Anglican High School
Secondary Four
Preliminary Examination
2025

S4

CANDIDATE NAME

CLASS 4

INDEX NUMBER

PHYSICS
Paper 2 Theory

6091/02
26 Aug 2025
1 hour 45 min

	Marks
Section A	
Section B	
s.f. error	
Total (80)	

Candidates answer on the Question Paper.

No additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all your work.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction tape.

Section A
Answer **all** questions.
Write your answers in the spaces provided.

Section B
Answer **one** question.
Write your answers in the spaces provided.

Assessment noted by :

_____

Name of Parent/Guardian

_____

Signature of Parent/Guardian

Date : _____

Candidates are reminded that **all** quantitative answers should be given to appropriate units and rounded off to the appropriate number of significant figures.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

This Question Paper consists of **22** printed pages including this cover page.

Section A

Answer **all** questions in this section.

1 **(a)** The second, metre and kilogram are all SI units of base quantities.

Name **two** other base quantities whose SI units are not stated above.

1 ……

2 …… [2]

(b) **(i)** Circle the value for the prefix *deci*.

10^{-9} 10^{-6} 10^{-3} 10^{-2} 10^{-1} 10^{3} 10^{6} 10^{9} 10^{12}

[1]

(ii) Rearrange the following prefixes in order from the largest value to the smallest value.

n μ G m k

…… [1]

[Total: 4]

2 A car is travelling at 30 m / s towards the East from start point A. Fig. 2.1 represents the velocity-time graph of the car for a duration of 90 s.

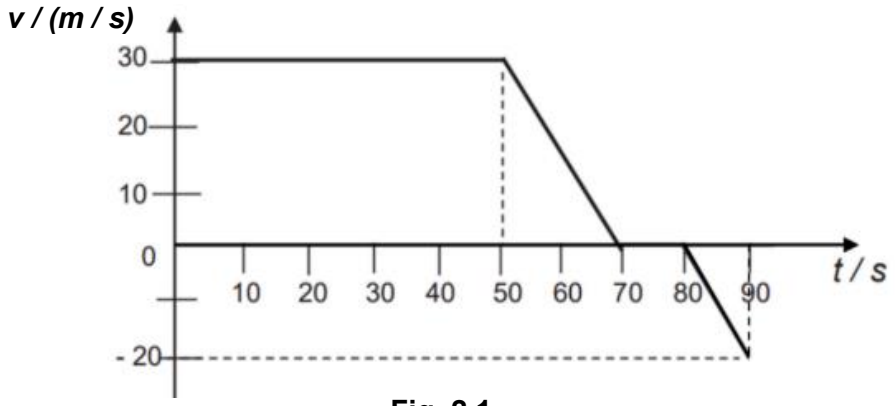

Fig. 2.1

(a) Calculate the displacement of the car from point A at t = 90 s.

displacement from point A = …….. [2]

(b) Describe the motion of the car from t = 80 s to t = 90 s.

……

……

……... [2]

[Total: 4]

3 Fig. 3.1 shows a load of mass 8.0 kg hanging from two strings.

When the load is stationary, the tension in the string on the left is 40 N. Using a labelled vector diagram, determine the tension in the other string, T_1.

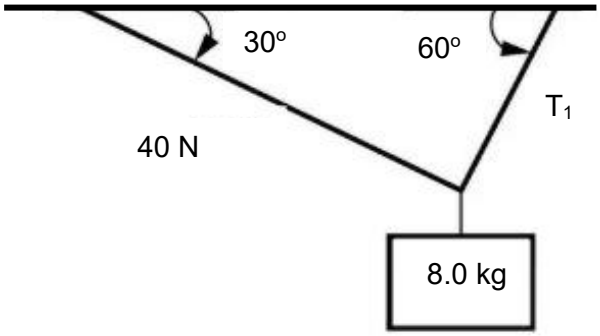

Fig. 3.1

Tension T_1 = ... [3]

[Total: 3]

4 Fig. 4.1 shows a worker carrying a ladder on his shoulder. There is a bucket of weight 20 N hanging at one end of the ladder, 1.3 m away from the worker's shoulder. The ladder has a mass of 1.6 kg, and its centre of mass is 0.85 m from the worker's shoulder. The gravitational field strength, *g* is taken to be 10 N / kg.

