Candidates' Performance

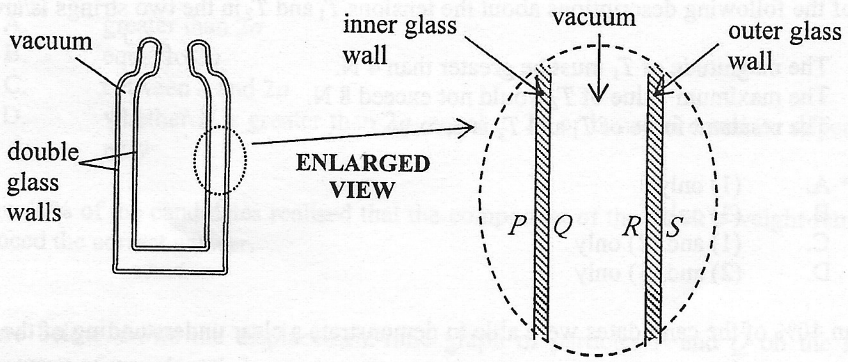
Paper 1

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 18. Items where candidates' performance was typically weaker will be discussed below.

1.



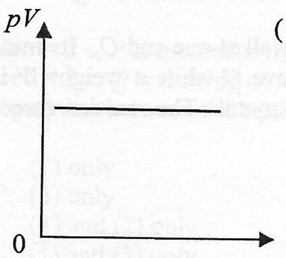
The figure shows a vacuum flask with double glass walls for keeping liquids cold. P, Q and R, S are the glass surfaces of the inner and outer glass walls respectively. Which two surfaces are usually coated with silver ?

A. P and R
B. Q and R
C. P and S
D. R and S

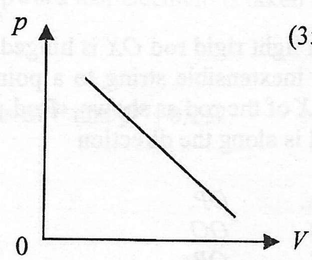
This item was deleted due to inadequate discrimination power. Reasons for candidates not choosing the key might be due to overlooking issues of practicality when determining whether the inner or outer glass surfaces should be coated with silver.

4. From which graph below can one deduce that the pressure p of a fixed mass of an ideal gas is inversely proportional to its volume V when the temperature of the gas is kept constant ?

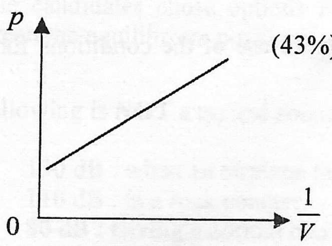
* A. (11%)



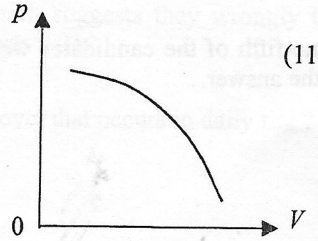
B. (35%)



C. (43%)

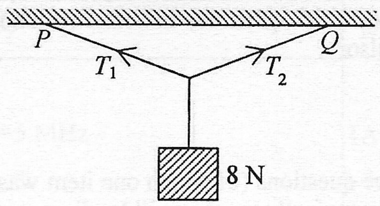


D. (11%)



Over 40% of the candidates chose option C to represent a directly proportional relationship, which is incorrect.

5. A block of weight 8 N is suspended from a horizontal ceiling by light inextensible strings to two different points P and Q as shown. The strings are equal in length.



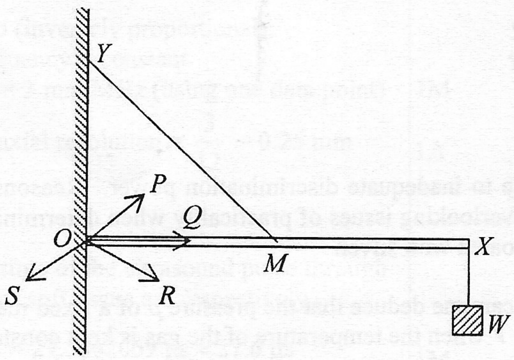
Which of the following descriptions about the tensions T_1 and T_2 in the two strings is/are correct ?

