O Level Pure Physics Structured

Energy, Work Done and Power Test 1.0

Q1

Fig. 2.1 shows an object of mass 500 g moving up a rough inclined plane. The object moves from **A** with an initial velocity of 9.00 m/s up the inclined plane to **B** and comes to a rest in 1.2 s. The horizontal distance between point **A** and **B** is 3.9 m.

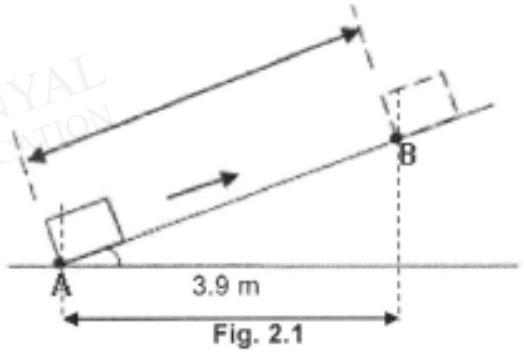

Fig. 2.1

(a) Calculate the distance **AB** along the inclined plane. [1]

(b) Calculate the

(i) gain in gravitational potential energy of object at **B**. [2]

(ii) loss in kinetic energy as it travels from **A** to **B**. [1]

(c) Suggest why the gain in gravitational potential energy is not equal in magnitude as the loss in kinetic energy of the object when moving the distance **AB**. [1]

Q2

(a) Fig 3.1 shows a stone drop at a certain height freely from rest near the surface of Earth. (Neglecting air resistance)

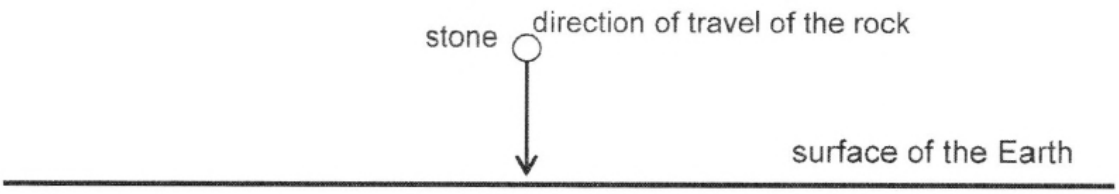

Fig. 3.1

On the axes given in Fig. 3.2, sketch the

(i) graph of the gravitational potential energy, label it as **P**, of the stone against time, t, just before it hits the ground. **[1]**

(ii) graph of the kinetic energy, label it as **K**, of the stone against time, t, just before it hits the ground. **[1]**

The graphs drawn should clearly show the relationship between them.
[no numerical value is required for the graphs]

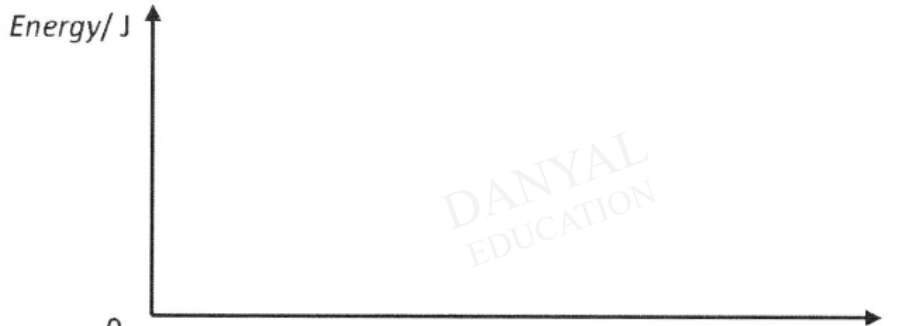

Fig. 3.2

(b) Fig. 3.3 shows a person hitting a billiard ball **X** on a smooth table. The billiard ball **X** will move straight and hit another ball **Y** at a velocity **v** m/s and come to a stop instantaneously while the ball **Y** will move forward at a certain velocity.