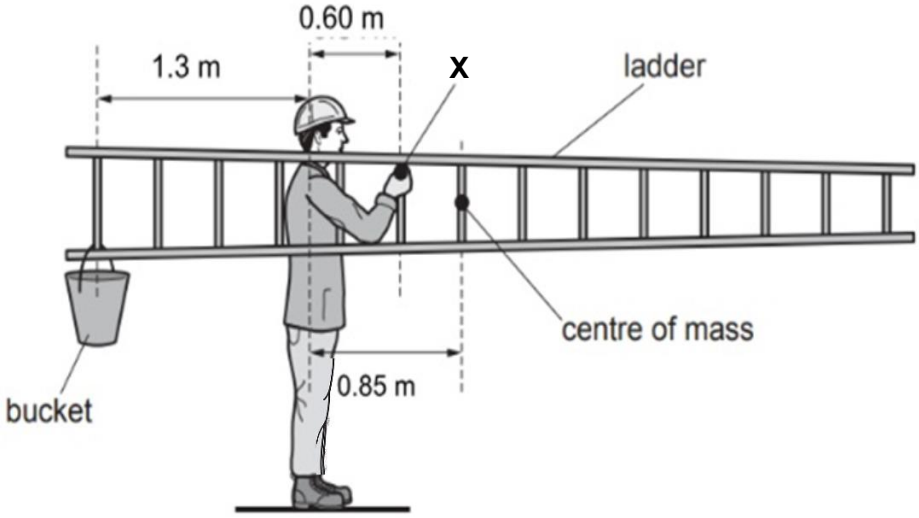

Fig. 4.1

The worker uses his hand to apply a vertical force at point X, on the ladder to keep the ladder horizontal. The horizontal distance of this force from his shoulder is 0.60 m.

(a) State the *principle of moments*.

……

……

…….. [2]

(b) Determine the force exerted by the worker at point X.

force = …… [2]

[Total: 4]

5 In Fig. 5.1, two liquid-in-glass barometers are set up side by side at sea level using identical glass tubes. One is filled with liquid A and the other filled with liquid B. There is vacuum in the space above the liquid columns in both set-ups.

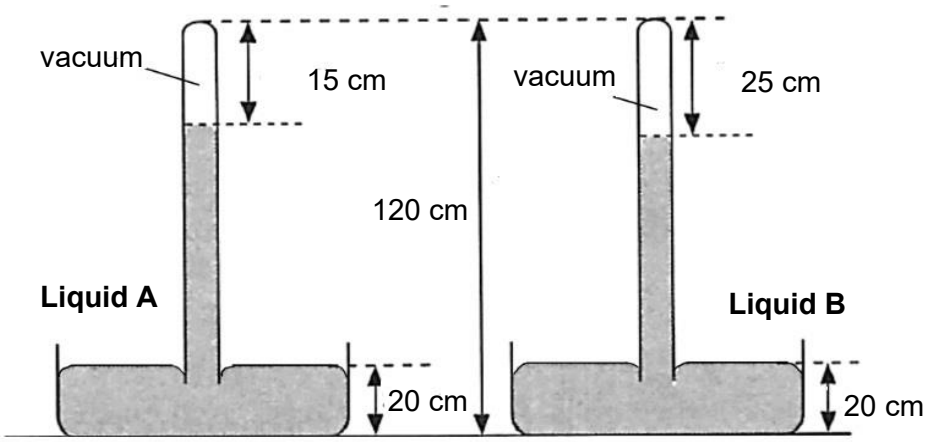

Fig. 5.1

(a) Liquid B is mercury, which has a density of 13 600 kg / m^3. The gravitational field strength *g* is taken to be 10 N / kg.

Determine the density of liquid A.

density of liquid A = …… [2]

(b) Without using any additional apparatus, suggest how you can check that there is no air that is trapped at the top of any one of the inverted glass tubes, while it is at the same place.

……....

……

……

…….... [2]

[Total: 4]

6 Fig. 6.1 shows a skier of mass 75 kg skiing down a very steep smooth slope.

The gravitational field strength, *g* is 10 N / kg.

