Candidates' Performance

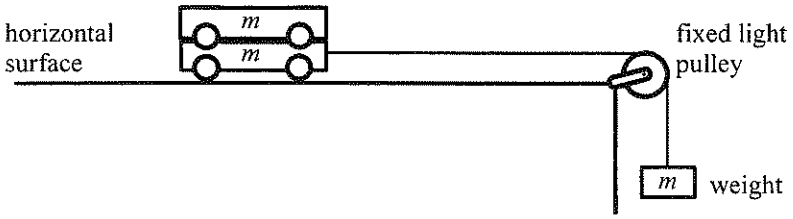
Paper 1

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

9. The figure shows a set-up in which a weight of mass m is attached to two trolleys stacked together, each trolley of mass m, via a light inextensible string.

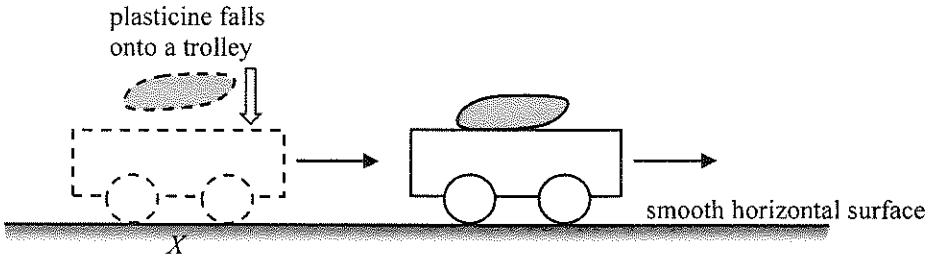


After the weight is released from rest, which of the following is correct ? Assume that all contact surfaces are smooth and neglect air resistance. g is the acceleration due to gravity.

	magnitude of the acceleration	**tension in the string**	
A.	$g/2$	smaller than mg	(14%)
B.	$g/2$	equal to mg	(22%)
*C.	$g/3$	smaller than mg	(45%)
D.	$g/3$	equal to mg	(19%)

Candidates choosing options B and D did not realise that the tension in the string should be less than the weight of the downward accelerating weight.

11. A trolley moves with a constant velocity along a smooth horizontal surface. When the trolley reaches point X, a plasticine falls vertically onto it. After the collision, they stick together and continue to move forward.

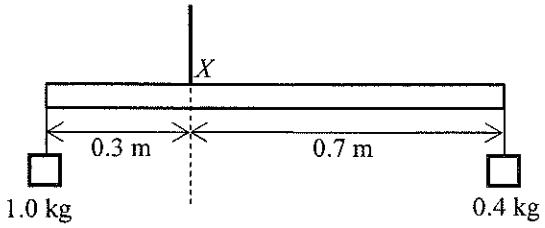


Which description about the **total linear momentum of the trolley and the plasticine** just before and just after collision is correct ?

	along the horizontal direction	**along the vertical direction**	
A.	conserved	conserved	(19%)
*B.	conserved	not conserved	(51%)
C.	not conserved	conserved	(18%)
D.	not conserved	not conserved	(12%)

About half of the candidates knew that the total momentum is conserved along the horizontal direction and is not conserved along the vertical direction.

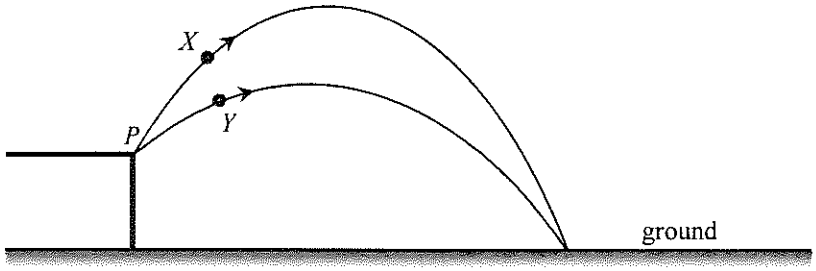
12. A uniform metre rule of a certain weight is hung by a string at X such that it is kept in equilibrium with weights hanging at both ends as shown. If the 1.0-kg weight is shifted 0.1 m towards X, what distance should the 0.4-kg weight be shifted towards X in order to restore equilibrium ?



