Name: _____ ( ) Class: _____

華僑中學
HWA CHONG INSTITUTION
END-OF-YEAR EXAMINATION 2014

PHYSICS
Paper 2

Level: Secondary Three
Duration: 1 hour 45 min

Do not open this booklet until you are told to do so.

INSTRUCTIONS TO CANDIDATES

Write your name, index number and class on the top of this page.

Answer the questions in **Section A and B** in the spaces provided. All workings must be shown.

In **Section B**, for **Question 10** answer '**EITHER**' or '**OR**'.

INFORMATION FOR CANDIDATES

In **Sections A and B** the intended marks for each question or part of a question are given in brackets [ ]. Any working should be done in the space provided.

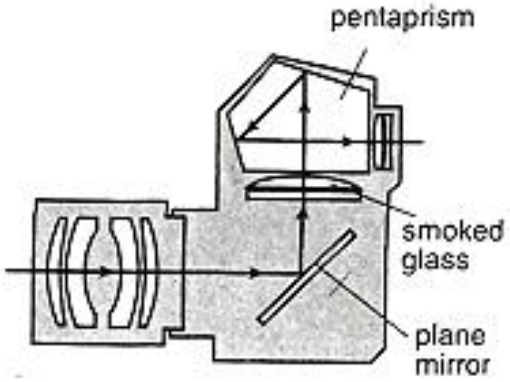
When necessary, take g to be 10 ms^{-2} or 10 Nkg^{-1}

This question paper consists of 15 printed pages, including this page.

SECTION A (40 MARKS)

Answer **all** *the questions in this section*

1. Pentaprism is used in a single-lens reflex camera to enable the user to see exactly what the lens of the camera views. Light entering the lens is reflected upward by a plane mirror to form an image on a piece of smoked glass. After two successive reflection inside the pentaprism, light from the image emerges from the viewfinder and reaches the user's eye.



(a) Explain why the plane mirror used in this system must be very thin. [2]

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(b) Determine the maximum angle of incidence for refraction to occur when light passes from glass to air. Give that $\eta_{glass} = 1.6$. [2]

(c) Explain why light rays are reflected on the two sides of the pentaprism. [2]

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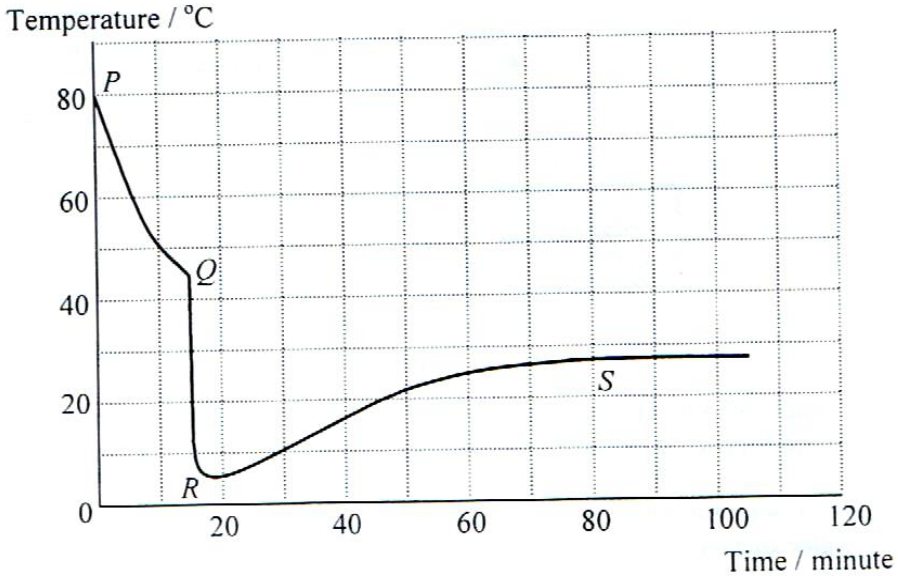
2. William makes a glass of hot tea. After a while, he adds some ice cubes into the tea. William uses a temperature sensor to measure the temperature of the tea. The figure below shows the temperature-time graph obtained.



