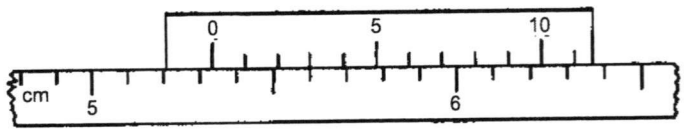
Section A [10 marks]

1 Which quantity represents the smallest value?

A 0.03 km **B** 17 mm

C 59 nm **D** 3110 μm

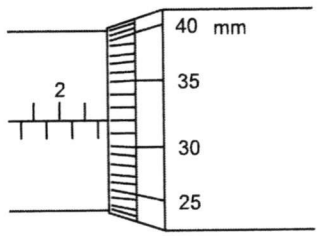
2 The diagram shows a vernier caliper.



What is the reading?

A 5.23 cm **B** 5.26 cm **C** 5.33 cm **D** 5.36 cm

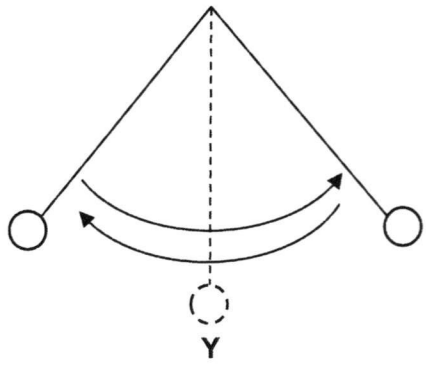
3 A micrometer screw gauge is used to measure the thickness of the wire.



What is the thickness of the wire?

A 2.83 mm **B** 3.82 mm **C** 3.88 mm **D** 5.83 mm

4 A pendulum swings backwards and forwards passing through **Y**, the middle point of the oscillation.

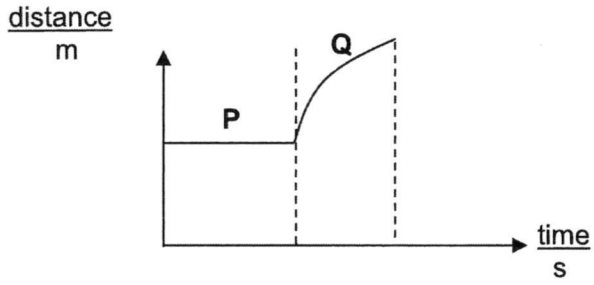


The first time the pendulum passes through **Y**, a stopwatch is started. The eleventh time the pendulum passes through **Y**, the stopwatch is stopped. The reading is *T*.

What is the period of the pendulum?

A *T*/5 **B** *T*/10 **C** *T*/11 **D** *T*/21

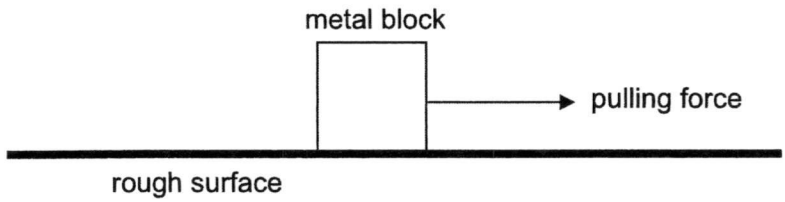
5 The graph shows a distance-time graph of an object in motion.



Which of the following shows the correct motion in each of the section of the graph?

	P	Q
A	at rest	decreasing acceleration
B	constant speed	decreasing acceleration
C	at rest	deceleration
D	constant speed	deceleration

6 A metal block is pulled across a rough surface at a constant speed.



Which statement is true?

A The pulling force increases to overcome the frictional force.

B The pulling force is equal in magnitude and in same direction as the frictional force.

C The pulling force is equal in magnitude and in opposite direction as the frictional force.

D The pulling force decreases as the metal block is being pulled.

