Candidates' Performance

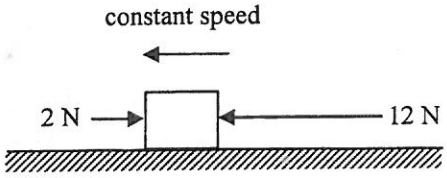
Paper 1

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 36 multiple-choice questions and the mean score was 19. Candidates' performance in the following items revealed some of their weaknesses:

7.

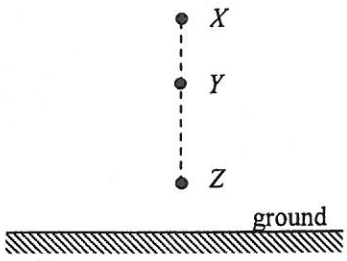


A block on a rough horizontal surface is moving to the left with constant speed under two horizontal forces 2 N and 12 N indicated as shown. If the force of 12 N is suddenly removed, what is the net force acting on the block at that instant ?

* A.	12 N	(25%)
B.	10 N	(15%)
C.	8 N	(26%)
D.	2 N	(34%)

Only one quarter of the candidates identified the correct answer as Option A, which suggests that a majority of candidates did not realise that friction applies as long as the block is still moving.

8.

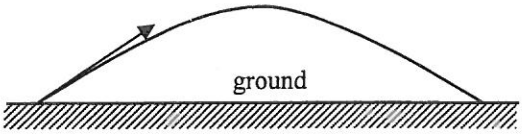


A particle is released from rest at X as shown. It takes time t_1 to fall from X to Y and time t_2 to fall from Y to Z. If $XY : YZ = 9 : 16$, find $t_1 : t_2$. Neglect air resistance.

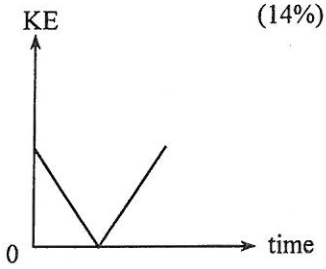
A.	2 : 3	(10%)
B.	3 : 4	(37%)
C.	4 : 3	(12%)
* D.	3 : 2	(41%)

It seems that candidates were not competent in using the formula $s = \frac{1}{2}gt^2$ to tackle this problem.

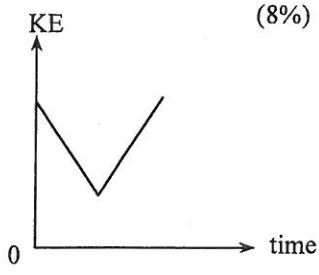
13.



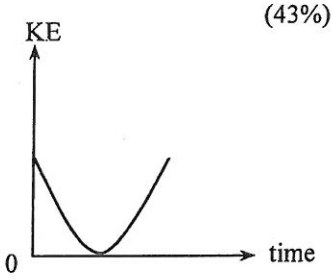
A particle is projected into the air at time $t = 0$ and it performs a parabolic motion before landing on the ground as shown. Which graph represents the variation of the kinetic energy (KE) of the particle with time before landing ? Neglect air resistance.

A. 

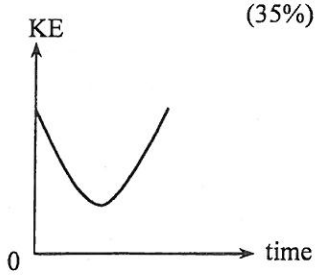
(14%)

B. 

(8%)

C. 

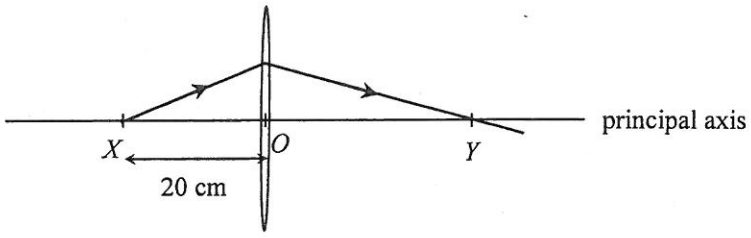
(43%)

* D. 

(35%)

More than half of the candidates did not realise that the particle still has kinetic energy when it flies horizontally at the highest point.

22.



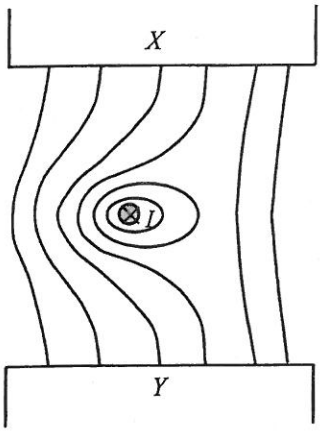
A point light source at X on the principal axis of a thin convex lens emits a ray of light. The ray passes through the lens and reaches the principal axis at point Y as shown. O is the optical centre of the lens such that $OX = 20$ cm and $OY > OX$. Which of the following statements is/are correct ?

