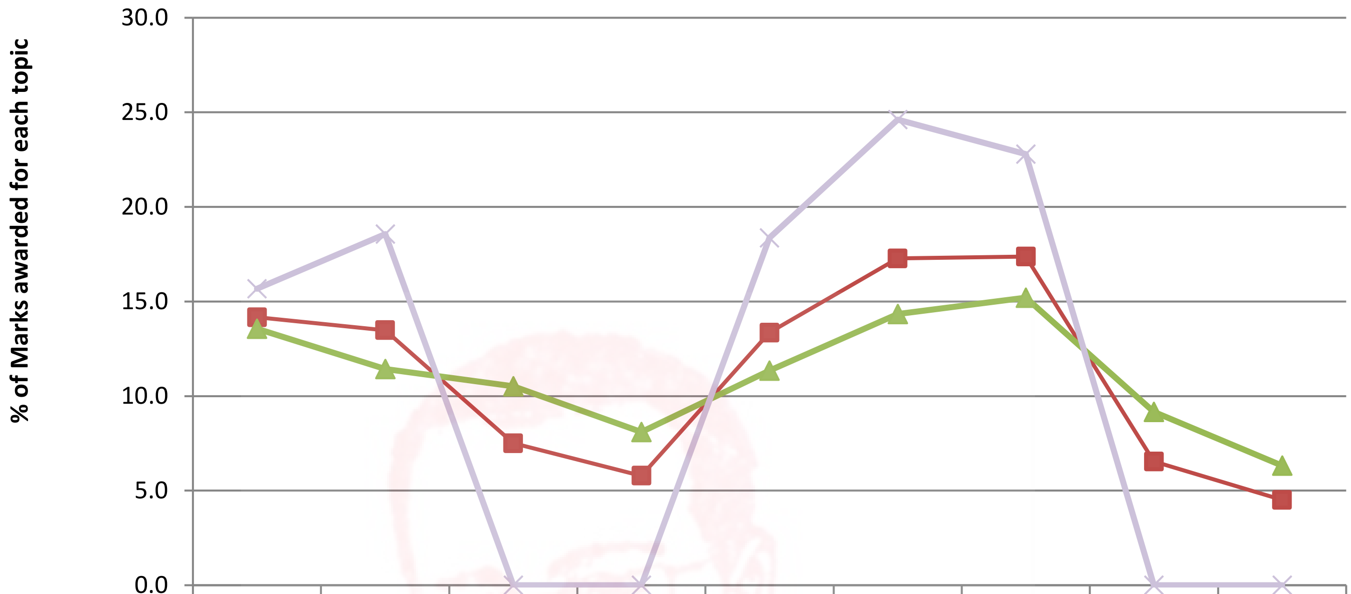
Name

iG Phx 3 EQ 14w to 02w P3 218marks

For these stats only papers 3 (which after 2016 became paper 4) and paper 6 were used to examine the topics.

iG Phx CIE 0625 PAPERS 3 and 6

Percentage of all WEIGHTED marks awarded for P3 & 6 each topic from s2002 to w2014 (red squares) and % of Paper 3 marks (green triangles) and paper 6 (purple crosses)

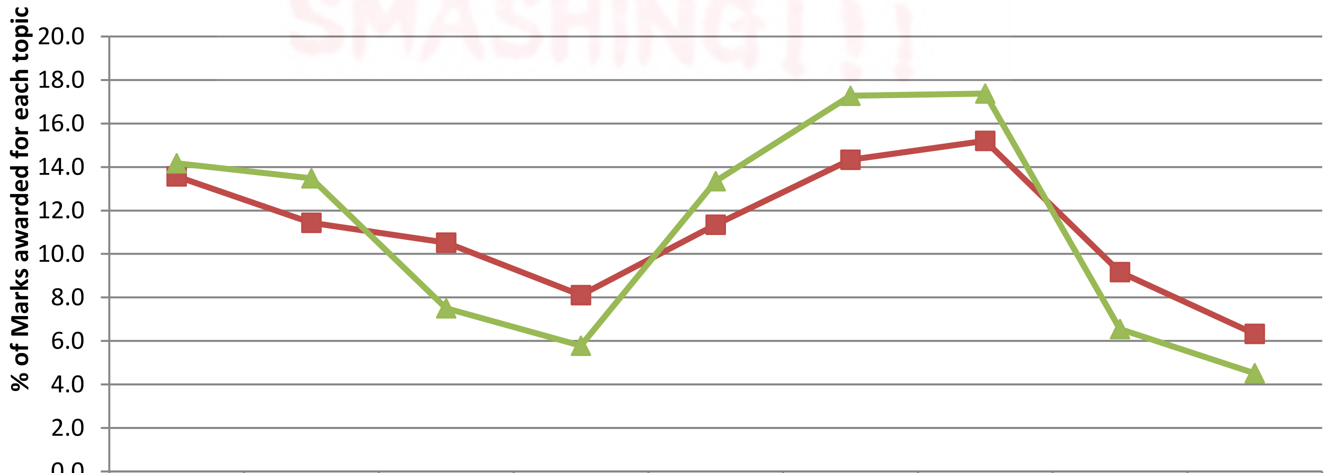


	1	2	3	4	5	6	7	8	9
PhxBoth P3&6	14.2	13.5	7.5	5.8	13.4	17.3	17.4	6.5	4.5
PhxP3	13.6	11.4	10.5	8.1	11.3	14.3	15.2	9.2	6.3
PhxP6	15.7	18.6	0.0	0.0	18.4	24.6	22.8	0.0	0.0

Papers 3 and 6 Topic Number

PAPER 3

Percentage of all marks awarded for each topic from s2002 to w2014 in Paper 3 (red squares) and marks per topic for papers 3 and 6 (green triangles)



	1	2	3	4	5	6	7	8	9
ALL P3 %	13.6	11.4	10.5	8.1	11.3	14.3	15.2	9.2	6.3
P3 & 6	14.2	13.5	7.5	5.8	13.4	17.3	17.4	6.5	4.5

Paper 3 Topic Number

Papers covered in this sample

	1st Paper	Last Paper	Marks/ paper	Theor. All Papers	Actual All Marks	Difference	Difference %	Weight per paper	Weight per mark
Paper 3	2002w	2014w	80	2000	2072	72	3.6	50	0.63
Paper 6	2002s	2015w	40	1120	1040	-80	-7.1	20	0.50

There are a few missing:

Got all Paper 31s (except 2014w Paper 31), and got 2014w 33

So papers in time zones 2 and 3 are not covered.

All topics ranked by frequency of marks in exams (P3 and 6 only)

Topic	PhxBoth P3&6	PhxP3	PhxP6
7	17.4	15.2	22.8
6	17.3	14.3	24.6
1	14.2	13.6	15.7
2	13.5	11.4	18.6
5	13.4	11.3	18.4
3	7.5	10.5	0.0
8	6.5	9.2	0.0
4	5.8	8.1	0.0
9	4.5	6.3	0.0

Other statistics that might be of interest:

	Topics:	1	2	3	4	5	6	7	8	9
P3/4 marks	2072	281	237	218	168	235	297	315	190	131
P3/4 %		13.6	11.4	10.5	8.1	11.3	14.3	15.2	9.2	6.3
P6	1040	163	193	0	0	191	256	237	0	0
P6 %		15.7	18.6	0.0	0.0	18.4	24.6	22.8	0.0	0.0
Total Marks (WIEGHTED)	1815	257	245	136	105	242	314	315	119	82
% of Marks (Weighted)	1815	14.2	13.5	7.5	5.8	13.4	17.3	17.4	6.5	4.5
# of Questions		63	64	35	16	63	74	70	26	20
Average marks per Q		**4.1**	**3.8**	**3.9**	**6.6**	**3.8**	**4.2**	**4.5**	**4.6**	**4.1**

Final note:

My iG and IB chemistry papers were broken down more carefully than these were, so there may be a mark or two in the wrong topic especially in topics 3 to 5, but if you learnt or taught these topics in sequence than you shouldn't have a problem with seeing material from an earlier topic.

Defining the Topics: Why not use the units given in the syllabus?

Artificial topics have been created for the physics syllabus by me so that each topic is roughly the same size. Topics go in syllabus order. I have decided to use the number of marks allocated in previous exams to each syllabus point to determine how many go into each topic.

1. General physics

Topic 1

1.1 Length and time
1.2 Motion
1.3 Mass and weight
1.4 Density

Topic 2

1.5 Forces
1.6 Momentum (Extended candidates only)

Topic 3

1.7 Energy, work and power
1.8 Pressure

2. Thermal physics

Topic 4

2.1 Simple kinetic molecular model of matter

Topic 5

2.2 Thermal properties and temperature
2.3 Thermal processes

3. Properties of waves, including light and sound

Topic 6

3.1 General wave properties
3.2 Light
3.3 Electromagnetic spectrum
3.4 Sound

4. Electricity and magnetism

Topic 7

4.1 Simple phenomena of magnetism
4.2 Electrical quantities
4.3 Electric circuits
4.4 Digital electronics (Extended candidates only)
4.5 Dangers of electricity

Topic 8

4.6 Electromagnetic effects

5. Atomic physics

Topic 9

5.1 The nuclear atom
5.2 Radioactivity

Q# 1/ iG Phx/2014/w/Paper 33/ NOT with Q2a

2 Fig. 2.1 shows a uniform, rectangular slab of concrete ABCD standing upright on the ground. The slab has height 0.60 m, width 0.30 m and mass 18 kg. A force of 40 N acts horizontally to the left at B.

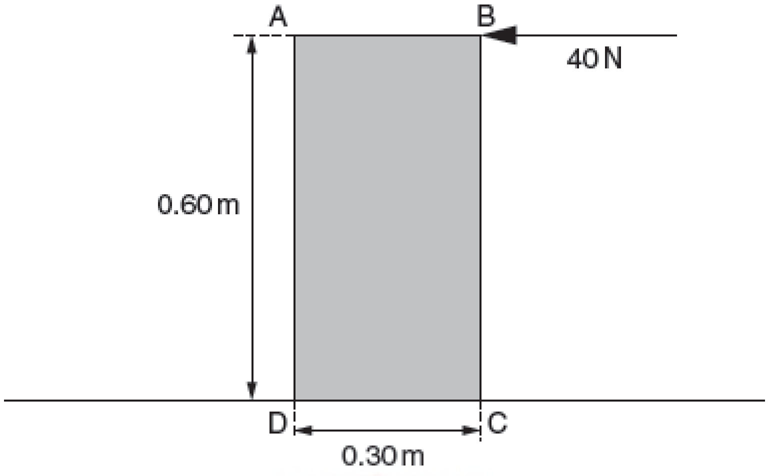


Fig. 2.1

The weight of the sab is 1.8Kg

(ii) The thickness of the slab is 0.040 m.