(1) The magnitude of T_1 must be greater than 4 N.
(2) The maximum value of T_2 would not exceed 8 N.
(3) The resultant force of T_1 and T_2 is zero.

* A. (1) only (38%)
B. (3) only (10%)
C. (1) and (2) only (28%)
D. (2) and (3) only (24%)

Less than 40% of the candidates were able to demonstrate a clear understanding of the vector nature of force.

6.

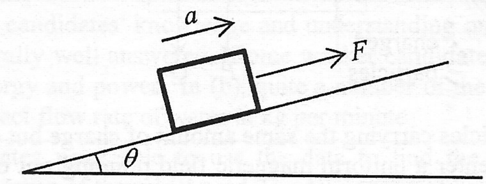


A uniform light rigid rod OX is hinged smoothly to a wall at one end O. Its mid-point M is connected by a light inextensible string to a point Y directly above O while a weight W is suspended from the other end X of the rod as shown. Rod OX remains horizontal. The reaction force acting on the rod due to the wall is along the direction

A. OP. (30%)
B. OQ. (39%)
* C. OR. (21%)
D. OS. (10%)

Around one-fifth of the candidates were able to make use of the conditions for static equilibrium to work out the answer.

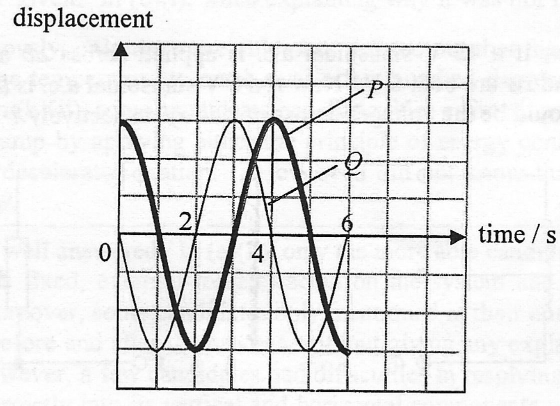
8. A block of mass m is placed on a smooth incline making an angle θ with the horizontal as shown. When a force of magnitude F parallel to the incline is applied to the block, it travels up the incline with an acceleration a. If the applied force becomes $2F$, what would the magnitude of the acceleration be ?



*	A.	greater than $2a$	(37%)
	B.	equal to $2a$	(26%)
	C.	between a and $2a$	(26%)
	D.	whether it is greater than $2a$, equal to $2a$ or between a and $2a$ depends on the value of θ	(11%)

Less than 40% of the candidates realised that the component of the block's weight remains unchanged and deduced the correct answer.

15. The figure below shows the displacement-time graph of particles P and Q on the same transverse travelling wave of wavelength λ.



Which of the following statements **MUST BE** correct ? Upward displacement is taken to be positive.

(1) At time $t = 2$ s, P is momentarily at rest.
(2) At time $t = 4$ s, Q is moving downwards.
(3) The separation between the equilibrium positions of P and Q is 0.25λ.

	A.	(2) only	(16%)
	B.	(3) only	(22%)
*	C.	(1) and (2) only	(32%)
	D.	(1) and (3) only	(30%)

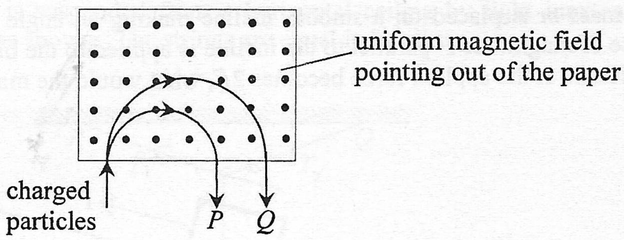
Over half of the candidates chose options B and D which suggests they wrongly thought that the separation between the equilibrium positions of P and Q was 0.25λ.