(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%)

About 40% of the candidates did not demonstrate a full understanding of the concept of reversibility of light.

26.

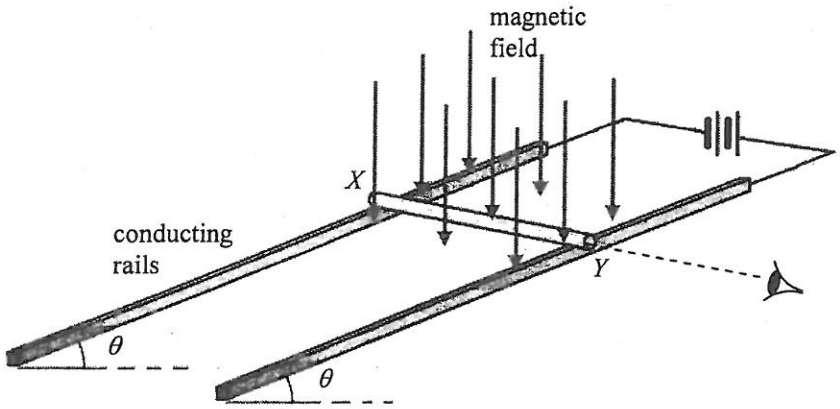


A straight wire carrying current I pointing into the paper is placed in a magnetic field between pole pieces X and Y. The figure shows the resultant field line pattern. What is the polarity of pole piece X and in what direction is the magnetic force acting on the wire ? Ignore the effect of the Earth's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

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

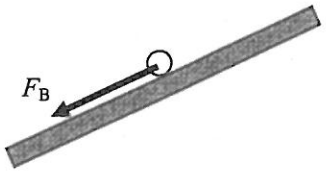
More than half of the candidates identified the correct polarity although some of them made mistakes in the direction of magnetic force.

28.

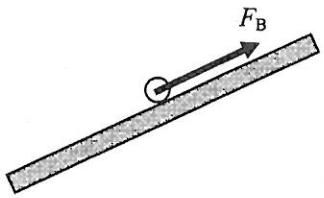


A copper rod XY is placed on a pair of smooth inclined conducting rails which are located in a magnetic field applied vertically downward. The rails make an angle θ to the horizontal and a battery is connected to the rails as shown above. Which diagram shown below represents the magnetic force F_B acting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

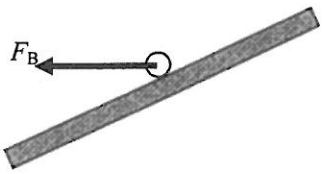
A. (23%)



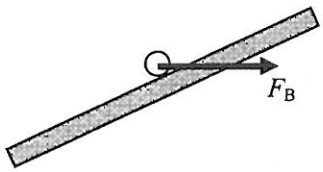
B. (13%)



* C. (42%)



D. (22%)



More than 30% of the candidates did not realise that the magnetic force F_B must be perpendicular to the magnetic field.

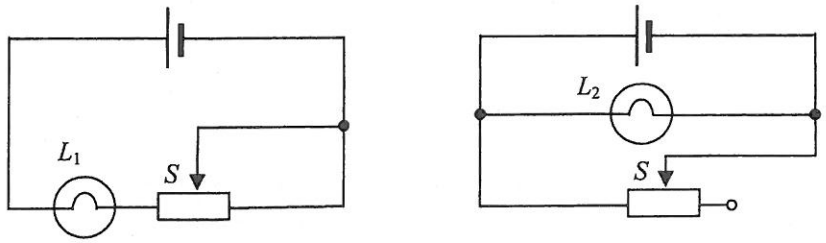
29.

A metal rod OP is rotated about O in a clockwise direction in the plane of the paper with a uniform magnetic field pointing into the paper. Which statement is correct ?

A.	An induced current flows in the rod from O to P.	(18%)
B.	An induced current flows in the rod from P to O.	(14%)
C.	E.m.f. is induced in the rod with end O at a higher electric potential.	(26%)
* D.	E.m.f. is induced in the rod with end P at a higher electric potential.	(42%)

More than 30% of the candidates wrongly thought that an induced current could flow in an incomplete circuit.

31.