(a) Explain why the temperature of the tea increases from R to S. [2]

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(b) Estimate the temperature of the surroundings. [1]

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(c) Another method to cool the hot tea without adding ice cubes is by leaving the cup of hot tea in the room to cool by evaporation.

Explain how evaporation causes this cooling. [2]

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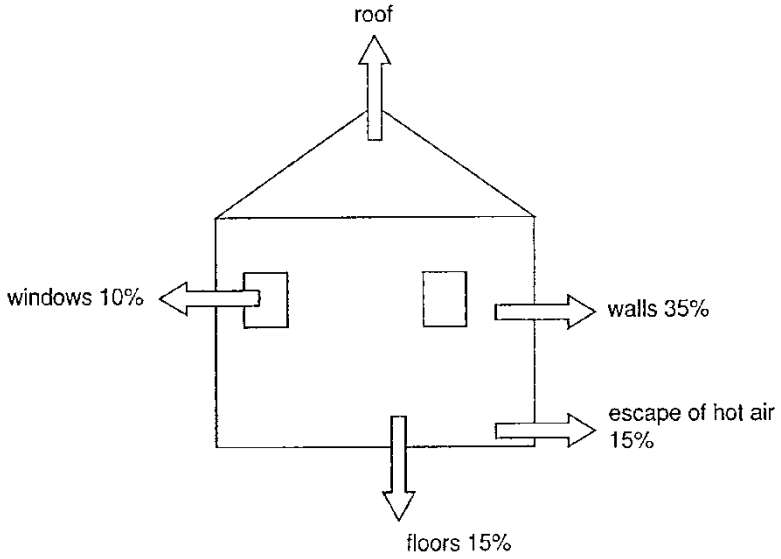
3. When a house is heated, thermal energy will be lost to the external surroundings. The figure below shows where the energy is lost from the house.



(a) Explain how the thermal energy in the air within the home is lost through the roof to the surroundings. [2]

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(b) The table below gives cost-savings information about three methods of reducing energy loss.

	method of reducing energy loss	**installation cost**	**saving on energy costs in one year**	**number of years of saving needed to cover installation costs**
A	Fitting carpets on the floor	$600	$10	60
B	Insulating the roof	$300	$100	3
C	Fitting modern windows	$800	$20	40

i) Which method listed above is most efficient in saving cost? Explain your answer [2]

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ii) State one other way, not already mentioned, of reducing thermal energy loss from the house. [1]

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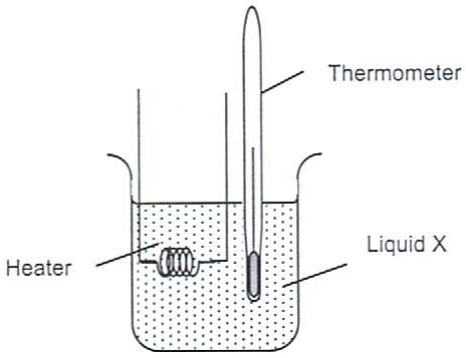
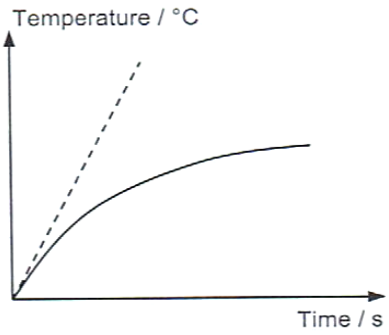
4. A student conducted an experiment to determine the specific heat capacity of a liquid X. He immersed a heater in a beaker of liquid X at room temperature as shown below. The heater was switched on and a graph was obtained.