21. Which of the following is **NOT** a typical sound intensity level that occurs in daily life ?

	A.	130 dB : when an airplane take-off	(33%)
	B.	110 dB : at a rock concert	(17%)
*	C.	80 dB : having a normal conversation	(39%)
	D.	30 dB : inside a library	(11%)

Candidates in general were not familiar with the typical sound intensity level that occurs in daily life.

28.



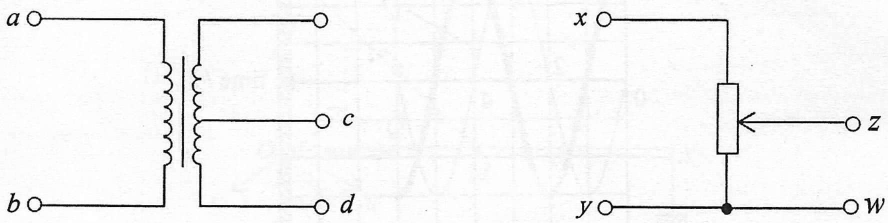
P and *Q* are two particles carrying the same amount of charge but of different masses. They travel with the same speed and enter a uniform magnetic field pointing out of the paper as shown. Semi-circular paths with different radii are described before they emerge from the field. Which descriptions below are correct ?

(1) Both *P* and *Q* are positively charged.
(2) *P* and *Q* emerge from the field with the same speed.
(3) The mass of *Q* is greater than that of *P*.

A.	(1) and (2) only	(19%)
B.	(1) and (3) only	(28%)
C.	(2) and (3) only	(17%)
* D.	(1), (2) and (3)	(36%)

Nearly 30% of the candidates chose option B which suggests they may not have realised that the speeds of the particles remain unchanged in the magnetic field.

30. In the circuits below, if a 12 V sinusoidal a.c. is applied across *ab* and across *xy* respectively, the voltages across *cd* and *zw* are both 6 V. Now if a 6 V sinusoidal a.c. is applied across *cd* and across *zw* respectively, what would be the voltages across *ab* and *xy* respectively ?



	voltage across *ab*	voltage across *xy*	
A.	12 V	12V	(19%)
*B.	12 V	6 V	(46%)
C.	6 V	6 V	(14%)
D.	12 V	0 V	(21%)

As 40% of the candidates chose options A and D, this suggests quite a number of them did not fully understand how a potential divider works.

32. *X* and *Y* are two radioactive nuclides. The ratio of the mass of an atom of *X* to that of an atom of *Y* is 1 : 2. The half-lives of *X* and *Y* are *T* and 2*T* respectively. If two samples consisting of purely *X* and *Y* respectively have the same initial mass, find the ratio of the number of undecayed nuclei of *X* to that of *Y* after a period of 4*T*.

A.	1 : 4	(36%)
* B.	1 : 2	(40%)
C.	1 : 1	(13%)
D.	2 : 1	(11%)

Only 40% of the candidates managed to obtain the correct answer by manipulating the ratio of half-lives of the two radioactive nuclides.

Section **B** (conventional questions)