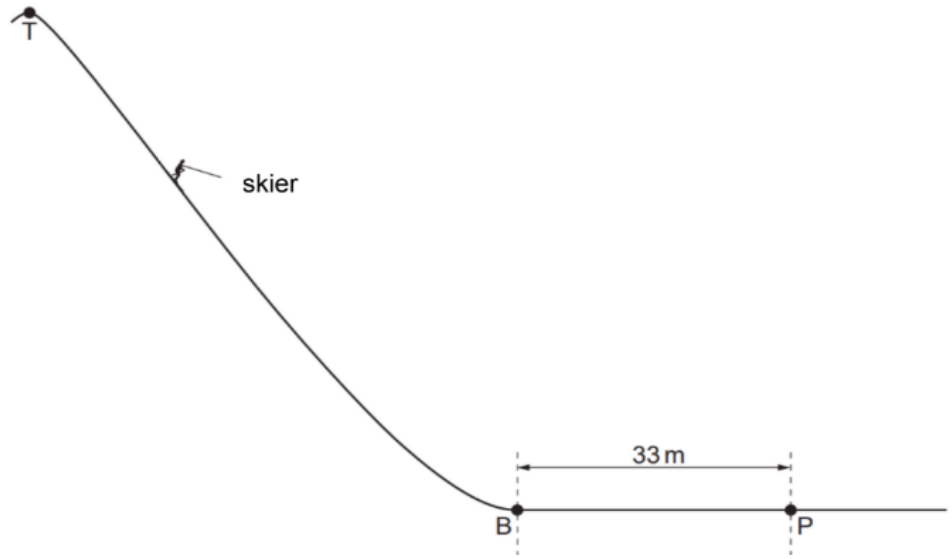

Fig. 6.1 (not to scale)

The skier starts moving from the top of the slope at point T with an initial speed of 2.0 m / s. He accelerates down the slope and reaches point B at the bottom of the slope with a speed of 30 m / s.

(a) (i) Calculate the change in energy in the kinetic store of the skier as he travelled from point T to point B.

change in energy in kinetic store = ... [2]

(ii) Hence, determine the height of point T from point B.

height = ... [1]

(b) Upon reaching point B, the skier digs his skis into the snow and comes to a stop at point P after moving horizontally for 33 m.

Calculate the average braking force that acts on the skier between points B and P.

average braking force = ……. [1]

(c) Describe, using ideas about energy stores and transfer pathways, how energy was transferred as the skier moves from point B to point P.

……....

……

……

……... [2]

[Total: 6]

7 **(a)** Define the *focal length* of a converging lens.

……[1]

(b) Describe briefly an experiment to determine the focal length of such a lens. You may include a diagram in your description.

……

……

……

……[2]

(c) A small object of height 4.0 cm is placed 5.0 cm away from a thin converging lens of focal length 10.0 cm. Using a suitable scale, draw a ray diagram to determine the size of the image.

size = ……. [3]

(d) Other than the location and the magnification of the image, state two other characteristics of the image formed.

……[2]

[Total: 8]

8 Fig. 8.1 shows an electrical circuit containing two resistors.

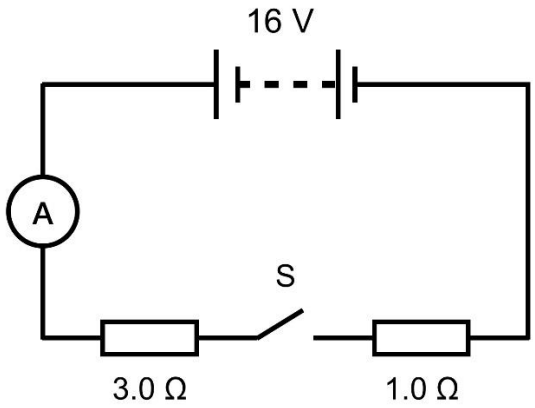

Fig. 8.1

(a) When switch S is open, the ammeter reading is zero.

State the value of the potential difference across switch S.

p.d.= ……..[1]

(b) Switch S is now closed.

(i) Calculate the current in the ammeter.

current = ……..[2]

(ii) Calculate the potential difference across the 3.0 Ω resistor.

p.d.= ……..[1]

(iii) The 1.0 Ω resistor is replaced with a different resistor. The potential difference across the 3.0 Ω resistor is now 1.5 V.

Calculate the resistance of the new resistor.

resistance = ……..[2]

[Total: 6]

9 The owner of a house records the details of the electricity usage for one day. The details are shown in Fig. 9.1.

appliance	power rating / W	time switched on / hours	energy used / kWh
TV and computer	1000	2.0	
kettle	2000	0.20	
lights	800	3.0	
water heater	3500	0.20	
air conditioner	1500	6.0	

Fig. 9.1

(a) Complete Fig. 9.1 by calculating the amount of energy used by each appliance. [1]

(b) The cost of electricity is 31 cents per unit. Calculate the cost of the electricity usage for one day.

cost = ……[2]

(c) The wires supplying electric current to the water heater are thicker than those supplying current to the lights.