Calculate the pressure exerted by the slab on the ground.

pressure = ... [2]

3 Fig. 3.1 shows a long, plastic tube, sealed at both ends. The tube contains 0.15 kg of small metal spheres.

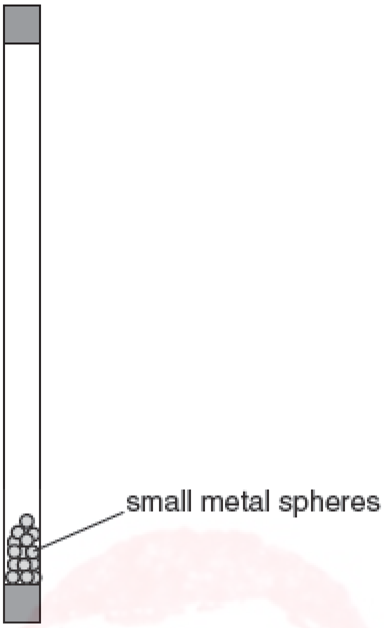


Fig. 3.1

A physics teacher turns the tube upside down very quickly and the small metal spheres then fall through 1.8 m and hit the bottom of the tube.

(a) Calculate

(i) the decrease in gravitational potential energy as the spheres fall 1.8 m,

decrease in gravitational potential energy = ... [2]

(ii) the speed of the spheres as they hit the bottom of the tube.

speed = ... [3]

(b) The gravitational potential energy of the spheres is eventually transformed to thermal energy in the metal spheres. The physics teacher explains that this procedure can be used to determine the specific heat capacity of the metal.

(i) State one other measurement that must be made in order for the specific heat capacity of the metal to be determined.

....

....[1]

(ii) Suggest a source of inaccuracy in determining the specific heat capacity using this experiment.

....

....[1]

(iii) The teacher turns the tube upside down and lets the spheres fall to the bottom 100 times within a short period of time.

Explain why turning the tube upside down 100 times, instead of just once, produces a more accurate value of the specific heat capacity.

....

....

....[2]

[Total: 9]

2 Fig. 2.1 shows a uniform, rectangular slab of concrete ABCD standing upright on the ground. The slab has height 0.60 m, width 0.30 m and mass 18 kg. A force of 40 N acts horizontally to the left at B.

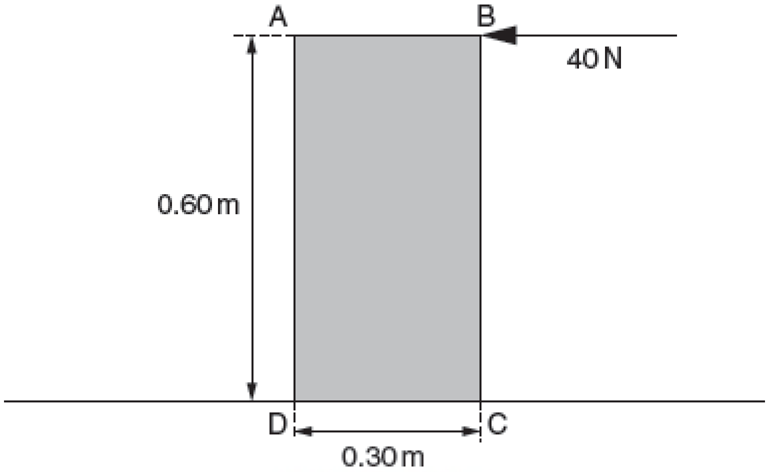


Fig. 2.1

(a) **(i)** Calculate the weight *W* of the concrete slab.

W = ... [1]

(b) **(i)** On Fig. 2.1, draw and label an arrow to show the weight *W* of the slab acting at its centre of mass. [1]

(ii) Calculate

1. the moment of the 40 N force about point D,

moment = ...

2. the moment of *W* about point D.

moment = ...

[3]

(iii) The ground is rough so that the slab does not slide.

State and explain what happens to the slab as the horizontal force at B is gradually increased.

....

....

....[2]

3 (a) On a day with no wind, a fountain in Switzerland propels 30 000 kg of water per minute to a height of 140 m.

Calculate the power used in raising the water.

power = ... [4]

(b) The efficiency of the pump which operates the fountain is 70%.

Calculate the power supplied to the pump.

power = ... [3]

(c) On another day, a horizontal wind is blowing. The water does not rise vertically.

Explain why the water still rises to a height of 140 m.

....

.... [1]

[Total: 8]

2 A train has a total mass of 7.5×10^5 kg.

(b) The train now travels with a constant speed of 24 m/s along a straight, horizontal track. The total force opposing the motion due to friction and air resistance is 7.2×10^4 N.

(i) By considering the work done by the train's engine in 1.0 s, calculate its output power.

power = ... [2]

(ii) The train begins to travel up a slope.

Explain why the power of the train's engine must be increased to maintain the speed of 24 m/s.

....

....

....

....

.... [3]

[Total: 9]

4 **(a)** State the energy changes that take place when

(i) a cyclist rides down a hill without pedalling,

....

....

(ii) a cyclist pedals up a hill at a constant speed.

....

....
[3]

(b) A car of mass 940 kg is travelling at 16 m/s.

(i) Calculate the kinetic energy of the car.

kinetic energy = ... [2]

3 Fig. 3.1 shows the descent of a sky-diver from a stationary balloon.

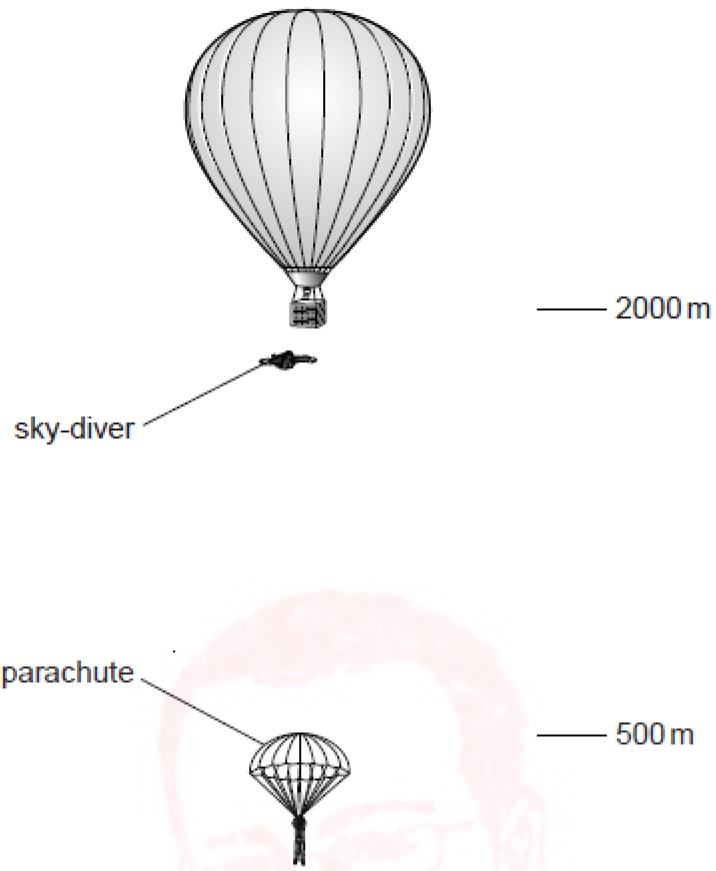


Fig. 3.1 (not to scale)

The sky-diver steps from the balloon at a height of 2000 m and accelerates downwards.

His speed is 52 m/s at a height of 500 m.

He then opens his parachute. From 400 m to ground level, he falls at constant speed.

(a) The total mass of the sky-diver and his equipment is 92 kg.

(i) Calculate, for the sky-diver,

1. the loss of gravitational potential energy in the fall from 2000 m to 500 m,

loss of gravitational potential energy = ... [2]

2. the kinetic energy at the height of 500 m.

kinetic energy = ... [2]

(ii) The kinetic energy at 500 m is not equal to the loss of gravitational potential energy. Explain why there is a difference in the values.

....

....

.... [1]

Q# 8/ iG Phx/2012/w/Paper 31/ NOT with Q3(b)
Q3(b) A plunger act/s/ with a force of iG Phx/2008/3.3N

(ii) The cross-sectional area *A* of the plunger in contact with the crushed material is $0.0036\,m^2$. Calculate the pressure exerted on the crushed material by the plunger.

pressure = ... [2]

Q# 9/ iG Phx/2012/w/Paper 31/ www.SmashingScience.org

4 (a) State what is meant by the *centre of mass* of a body.

....

....

.... [1]

(b) Fig. 4.1 shows an athlete successfully performing a high jump.

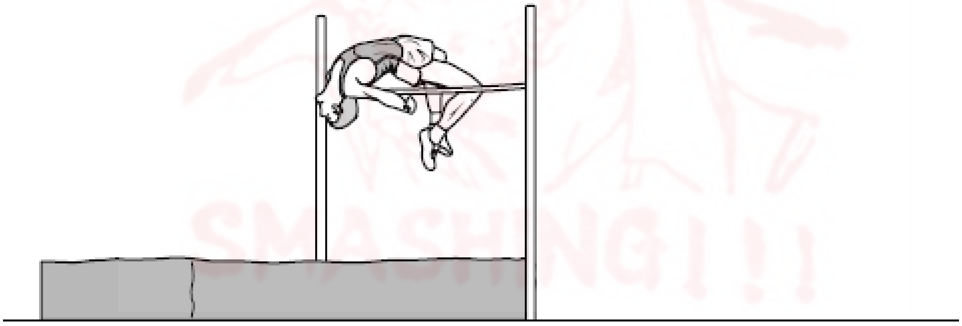


Fig. 4.1

The height of the bar above the ground is 2.0 m. The maximum increase in gravitational potential energy (g.p.e.) of the athlete during the jump is calculated using the expression g.p.e. = *mgh*.

Explain why the value of *h* used in the calculation is much less than 2.0 m.

....

....

.... [1]

(c) Fig. 4.2 shows, in order, five stages of an athlete successfully performing a pole-vault.