Question Number	Performance in General
1	This question tested candidates' knowledge and understanding on heat capacity and electric power. It was generally well answered. Some weaker candidates did not know the correct relation between energy and power. In (b), quite a number of the candidates had difficulties working out the correct flow rate of water in kg per minute.
2	In (a), most candidates were able to use the data to find the amount of helium gas in vessel *A*. However, some of them just used 3 and 1 instead of $3p$ and V in their working. In (b)(i), not many started with the conservation of number of gas molecules. Weaker ones even tried to employ $\frac{p_A V_A}{n_A R} = \frac{p_B V_B}{n_B R}$ to find the answer. (b)(ii) was well answered though some candidates considered the whole system which led to the conclusion that the volume of the gas increases, which was not appropriate. In general, candidates were able to use the terms in kinetic theory to answer the question (like 'particles hit the container wall more frequently'). Weaker ones held a misconception that pressure was due to collisions among gas molecules.
3	Candidates' performance was satisfactory. In (a), many candidates missed the point that if the friction F_r remained unchanged (at its maximum value) while the maximum load limit was exceeded, the braking distance d would be longer according to the equation $\frac{1}{2}mv^2 = F_r \times d$ given. In (b)(i), when explaining why it was not recommended to apply the brakes continuously, only the more able ones pointed out that the thermal energy generated would cause the temperature to reach over a few hundred degrees Celsius as mentioned in the passage. In (b)(ii), some candidates had difficulties estimating how far the vehicle would travel up the ramp by applying either the principle of energy conservation or the equations for uniformly decelerated motion. A few even did not know that the deceleration up the ramp was $g\sin\theta$.
4	Part (a)(i) was well answered. In (a)(ii), only the more able candidates understood that as the spring gun was fixed, external force(s) acted on the system and thus momentum was not conserved. Moreover, some candidates only mentioned in their answers that momentum was not the same before and after the process, without giving any explanation. Part (b) was well answered. However, a few candidates had difficulties in resolving the initial velocity of the cannon ball correctly into its vertical and horizontal components. In (c), only the more able ones reasoned without any numerical calculation that t_f would increase as the initial vertical velocity $v\sin\theta$ increased.
5	In (a)(i), most candidates correctly considered the balance of moments in the system. However, a few made mistakes in the conversion of units (like 1 cm = 0.001 m or 50 g = 0.5 kg). (a)(ii) was new to most candidates. Many considered the maximum and minimum values and found their difference instead of using percentage error. Some candidates overlooked that only the error associated with the counter-weight's position was considered or used ±0.05 cm in their calculations. In (b), most were able to use $W = mg$ to find the correct value. In (c), only some candidates were able to correctly state the counter-weight position on the beam balance. Most were able to indicate that there was an increase of spring balance reading. Candidates' performance in (c)(ii) was poor. Very few were able to precisely explain why the beam balance failed to work in a free falling lift. Some of them wrongly thought that the beam balance reading would decrease.

6	Candidates' performance in (a) was poor. Not many of them correctly suggested various methods, using one ray (with the lens position and principal axis correctly marked on the piece of paper) or two parallel rays from the ray box to find the focal length of the concave lens. Weaker candidates, however, wrongly tried to obtain an image formed by the concave lens using just a single light ray from the ray box. Part (b) was in general well answered. Most were able to draw a suitable light ray to find the focal length of the lens in (b)(ii). In (b)(iii), however, some candidates failed to indicate the correct path of ray *p*.
7	Candidates performed well in (a)(i). Only a few candidates did not realise that the percentage error in measurement was being referred to and they answered 'easier to locate the positions of maxima as the dots are brighter'. Some candidates failed to find the correct values of θ or mistook the order of diffraction as $n = 4$ in (a)(iii). Weaker ones wrongly applied $\Delta y = \frac{\lambda D}{a}$ in this situation. In (b)(i), not many candidates knew that the equation $\Delta y = \frac{\lambda D}{a}$ could only be applied when $\lambda << a$ and $a << D$. Some even thought that the equation was only applicable for light.
8	A considerable number of candidates wrongly chose terminals *Y* in (a)(i) for the 'heating' mode. Even for those who chose terminals *X* and correctly found the current drawn from the supply in (a)(ii), some wrongly employed this total current to find the power consumed in the mode of 'keeping warm' in (a)(iii). In (b)(i), many thought that the meter *M* was to record voltage, current or power. (b)(ii) was in general well answered although some candidates did not attempt this part possibly as it was too challenging.
9	Although most candidates indicated the direction of *I* correctly in (a)(i), not many mentioned the resulting magnetic force as well as the need for an external force to balance it in order to maintain a uniform motion of the rod. In (a)(iii), many candidates employed Faraday's law to prove the equation instead of considering the mechanical power input, which was required by the question. In calculating the induced e.m.f. in (b)(ii), some candidates made mistakes in resolving the magnetic field or in converting its unit. Many did not understand the relation of induced e.m.f. and distribution of charges inside a conducting rod. (b)(iii) was poorly answered. Weaker candidates just based their answers on whether the circuit was open or closed to determine whether there would be a current. Some stated that the induced current flowing in opposite directions would cancel each other.
10	Part (a) was well answered though some candidates commented that atoms with more neutrons or greater mass numbers were more stable. In (b)(i), the answers of some candidates were far from precise e.g. 'as the ionizing power is random or the type of radiation emitted is random'. Weaker candidates only focused on the EHT device. In (b)(ii), many candidates wrongly held that the Ra-226 source was not pure and thus emitted all three kinds of radiation. It seems that candidates did not fully understand the mechanism of a decay series. In (b)(iii), quite a number of them pointed out that the sparks were related to the strong ionizing power of α radiation, but many just suggested using a cloud chamber to distinguish different types of radiations emitted instead of describing a way to verify the sparks were caused by the α radiation.

