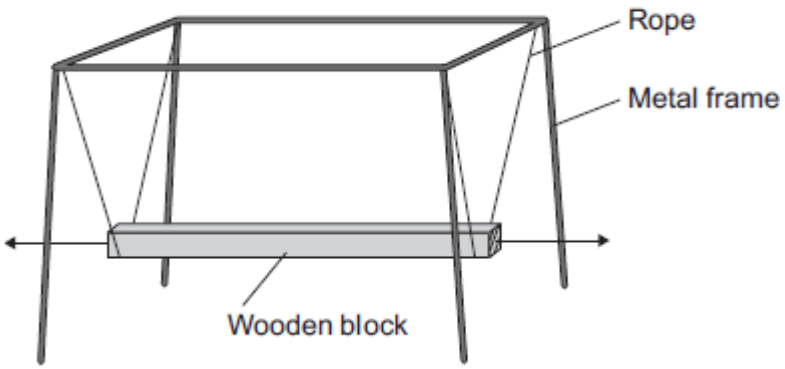
Name of the Student:_____
Max. Marks : 26 Marks **Time : 26 Minutes**

Q1.

Figure 1 shows the design of a playground ride.

Figure 1



A large wooden block rests on ropes. The ropes are attached to a metal frame.

Children sit on the wooden block.

When the wooden block is moved to the left and released it moves to and fro.

When the wooden block returns to the point of release it has completed one cycle.

(a) Identify **two** possible hazards of the ride in **Figure 1**.

_____

_____

_____

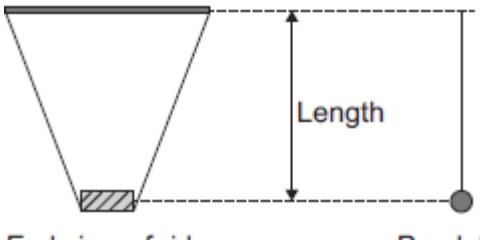
_____

(2)

(b) The designer of the ride wants to know if the ride has the same time period as a pendulum of the same length.

The designer used a model of the ride and a pendulum as shown in **Figure 2**.

Figure 2



The designer measured the time taken to complete 10 cycles for different lengths of both the model ride and the pendulum.

The results for the model ride are shown in **Table 1**.

Table 1

Length in metres	Time for 10 cycles in seconds				Mean time period in seconds
	First time	Second time	Third time	Mean	
0.100	6.36	6.37	6.29	6.34	0.63
0.150	7.76	7.74	7.80		
0.200	8.97	8.99	8.95	8.97	0.90

The results for the pendulum are shown in **Table 2**.

Table 2

Length in metres	Time for 10 cycles in seconds				Mean time period in seconds
	First time	Second time	Third time	Mean	
0.250	10.00	10.04	10.02	10.02	1.00
0.300	10.99	11.01	10.94	10.98	1.10
0.350	11.88	11.83	11.87	11.86	1.19

(i) Complete **Table 1**, giving values to an appropriate number of significant figures.

_____

_____

(3)

(ii) The investigation already includes repeated readings.

Suggest **one** improvement that could be made to this investigation.

_____

_____

(1)

(iii) The designer reads in an Advanced Physics textbook that:
'The square of the time period, *T*, for a simple pendulum is proportional to its length, l.'

$$T^2 \propto l$$

Would the model ride have the same time period as a simple pendulum of the same length?

Use **one** row of data from **Table 1** and **one** row of data from **Table 2** to work out your answer.

State your conclusion.

_____

_____

_____

_____

_____

_____

(3)

(c) The ride was redesigned and built to make it safer.

The wood was moving at maximum speed. The maximum kinetic energy of the wood was 180 J.

A parent applied a force to the wood and stopped it in a distance of 0.25 m.

Calculate the force required.