(a) Another students feels that this method can be improved by first cooling liquid X to about ***10 ºC below room temperature*** and then heated to ***10 ºC above room temperature.*** Explain why this suggested method is more accurate. [2]

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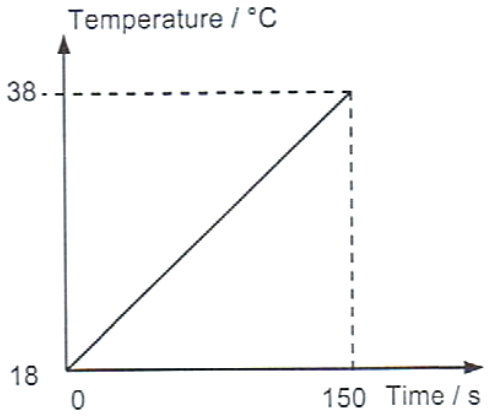
(b) Another student insulated the set-up and obtained the graph shown below.



i) If the student has used a heater rated 180 W immersed in 0.60 kg of liquid X, calculate the heat capacity of liquid X. [2]

ii) Give two reasons why the calculated value in b(i) must be larger than the actual value. [2]

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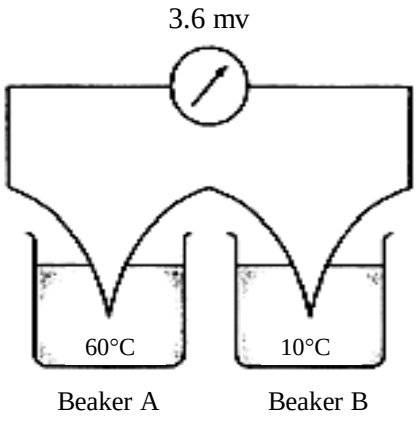
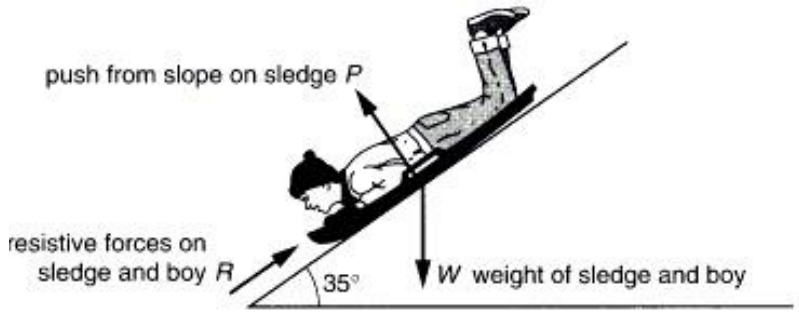
5. In a laboratory experiment, Beaker A and Beaker B are filled with equal amounts of water. The temperature of the water in Beaker A and Beaker B are 60 °C and 10 °C respectively. A voltage reading of 3.6 mV is recorded when the two junctions of a thermocouple are placed separately in each beaker.



If the water in Beaker B is now replaced by water at 100 °C, determine the voltage reading of the thermocouple. [2]

6. The figure below shows a boy on a sledge travelling down a slope. The boy and sledge have a total mass of 60 kg and are travelling at a constant speed. The angle of the slope to the horizontal is 35°. All the forces acting on the boy and sledge are shown in the figure below.



(a) Determine the magnitude of W, the total weight of the boy and the sledge. [1]

(b) By drawing a vector diagram, or otherwise, determine the magnitude of the resistive force R. [4]

(c) Explain why the boy is travelling at a constant speed even though he is moving down a slope. [2]

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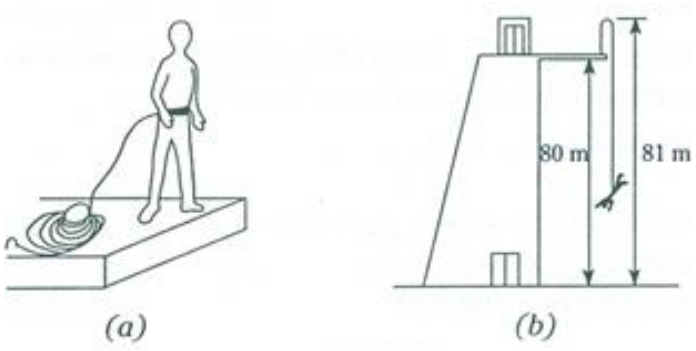
7. In a sports game, one end of a long elastic string is tied to an athlete while the other end is fixed on a high platform as shown below. The athlete has to jump up into the air as high as he can. The elastic string prevents him from hitting the ground.