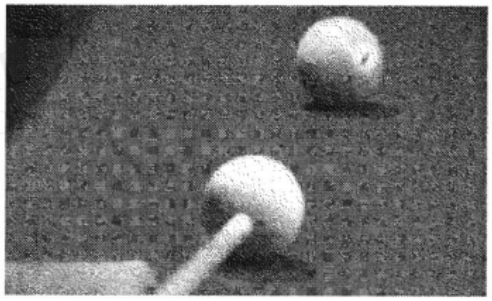

Fig. 3.3

Given that the mass of the ball **X** is larger than ball **Y**, state and explain if the velocity of ball **Y** be greater than, equal or less than **v** m/s. **[2]**

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_____

Q3

Water is transported to a village in a tank pulled by a tractor.

Fig. 2.1 shows the tank being pulled by a tractor.

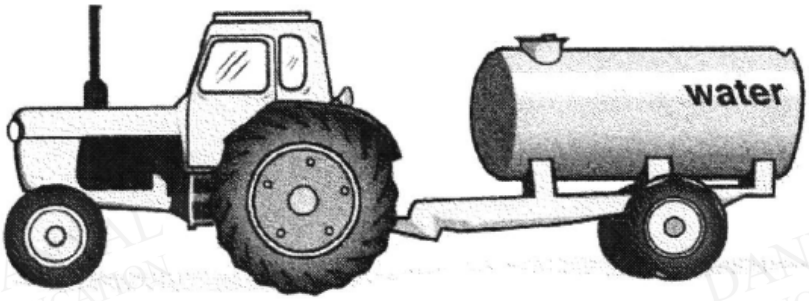


Fig. 2.1

The combined mass of the tractor and the tank is 4100 kg when the tank is empty and 6500 kg when the tank is full of water.

(b) At the start of the journey, the tractor and tank accelerates from rest along a straight horizontal road. As their speed increases, one form of energy is decreasing.

(i) State the name of the form of energy that is decreasing.

.....[1]

(ii) Explain what happens to this energy.

.....

.....

.....

.....[2]

(c) The village is located on a mountain at a vertical height of 850 m above the water supply. The gravitational field strength g is 10 N/kg.

Calculate the gravitational potential energy gained by the water as it is transported from the supply to the village.

energy gained = ... [2]

Q4

Fig. 3.1 shows a simplified structure of a tidal generator used to generate electricity.

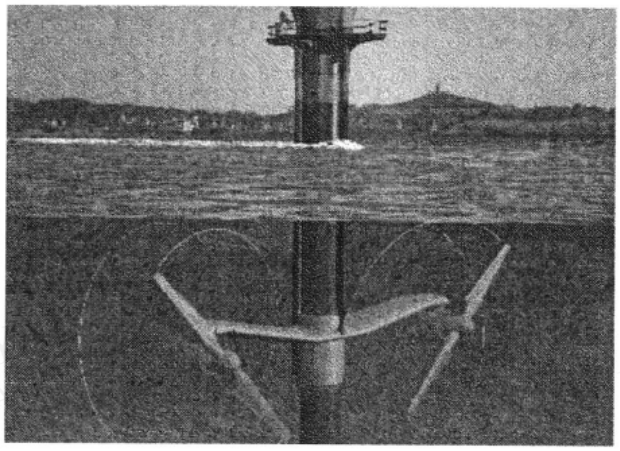


Fig. 3.1

(a) **(i)** State the Principle of Conservation of Energy.

.....

.....[1]

(ii) The total kinetic energy provided by tidal currents acting in a second is 111 240 J.

The efficiency of the tidal generator is 77%.

Calculate the energy output of the tidal generator in 10 min.

output = ...[2]

(iii) Give a reason why the efficiency of the tidal generator is not 100%.

.....

.....[1]

(b) Both wind turbines and tidal turbines are potentially eco-friendly and inexpensive sources of renewable energy.