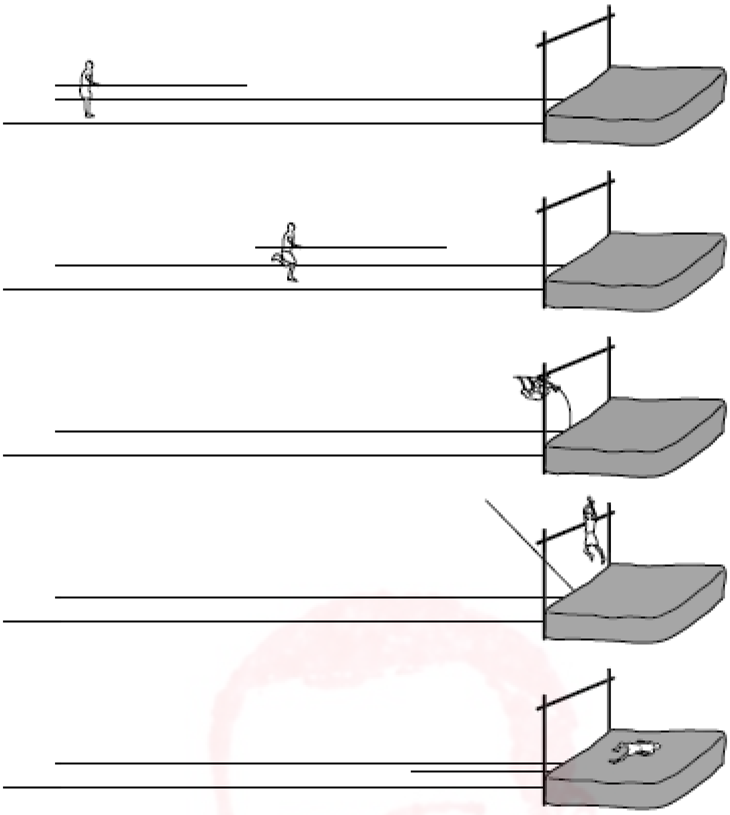


Fig. 4.2

Describe the energy changes which take place during the performance of the pole-vault, from the original stationary position of the pole-vaulter before the run-up, to the final stationary position after the vault.

....

....

....

....

....

....

....

....

....

....

.... [6]

4 Fig. 4.1 represents part of the hydraulic braking system of a car.

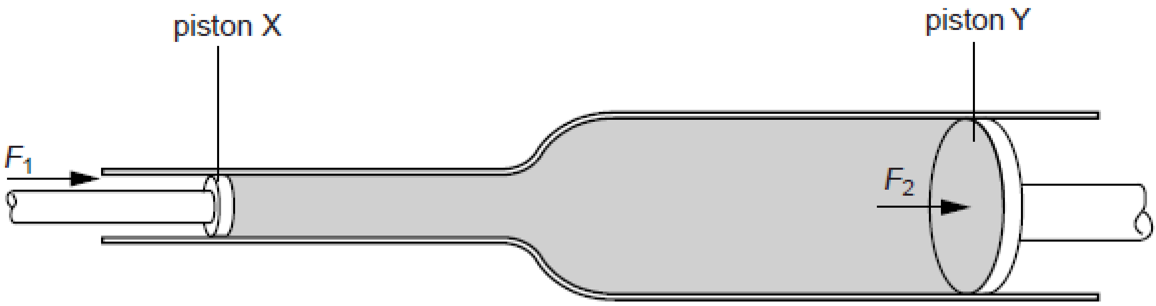


Fig. 4.1

The force F_1 of the driver's foot on the brake pedal moves piston X. The space between pistons X and Y is filled with oil which cannot be compressed. The force F_2 exerted by the oil moves piston Y. This force is applied to the brake mechanism in the wheels of the car.

The area of cross-section of piston X is $4.8\,cm^2$.

(a) The force F_1 is 90 N. Calculate the pressure exerted on the oil by piston X.

pressure = ... [2]

(b) The pressure on piston Y is the same as the pressure applied by piston X. Explain why the force F_2 is greater than the force F_1.

....

.... [1]

(c) Piston Y moves a smaller distance than piston X. Explain why.

....

....

.... [2]

(d) Suggest why the braking system does not work properly if the oil contains bubbles of air.

....

....

.... [2]

[Total: 7]

3 **(a)** State an example of the conversion of chemical energy to another form of energy.

example ....

energy conversion ....[1]

(b) The electrical output of a solar panel powers a pump. The pump operates a water fountain. The output of the solar panel is 17 V and the current supplied to the pump is 0.27 A.

(i) Calculate the electrical power generated by the solar panel.

power = ... [2]

(ii) The pump converts electrical energy to kinetic energy of water with an efficiency of 35%.

Calculate the kinetic energy of the water delivered by the pump in 1 second.

kinetic energy = ... [2]

(iii) The pump propels 0.00014 m^3 of water per second. This water rises vertically as a jet. The density of water is 1000 kg/m^3.

Calculate

1. the mass of water propelled by the pump in 1 second,

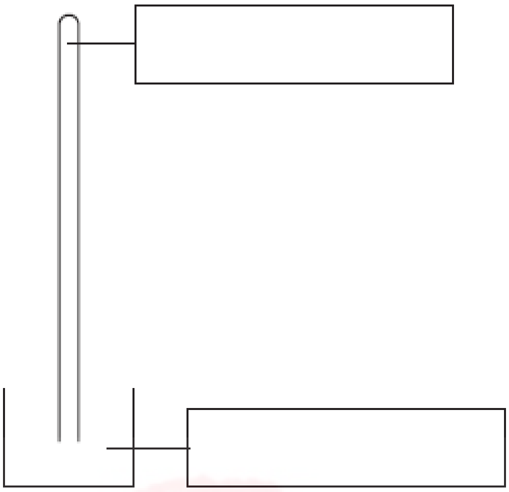
mass = ... [2]

2. the maximum height of the jet of water.

maximum height = ... [2]

[Total: 9]

4 **(a)** Complete Fig. 4.1 to show a simple mercury barometer. Insert the correct labels in the boxes. Label with the letter *h* the measurement required to calculate the pressure of the atmosphere.



[3]

Fig. 4.1

(b) The value of *h* taken using this barometer is 0.73 m. The density of mercury is 13 600 kg / m^3. Calculate the value of the atmospheric pressure suggested by this measurement. Use g = 10 m / s^2.

atmospheric pressure = ...[2]

(c) Standard atmospheric pressure is 0.76 m of mercury. Suggest a reason why the value of *h* in **(b)** is lower than this.

....

....[1]

[Total: 6]

Q# 13/_iG Phx/2011/w/Paper 31/ www.SmashingScience.org

2 **(a)** Energy from the Sun evaporates water from the sea. Some of this water eventually drives a hydroelectric power station. Give an account of the processes and energy changes involved.

....

....

....

....

....

....

....

....

....

....[4]

(b) In a hydroelectric power station, 200 000 kg of water per second fall through a vertical distance of 120 m. The water passes through turbines to generate electricity, and leaves the turbines with a speed of 14 m/s.

(i) Calculate the gravitational potential energy lost by the water in 1 second. Use $g = 10\,m/s^2$.

potential energy lost = ...[2]

(ii) Calculate the kinetic energy of the water leaving the turbines in 1 second.

kinetic energy = ...[2]

[Total: 8]

Q# 14/_iG Phx/2011/s/Paper 31/ www.SmashingScience.org

The force of gravity can be considered to be 10N/Kg

3 During a period of hot weather, the atmospheric pressure on the pond in Fig. 3.1 remains constant. Water evaporates from the pond, so that the depth h decreases.

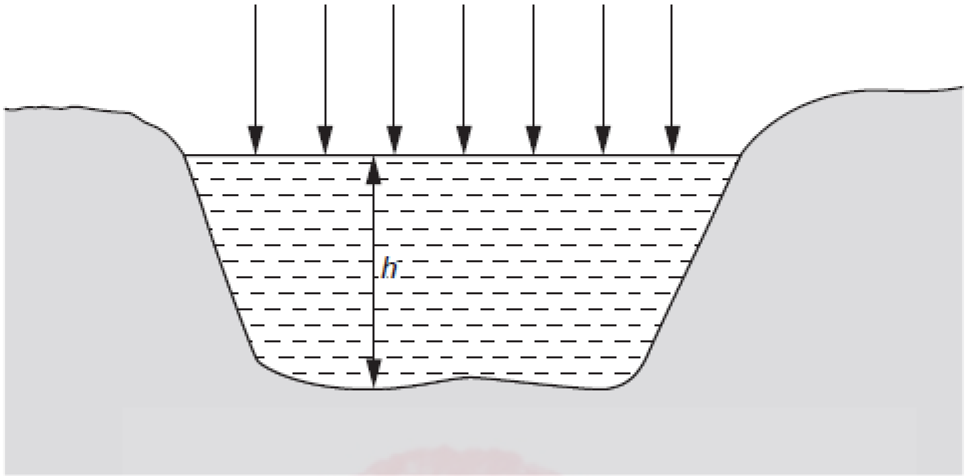


Fig. 3.1

(a) Study the diagram and state, giving your reason, what happens during this hot period to

(i) the force of the air on the surface of the pond,

....

....[1]

(ii) the pressure at the bottom of the pond.

....

....[1]

(b) On a certain day, the pond is 12 m deep.

(i) Water has a density of 1000 kg / m^3.

Calculate the pressure at the bottom of the pond due to the water.

pressure due to the water = ...[2]

2 Some builders decide to measure their personal power ratings using apparatus they already have on site. Fig. 2.1 shows the arrangement they use.

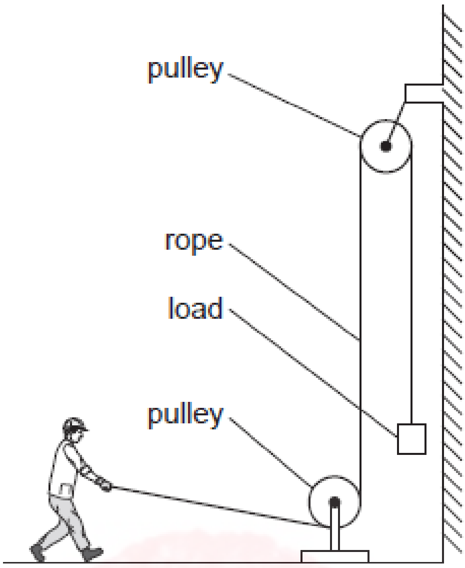


Fig. 2.1

(a) In the table below, list the three quantities they must measure in order to calculate one man's power, and the instrument they would use for each measurement.

quantity to be measured	instrument used for measurement
1.	
2.	
3.	

[3]

(b) One workman is measured as having a power of 528W. His weight is 800N.

He can develop the same power climbing a ladder, whose rungs are 30cm apart.

How many rungs can he climb in 5s?

number of rungs = ...[3]

(c) The human body is only about 15% efficient when climbing ladders.