An athlete of mass 70 kg is carried onto the platform of height 80 m by a lift in 20 s. The length of the unstretched elastic string is 40 m.

(a) i) Find the potential energy gained by the athlete upon reaching the platform. [2]

ii) Find the power required to lift the athlete to the platform. [2]

(b) The athlete then jumps up into the air. He reaches a height of 81 m above the ground and then falls down again. If the average resistive force due to the elastic string on the athlete is 2000 N, what is the lowest point above the ground he can reach? [3]

(c) In a real situation, is the lowest point reached by the man greater than, or equal to or smaller than the calculated value in (b) ? Explain. [2]

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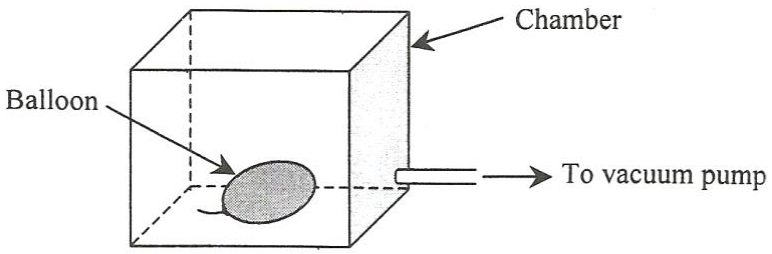
SECTION B (30 Marks)

Answer question Q8, Q9 and either Q10A or Q10B in this section

8(a) A balloon containing 0.010 m^3 of gas at a pressure of 100 kPa is placed inside a chamber as shown in the figure below. Air is slowly pumped out of the chamber until the volume of the balloon is increase to 0.020 m^3. Assume the temperature remain unchanged.



(i) Explain why the balloon expands when air is pumped out of the chamber. [2]

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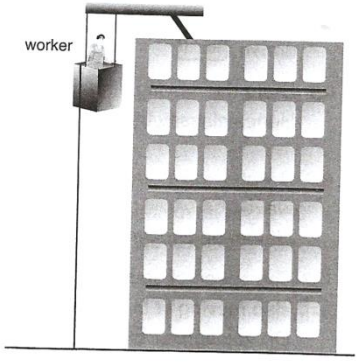
(ii) Determine the final pressure inside the balloon. [2]

(b) A worker is painting the outer wall of a tall building. He is standing in a wooden box which is suspended from the roof by two long ropes as shown in the diagram. When the worker is at a height of 48 m, a strong wind makes the box swing from left to right and it swings back to original position. A wave is created along the rope from box to the ground.



(i) What type of wave is created along the rope? [1]

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It takes 1.2 seconds for the worker to swing from left to right and 4.0 seconds for the vibration to reach the ground along the rope.

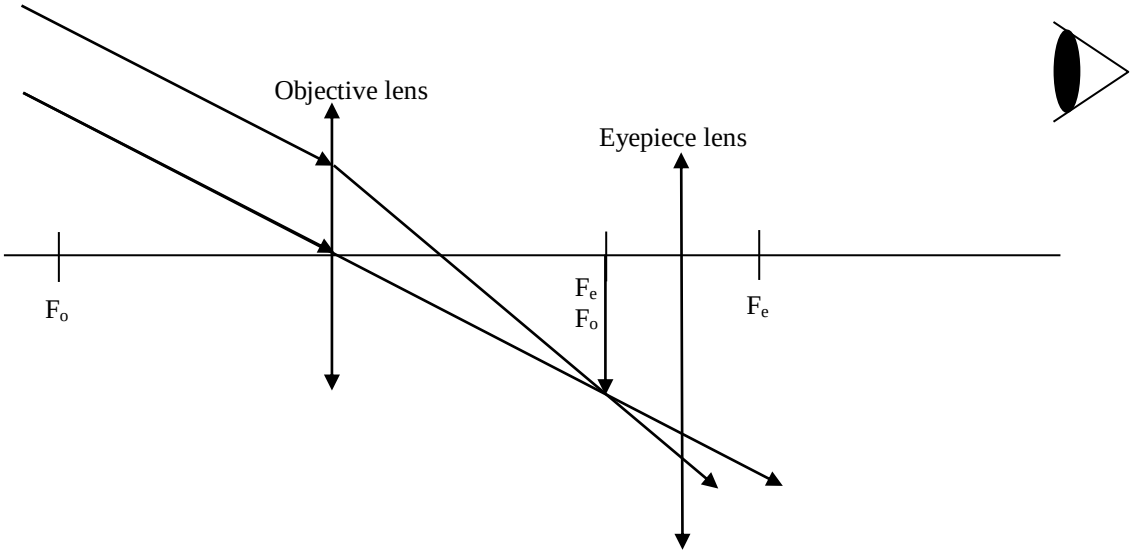
(ii) Determine the frequency of the wave formed in the rope. [2]

