic flux due to the decrease in magnetic field strength but forgot to mention the induced e.m.f. for driving the induced current. Some candidates were confused about 'flux change' and 'change in total flux linkage' in (a)(ii) though they managed to find the induced e.m.f. in the coil. In (b)(i), many failed to realise that the direction of magnetic flux through the coil would have been reversed after a rotation of 180°. In (b)(ii), many candidates wrongly thought that there would be no induced current at the moment when the magnetic flux through the coil was zero (while the change of magnetic flux was in fact at a maximum). Part (c) was poorly answered. Most candidates failed to indicate precisely where the eddy currents were induced. It seemed that candidates' answer to (c)(ii) were quite random – not moving, from left to right, or even rotating or oscillating.
10	Part (a)(i) was well answered. Not many gave the crucial condition that the number of neutrons produced in fission must be greater than one for a chain reaction be sustained in (a)(ii). Weaker candidates may have thought that slow neutrons had to be the products of the fission reaction. Most managed to find the amount of U-235 in the sample 2×10^9 years ago in (b)(i) but not many obtained the correct value of its concentration by mass in (b)(ii). Candidates' performance in (c) was poor. Very few were able to relate the energy of fission with the dry up of underground water, which led to a ceasing of the supply of slow neutrons. Wrong answers given by candidates included: the neutrons were not energetic enough or the concentration of the fuel was not high enough.

The mean mark 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	20	In (a)(i), most candidates knew how to find the speed of the spacecraft at B using conservation of total mechanical energy though a few made mistakes in unit conversion. Some candidates failed to answer (a)(ii) correctly as they did not know that the semi-major axis of the elliptical orbit should be employed in the calculation. Not many were able to explain the 'weightlessness' phenomenon in (a)(iii). A few had a misconception that both the astronaut and the spacecraft moving at the same acceleration would necessarily result in weightlessness. Quite a number of the candidates managed to find the angular separation θ required in (b)(i) using various methods. Parts (b)(ii)(iii) were poorly answered. It seemed that most candidates did not know that the initial launching speed of the spacecraft at the Earth's surface would eventually determine the shape of its trajectory.
2	66	In (a)(i), it seemed that most candidates knew the results of Rutherford's scattering experiment, however, some failed to provide a concise description regarding the degree of deflection and the amount of alpha particles being deflected. Part (a)(ii) was poorly answered. More than half of the candidates held the belief that the majority of the alpha particles would be rebounded backward if the Thomson's atomic model were true. In (b)(i), weaker candidates did not know the physical significance of energy levels being negative. Some tried to relate it with the force of attraction between electrons and the nucleus. Candidates' performance in (b)(ii) was satisfactory. Most knew how to find the energy difference corresponding to the electron transition though a few failed to obtain the correct wavelength. In (b)(iii), some candidates just took the energy of the 3rd excited state instead of the difference between this value and E_∞ as the energy for ionizing an atom at that particular energy level.
3	84	Part (a)(i) was in general well answered. Some candidates failed to realise that the power of the Sun distributes evenly on a spherical surface according to the inverse square law. In (a)(ii), quite a number of the candidates were unable to account for the energy loss of the solar radiation power through the atmosphere. Not many managed to describe the energy conversions in (b)(i) correctly. Some wrongly thought that it was electrical energy instead of chemical energy being stored in the battery while a few believed that heat or heat and light energy were being converted by the solar panel. Most managed to find the efficiency of the solar panel in (b)(ii). Candidates' performance in (b)(iii) was fair. Some candidates did not realise that the capacity '100 Ah 12 V' of the battery actually gives the maximum energy 1.2 kW h which can be stored. Many failed to get the correct answer as they wrongly multiplied this energy by the time of charging or made mistakes in the charging efficiency.
4	30	Part (a)(i) was well answered. Candidates' performance in (a)(ii) was far from satisfactory. Weaker candidates even mistook α_{max} in air as the critical angle while some wrote about total internal reflection at the air-glass boundary instead of the glass-cladding boundary inside the endoscope. Most were able to give either one advantage or disadvantage of using an endoscope over a radiographic imaging using X-rays in the context of (a)(iii). However, some failed to give a more precise answer such as 'radiations' instead of 'ionizing radiations' when discussing the associated harmful effects as a disadvantage. Part (b)(i) was well answered. In (b)(ii), a few misinterpreted the question and they calculated wrong ratios, e.g. the intensity of ultrasound transmitted through the boundary to that incident to the boundary or the ratio between the reflected and transmitted intensities. In (b)(iii), not many explicitly pointed out that a greater acoustic impedance difference between two tissues yields an easier distinguishable boundary due to a larger intensity reflection coefficient.