Calculate the actual energy used from the body of the workman in **(b)** when he climbs 20 rungs.

energy used = ...[2]

[Total: 8]

3 Fig. 3.1 shows a hydraulic lift in a car repair workshop.

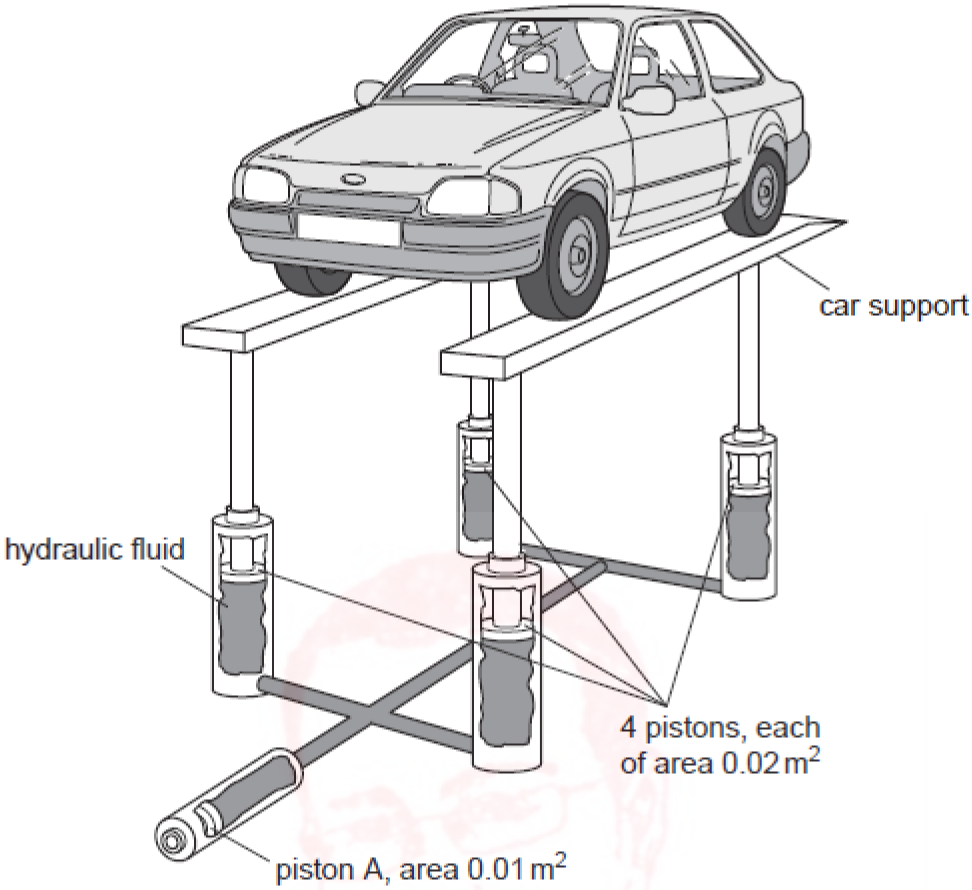


Fig. 3.1

The hydraulic fluid transmits the pressure, caused by piston A, equally to each of the four pistons holding up the car supports. The pressure throughout the fluid is the same.

A force of 1000 N on piston A is just enough to raise the car.

(a) Using values from Fig. 3.1, find

(i) the pressure caused by piston A on the fluid,

pressure = ... [2]

(ii) the total upward force caused by the fluid.

force = ... [3]

(b) The weight of each of the two car supports is 1000 N.

Calculate the mass of the car.

mass = ... [2]

[Total: 7]

5 Fig. 5.1 shows a model cable-car system. It is driven by an electric motor coupled to a gear system.

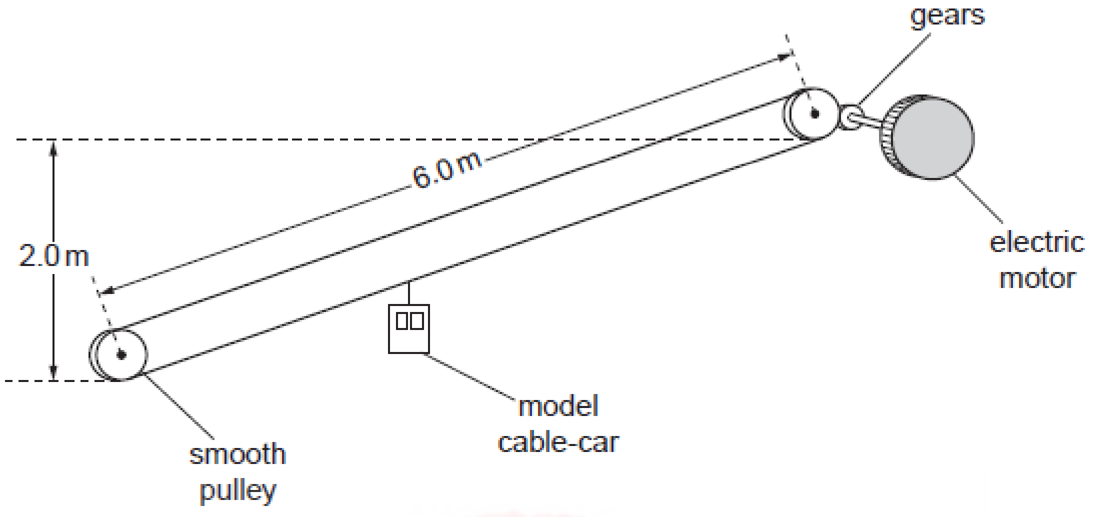


Fig. 5.1

The model cable-car has a mass of 5.0 kg and is lifted from the bottom pulley to the top pulley in 40 s. It stops automatically at the top.

(a) Calculate

(i) the average speed of the cable-car,

average speed = ... [2]

(ii) the gravitational potential energy gained by the cable-car,

gravitational potential energy gained = ... [2]

(iii) the useful output power of the driving mechanism.

power = ... [2]

(b) How would the electrical power input to the motor compare with your answer to **(a)(iii)**?

.... [1]

[Total: 7]

2 A car of mass 900 kg is travelling at a steady speed of 30 m/s against a resistive force of 2000 N, as illustrated in Fig. 2.1.

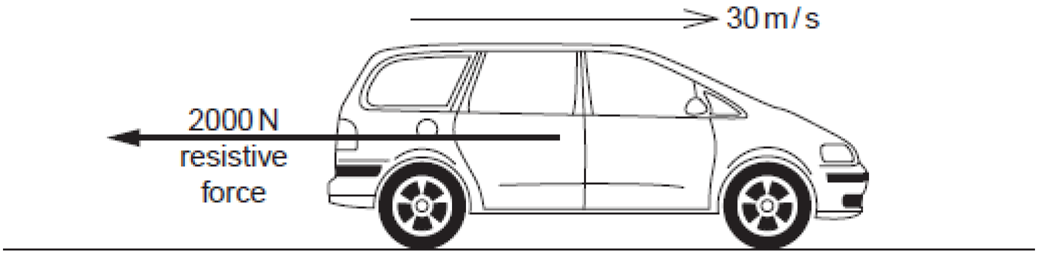


Fig. 2.1

(a) Calculate the kinetic energy of the car.

kinetic energy = ... [2]

(b) Calculate the energy used in 1.0 s against the resistive force.

energy = ... [2]

(c) What is the minimum power that the car engine has to deliver to the wheels?

minimum power = ... [1]

(d) What form of energy is in the fuel, used by the engine to drive the car?

.... [1]

(e) State why the energy in the fuel is converted at a greater rate than you have calculated in **(c)**.

....

.... [1]

[Total: 7]

5 A farmer uses an electric pump to raise water from a river in order to fill the irrigation channels that keep the soil in his fields moist.

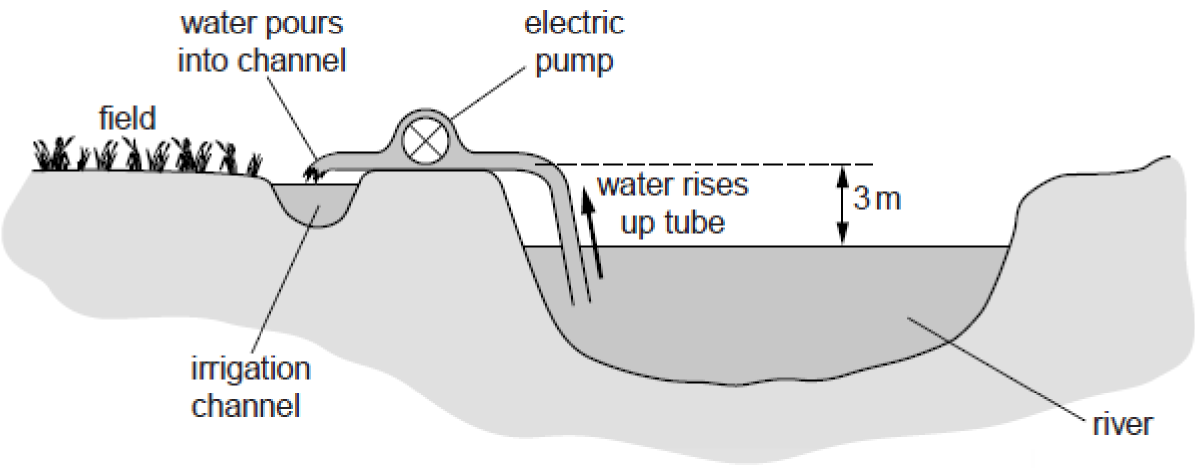


Fig. 5.1

Every minute, the pump raises 12 kg of water through a vertical height of 3 m.

(a) Calculate the increase in the gravitational potential energy of 12 kg of water when it is raised 3 m.

increase in gravitational potential energy = ... [3]

(b) Calculate the useful power output of the pump as it raises the water.

power = ... [3]

[Total: 6]

6 **(a)** A man squeezes a pin between his thumb and finger, as shown in Fig. 6.1.

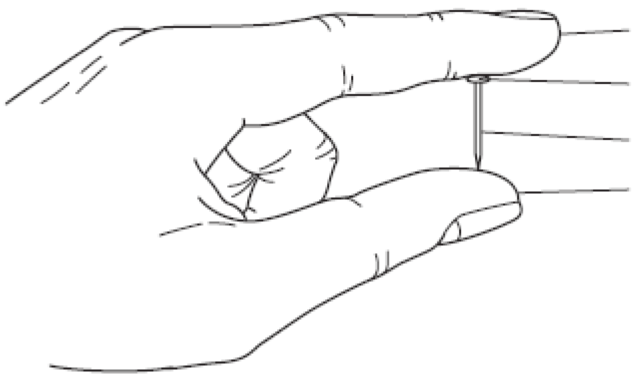


Fig. 6.1

The finger exerts a force of 84 N on the pinhead.

The pinhead has an area of $6.0 \times 10^{-5}\,m^2$.

(i) Calculate the pressure exerted by the finger on the pinhead.

pressure = ... [2]

(ii) State the value of the force exerted by the pin on the thumb.

.... [1]

(iii) Explain why the pin causes more pain in the man's thumb than in his finger.

....

.... [2]

(b) The density of the water in a swimming pool is 1000 kg/m^3. The pool is 3 m deep.

(i) Calculate the pressure of the water at the bottom of the pool.

pressure = ... [2]

(ii) Another pool has the same depth of water, but has twice the area.