(iii) Hence or otherwise, determine the wavelength. [3]

9. The table below provides information about three telescopes used to examine different sources of radiation from space.

Location	Objective Lens Diameter (D)	Source of radiation	Wavelength detected (λ)
Yorkes Observatory (USA)	1.0 m	Sirius	500 nm
Mount Palomar (USA)	5.0 m	Polaris	600 nm
Jodrell Bank (USA)	75 m	Inter-stellar hyrdrogen	0.21 m

(a) The image of a distant object is formed along the focal plane of the objective lens. By drawing 2 light rays from this inverted image, show how the eye sees the image of the distant object through the eyepiece lens. [2]



(b) State one **other** characteristic of the image, not seen from the above figure, that is formed by the objective lens. [1]

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(c) The smaller the ratio of the wavelength to the objective diameter, the more effective is the telescope in clearly separating the images of distant sources. This ratio (λ/D) is called the resolving power of the telescope.

Using the data from the table, show by calculation which telescope has the best resolving power. [4]

(d) Apart from improving the resolving power, why do you think the telescope should have a large value of D? [1]

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(e) The higher the frequency of radiation emitted by a source, the higher the source temperature. Which radiation source given in the table has the highest temperature? Explain your answer. [2]

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EITHER

10A. Fig. 10.1 shows a man of mass 55 kg, tied to a thick elastic rope attached to a high platform, making a bungee jump. The graph in Fig. 10.2 shows how the velocity of the bungee jumper varies with time during the first 6.0 s of a jump. Upward motion is taken to be positive.