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	19	In (a)(i), most candidates knew how to deduce the distance of a star using parallax though a few of them made mistakes in units conversion. (a)(ii) was well answered. Only some drew incorrect conclusion from their results. Some candidates did not fully understand the concept of luminosity and brightness, and thus performed poorly in (b)(i). Not many were able to state the physical quantity of X that should be measured in order to find the period T in (b)(ii). Weaker ones did not understand Doppler shift or simply did not know what the question asked for. Candidates' performance was fair in (b)(iii).
2	67	Candidates were in general weak at presenting qualitative answers like those required in (a). Many just stated 'no current passing through the circuit' without describing the procedures to achieve that condition. Some thought that the voltage V_s was the maximum kinetic energy of the photoelectrons. In (b)(i), most candidates were able to find the wavelength correctly but some could not tell the radiation was ultra-violet. In (b)(ii), most candidates found the slope correctly but a lot of them gave incorrect units or forgot to include 10^{14} for the frequency in their calculation. Weaker ones just chose one point from the graph together with (0, 0) to find the slope. Not many knew the physical meaning of the slope and some wrongly stated the slope as h/e. In (b)(iii), most candidates knew how to find the work function. However, some of them gave the answer in J or wrongly read the threshold frequency from the graph. In (c), most candidates knew that the graph remained unchanged but not many were able to correctly explain the concept 'maximum kinetic energy of photoelectrons depends on frequency only' of photoelectric effect.
3	86	In (a)(i), candidates in general knew that most of the energy became thermal energy in incandescent lamps, but many of them failed to state that these lamps produced light by joule heating of a tungsten filament at a high temperature. Candidates' performance in (a)(ii) was satisfactory though quite a number of them did not realise that luminous flux depends on the sensitivity of the human eye to light of different wavelengths. In (b)(i), most candidates were able to calculate the angle θ correctly, but some of them failed to apply $\frac{E\times\cos^3\theta\times 2}{4\pi d^2}$ or $\frac{E\times\cos\theta\times 2}{4\pi r^2}$ to find the illuminance. Part (b)(ii) was well answered. In (b)(iii), not many candidates were able to state explicitly the advantage and the disadvantage of the two arrangements of tunnel lights.
4	28	Candidates' performance in (a)(i) was fair. A few did not realise that the wavelength was twice the crystal's thickness. Many candidates failed to give concise explanations in (a)(ii). Few pointed out explicitly that the vibration of the crystal generates a 'voltage'. A lot of them just stated that an 'electrical signal' was produced when the ultrasound 'moves' the crystal, which was too general as an explanation. Many candidates did not understand what (b)(i) asked for, particularly the meaning of 'axial resolution'. Most candidates just answered how the frequency affected resolution and penetration or used generic terms such as 'clear' to describe the effects of a higher resolution. In (b)(ii), some candidates were not able to manipulate the calculation of inverse proportion. (c)(i) was well answered though a few candidates omitted the factor '2' for a round trip. Candidates' performance in (c)(ii) was fair as they did not realise that the true depth was 10 cm. Weaker candidates simply did not understand the relationship between the computed depth and the calibration speed.