State the pressure of the water at the bottom of this pool.

pressure = ... [1]

[Total: 8]

5 A wind turbine has blades, which sweep out an area of diameter 25 m.

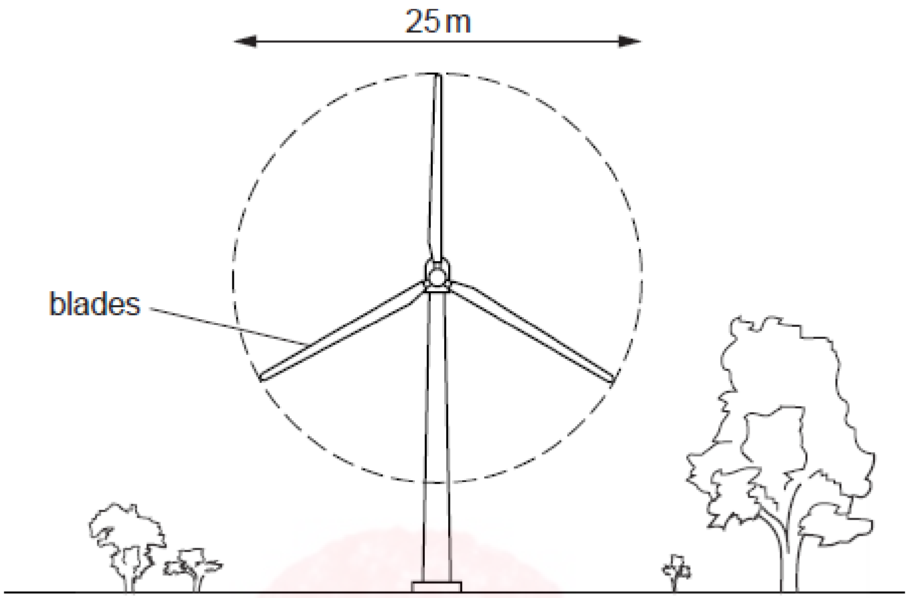


Fig. 5.1

(a) The wind is blowing directly towards the wind turbine at a speed of 12 m/s. At this wind speed, 7500 kg of air passes every second through the circular area swept out by the blades.

(i) Calculate the kinetic energy of the air travelling at 12 m/s, which passes through the circular area in 1 second.

kinetic energy = ... [3]

(ii) The turbine converts 10% of the kinetic energy of the wind to electrical energy.

Calculate the electrical power output of the turbine. State any equation that you use.

power = ... [3]

(b) On another day, the wind speed is half that in **(a)**.

(i) Calculate the mass of air passing through the circular area per second on this day.

mass = ... [1]

(ii) Calculate the power output of the wind turbine on the second day as a fraction of that on the first day.

fraction = ... [3]

[Total: 10]

3 **(a)** A submarine descends to a depth of 70 m below the surface of water.

The density of the water is 1050 kg/m^3. Atmospheric pressure is 1.0×10^5 Pa.

Calculate

(i) the increase in pressure as it descends from the surface to a depth of 70 m,

increase in pressure = ... [2]

(ii) the total pressure on the submarine at a depth of 70 m.

total pressure = ... [1]

(b) On another dive, the submarine experiences a total pressure of 6.5×10^5 Pa. A hatch cover on the submarine has an area of 2.5 m^2.

Calculate the force on the outside of the cover.

force = ... [2]

(c) The submarine undergoes tests in fresh water of density 1000 kg/m^3.

Explain why the pressure on the submarine is less at the same depth.

....

.... [1]

[Total: 6]

2 **(a)** Name the process by which energy is released in the core of the Sun.

.... [1]

(b) Describe how energy from the Sun becomes stored energy in water behind a dam.

....

....

....

.... [3]

(c) Data for two small power stations is given in Table 2.1.

	input to power station	**output of power station**
gas-fired	100 MW	25 MW
hydroelectric	90 MW	30 MW

Table 2.1

(i) State what is meant by the *efficiency* of a power station.

....

....

....

.... [1]

(ii) Use the data in Table 2.1 to explain that the hydroelectric station is more efficient than the gas-fired power station.

....

....

.... [1]

[Total: 6]

3 A cyclist rides up and then back down the hill shown in Fig. 3.1.

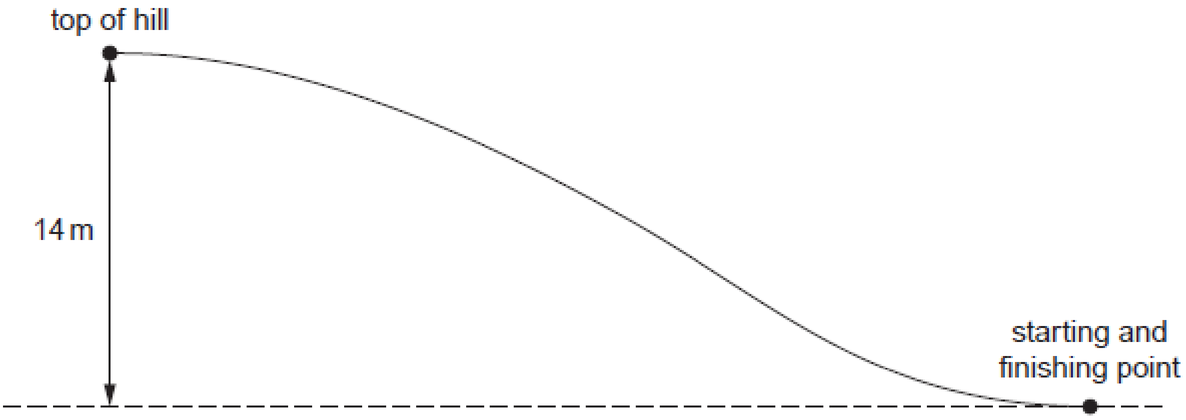


Fig. 3.1

The cyclist and her bicycle have a combined mass of 90 kg. She pedals up to the top and then stops. She turns around and rides back to the bottom without pedalling or using her brakes.

(a) Calculate the potential energy gained by the cyclist and her bicycle when she has reached the top of the hill.

potential energy = ... [2]

(b) Calculate the maximum speed she could have when she arrives back at the starting point.

speed = ... [3]

(c) Explain why her actual speed will be less than that calculated in **(b)**.

....

....

.... [1]

[Total: 6]

4 Fig. 4.1 is a design for remotely operating an electrical switch using air pressure.

Fig. 4.1

The metal box and the pipe contain air at normal atmospheric pressure and the switch is off. When the pressure in the metal box and pipe is raised to 1.5 times atmospheric pressure by pressing down on the flexible rubber box cover, the switch comes on.

(a) Explain in terms of pressure and volume how the switch is made to come on.

....

....

....

.... [2]

(b) Normal atmospheric pressure is 1.0×10^5 Pa. At this pressure, the volume of the box and pipe is 60 cm^3.

Calculate the **reduction** in volume that must occur for the switch to be on.

reduction in volume = ... [3]

(c) Explain, in terms of air particles, why the switch may operate, without the rubber cover being squashed, when there is a large rise in temperature.

....

....

....

.... [2]

[Total: 7]

2 Fig. 2.1 shows a track for a model car.

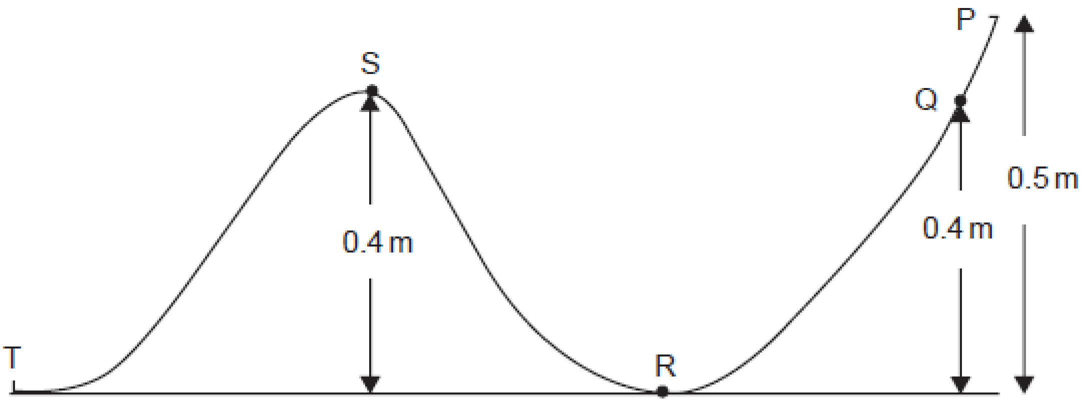


Fig. 2.1

The car has no power supply, but can run down a sloping track due to its weight.

(a) The car is released at Q. It comes to rest just before it reaches S and rolls back.

(i) Describe the motion of the car after it starts rolling back and until it eventually comes to rest.

....

....

.... [2]

(ii) Explain in terms of energy transformations why the car, starting at Q, cannot pass S.

....

....

.... [1]

(b) A second car, of mass 0.12 kg, is released from P. It continues until it runs off the track at T.

Calculate the maximum speed that the car could have at T assuming friction in the car is negligible.

speed = ... [3]

[Total: 6]

4 Fig. 4.1 shows a sealed steel cylinder filled with high pressure steam.

Fig. 4.1

Fig. 4.2 shows the same cylinder much later when all the steam has condensed.

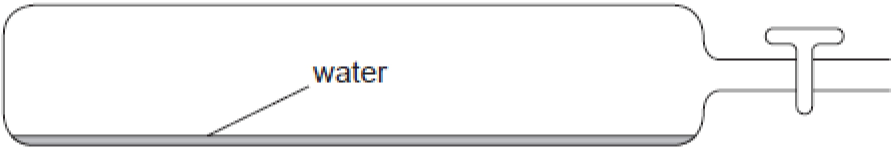


Fig. 4.2

(a) **(i)** Describe the movement of the molecules in the high pressure steam.

....

....

.... [2]

(ii) Explain how the molecules in the steam exert a high pressure on the inside walls of the cylinder.

....

....

.... [2]

(b) Describe, in terms of particles, the process by which heat is transferred through the cylinder wall.

....

....

.... [2]

3 A student wishes to work out how much power she uses to lift her body when climbing a flight of stairs.

Her body mass is 60 kg and the vertical height of the stairs is 3.0 m. She takes 12 s to walk up the stairs.

(a) Calculate

(i) the work done in raising her body mass as she climbs the stairs,

work = ... [2]

(ii) the output power she develops when raising her body mass.

power = ... [2]

(b) At the top of the stairs she has gravitational potential energy.

Describe the energy transformations taking place as she walks back down the stairs and stops at the bottom.

....

....

....

.... [2]

[Total: 6]

3 Fig. 3.1 shows water falling over a dam.

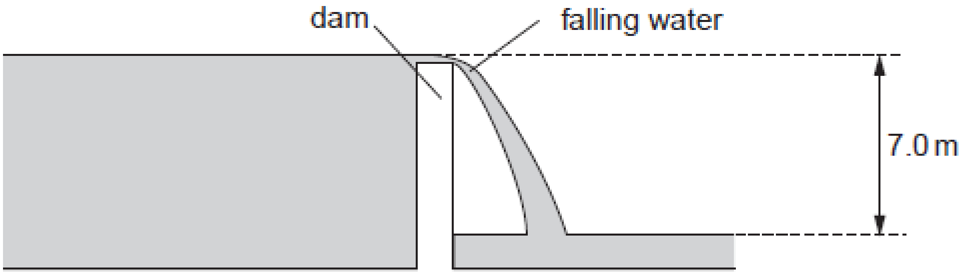


Fig. 3.1

(a) The vertical height that the water falls is 7.0 m.
Calculate the potential energy lost by 1.0 kg of water during the fall.

potential energy = ...[2]

(b) Assuming all this potential energy loss is changed to kinetic energy of the water, calculate the speed of the water, in the vertical direction, at the end of the fall.

speed = ...[3]

(c) The vertical speed of the water is less than that calculated in **(b)**. Suggest one reason for this.