7 Which of the following has the smallest inertia? (The gravitational field strength on Earth is 10 N/kg.)

A a 30 kg girl running at a speed of 7 m/s

B a 45 kg girl resting stationary on the ground

C a block of weight 550 N rolling down a slope at 5 m/s

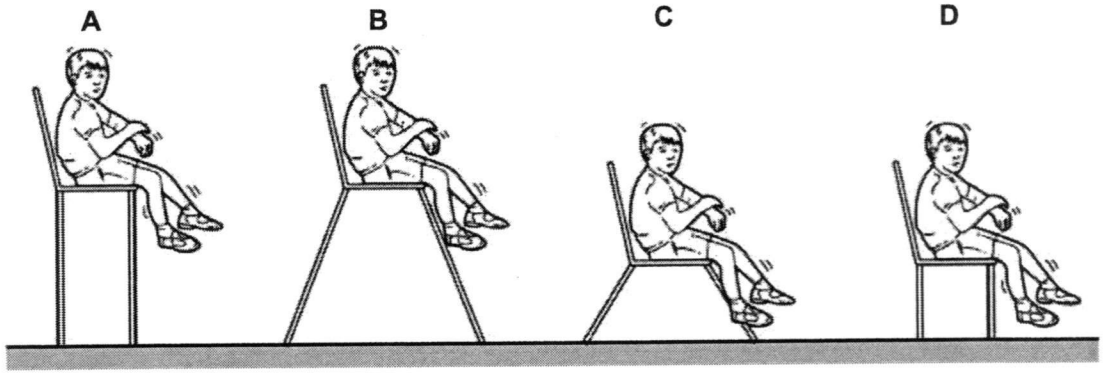
D a block of weight 600 N sliding along the horizontal ground at 3 m/s

8 A teacher lifts a stack of books vertically upwards through a distance of 1.2 m with an upward force of 80 N.

What is the work done by the teacher?

A 9.6 J **B** 67 J **C** 80 J **D** 96 J

9 Which chair is the most stable if the child moves?



10 Boiling is different from evaporation because _____.

A it takes only at the bottom of the liquid

B it takes place in solid as well

C it takes place only at the surface of the liquid

D it takes place throughout the liquid

Section B [40 marks]

Answer **all** the questions in the spaces provided.

1 A motorcycle travels at 15 m/s for 4 minutes.
It then accelerates uniformly to a speed of 35 m/s in 2 minutes.
It travels at a uniform speed of 35 m/s for a further 5 minutes before decelerating non-uniformly to rest in 2 minutes.

(a) Plot a graph on Fig. 1.1 to show how the speed of the motorcycle varies with time. [4]