State one advantage of tidal turbines as compared to wind turbines.

.....

.....[1]

Q5

9. A wind turbine uses renewable energy source to generate electricity.

Fig 9.1 shows how the power output of a wind turbine varies with wind speed.

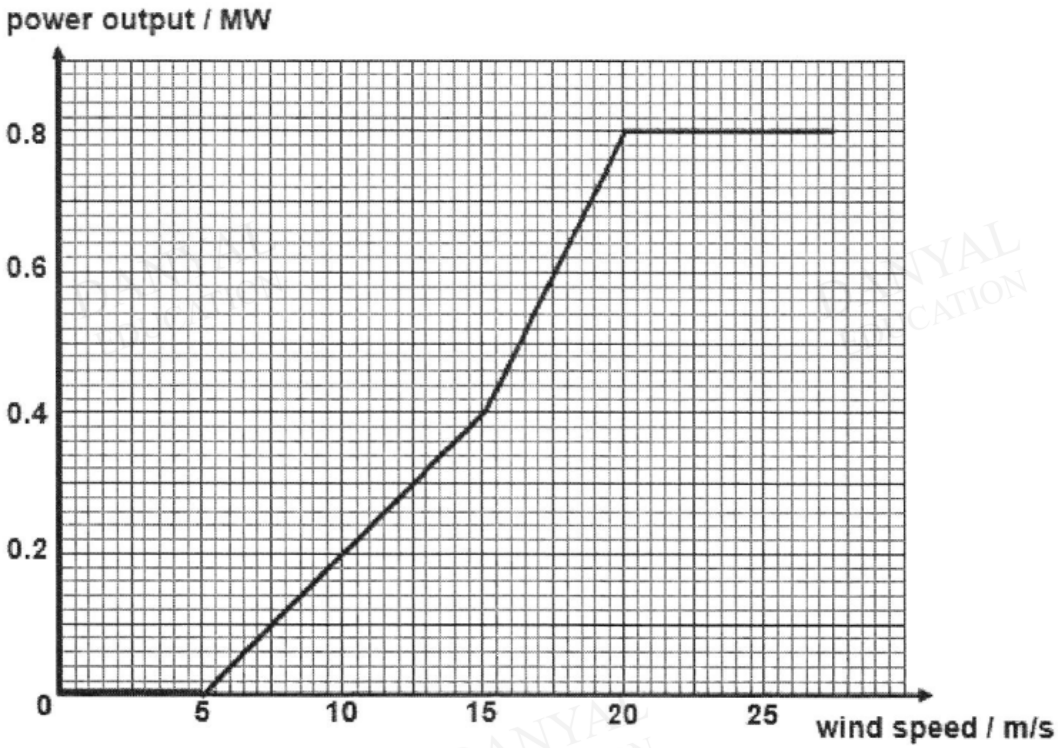


Fig 9.1

a) Calculate the rate of power output (in MW / m/s) of the wind turbine for wind speed of 10 m/s. [1]

Rate of power output =……..

b) Using **Fig 9.1**, describe how the power output varies with the wind speed of 5 m/s to 20 m/s. In your description, you are to include any numerical value(s) where necessary. [2]

……..

……..

……..

……..

……..

c) The wind speed is recorded at two minute intervals as shown in **Fig 9.2**. [3]

Time / min	0	2	4	6	8	10	12	14	16	18
Wind speed / m/s	2	3	6	18	1	0	15	15	20	22

Fig 9.2

Using the data provided in **Fig 9.1** and **Fig 9.2**, estimate the total energy produced in the 18 minute interval. Give your answer in joules

Total energy = ...