....

....[1]

5 **(a)** Fig. 5.1 shows a tank used for evaporating salt solution to produce crystals.

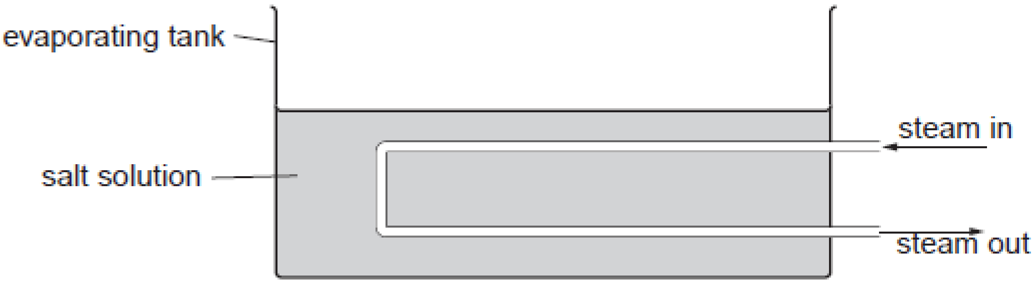


Fig. 5.1

Suggest two ways of increasing the rate of evaporation of the water from the solution. Changes may be made to the apparatus, but the rate of steam supply must stay constant. You may assume the temperature of the salt solution remains constant.

1. ....

....

2. ....

....[2]

(b) A manufacturer of liquid-in-glass thermometers changes the design in order to meet new requirements.

Describe the changes that could be made to

(i) give the thermometer a greater range,

....[1]

(ii) make the thermometer more sensitive.

....[1]

(c) A toilet flush is operated by the compression of air. The air inside the flush has a pressure of 1.0×10^5 Pa and a volume of $150\,cm^3$. When the flush is operated the volume is reduced to $50\,cm^3$. The temperature of the air remains constant during this process.
Calculate the new pressure of the air inside the flush.

pressure = ...[2]

3 An electric pump is used to raise water from a well, as shown in Fig. 3.1.

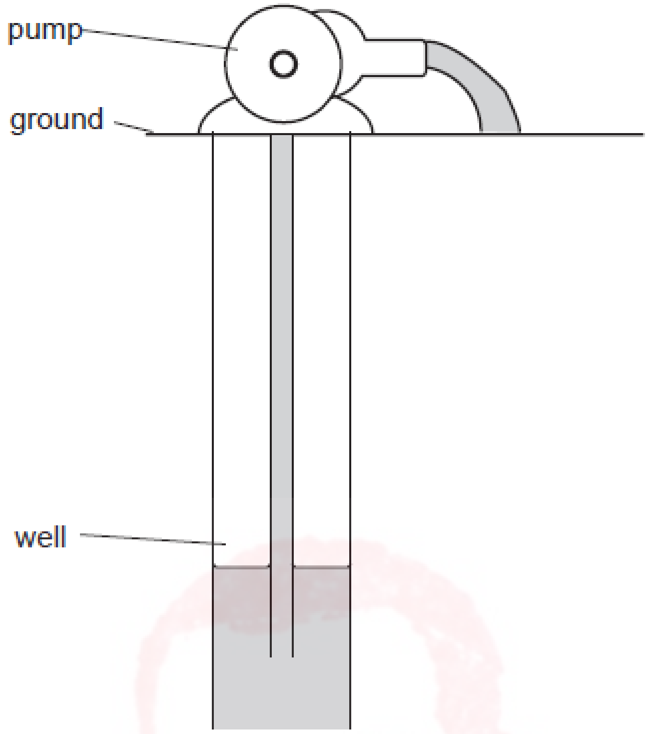


Fig. 3.1

(a) The pump does work in raising the water. State an equation that could be used to calculate the work done in raising the water.

....[2]

(b) The water is raised through a vertical distance of 8.0 m. The weight of water raised in 5.0 s is 100 N.

(i) Calculate the work done in raising the water in this time.

work done = ...[1]

(ii) Calculate the power the pump uses to raise the water.

power = ...[1]

(iii) The energy transferred by the pump to the water is greater than your answer to **(i)**. Suggest what the additional energy is used for.

....[1]

Q# 32/_iG Phx/2005/w/Paper 31/ www.SmashingScience.org

3 Fig. 3.1 shows a pond that is kept at a constant depth by a pressure-operated valve in the base.

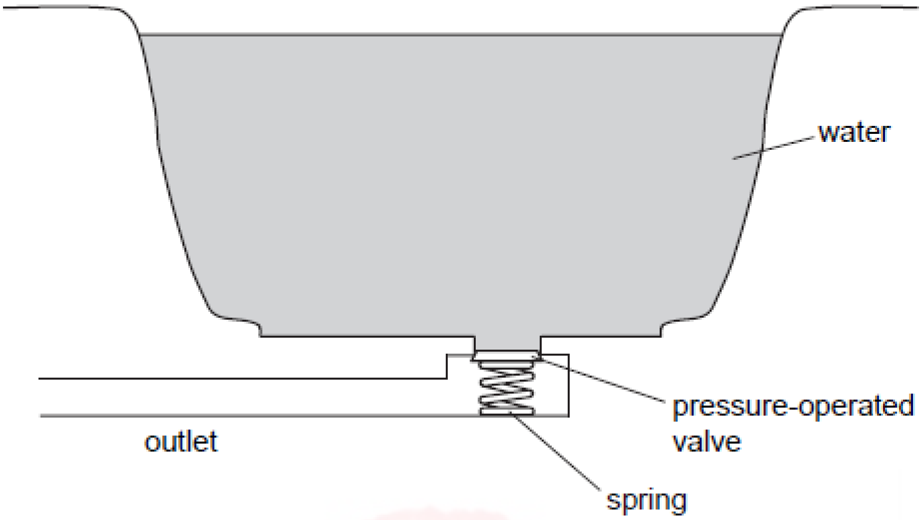


Fig. 3.1

(a) The pond is kept at a depth of 2.0 m. The density of water is 1000 kg/m^3.

Calculate the water pressure on the valve.

pressure =.......................... [2]

(b) The force required to open the valve is 50 N. The valve will open when the water depth reaches 2.0 m.

Calculate the area of the valve.

area = ... [2]

(c) The water supply is turned off and the valve is held open so that water drains out through the valve.

State the energy changes of the water that occur as the depth of the water drops from 2.0 m to zero.

....

.... [2]

Q# 33/_iG Phx/2005/s/3

3 A mass of 3.0 kg accelerates at 2.0 m/s^2 in a straight line.

(c) The mass hits a wall.
The average force exerted on the wall during the impact is 120 N.
The area of the mass in contact with the wall at impact is 0.050 m^2.
Calculate the average pressure that the mass exerts on the wall during the impact.

pressure = ... [2]

2 Fig. 2.1 shows a reservoir that stores water.

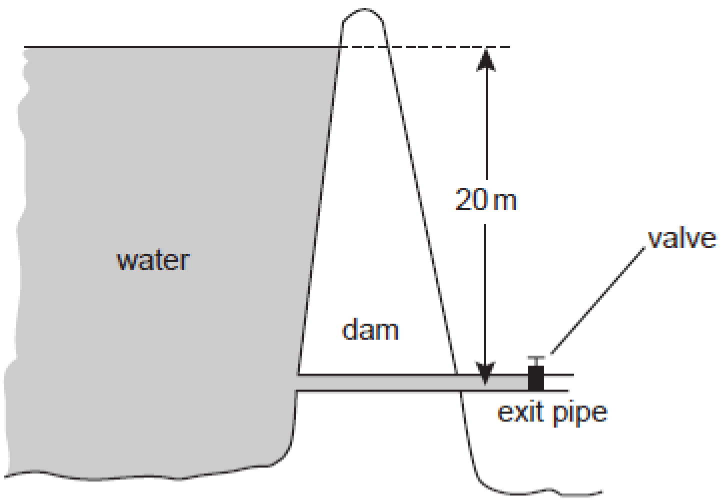


Fig. 2.1

(a) The valve in the exit pipe is closed. The density of water is 1000 kg/m^3 and the acceleration of free fall is 10 m/s^2.
Calculate the pressure of the water acting on the closed valve in the exit pipe.

pressure = ...[2]

(b) The cross-sectional area of the pipe is 0.5 m^2.
Calculate the force exerted by the water on the closed valve.

force = ...[2]

(c) The valve is then opened and water, originally at the surface of the reservoir, finally flows out of the exit pipe. State the energy transformation of this water between the surface of the reservoir and the open end of the pipe.

....

....[2]

2 Fig. 2.1 shows a diver 50 m below the surface of the water.

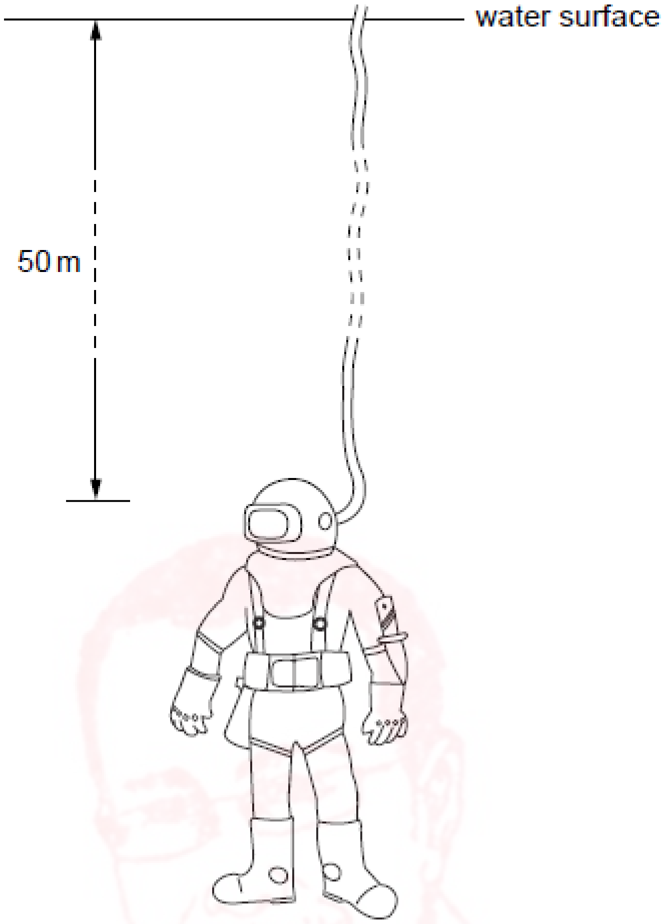


Fig. 2.1

(a) The density of water is 1000 kg/m^3 and the acceleration of free fall is 10 m/s^2. Calculate the pressure that the water exerts on the diver.

pressure = ... [3]

(b) The window in the diver's helmet is 150 mm wide and 70 mm from top to bottom.