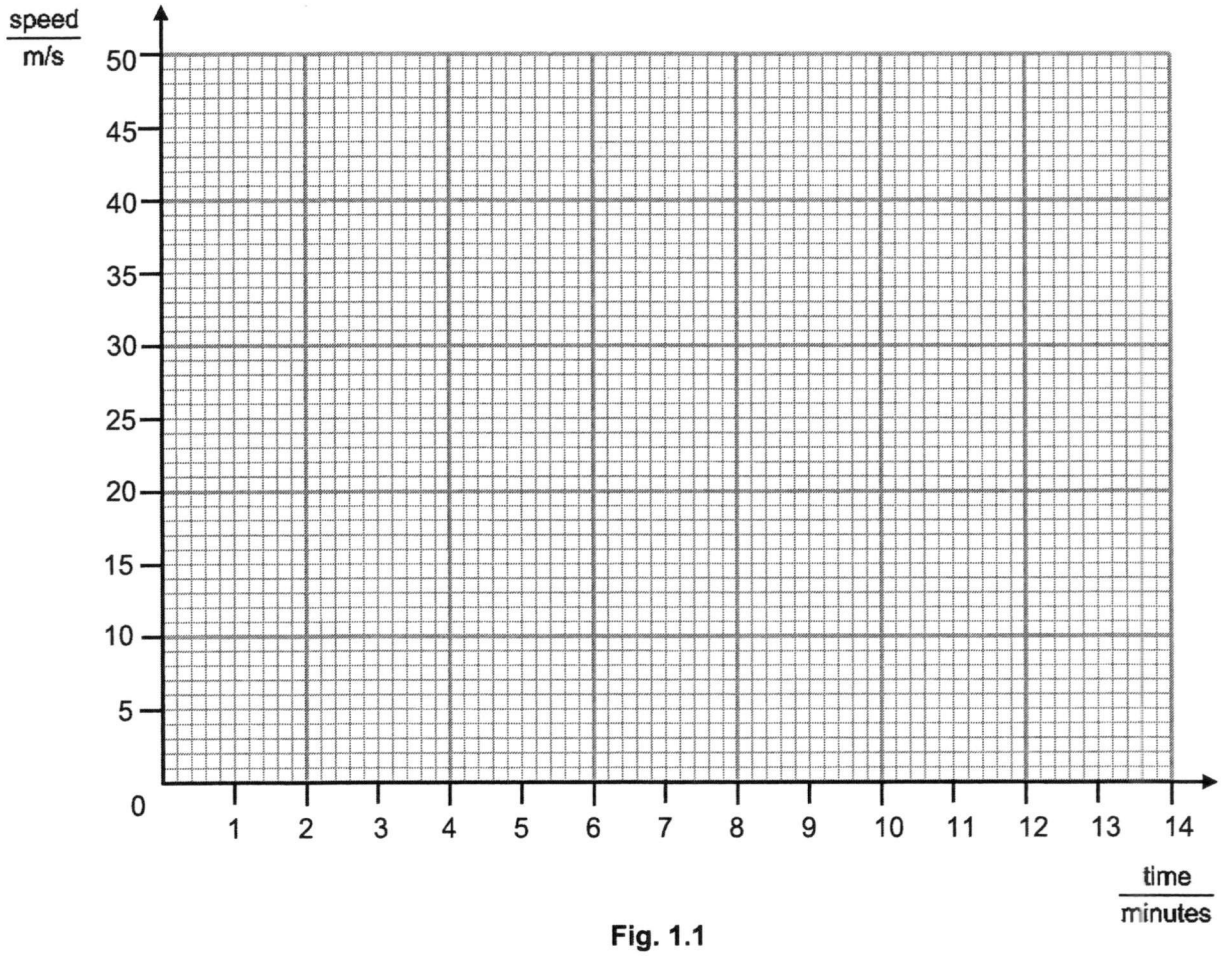


Fig. 1.1

(b) Calculate the acceleration of the motorcycle from time = 4.5 minutes to 5.5 minutes.

acceleration = ... m/s^2 [2]

(c) Calculate the total distance travelled by the motorcycle from time = 0 minute to time = 11 minute.

distance = ... m [2]

2 Fig. 2.1 shows an astronaut using a jet propulsion backpack to travel in space. The backpack contains a pressurised gas cylinder connected to a valve. When the valve is opened, a jet of gas is released and the astronaut moves forward.

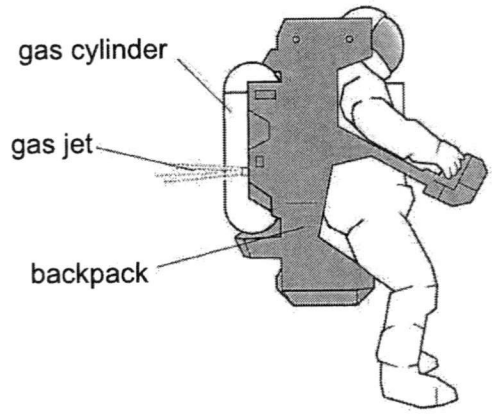


Fig. 2.1

The astronaut and backpack have a total mass of 120 kg. The jet of gas exerts a constant force of 15 N.