A.	0.1 m	(4%)
B.	0.2 m	(37%)
*C.	0.25 m	(44%)
D.	0.45 m	(15%)

Less than half of the candidates managed to obtain the answer by considering the change in clockwise and anti-clockwise moments.

13. Two identical particles X and Y are projected from point P **simultaneously with the same initial speed** but with different angles as shown. They finally hit the ground at the same point via different paths.



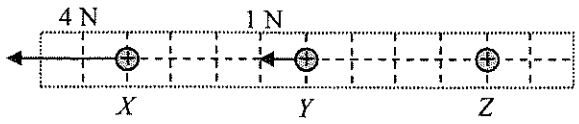
Which of the following statements is/are correct ? Neglect air resistance.

(1) They hit the ground at the same time.
(2) They hit the ground with the same speed.
(3) The kinetic energy of Y is greater than that of X at their respective maximum heights.

A.	(1) only	(22%)
B.	(3) only	(28%)
C.	(1) and (2) only	(13%)
*D.	(2) and (3) only	(37%)

Candidates choosing options A and B suggest they did not realise that the two particles will hit the ground with the same speed according to the conservation of mechanical energy.

23. Positive point charges X, Y and Z are placed along a straight line with Y at the mid-point between X and Z. Assume that the only interaction among them is the electrostatic force.



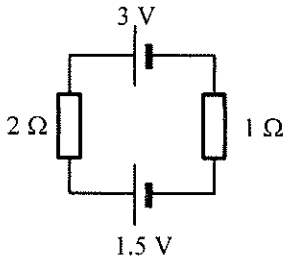
At the instant shown, the net forces acting on X and Y respectively are 4 N and 1 N both towards the left. At that instant, which statements about Z are correct ?

(1) The net force acting on Z is towards the right.
(2) The net force acting on Z is 5 N in magnitude.
(3) The charge of Z must be larger than that of X.

A.	(1) and (2) only	(19%)
B.	(1) and (3) only	(42%)
C.	(2) and (3) only	(9%)
*D.	(1), (2) and (3)	(30%)

Over 40% of the candidates chose option B which suggests they did not realise that the total repulsive force acting on X and Y is equal to that acting on Z in magnitude.

25. Two cells of negligible internal resistance are connected to two resistors as shown.

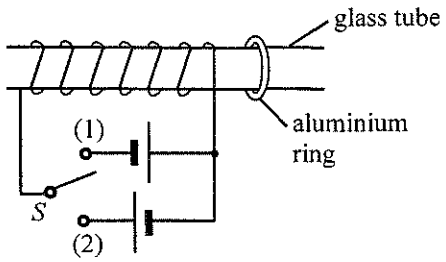


Which of the following is correct ?

	direction of current	**current in the circuit**	
*A.	anticlockwise	0.5 A	(48%)
B.	clockwise	0.5 A	(9%)
C.	anticlockwise	1.5 A	(31%)
D.	clockwise	1.5 A	(12%)

Over 40% of the candidates failed to identify the correct current delivered by the two cells connected in opposite directions, wrongly choosing options C and D.

27. A solenoid is tightly wound around a smooth horizontal glass tube as shown. A movable aluminium ring is threaded on the right side of the tube.



Initially the ring is at rest and the 2-way switch *S* is in open circuit. In what direction would the ring move at the moment when *S* is connected in turns to (1) and (2) ?

	when *S* is connected to (1)	**when *S* is connected to (2)**	
A.	to the left	to the left	(10%)
*B.	to the right	to the right	(31%)
C.	to the right	to the left	(27%)
D.	to the left	to the right	(32%)

About 30% of the candidates fully understood Lenz's law and managed to obtain the correct answer.

28. Which of the following statements about domestic circuits is/are correct ?

(1) The live (L) wire is sometimes positive and sometimes negative with respect to the neutral (N) wire.
(2) The kilowatt-hour meter measures the total power consumed by the domestic electrical appliances.
(3) With more electrical appliances connected, the total resistance of the domestic circuit becomes smaller.

A.	(1) only	(14%)
B.	(2) only	(27%)
*C.	(1) and (3) only	(31%)
D.	(2) and (3) only	(28%)

Over half of the candidates thought that the kilowatt-hour meter measures the power consumed by electrical appliances and wrongly chose options B and D.