Calculate the force that the water exerts on this window.

force = ... [3]

Q# 1/ iG Phx/2014/w/Paper 33/Q2a

(ii)	(P =) $F \div A$ **OR** 180÷(0.30 × 0.04)	C1
	15 000 Pa	A1

Q# 2/ iG Phx/2014/w/Paper 33/ www.SmashingScience.org

3 (a) (i)	(g.p.e. =) mgh **OR** 0.15 × 10 × 1.8	C1
	2.7 J ignore minus sign	A1
(ii)	(k.e. **OR** 2.7 =) $\frac{1}{2}mv^2$ **OR** ½ × 0.15v^2	C1
	(v^2 =) 36	C1
	6.0 m/s	A1
(b) (i)	initial temperature (of metal) **OR** final temperature (of metal) **OR** temperature change (of metal)	B1
(ii)	thermal energy transferred to something specific e.g. air/tube/stopper/thermometer/surroundings/environment **OR** small spheres lost before/after weighing **OR** not all the spheres fall the same distance	B1
(iii)	higher temperature increase **OR** calculate mean of (100) readings	M1
	small measurements less accurate owtte	A1
		[Total: 9]

Q# 3/ iG Phx/2014/w/Paper 33/ www.SmashingScience.org

2 (a) (i)	180 N	B1
(ii)	(P =) $F \div A$ **OR** 180÷(0.30 × 0.04)	C1
	15 000 Pa	A1
(b) (i)	arrow (labelled W) from/to correct centre of mass	B1
(ii)	**1.** force × (perpendicular) distance **OR** 40 × 0.60 **OR** 180 × 0.15 in **2.**	C1
	24 N m	A1
	2. 27 N m — e.c.f. from **(a)(i)**	A1
(iii)	slab topples/rotates (about point D) **OR** corner C lifts from ground **OR** falls over	B1
	moment of force at B becomes bigger than moment of weight / W **OR** anticlockwise moment becomes bigger than clockwise moment **OR** weight/centre of mass outside base	B1
		[Total: 9]

Q# 4/_iG Phx/2014/s/Paper 31/ www.SmashingScience.org

3 (a) *Fd* OR weight × *d* OR *mgh* OR 30 000 × 10 × 140 OR 4.2 × 10^7 seen anywhere C1

(P =) E/t OR W/t OR mgh/t symbols or words C1

4.2 × 10^7/60 C1

7.0 ×10^5 W / 700 kW / 0.7 MW A1

(b) efficiency = output / input OR (P_{in} =) 100 × P_{out} / efficiency C1

(P_{in} =) 100 × 7 × 10^5/70 C1

1.0 × 10^6 W OR 1 000 000 W OR 1.0 MW A1

(c) (horizontal) wind has no effect on P.E gained / vertical force on water
OR same upward / vertical force acts on water
OR force from wind is horizontal B1

[Total: 8]

Q# 5/_iG Phx/2013/w/Paper 31/Q2

(b) (i) in words or symbols (P =) W/t OR F x d/t OR Fv
OR 7.2 × 10^4 × 24 / 1 OR OR 7.2 × 10^4 × 24 C1
1.7 × 10^6 W A1

(ii) gravitational/potential energy of train has to be increased
OR force acts down the slope / backward force acts (on train) B1

(for the same distance moved) more work done has to be done OR energy has to be provided (by the engine) B1
in the same time (so needs more power) B1

Q# 6/_iG Phx/2013/w/Paper 31/ www.SmashingScience.org

4 (a) (i) (gravitational) potential energy to kinetic energy B1

(ii) chemical energy to (gravitational) potential energy B1

reference in **(i)** or **(ii)** to heat / thermal / internal energy produced OR work done against air resistance or friction B1

(b) (i) (K.E. =) $\frac{1}{2}mv^2$ OR 0.5 × 940 × 16^2 C1
1.2 × 10^5 J A1

Q# 7/_iG Phx/2013/s/Paper 31/ www.SmashingScience.org

3 (a) (i) 1. (loss of P.E. =) *mgh* OR 92 × 10 × 1500 C1
1.38 × 10^6 J A1
correct use of *mgh* with *h* = 500 or 2000 gains 1 mark only

(ii) 2. (K.E. =) ½ mv^2 OR ½ × 92 × 52^2 C1
1.244 × 10^5 J at least 2 sig. figs A1

(a) (ii) difference is due to:
(work done in overcoming) air resistance/drag
OR energy converted to/lost as heat (by air resistance/drag) B1

Q# 8/ iG Phx/2012/w/Paper 31/ www.SmashingScience.org

(ii) F/A or in words OR 83.3/0.0036 ecf from **(b)(i)** C1
= 23100 Pa / N/m^2 OR 2.31 N/cm^2 OR 23.1 kPa *Unit penalty applies A1 **[7]**

*Apply unit penalty once only

Q# 9/ iG Phx/2012/w/Paper 31/ www.SmashingScience.org

4 **(a)** (The point in the body) where (all) the mass / weight / gravity acts / appears to act (owtte) B1

(b) h is the height through which the centre of mass/rises
OR centre of mass/rises (much) less than 2.0 m

OR centre of mass/of athlete is above the ground level
OR centre of mass/gravity passes under bar B1

Allow centre of gravity in place of centre of mass

(c) Standing: has chemical energy B1
Run-up: kinetic energy gained B1
Pole bent: has strain / elastic energy B1
Rise: potential energy gained B1
Fall: kinetic energy gained B1
On mat: has thermal / heat / sound / strain / elastic energy B1 **[8]**

Q# 10/ iG Phx/2012/s/Paper 31/ www.SmashingScience.org

4 **(a)** (p =) F/A OR in words OR 90/4.8 OR 90 / 0.00048 C1
= 18.75 N/cm^2 OR 1.875 × 10^5 Pa OR 187500 Pa
OR 187.5 kPa OR 0.1875 MPa at least 2 s.f. A1

(b) Area of Y bigger (than area of X so force greater) B1

(c) Volume of oil moved at Y = volume of oil moved at X B1
Area of Y × distance moved by Y = Area of X × distance moved by X (so distance move by Y smaller) B1
OR
Work done by piston X = work done on piston Y (B1)
Work = force × distance and F_2 is greater than F_1 so distance moved by Y smaller (than distance moved by X) (B1)

(d) Air bubbles compress when pressure applied M1
More movement of piston X required for same movement of piston Y
OR Y moves less (for same movement of X)
OR Driver must push the brake pedal further / do more work
OR Pressure reduced / force on Y reduced
OR System is less efficient A1

[Total: 7]

Q# 11/ iG Phx/2012/s/Paper 31/ www.SmashingScience.org

3 (a) Example: e.g. battery: (chemical to) electrical
engine: (chemical to) kinetic / mechanical
fire: (chemical to) thermal / heat
(human) body: (chemical to) heat / kinetic — B1

(b) (i) (P =) IV OR in words OR 0.27 × 17 — C1
= 4.59 W at least 2 s.f. — A1

(ii) (K.E. =) efficiency × input OR 0.35 × 4.59 — C1
= 1.61 J or Nm at least 2 s.f. — A1

(iii) 1. $d = m/V$ OR (m =) $V \times d$ OR in words OR 0.00014 × 1000 — C1
= 0.14 kg — A1

2. P.E. gained = K.E. lost OR $mgh = ½ mv^2$
OR 0.14 × 10 × h = 1.61 OR 1.6 — C1
h = 1.15 m OR 1.14 m at least 2 s.f. — A1

OR
$½ mv^2 = 1.61$ OR
$v^2 = 2 \times 1.61 / 0.14 = 23$ OR $v^2 = 2 \times 1.6 / 0.14 = 22.86$ — (C1)
(h =) $v^2/2g$ = 23/20 = 1.15 m OR (h =) 22.86/20 = 1.14 m — (A1)

[Total: 9]

Q# 12/ iG Phx/2011/w/Paper 31/ www.SmashingScience.org

4 (a) surfaces shown at realistic levels in dish and tube AND vertical height h between levels clearly shown — B1
top label: vacuum / mercury vapour — B1
bottom label: mercury — B1

(b) (P =) hdg OR 0.73 × 13600 × 10 — C1
99280 Pa at least 2 s.f. — B1

(c) one from:
abnormal weather / atmospheric conditions o.w.t.t.e.
air in space above mercury in tube
barometer is in a high altitude location o.w.t.t.e.
space above mercury is not a vacuum — B1 [6]
ignore atmospheric pressure varies ignore temperature

Q# 13/_iG Phx/2011/w/Paper 31/ www.SmashingScience.org

2 (a) two processes from:
vapour rising
condensation
rain falling
water falling from lake / through pipes
water turns turbine / generator
electricity generated. max B2

energy changes:
PE to KE matched to a process B1
KE to electricity energy for turbine / power station B1

(b) (i) (PE =) mgh OR $2 \times 10^5 \times 10 \times 120$ allow $g = 9.8$ or 9.81 C1
2.4×10^8 J A1

(ii) (KE of water =) $\frac{1}{2}mv^2$ OR $\frac{1}{2} \times 2 \times 10^5 \times 14^2$ C1
1.96×10^7 J OR 2.0×10^7 J A1 [8]

Q# 14/_iG Phx/2011/s/Paper 31/ www.SmashingScience.org

3 (a) (i) smaller because <u>area</u> smaller B1

(ii) smaller because depth/height smaller ignore less water B1

(b) (i) $h\rho g$ OR $12 \times 1000 \times 10$ C1
1.2×10^5 Pa OR 1.1772×10^5 Pa OR 1.176×10^5 Pa accept N/m^2 A1

Q# 15/_iG Phx/2011/s/Paper 31/ www.SmashingScience.org

2 (a) distance/height AND tape measure/(metre) rule(r) B1
weight OR load OR force
AND balance/scale(s) OR newton-meter/spring balance/force meter B1
time AND watch/clock/timer B1

(b) power = work/time OR energy/time in any form
OR Pt words or numbers seen anywhere e.g. 528 x 5 C1
(work =) force × distance in any form C1
11 A1

(c) efficiency = E_{out}/E_{in} OR P_{out}/P_{in} seen anywhere, clearly identified
OR 520 × (20/11) × 5
OR (work done =) 800 × 20 × 0.3 OR 800 × 20 × 30 OR 4800 (J) OR 720 (J) C1
(energy used =) 32,000 J A1 [8]