(a) Calculate the acceleration of the astronaut when the jet is switched on.

acceleration = ... m/s^2 [2]

(b) The jet is now switched off. Describe the motion of the astronaut. Explain your answer.

.....

.....[2]

3 A beaker contains 200 cm^3 of liquid. When it is completely filled with oil, its total weight is 3.0 N.

The density of oil is 0.92 g/cm^3.
The gravitational field strength on Earth is 10 N/kg.

(a) State a difference between *mass* and *weight* of an object.

.....

.....[2]

(b) Calculate the mass of the oil in the beaker.

mass = ... kg [2]

(c) Calculate the mass of the empty beaker.

mass = ... kg [2]

4 Fig. 4.1 shows a toy dragonfly balanced on a fingertip.

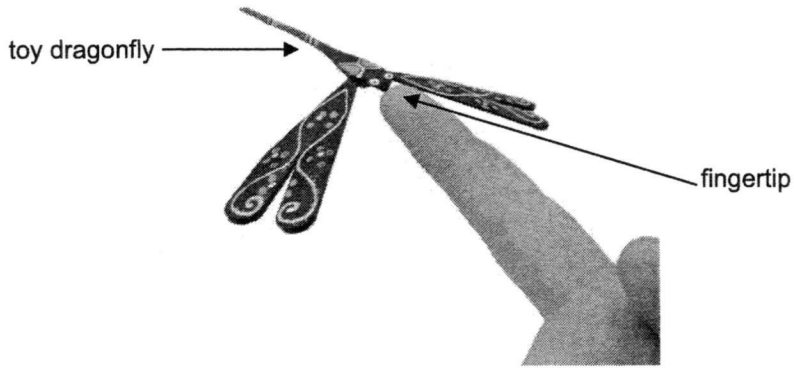


Fig. 4.1

Explain why the toy dragonfly is able to balance on the fingertip.

.....

.....

.....[3]

5 Fig. 5.1 shows a device for punching holes in a thin piece of wood. A person applies a force **F** at one end of the movable arm. Just before the hole is made in wood by the steel rod, the moveable arm is at rest and the force acting upward on the steel rod by the wood is 6.3 N.

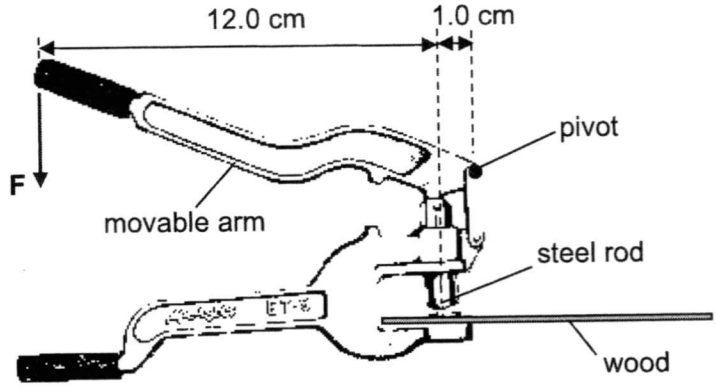


Fig. 5.1

(a) Calculate the value of **F**.

F = ... N [2]

(b) The steel rod has a contact area of 0.24 cm^2 with the wood.

Calculate the pressure exerted on the wood when the steel rod pushes the wood to make a hole.

pressure = ... Pa [2]

(c) The surface of the steel rod that comes in contact with the piece of wood has a flat end. Suggest a change to the rod so that it is easier to punch a hole in the piece of wood. Explain your answer.

.....