School-based Assessment

All school candidates sitting for HKDSE Physics have to participate in School-based Assessment (SBA). For the 2019 examination, 10323 students from 437 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. 53.2% of schools fall into the 'within the expected range' category, with 28.3% of schools having marks slightly higher than expected, and 18.5% 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. Based on the reports submitted, it was found that most schools opted for detailed reports instead of 'Investigative Study' (denoted as IS) for SBA. It is worth mentioning that curriculum time of sixteen hours has been set aside exclusively for teachers to conduct IS. As a complement to course work, practical work helps students achieve the learning targets mentioned in the Physics Curriculum and Assessment Guide (Secondary 4-6).

2. Schools were expected to provide a minimum of eight tasks to students in SS5 and SS6. The task lists of experiments submitted for SBA were diverse. Most of the tasks were appropriate and they covered relevant topics drawn from the curriculum. It was found that the average number of SBA tasks submitted was around five experiments (Note: The mandatory requirement is three experiments). The reports submitted also revealed that tasks of diverse difficulty levels were chosen by teachers to match students' ability spectrum. On the whole, about one-third of the tasks was related to Light and Optics, one-third was in Electricity and Magnetism, one-sixth was about Mechanics, just over 10% was in Heat and Gases, the rest was in Atomic World and Energy and Use of Energy.

3. Based on the detailed reports submitted for SBA, it revealed that most students were able to follow procedures to carry out experiments, make observations and measurements, record data, interpret results and draw conclusion. Students are expected to work efficiently and complete the experiment as well as all the data analysis during the laboratory session. It is encouraging to observe that some students were able to make comments on things that went wrong, make notes on additional procedures attempted that were not stipulated in the manual, or comment on problems encountered, e.g. instrument handling, difficulties, errors or outliers in the data. There were some teachers who deliberately designed SBA tasks to be open-ended in which procedures of the experiment were not given and the result unknown.

4. Most reports were satisfactorily marked. Besides indicating marks awarded to different parts of the reports, many teachers provided assessment criteria and written feedback in the reports wherever appropriate in order to enhance assessment for learning. The mark allocation for practical skills (ranging from 20% to 40%) and report writing skills was on the whole stated clearly in the reports submitted. Common mistakes such as the number of decimal places, significant figures, dependent and independent variables, choice of scales and line of best-fit can be highlighted by teachers, together with comments of what is acceptable or what is not acceptable work in the report, so that students may learn from these comments.

5. In general, most tasks selected or devised were suitable for SBA as well as for learning. However, there were a few cases in which the experiments chosen were either too trivial for assessment or of limited science process skills. As such, the students concerned might be deprived of achieving the learning targets of practical work for physics. Some of the experiments were simple activities given as cookbook worksheets that require a few words to be filled in rather than developing basic science writing skills. The assessment aims and skills required were reiterated in the SBA Conference, and a follow-up by respective DCs was conducted. Teachers are expected to exercise professional judgment in selecting and devising tasks/worksheets, so that students' science process skills and competencies in report writing can be nurtured through these tasks.

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 plagiarising others' work. The HKDSE Examination Regulations stipulate that a student 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.