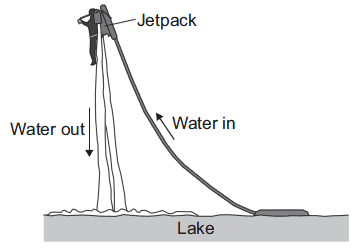
**Q1.** The diagram below shows a person using a device called a jetpack. Water is forced downwards from the jetpack and produces an upward force on the person.



(a)     State the condition necessary for the person to be able to remain stationary in mid-air.

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**(1)**

(b)     The person weighs 700 N and the jetpack weighs 140 N.

(i)      Calculate the combined mass of the person and the jetpack.

Gravitational field strength = 10 N/kg

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Combined mass = \_\_\_\_\_\_\_\_\_\_\_ kg

**(2)**

(ii)     Increasing the upward force to 1850 N causes the person to accelerate upwards.

Calculate the acceleration of the person and the jetpack. Give the unit.

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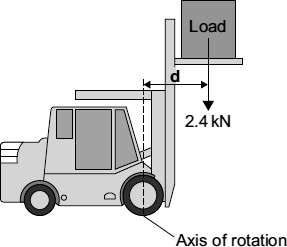
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Acceleration = \_\_\_\_\_\_\_\_\_\_\_ Unit \_\_\_\_\_\_\_\_\_\_\_

**(3)**

**(Total 6 marks)**

**Q2.** The diagram shows a fork-lift truck with a load of 2.4 kN. The clockwise moment caused by this load is 2880 Nm.



(a)     Use the equation in the box to calculate the distance **d**.

|  |  |
| --- | --- |
| moment    =    force    × | perpendicular distance from the line of action of the force to the axis of rotation |

Show clearly how you work out the answer and give the unit.

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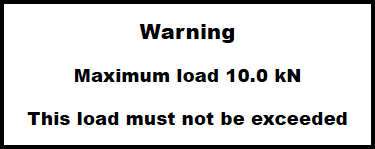
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Distance **d** = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(3)**

(b)     This warning notice is in the driver’s cab.



Explain in terms of moments why the maximum load must not be exceeded.

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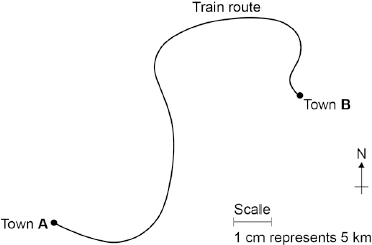
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**Q3.** A train travels from town **A** to town **B**.

**Figure 1** shows the route taken by the train.

**Figure 1** has been drawn to scale.

**Figure 1**

****

(a)     The distance the train travels between **A** and **B** is not the same as the displacement of the train.

What is the difference between distance and displacement?

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**(1)**

(b)     Use **Figure 1** to determine the displacement of the train in travelling from **A** to **B**.

Show how you obtain your answer.

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Displacement = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ km

Direction = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(c)     There are places on the journey where the train accelerates without changing speed.

Explain how this can happen.

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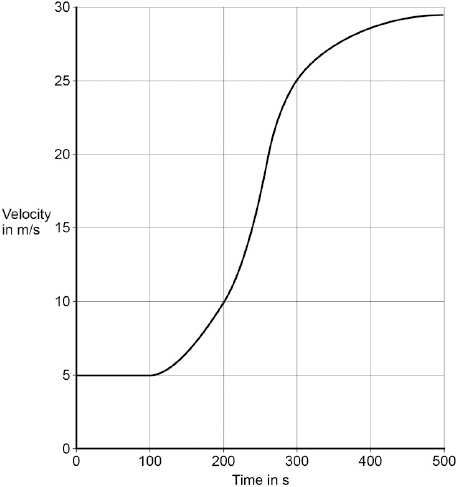
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**(2)**

(d)     **Figure 2** shows how the velocity of the train changes with time as the train travels along a straight section of the journey.

**Figure 2**

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Estimate the distance travelled by the train along the section of the journey shown in **Figure 2**.

To gain full marks you must show how you worked out your answer.

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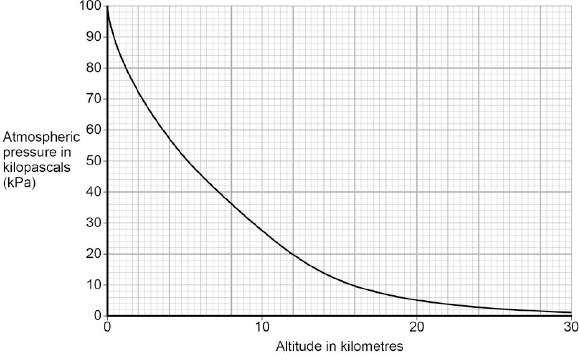
Distance = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ m

**(3)**

**(Total 8 marks)**

**Q4.Figure 1** shows how atmospheric pressure varies with altitude.

**Figure 1**

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(a)     Explain why atmospheric pressure decreases with increasing altitude.