.....[2]

6 A car decelerates uniformly up a slope as shown in Fig. 6.1.

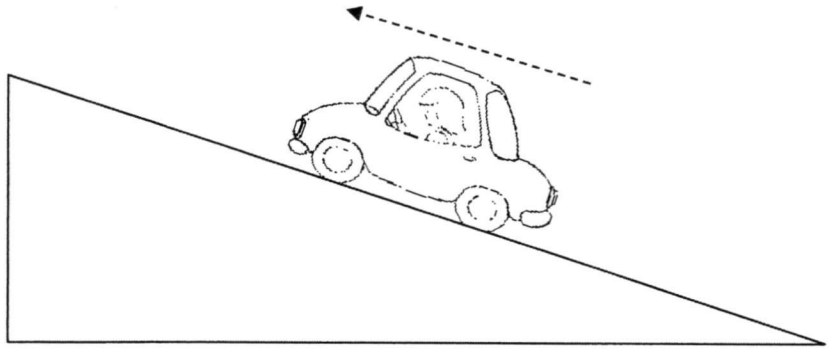


Fig. 6.1

Draw and label all forces acting on the car in Fig. 6.1 as it travels up the slope. [2]

7 Fig. 7.1 shows a metallic ice cream scoop. The metallic scoop allows ice cream from the container to be scooped easily.

Fig. 7.1

(a) Explain how the material of the ice cream scoop helps in the melting of the ice cream.

.....

.....[1]

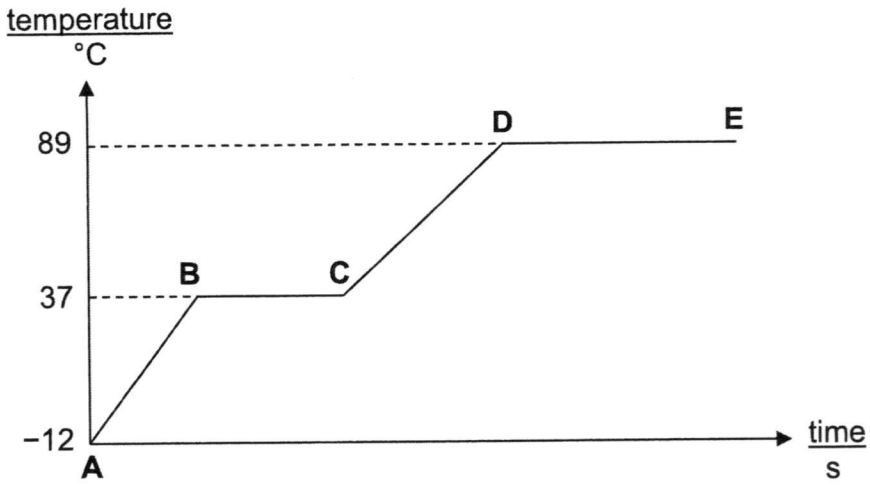
(b) Explain why it is easier to scoop the ice cream if the scoop is placed into water after every scoop.

.....

.....

.....[2]

8 The graph below shows how the temperature of a pure substance X varies with time when it is heated at a constant rate.



(a) State the physical state of substance X at room temperature.

.....[1]

(b) State the boiling point of substance X.

.....[1]

(c) Describe the movement of the molecules of the substance

(i) at point **A**.

.....

.....[1]

(i) at point **C**.

.....

.....[1]

(d) A student claims that the temperature remains constant at **BC** because substance **X** is not absorbing thermal energy.

Do you agree with him? Explain your answer.

.....

.....[2]

(e) With reference to the kinetic model of matter, explain why liquid substance has a much higher density than its gaseous form.

.....

.....

.....[2]

Section C [20 marks]

Answer **all** the questions in the spaces provided.

9 A pile driver shown in Fig. 9.1 is a machine used to drive pile into soil to provide foundation support for buildings. The hammer is lifted by an electric motor and then falls freely to hit the pile into the ground.