Explain why this is necessary.

……

……

……

……..……..……..[2]

[Total: 5]

10 Fig. 10.1 shows four magnets fixed to a turntable spinning in the direction shown. An alternating e.m.f. is induced in a coil placed near it.

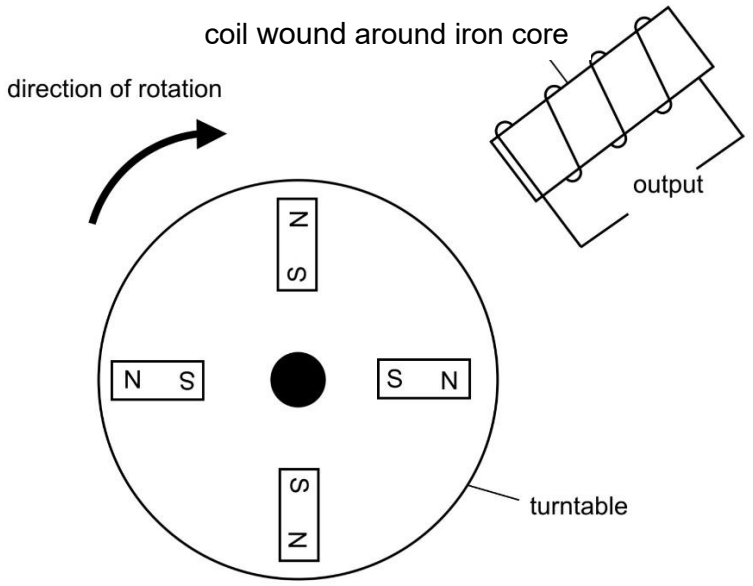

Fig. 10.1

(a) Explain why an e.m.f. is induced in the coil as the turntable rotates.

……

……

……[2]

(b) As one of the magnets approaches the coil, the magnet experiences an opposing force. Explain why.

……

……

……

……[2]

(c) The graph below shows how the e.m.f. varies with time when the turntable rotates at a constant speed. On Fig. 10.2, draw the graph for 0 to 30 ms to show how the e.m.f varies with time if the turntable rotates at twice the speed. [2]

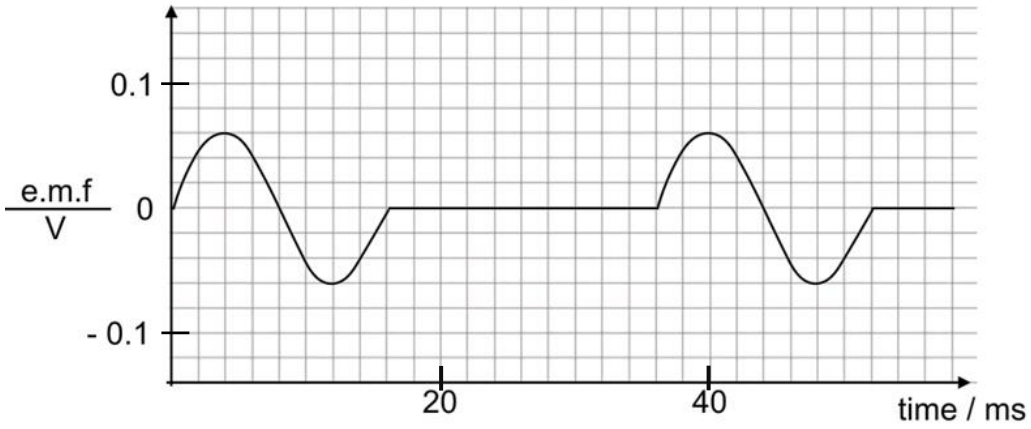

Fig. 10.2

[Total: 6]

11 A company makes insulating bowls to keep food cold. It carries out an experiment to determine the better material for making the bowl and whether it is worth supplying a lid. Bowls made of polystyrene and waterproof paper cardboard are filled with 200 g of ice at 0˚C at the start. The mass of water (melted ice) is recorded at 5 minute intervals and the results are shown in Table 11.1 below.

Table 11.1

	bowl made from polystyrene		**bowl made from paper cardboard**	
	without lid	with lid	without lid	with lid
time / min	mass / g	mass / g	mass / g	mass / g
0	0	0	0	0
5	2	0	12	5
10	9	5	25	14
15	13	9	44	30
20	20	14	58	45
25	30	23	79	63

(a) State one other variable that should be kept constant to ensure a fair test.