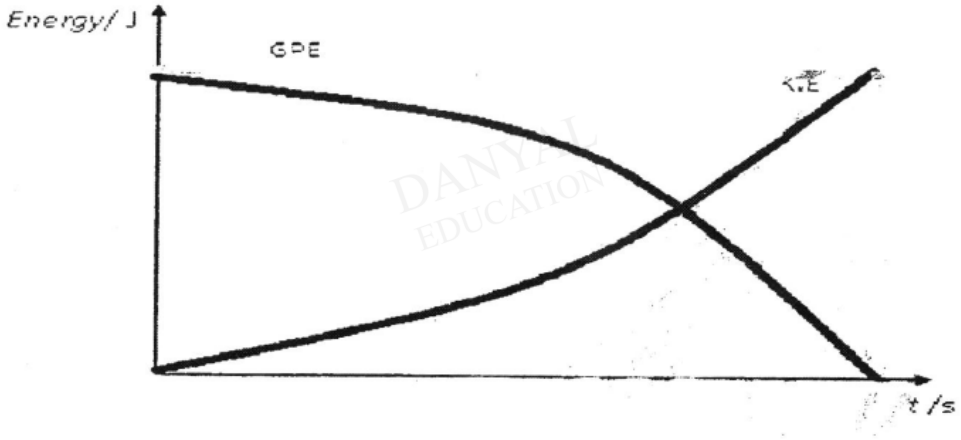
Answers

Energy, Work Done and Power Test 1.0

Q1

(a)	Distance AB along the inclined plane = 0.5 x 9.0 x 1.2 = 5.4m	B1
(b)(i)	5.4 ^{2}= vertical distance – 3.9^2 Vertical distance = 3.735 m Gain in G.P.E = 0.5 x 10 x 3.735 =18.67 J =18.7 J	M1 A1
(ii)	Loss in K.E = 0.5 x 0.5 x $(9.0)^2$ = 20.25 J = 20.3 J	A1
(c)	Loss in K.E is the sum of the gain in GPE and work done against friction	A1

Q2

(a)		Shape 1 Inverse proportional 1
(b)	Velocity of ball Y is higher. Conservation of energy, T.E changed in X is equal to T.E changed in Y. Given no change in GPE, change in K.E of X is equal to change in K.E of Y. ½ m_x v^2 = ½ m_y v Since a larger m_x than m_y, v will be greater than v **Wrong concept** RESULTANT FORCE = m X a a higher, v higher.	[1] [1]

Q3

2b(i)	fuel/chemical (potential energy)	[1]
MC	Generally well done. No credit if they only mention potential energy.	
2b(ii)	some energy converted to heat /thermal (energy) some energy converted to kinetic (energy of air or tractor)	[1] [1]
MC	Not so well done. Many students only mention energy conversion to either kinetic energy or heat but not both. So they only obtained half the credits.	
2(c)	(GPE) = mgh = 2400 x 10 x 850 = 2.04×10^7 J	[1] [1]

Q4

ai	Energy cannot be created nor destroyed but can be converted from one form to another (total amount of energy in a closed system remains constant)	B1
aii	Efficiency = (Useful energy output / energy input) x 100% 77 = (Electrical energy output / KE energy input) x 100 77 = (Electrical energy output / (111 240 x 10 x 60)) x 100 Electrical energy output = 51 392 880 J	M1 A1
aiii	Energy is used to overcome frictional forces / resistive forces. *Do not accept heat loss / converted to other forms of energy	B1
b	-There are constant tidal currents compared to wind speeds which fluctuate -Tidal turbines take up less space on land to construct compared to wind turbines *Any one	B1

Q5

a)	Rate of power output = 0.4 ÷ 10 = 0.040 MW / m/s	A1

b)	For wind speed from 5 m/s to 15 m/s, the power output increases at a constant rate of 0.040 MW / m/s [1]. For wind speed from 15 m/s to 20 m/s, there is a the power output increases of 0.080 MW / m/s [1].	
c)	Total energy produced = [(0.04 + 0.64 + 0.4 + 0.4 + 0.8 + 0.8) / 6] × 10^6 × 18 × 60 [2] = 5.54 × 10^8 J [1]	