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**(3)**

(b)     When flying, the pressure inside the cabin of an aircraft is kept at 70 kPa.

The aircraft window has an area of 810 cm2.

Use data from **Figure 1** to calculate the resultant force acting on an aircraft window when the aircraft is flying at an altitude of 12 km.

Give your answer to two significant figures

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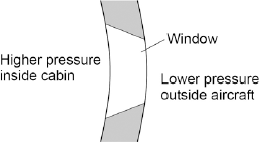
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Resultant force = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ N **(5)**

(c)     **Figure 2** shows the cross-section of one type of aircraft window.

**Figure 2**

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Explain why the window has been designed to have this shape.

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**(2)**

**(Total 10 marks)**

**Q5.** Waves may be either longitudinal or transverse.

(a)     Describe the difference between a longitudinal and a transverse wave.

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**(2)**

(b)     Describe **one** piece of evidence that shows when a sound wave travels through the air it is the wave and not the air itself that travels.

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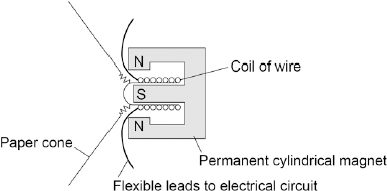
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**(1)**

(c)     The figure below shows the parts of a moving-coil loudspeaker.

A coil of wire is positioned in the gap between the north and south poles of the cylindrical magnet.



Explain how the loudspeaker converts current in an electrical circuit to a sound wave.

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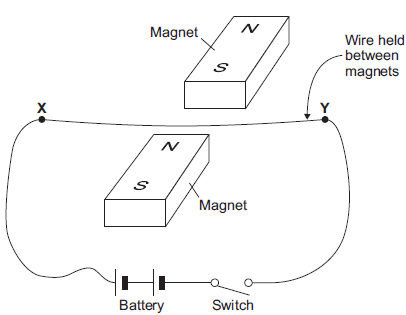
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**(6)**

**(Total 9 marks)**

**Q6.** The diagram shows apparatus set up by a student.



Closing the switch creates a force that acts on the wire **XY**.

(a)     (i)      Explain why a force acts on the wire **XY** when the switch is closed.

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**(3)**

(ii)     The force causes the wire **XY** to move.  
Draw an arrow on the diagram above to show the direction in which the wire **XY** will move.

**(1)**

(iii)    State the effect that this experiment demonstrates.

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**(1)**

(b)     The student replaced the battery with a low frequency alternating current (a.c.) power supply.

The student closed the switch.

(i)      Describe the movement of the wire.

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**(1)**

(ii)     Give a reason for your answer to part (i).

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**(1)**

**(Total 7 marks)**

**Q7.** Galaxies emit all types of electromagnetic wave.

(a)    (i)      Which type of electromagnetic wave has the shortest wavelength?

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**(1)**

(ii)     State **one** difference between an ultraviolet wave and a visible light wave.

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**(1)**

(b)     Electromagnetic waves travel through space at a speed of 3.0 x 108 m/s.

The radio waves emitted from a distant galaxy have a wavelength of 25 metres.

Calculate the frequency of the radio waves emitted from the galaxy and give the unit.

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Frequency = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(3)**

(c)     Scientists use a radio telescope to measure the wavelength of the radio waves emitted from the galaxy in part (b) as the waves reach the Earth. The scientists measure the wavelength as 25.2 metres. The effect causing this observed increase in wavelength is called red-shift.

(i)      The waves emitted from most galaxies show red-shift.

What does red-shift tell scientists about the direction most galaxies are moving?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(1)**

(ii)     The size of the red-shift is **not** the same for all galaxies.

What information can scientists find out about a galaxy when they measure the size of the red-shift the galaxy produces?

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**(2)**

(iii)    What does the observation of red-shift suggest is happening to the Universe?

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**(1)**

**(Total 9 marks)**

**Q8.** (a)     As part of its life cycle, a star changes from being a protostar to a main sequence star.

Explain the difference between a protostar and a main sequence star.

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**(2)**

(b)     The early Universe contained only atoms of hydrogen. The Universe now contains atoms of over one hundred different elements.

Explain how the different elements now contained in the Universe were formed.

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**(3)**

**(Total 5 marks)**