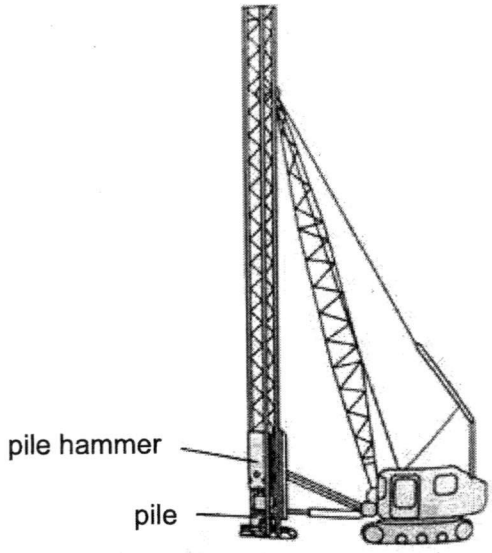


Fig. 9.1

(a) **(i)** State the *principle of conservation of energy.*

.....

.....

.....[2]

(ii) State the energy conversions that take place from as the hammer falls from its initial position at the top.

.....[1]

(b) The hammer has a mass of 2000 kg and it hits the pile with a speed of 7.0 m/s. Assume the effects of air resistance and friction are negligible.

(i) Calculate the kinetic energy of the hammer as it hits the ground.

kinetic energy = ... [2]

(ii) Calculate the height above the ground from which the hammer is dropped.

height = ... [3]

(iii) It takes 6.0 s to lift the hammer to the height calculated in **(b)(ii)**.
Determine the power of the electric motor used to lift the hammer.

power = ... [2]

10 Fig. 10.1 shows a water heater that is placed on the roof of the house. The water heater uses solar energy to produce hot water for the household.

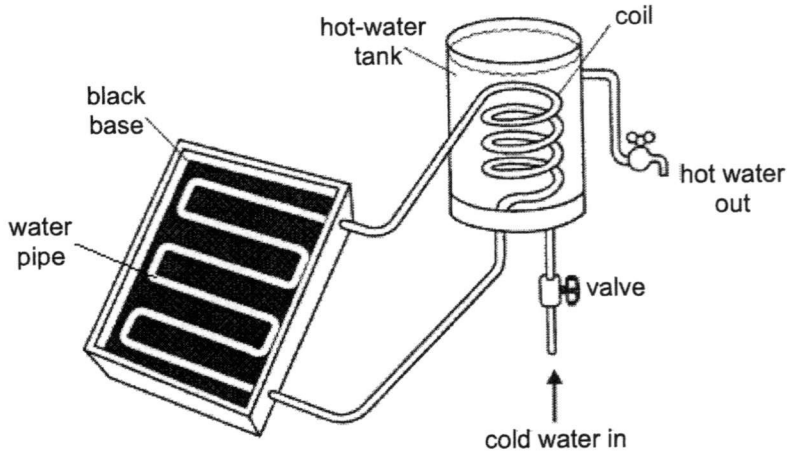


Fig. 10.1

(a) Name the main process by which thermal energy from the Sun is transferred to Earth. Explain your answer.

.....

.....

.....[2]

(b) Explain why the solar collector has a black base.

.....

.....[1]

(c) Explain why the water pipe has many loops.

.....

.....[1]

(d) Explain how hot water in the pipes of the solar collector travels up to the hot-water tank.

.....

.....

.....[3]

(e) Suggest a suitable texture for the surface for the hot-water tank. Explain your choice.

.....

.....[2]

(f) The hot-water tank in Fig. 10.1 is insulated with a layer of polystyrene foam. Explain how this layer of polystyrene foam minimises heat loss to the surrounding.

.....

.....[1]