33. Which statement about nuclear fission is correct ?

A.	It involves two nuclei combined together.	(9%)
B.	All nuclear fission reactions are spontaneous.	(19%)
C.	Rate of fission reaction is temperature dependent.	(26%)
*D.	Fission of heavy nuclei yields products that are more stable in terms of energy.	(46%)

About one-quarter of the candidates were distracted by the statement the 'rate of fission reaction is temperature dependent' and chose option C instead of D.

Section B (conventional questions)

Question Number	Performance in General
1	This question examined candidates' knowledge and understanding of heat transfer. The performance was satisfactory. Most candidates managed to find the temperature of the iron cube in (a). A few made mistakes in the temperature drop of the iron cube. Part (b) was well answered. In (c), although candidates knew there was heat loss to the surroundings, many were unable to account for the underestimation of the cube's temperature. In (d)(i), quite a number of the candidates wrongly thought that the measuring limits of the mercury-in-glass thermometer was the reason. Very few were aware of the poor thermal contact. Less than half of the candidates answered (d)(ii) correctly.
2	Candidates' performance was satisfactory. Most candidates managed to find the mass of the trapped air in (a). Candidates did well in (b)(i) although some made mistakes in manipulating ratios. In (b)(ii), some candidates forgot to mention that there were more gas molecules trapped in the bottle. A few wrongly held that the gas pressure was due to collisions between molecules while some candidates mistook 'more collisions' as 'more violently'. In (b)(iii), quite of number of the candidates employed an incorrect equation relating pressure and force – pressure = force × area. Candidates' performance in (c)(i) was poor. Some failed to identify the correct pair of action and reaction forces between water and rocket. A common misconception was that the 'action force on the ground by the water' caused the 'reaction force on the rocket'.
3	This question tested candidates' knowledge and understanding of force and motion in the context of a cyclist. Candidates' performance was good. In (a), more than half of the candidates correctly indicated the frictional force acting on the rear wheel. Candidates did well in (b) and (c)(i). A few omitted the reaction time in completing the v-t graph. Consequently, this might have lead to incorrect numerical answers in (c)(ii)(iii). Some candidates wrongly stated that a padded cushion was for 'absorbing force' or 'reducing pressure' due to its softness and large area as explanations for (d).
4	The overall performance was satisfactory. In (a)(i), quite a number of the candidates failed to label the forces indicated. Not many were able to obtain the rotation speed in revolutions per minutes in (b)(i). Candidates did well in (b)(ii). Although most were able to find the speed of the water droplet in (b)(iii), some employed the centripetal force equation instead of simply using $v = \omega r$. Candidates' performance in (b)(iv) was fair and just over half of them answered it correctly.
5	This question tested candidates' basic understanding of longitudinal waves. The overall performance was good. Candidates did well in (a). A few made rudimentary mistakes in the calculations in (b)(i)(ii), e.g. wrongly converting 200 cm to 0.2 m. More than half of the candidates correctly deduced the displacement-time graph for particle m in (b)(iii). Some failed to state clearly the change on the position of particle h in (c).
6	This question tested candidates' knowledge and understanding of wave motion in the context of a rainbow. Candidates' performance was satisfactory. Most were able to find the angle of refraction in (a)(i). Although candidates were able to obtain the critical angle c in (a)(ii), some did not compare it with the angle of incidence within the water droplet or wrongly compared it with the angle in the air, i.e. 45°. Not many candidates obtained full marks in (b)(i) as quite a number of them failed to draw the normal (through O) correctly and thus failed to sketch the light rays properly. The performance of candidates in (b)(ii) was poor. Candidates did mention points related to energy loss in their answers, however, few were able to give concise explanations including energy absorbed by water droplet via a longer path or leakage of light (energy) due to one more reflection.