_____

_____

Force = _____ N

(3)

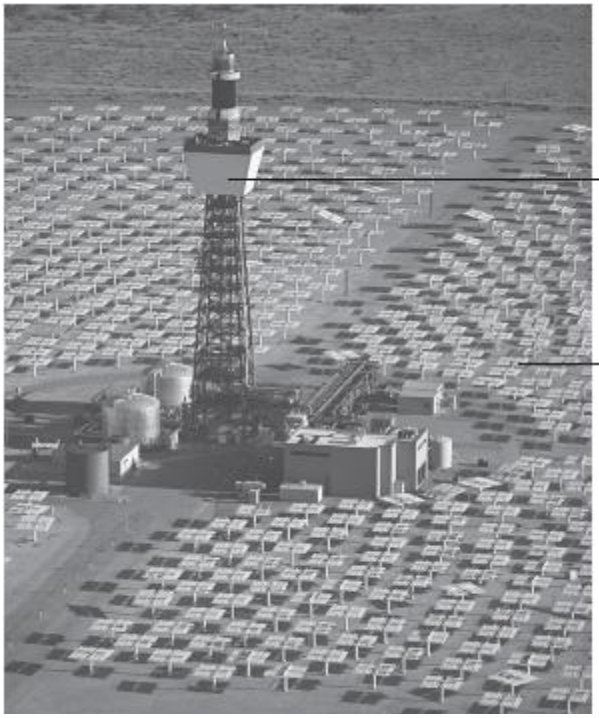
(Total 12 marks)

Q2.

The image below shows a solar thermal power station that has been built in a hot desert.

The power station uses energy from the Sun to heat water to generate electricity.

Energy from the Sun is reflected towards a solar receiver using many mirrors.



(a) (i) Which part of the electromagnetic spectrum provides most of the energy to heat the water in a solar thermal power station?

_____

(1)

(ii) Describe how heated water is used to generate electricity by this solar thermal power station.
The process is the same as in a fossil fuel power station.

_____

_____

_____

_____

_____

_____

(3)

(b) A new type of solar power station, called a solar storage power station, is able to store energy from the Sun by heating molten chemical salts.
The stored energy can be used to generate electricity at night.

(i) It is important that the molten chemical salts have a high specific heat capacity.
Suggest **one** reason why.

_____

_____

(1)

(ii) The solar storage power station can store a maximum of 2 200 000 kWh of energy. The solar storage power station can supply a town with a maximum electrical power of 140 000 kW.

Calculate for how many hours the energy stored by the solar storage power station can supply the town with electrical power.

Give your answer to 2 significant figures.

_____

_____

_____

Time = _____ hours

(3)

(iii) **Table 1** gives information about the place where the solar storage power station has been built.

Table 1

Season	**Mean number of daylight hours**	**Mean power received from the Sun per square metre in kW**
Spring	11.5	0.90
Summer	13.5	1.10
Autumn	12.0	0.95
Winter	10.5	0.71

The solar storage power station does not operate at the maximum possible electrical output every day of the year.

Suggest why.

_____

_____

_____

_____

(2)

(c) Power stations do not work at maximum possible electrical output all the time.The 'capacity factor' of a power station is calculated using the equation:

$$\text{Capacity factor} = \frac{\text{actual electrical output per year}}{\text{maximum possible electrical output per year}}$$

Table 2 shows capacity factors for different types of power station.

Table 2

Type of power station	Renewable energy source	Capacity factor
Coal	No	0.41
Natural gas	No	0.48
Nuclear	No	0.66
Solar thermal	Yes	0.33
Tidal	Yes	0.26
Wind turbine	Yes	0.30

(i) Compare the capacity factors of the renewable power stations with those of the non-renewable power stations in **Table 2**.
Explain the reason for the difference between the capacity factors.

_____

_____

_____

_____

_____

_____

(3)

(ii) The capacity factor of a solar storage power station is higher than for all other renewable power stations.
Suggest **one** reason why.

_____

_____

(1)
(Total 14 marks)