……... [1]

(b) Using the information from Table 11.1, suggest which material is better for insulation and explain your choice.

……....

……

……

……... [1]

(c) Using ideas about thermal processes, suggest one reason for the difference in the mass of water collected with and without lid for both materials.

……

……

……... [1]

(d) State and explain whether the bowl should be light-coloured or dark-coloured.

……

…….. [1]

(e) An ice maker is used to produce the ice for the above experiment. Water at a temperature of 25.0 °C is fed into the machine and ice cubes at a temperature of – 3.0 °C emerge from it. The following information is given:

specific heat capacity of water	=	4.2 J / (g °C)
specific latent heat of fusion of water	=	340 J / g
specific heat capacity of ice	=	2.1 J / (g °C)

(i) State what is meant by *specific latent heat of fusion of water is 340 J / g.*

……

……

…….. [2]

(ii) Explain why the internal energy of water decreases even though the temperature of water remains constant as it solidifies into ice.

……

……

…….. [1]

(iii) Calculate the total amount of energy transferred as 500 g of water at 25.0 °C is cooled to form ice at – 3.0 °C.

energy transferred = …….. [3]

[Total: 10]

12 A doctor uses a radioactive isotope, iodine-131, to determine the volume of blood in a patient's body. Iodine-131 decays by emitting beta particles and gamma rays.

(a) State two differences between beta particles and gamma rays.

……..

……..

……..

……..…….[2]

(b) Some iodine-131 is injected into the patient and spreads evenly throughout the patient's blood after twelve minutes. Nine samples of blood, each of volume 2.0 cm^3 are taken from the other arm at two minute intervals.

Fig. 12.1 shows the count rates from the nine samples after subtracting background radiation.

Sample number	1	2	3	4	5	6	7	8	9
Time after injection / min	2	4	6	8	10	12	14	16	18
Count rate / per second	0	4	12	18	28	40	38	36	40

Fig 12.1

(i) State the reason why the count rates of samples 6 to 9 are not constant throughout.

……...

……..……..[1]

(ii) The average value of the last four samples is the average count rate from 2.0 cm^3 of blood. Determine the volume of blood in the patient's body which has a total count rate of 144 000 per second.

volume = ……..[2]

(iii) Iodine -131 (I) has nucleon number 131 and atomic number 53. It decays into Xenon (Xe) by emitting beta radiation.

Write the nuclear decay equation.

……..…….[1]

(iv) Sample number 9 is kept.

The count rate is measured after 16 days. Estimate the count rate given that the half-life of iodine-131 is 8.0 days.

count rate = ……..[2]

(c) State two factors the doctor must consider when selecting the radioactive isotope to be used for this purpose.

……..

……..

……..

……..…….[2]

[Total: 10]

Section B

Answer **one** question from this section.
Answer either **Question 13** or **Question 14**

13 The voltage of a power supply P varies with time as shown in Fig.11.1.

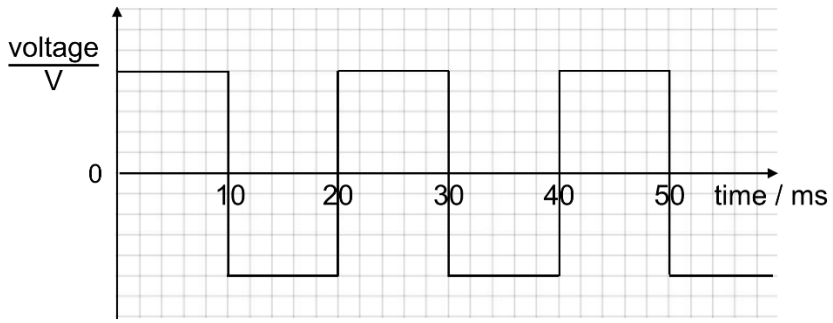

Fig. 13.1

A coil of wire is wrapped around an iron core and connected to power supply P.

A light bar magnet is attached to a paper cone to make a simple speaker as shown in Fig. 13.2.