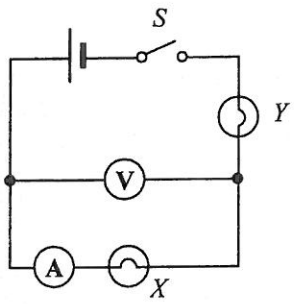


In each of the above circuits, the cell has constant e.m.f. and negligible internal resistance. When the sliding contact S of each rheostat shifts from the mid-position to the right, how would the brightness of each bulb change ?

	bulb L_1	**bulb L_2**	
* A.	becomes dimmer	remains unchanged	(43%)
B.	becomes dimmer	becomes brighter	(29%)
C.	remains unchanged	becomes dimmer	(17%)
D.	becomes brighter	remains unchanged	(11%)

More than 40% of the candidates failed to realise that the brightness of L_2 would not be affected by the change in resistance of S in the parallel branch.

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 ?

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

It seems that more than half of the candidates did not fully understand the meaning of short circuit and open circuit.

Section B (conventional questions)

Question Number	Performance in General
1	This question was in general well answered. In (a), most candidates were able to calculate the energy released by the water using the equation $E = mc\Delta T$, but less able candidates failed to include the 15% energy lost during the transfer of water. In (b), most candidates were able to work out the time needed for the water temperature to drop to 60℃ although some did not give their answers in hours as required. In (c), only the more able candidates gave a satisfactory explanation on why the rate of heat released by the system gradually dropped.
2	In (a), not many candidates were able to state the correct procedures to be done before taking a reading. They mentioned stirring the water but not stopping the heat. In (b)(i), many candidates managed to work out the correct numerical answer but some of them used incorrect units. In (b)(ii), the concept of absolute zero by experiment ($\ell = 0$) was not well interpreted by some candidates. Many of them just stated –273°C as absolute zero without deducing the value from the data given.
3	This question tested candidates' knowledge and understanding on work, energy and power using the example of a lift. Candidates' performance was satisfactory. Part (a) was well answered. In (b)(i), only the more able candidates worked out correctly the total mechanical power output of the motor when the counterweight was installed. Most knew that in (b)(ii) the output power required from the motor was smaller with the addition of the counterweight. Few candidates were able to explain clearly why the claim in (b)(iii) was not true. Some wrongly thought that the lift could still be raised even when the drum's surface was frictionless.
4	Part (a)(i) was well answered. In (a)(ii), some candidates failed to indicate the direction of the electron's acceleration at point P. In (b), many candidates were able to point out that the force was perpendicular to the electron's displacement/velocity but very few mentioned that there was no work done or that the kinetic energy remained unchanged. In (c), some candidates were able to arrive at $r = \frac{mv}{qB}$ but they failed to deduce that v should be halved either by calculation or explanation.
5	This question required candidates to use the apparatus provided to describe an experiment to study how the stopping distance of a toy skier depends on its height of release. The general performance was poor. Only the more able candidates showed clearly in their answers the procedures taken, the physical quantities to be measured and the expected result based on the work-energy principle. Many candidates stated that the stopping distance would increase with the height of release, but without any graphical or mathematical elaboration. Quite a number of them did not make proper use of the long rough paper strip and the metre rule provided to perform the experiment.
6	This question tested candidates' knowledge and understanding in Mechanics in the context of bungee jumping. The overall performance was only fair. In (a)(i), most candidates knew that the jumper was in free fall at the start. However, only the most able ones described correctly the change in acceleration after the cord began to stretch. Many candidates wrongly thought that the jumper began to decelerate once the cord stretched. In (a)(ii), most demonstrated an understanding that gravitational potential energy changed to kinetic energy during the fall. However, not many mentioned that all the gravitational potential energy changed to elastic potential energy in the cord at the lowest point. In (b), only the more able candidates explained clearly that the elastic cord lengthened the stopping time, hence reducing the net force acting on the jumper. In (c), candidates knew that contact area was larger for a 'full body harness' but few were able to apply the concept of pressure in their explanations.