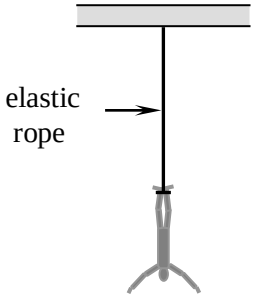

Fig. 10.1

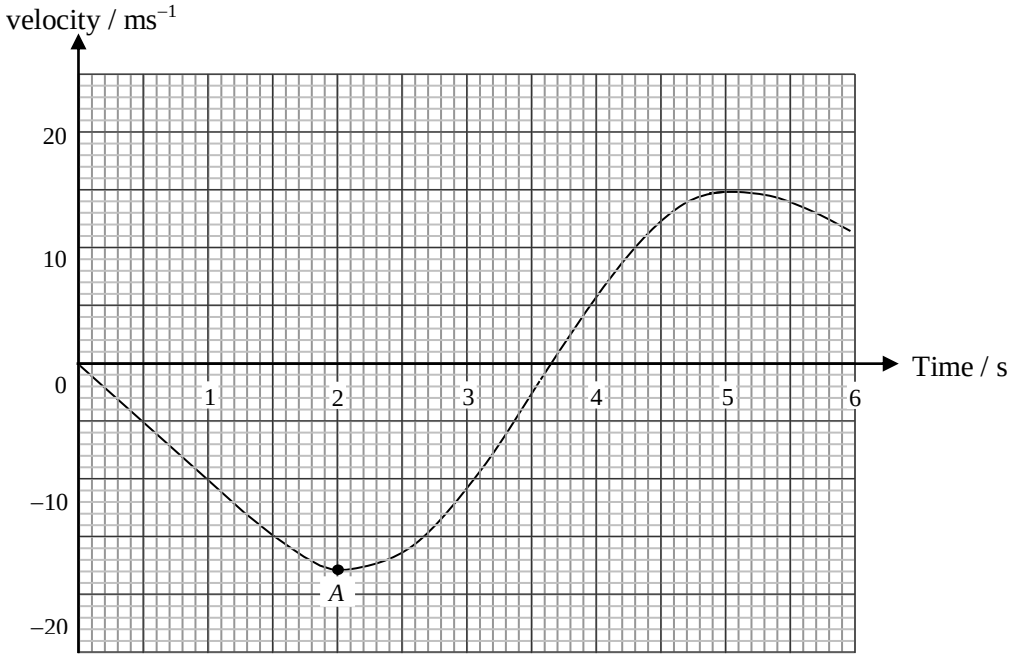

Fig. 10.2

(a) i) Find the average acceleration of the jumper during the first second. [1]

ii) Deduce the tension in the bungee rope during this time interval. [1]

(b) i) What is the acceleration of the jumper at point *A* of the graph? [1]

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ii) Find the tension in the bungee rope at point *A* of the graph. [1]

(c) Using information from the graph, state the time at which the bungee rope is at its maximum length. [1]

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(d) State the energy changes from the time when the rope first becomes stretched to the time when it reaches the maximum length. [3]

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(e) Explain, in terms of the tension of the rope acting on the bungee jumper, why an elastic rope is used rather than a rope that cannot be stretched very much. [2]

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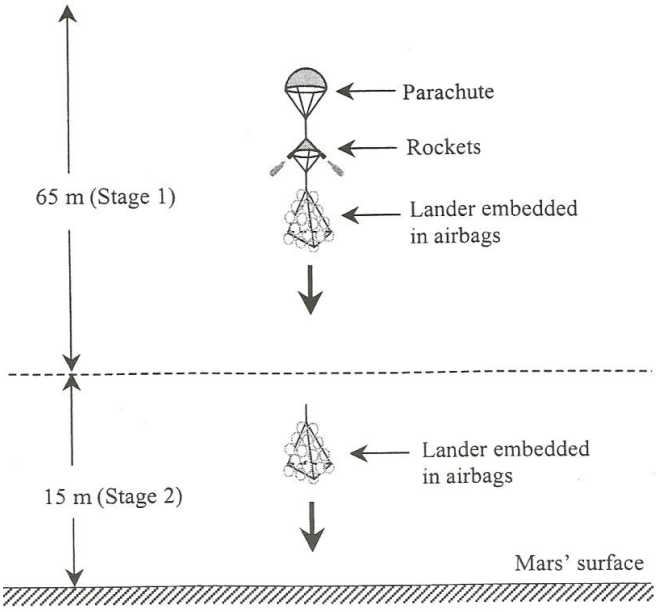
OR

10B. On 4th July 1997, the lander 'Mars Pathfinder' landed on the surface of Mars as shown in the figure below.



The details about the last two stages of the landing process are as follows:

Stage 1: When the spacecraft (including the lander embedded in some airbags, a parachute and decelerating rockets) was at a height of 80 m above Mars' surface, it was falling with a speed of 75 ms^{-1}. At this instant, the rockets were fired. The parachute and rockets exerted a total upward force of 16 900 N on the lander and brought it to an instantaneous rest at a height of 15 m above the surface.

Stage 2: At the instant when the lander was 15 m above the surface, the parachute and rockets were separated from it. The lander then fell from rest to the surface under the action of the gravity of Mars.

You may assume that the lander descended vertically and the resistance exerted by the atmosphere on the lander was negligible.

(a) Consider **Stage 1** and answer the following:
i) Determine the deceleration of the lander. [2]

ii) The mass of the lander was 360 kg. Estimate the acceleration due to gravity on Mars' surface. [2]

(b) Consider **Stage 2** and answer the following:

i) Find the time required for the lander to reach the surface. [2]

ii) Explain how the airbags helped the lander to land on the surface safely. [2]

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iii) The lander bounced a few times on the surface before coming to rest. Sketch the velocity-time graph of the lander, with t = 0 denoting the instant when the lander was 15 m above the surface. You can assume the motion took place in a vertical direction. [2]

END OF PAPER