7	The overall performance of candidates was fair. Part (a) was well answered although a few candidates confused resistance and resistivity. Most answered correctly in (b)(i). Candidates did poorly in (b)(ii) as many of them failed to identify the three branches connected in parallel across *MN*, namely, R_1 (2.0 Ω), *CF* (0.5 Ω) and *CDEF* (1.5 Ω). More than half of the candidates understood that the potential difference across R_2 was greater in (b)(iii). Not many realised that in (b)(iv) there was no potential difference across the coil with *S* connected to terminal 1, thus the power dissipated should be zero. Some candidates knew that there was no current in the coil but they wrongly related this to 'short circuit'.
8	Candidates' performance was fair. Nearly one-third of them wrongly marked the (+) and (–) terminals of the ammeter in (a). Most were able to indicate the current and the magnetic force but not the magnetic field in (b). Part (c) was well answered. Quite a number of the candidates forgot to mention using the ammeter to measure the current in (d)(i). In (d)(ii), very few correctly described the linear relationship between the two quantities. A 'proportional relationship' was the most common mistake. In (d)(iii), many realised that the weight of wire/support was the reason, which could be taken as an alternative to 'reset the balance to zero'.
9	This question tested candidates' knowledge and understanding of radioactivity. The overall performance was satisfactory. Most candidates answered correctly in (a). A few wrongly stated 'α-decay' as a kind of radiation. In (b), quite a number of the candidates mistook $\frac{N}{N_0}$ as the proportion of Th-232 decaying in ten years. Less than half of them answered correctly in (c)(i). Some candidates held a misconception that the long half-life of Th implied low activity and therefore caused no harmful effect. In (c)(ii), some candidates failed to employ the result found in (b) to answer this part.

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	17	Part (a) was well answered. In (b), many candidates tried to use Stefan's law to explain that the luminosity of a star could not be estimated when its distance from the Earth was unknown. This suggests that they did not fully understand the concepts of absolute magnitude, apparent magnitude, luminosity and brightness of stars. In (c), a few candidates mistook the wavelength observed from a moving source as the denominator of the Doppler equation. In (d), some candidates had difficulties in handling distances in parsec. Quite a number of them tackled this part using geometry, however, they often made mistakes in converting units.
2	64	Candidates' performance in (a) was satisfactory. In (a)(i), some did not realise that a constant should not contain any variables (e.g. v or r). Many candidates had difficulties in relating the emission spectrum and the energy levels in (b)(i). Consequently, quite a number of them failed to state the corresponding transition for spectral line X. In (b)(ii), candidates knew how to find the wavelength. However, they seldom obtained a correct answer due to the error carried forward from (b)(i). The manipulation of 1.60×10^{-19} was often incorrect. Candidates did poorly in (b)(iii) as some ignored the given range of energy of the photons in the visible spectrum. Those transitions that were chosen for calculation did not correspond to the visible spectrum. They then concluded that such transitions failed to give a photon of visible light, which was an incorrect logic. The second part of (b)(iii) was about the hydrogen atom being excited by a photon but many candidates still answered something about a photon being emitted from the atom. Few were able to obtain the energy of the radiation in (c) and some candidates gave answers in J instead of eV required.
3	88	Candidates' performance in (a)(i) was fair. Some had difficulties in identifying the direction of flow of refrigerant and failed to describe the change of state correctly. About half of the candidates were correct in (a)(ii). In (a)(iii), many candidates managed to explain why the total amount of heat released outdoors was larger than that removed from indoors. Less able candidates mixed up energy and power in the calculation of cooling capacity in (b)(i) and the COP (coefficient of performance) in (b)(iii). Candidates did well in (b)(ii) when estimating the temperature change of the classroom.
4	31	In (a), most candidates were able to point out that rods do not differentiate colours while cones do. However, quite a number of them failed to mention that rods operate at low light intensity while cones need higher light intensity. In (b)(i), candidates knew that the near point is the closest or shortest distance of an object at which an eye is able to focus. However, some answers were far from concise as one can 'see' an image which might not be in 'focus'. Less than half of the candidates knew the reason why the power of the eyes decreases with age, that is, the lens loses its flexibility to change its thickness and refractive power or the ciliary muscle that control the lens thickness weakens. In (b)(iii), most candidates understood that accommodation of the eyes involves the eyes' ability to focus at different distances. Candidates' performance in (b)(iv) was fair. Not many were able to apply the lens formula correctly to find the power of eyes at the far point and the near point. Some wrongly employed cm rather than m to calculate the power of eyes. Candidates did well in (c). However, a few forgot to specify the direction of movement of the newspaper (i.e. away from the eye) as the question required.