Question Number	Performance in General
7	Most candidates answered part (a) correctly although a few of them forgot to convert the unit of wavelength to metres. Some candidates were not able to demonstrate an understanding that microwaves travel at the speed of light and a few even mistook it as the speed of sound (340 m s^{-1}). In (b)(i), candidates showed an understanding that the alternate maxima and minima were due to constructive and destructive interference respectively, but very few stated the reason for this was due to variation of path difference along XY. In (b)(ii), some candidates failed to realize that the path difference concerned was $1\frac{1}{2}\lambda$ or mistook it as $AP - BP$. Candidates' performance in (b)(iii) was poor. Many did not count the zeroth order maximum or incorrectly stated that the order corresponding to $\theta = 90°$ could still be observed. The equation $d\sin\theta = n\lambda$ was also incorrectly applied as the slit separation was not negligible in such a situation. In (c), most candidates knew that the diffraction effect of radio waves was more significant compared to microwaves but very few mentioned how the reflection of waves from small obstacles would be affected as a result.
8	Part (a) was well answered. In (b), most candidates were able to find the position of the lens and locate the focus correctly although mistakes in drawing light rays, like incorrect use of dotted/solid lines or wrong direction of rays, were common. Some candidates made mistakes in finding the focal length from the ray diagram. In (c), many seemed to be drawing light rays randomly or did not even attempt this part.
9	In (a), candidates knew how to find the decay constant and the number of C-14 nuclei by different methods. In (c), some candidates confused N and N_0 or A and A_0, thus wrongly substituted the number of C-14 nuclei into the formula and failing to find the correct age of the wood sample.
10	Part (a) was in general well answered. Many candidates attempted to tackle part (b) in terms of current passing through the voltmeter rather than the voltage across AB. As a result, many failed to explain precisely how the reading was affected. In (c)(i), 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. Some candidates did not attempt part (c)(ii) which involved unfamiliar situation. For those who did attempt the question, not many were able to explain the action of the circuit.
11	In (a), although many candidates were able to quote the formula for calculating the electrostatic force, common mistakes included 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, etc. In (b)(i), quite a number of candidates omitted this part. Some sketched the whole electric field pattern while a few wrongly identified the resultant field was pointing upwards to the positive charges. In (b)(ii), many mistook the electric potential as a vector quantity. In (b)(iii), less than half of the candidates answered this item correctly. This suggests that many candidates failed to understand the induction of charges on a conductor, and the effect of nearby charges or an electric field.

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	26	In (a), some candidates were not familiar with the geostationary orbit and the applications of the satellites in it. Part (b) was well answered although mistakes like substituting incorrect radii, missing square roots or using wrong units were common. In (c)(i), the less able candidates did not demonstrate they understood that total mechanical energy is the sum of kinetic energy and potential energy. They failed to use the result in (c)(i) to attempt (c)(ii) or wrongly stated that $\Delta E = \frac{-GMm}{2}\left(\frac{1}{r_2 - r_1}\right)$. A few candidates omitted the factor $\frac{1}{2}$ or gave a negative ΔE. In (c)(iii), 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).
2	64	Part (a) was well answered. In (b)(i), many candidates had difficulty in converting the area from nm^2 to m^2. In (b)(ii), a lot of them failed to provide an explanation in terms of the particle nature of photons. In (c), some candidates wrongly used 0.81 eV or 2.30 eV to calculate the number of photons emitted. Part (d) was well answered although the less able candidates were unable to show that the new current was half of the original one. Some candidates swapped the solid and dotted lines without giving any labels.
3	81	In (a), most candidates employed wrong formula/angle/distance or got sine and cosine mixed up. In (b), candidates were in general weak in their understanding of the concept of 'glare'. In (c)(i), many calculated the heat produced inside the room only. In (c)(ii), quite a number of the candidates wrongly stated 16.48 kW × 2 rather than 16.48 kW × 50%. Part (c)(iii) was well answered.
4	29	Part (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). 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. 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'. Candidates' performance in (b)(iii) was satisfactory except for misconceptions like CT scan let patients receive more 'radioactive substances'.

School-based Assessment

All school candidates sitting for HKDSE Physics have to participate in School-based Assessment (SBA). For the 2013 examination, 14087 Physics students from 440 schools submitted their SBA marks this year. The schools were divided into twenty four 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.

57.5% of schools fall into the 'within the expected range' category, with 25.4% of schools having marks slightly higher than expected, and 17.1% 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 and suggestions for this year's SBA are:

1. The experiments selected for assessment were of an appropriate level of difficulty for students and relevant to the curriculum. The majority of teachers used 3 experiments each year for assessment, which was more than the minimum requirement. It was encouraging to observe that some teachers provided extended questions to stretch higher-tier students for deeper understanding of physics concepts.

2. 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.

3. Based on the student work submitted, teachers had selected a diverse range of experiments as the practical tasks. The popular list includes 'projectile motion', 'refractive index and critical angle of a glass block', 'focal length of a lens', 'wavelength of visible light', 'measurement of resistance of a wire' and 'magnetic flux of a current-carrying solenoid'. Also experiments involving the verification of Boyle's law, Ohm's law, centripetal force and interference of waves were common. It is worth to note that some teachers designed experiments such as 'measurement of illuminance, luminous flux and efficacy of electric light sources' to support the learning and teaching of the elective part of the curriculum.

4. Apart from assessment tasks selected from the Sample SBA Tasks or practical workbooks available, there were tasks or worksheets designed by some enthusiastic teachers. 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 current using an ammeter) as these simple tasks only require limited science process skills. The assessment aims and skills required were reiterated in the 2013 SBA Conference and follow-up waves by respective DCs was done. Teachers are expected to exercise professional judgment in selecting and devising tasks/worksheets that allow students to demonstrate their ability in the subject.