Q# 16/_iG Phx/2010/w/Paper 31/ www.SmashingScience.org

3	(a)	(i)	(P =) F/A in any form OR 1000/0.01	C1
			100 000 Pa accept N/m^2	A1
		(ii)	multiplication of either force or area by 4	C1
			0.08 × his **(i)** OR 0.02 × his **(i)**	C1
			8000 N e.c.f. from **(i)**	A1
			(2000 N gets C0, C1, A1)	
	(b)		his **(ii)** – 2000 correctly evaluated	C1
			600 kg e.c.f.	A1
				[Total: 7]

Q# 17/_iG Phx/2010/w/Paper 31/ www.SmashingScience.org

5	(a)	(i)	(speed =) distance/time in any form, words, letters, numbers	C1
			0.15 m/s or 15 cm/s	A1
			(if answer only, 1 mark for either if no units)	
		(ii)	(PE =) mgh OR mgh OR Wh symbols, words or numbers	C1
			100 J OR 98.1 J OR 98 J	A1
		(iii)	his **(ii)**/40 OR his **(ii)**/4	C1
			2.5 W OR 2.45 W e.c.f. from **(ii)**	A1
	(b)		(input) greater/output less NOT a numerical factor	B1
				[Total: 7]

Q# 18/_iG Phx/2010/s/Paper 31/ www.SmashingScience.org

2	(a)	½mv^2 OR ½ × 900 x 30^2	C1	
		405 000 J	A1	
	(b)	force x distance OR 2000 x 30	C1	
		60 000 J OR 60 kJ	A1	
	(c)	60 000 W OR 60 000 J/s OR 60kW OR 60 kJ/s ecf from (b)	B1	
	(d)	chemical	B1	
	(e)	idea of energy loss / heat / sound / inefficiency / energy used within car / possibility of increase in P.E. Ignore work done against against friction	B1	[7]

Q# 19/_iG Phx/2009/w/Paper 31/ www.SmashingScience.org

5	(a)	(P.E.) = mgh	C1
		12 × 10 × 3 Accept g = 9.8 or 9.81	C1
		360 J g = 9.8 gives 352.8 J (minimum 2 s.f.) g = 9.81 gives 353.16 J (minimum 2 s.f.)	A1
	(b)	(P =) E/t	C1
		360/60	C1
		6 W 352.8 J gives 5.88 W 353.16 J gives 5.886 W (minimum 2 s.f.)	A1
			[6]

Q# 20/_iG Phx/2009/s/Paper 31/ www.SmashingScience.org

6	(a)	(i)	*P* = *F* / *A* in any form, letters, words or numbers	C1	
			1.4×10^6 Pa accept N/m^2	A1	
		(ii)	84 N OR 84.0 N	B1	
		(iii)	same force over (much) smaller area	B1	
			(much) bigger pressure	B1	
	(b)	(i)	*P* = *hdg* in any form, letters, words or numbers	C1	
			3×10^4 Pa OR 30 000 Pa OR 30 kPa accept N/m^2	A1	
		(ii)	his (i)	B1	[8]

Q# 21/_iG Phx/2009/s/Paper 31/ www.SmashingScience.org

5	(a)	(i)	$½mv^2$	C1	
			½ × 7500 × 12 × 12	C1	
			540 000 J OR 540 kJ	A1	
		(ii)	*W* = *E*/*t* in any form	B1	
			10% × his (a)	C1	
			54 000 W OR 54 kW e.c.f.	A1	
	(b)	(i)	3750 kg	B1	
		(ii)	[If ecf from (i) and no other errors, maximum mark is 2]		
			mass: ½ OR correct sub in $½mv^2$	C1	
			speed: ½ OR 6750 (J)	C1	
			fraction = ⅛ / 0.125 / 1:8 ? 12.5 % (c.a.o.)	A1	[10]

Q# 22/_iG Phx/2008/w/Paper 31/ www.SmashingScience.org

3	(a)	(i)	hdg or 70 × 1050 × 10	C1	
			735 000 Pa or 7.35×10^5 Pa accept N/m^2 for Pa	A1	
		(ii)	8.35×10^5 Pa OR his **(a)(i)** + 1.0×10^5 accept N/m^2 for Pa	B1	
	(b)		pressure × area or P = F/A or $6.5 \times 10^5 \times 2.5$	C1	
			1.625×10^6 N	A1	
	(c)		because density is less accept new calculation of pressure OR because salt water is denser	B1	[6]

Q# 23/_iG Phx/2008/s/Paper 31/ www.SmashingScience.org

2 (a) fusion (of nuclei) CARE: NOT fission or fision ACCEPT fussion — B1
condone radiation as an extra

(b) radiant/heat energy from Sun or radiation from Sun)
energy from Sun raises temperature of water/heats water/melts ice)
energy from Sun evaporates water) any 3 — B1 × 3
PE in cloud)
rain)
stored water has PE)

(c) (i) 25/100 for gas-fired or 30/90 for hydroelectric
or energy out/energy in or power out/power in — B1

(ii) 30/90 or 1/3 or 33% is more than 25/100 or ¼ or 25%
OR lower input into hydroelectric station, but more output than gas-fired station — B1
IGNORE hydroelectric losses less than gas-fired losses

[6]

Q# 24/_iG Phx/2008/s/Paper 31/ www.SmashingScience.org

3 (a) mgh or 90 × 10 × 14 accept 9.8 or 9.81 instead of 10 — C1
12 600 J or 12348 J or 12360.6 J nothing else — A1

(b) PE lost = KE gained or mgh = $\frac{1}{2}mv^2$ — C1
(v^2 =) 280 e.c.f. or 274.4 or 274.68 — C1
16.7 m/s e.c.f. or 16.565 m/s or 16.573 m/s NOTE: 16.8 m/s gets A0 — A1

(c) energy lost or friction/air resistance/drag/wind resistance — B1

[6]

Q# 25/_iG Phx/2008/s/Paper 31/ www.SmashingScience.org

4 (a) (pushing rubber cover) volume reduced — M1
(when volume reduce), pressure goes up — A1

(b) $1 \times (10^5) \times 60 = 1.5 \times (10^5) \times V$ — C1
40 (cm^3) — C1
reduction in volume = 20 cm^3 or 1/3 — A1

(c) (ave) speed of mols/particles/atoms greater at high temp NOT energy/KE — B1
stronger/more collisions with walls OR greater pressure — B1

[7]

Q# 26/ iG Phx/2007/w/Paper 31/ www.SmashingScience.org

2	(a)	(i)	down to R and up towards Q/S, then reverse OR equivalent OR back towards Q, then reverse	B1
			continues backward and forward until stops (at R)	B1
		(ii)	idea of energy loss OR because of friction NOT PE/KE	B1
	(b)		(PE lost =) 1.2 × 0.5 OR 0.6 (J) OR 0.12 × 10 × 0.5 OR mgh OR wt × dist i.e. evidence of mgh	C1
			$0.5 \times 0.12 \times v^2$ = mgh OR 0.6 etc. e.c.f. i.e. evidence of $\frac{1}{2}mv^2$	C1
			3.16 OR 3.2 m/s c.a.o.	A1
				[Total: 6]

Q# 27/ iG Phx/2007/w/Paper 31/ www.SmashingScience.org

4	(a)	(i)	random	B1
			high speed (between collisions)	B1
		(ii)	hit walls	B1
			many hits/unit area OR hit hard OR large force OR high energy OR many hits/s OR hit very often	B1
	(b)		particles vibrate (more) OR electrons gain energy	B1
			particle to particle transfer OR flow of free electrons	B1

Q# 28/ iG Phx/2007/s/Paper 31/ www.SmashingScience.org

3	(a)	(i)	work done = force x dist or 600 x 3 or 60 x 3 or fd or mgh	C1	
			work = 1800 J c.a.o. accept j or Nm for unit	A1	[2]
		(ii)	power = work/time or 1800/12 e.c.f.	C1	
			power = 150 W e.c.f. accept J/s or NM/s for unit	A1	[2]
	(b)		P.E. decreases/transformed (ignore mention of KE)	C1	
			all the decrease becomes heat (ignore mention of sound)	A1	[2]
					[Total: 6]

Q# 29/ iG Phx/2006/w/Paper 31/ www.SmashingScience.org

3	(a)	p.e. lost = mgh or 1 x 10 x 7	C1	
		= 70 J	A1	[2]
	(b)	70 = 0.5 x *m* x v^2 or ecf	C1	
		v^2 = 140 or 2 x p.e.	C1	
		v = 12 m/s	A1	[3]
	(c)	some p.e. changed to heat/sound/either one/work done against air resistance air/resistance acts against the motion	B1	[1]
				[Total: 6]

Q# 30/_iG Phx/2006/s/Paper 31/ www.SmashingScience.org

5	**(a)**		increase surface area of tank	B1	
			blow air over surface/put in windy place	B1	**2**
	(b)	**(i)**	capillary tube longer or liquid with lower expansivity	B1	
		(ii)	capillary tube thinner/finer or liquid with higher expansivity or bigger bulb	B1	**2**
	(c)		$p_1v_1 = p_2v_2$ or $1 \times 10^5 \times 150 = p_2 \times 50$	C1	
			$p_2 = 3 \times 10^5$ (Pa)	A1	**2** **[6]**

Q# 31/_iG Phx/2006/s/Paper 31/ www.SmashingScience.org

3	**(a)**		work = force x distance	C1	
			= force of gravity/weight x (vertical) distance/height	A1	**2**
	(b)	**(i)**	work = (100 x 8) = 800 J	A1	
				A1	**2**
		(ii)	power = (800/5) = 160 W		
		(iii)	increases the k.e. of the water (ignore heat/sound)	B1	**1** **[5]**

Q# 32/_iG Phx/2005/w/Paper 31/ www.SmashingScience.org

3	(a)	P = hdg or 2 x 1000 x 10 = 20 000 N/m^2 or Pa	C1 A1	[2]
	(b)	p = f/a or 20 000 = 50/a a = 0.0025 m^2	C1 A1	[2]
	(c)	potential energy of the water converted to kinetic energy of water through outlet (and heat)	B1 B1	[2] Total[6]

Q# 33/_iG Phx/2005/s/3Q3

	(c)	P = F/a or P = 120/0.05 = 2400 N/m^2 (or Pa)	C1 A1	2 [5]

Q# 34/_iG Phx/2004/w/Paper 3/ www.SmashingScience.org

2	**(a)**	pressure = hdg or 20 x 1000 x 10	**1**	
		= 2×10^5 Pa	**1**	**2**
	(b)	force = pressure x area or $2 \times 10^5 \times 0.5$ e.c.f.	**1**	
		= 1×10^5 N	**1**	**2**
	(c)	potential energy (at water surface)	**1**	
		changed to kinetic energy (at pipe exit)	**1**	**2** **(6)**

2	(a)	pressure = depth x g x density of water	C1	
		pressure = 50 x 10 x 1000	C1	
		so value is 500 000 Pa or N/m^2	A1	3
	(b)	force = pressure x area in any form	C1	
		force = 500 000 x 0.15 x 0.07	C1	
		force = 5250 N	A1	3
				[6]