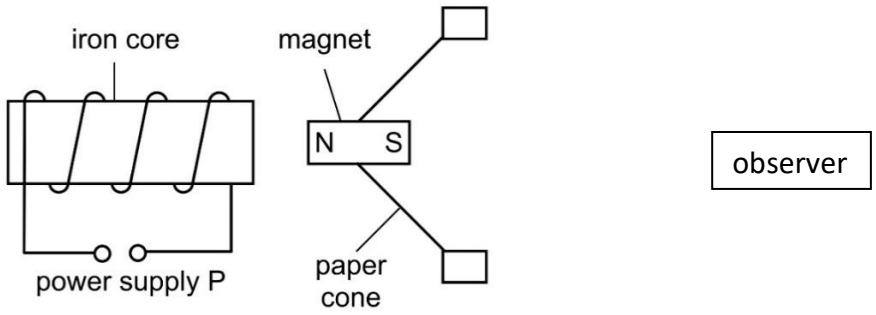

Fig. 13.2

The paper cone vibrates, and a sound is heard by an observer 1.0 m away from the paper cone.

(a) Calculate the frequency of the sound wave.

frequency = ……..[2]

(b) The speed of sound in air is 330 m / s. Calculate the wavelength of the sound wave.

wavelength = ……..[1]

(c) Describe how the vibration of the paper cone causes sound to travel to the observer.

……..

……..

……..

……[3]

(d) Power supply P is replaced with one with a lower voltage and higher frequency.

State how the sound produced changes.

……..…….[2]

(e) Explain why no sound is heard when power supply P is replaced with a direct current power supply.

……..

……..

……..

……[2]

[Total: 10]

14 China launched the Chang-e 6 spacecraft to the far side of the Moon in May 2024 to collect samples from the surface of the Moon. The spacecraft consists of four modules; the lander, the ascender, the orbiter and the return vehicle.

Upon reaching close to the Moon, the lander and ascender modules separated from the spacecraft and combined together to land on the Moon. Fig. 14.1 shows the combined lander-ascender module descending.

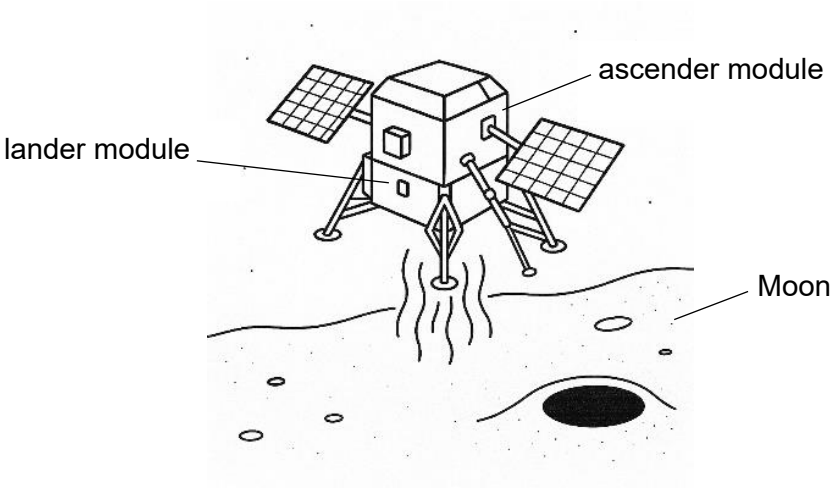

Fig. 14.1

The rocket engine of the lander was fired to slow down the combined lander-ascender module during the descent towards the Moon.

The masses of the lander and ascender modules were 3200 kg and 700 kg respectively. The gravitational field strength on the Moon is 1.6 N / kg.

(a) Explain why deploying a parachute is not an option to slow down the descending combined lander-ascender module.

……

……

……[2]

(b) At 100 m above the surface of the Moon, the combined lander-ascender module started to descend at a constant speed.

(i) Draw and label on Fig. 14.2 below, the two forces acting on the combined lander-ascender module as it descends at constant speed. Indicate the magnitude of both forces. [2]

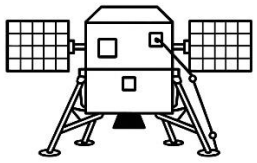

Fig. 14.2

(ii) Explain, using Newton's laws of motion, how the forces acting on the combined lander-ascender module should change to cause it to decelerate as it approaches the Moon's surface.

……

……

……

…… [2]

(c) After collecting the lunar sample, the ascender module separated from the lander module. It was launched using a 3000 N thrust booster to lift it off the Moon's surface. The ascender module will then be combined with the orbiter and return vehicle modules. The combined modules then orbit around the Moon.

(i) Calculate the acceleration of the ascender module as it lifted off the Moon's surface.

acceleration = …….. [2]

(ii) When orbiting around the Moon, the combined modules are moving with constant speed. State and explain whether they are accelerating or not.

……

……

……

…… [2]

[Total: 10]