- END OF PAPER -

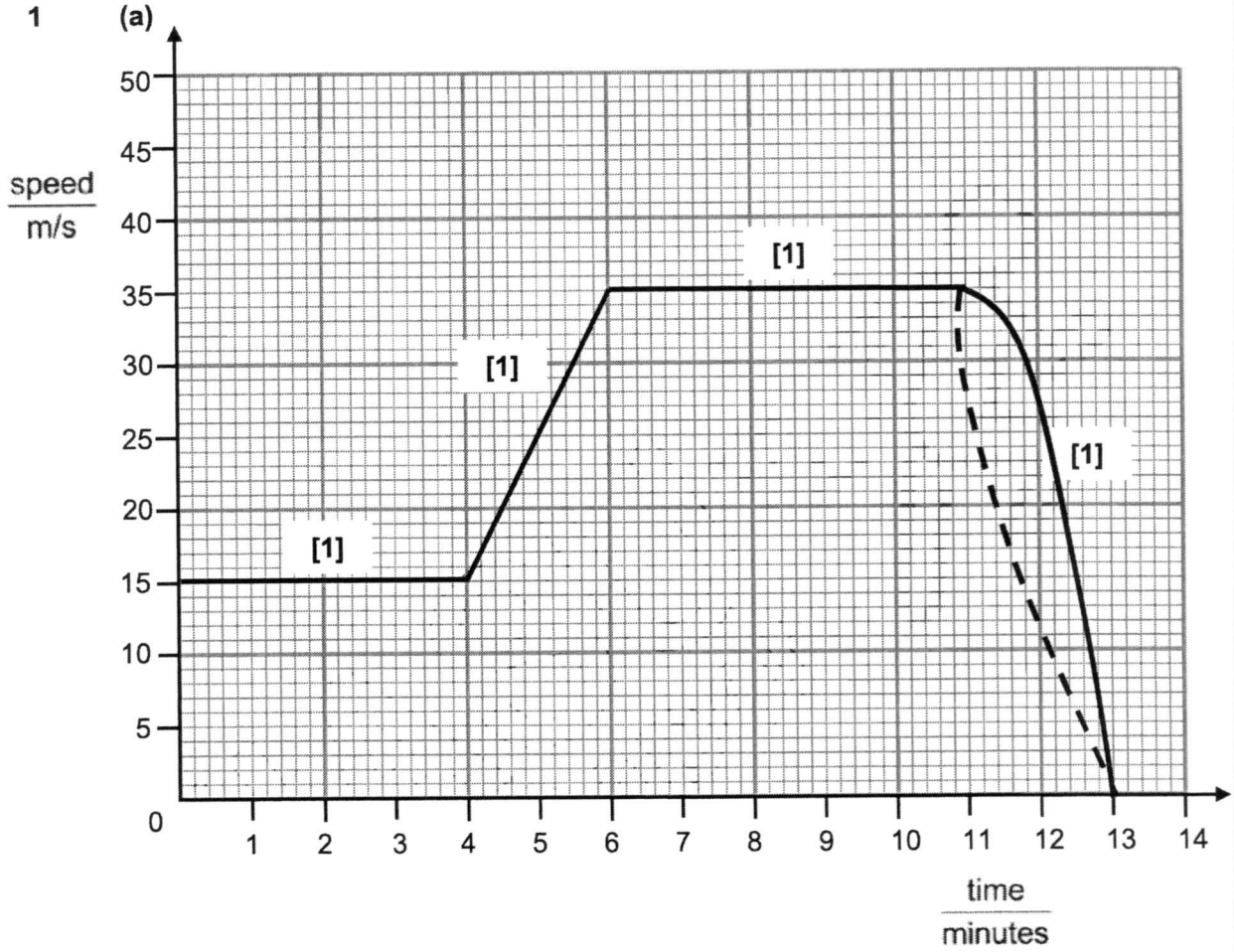
2017 3Express Science Physics 5076 SA2

Section A – MCQ

1	2	3	4	5	6	7	8	9	10
C	**D**	**B**	**A**	**C**	**C**	**A**	**D**	**C**	**D**

Section B [30 marks]

1 (a)



(b) a = (35 – 15) / (2 × 60) **[1]**
= 0.167 m/s^2 **[1]**

(c) d =((15 × 240) + [1/2 × (15+35) × 120] + (35 × 300) **[1]**
= 17 100 m **[1]**

note: partial credit was given for calculating distance using minutes (i.e. 285m)

2 (a) 15 = (120)(a) **[1]**
a = 0.125 m/s^2 **[1]**

(b) Astronaut continues to move forward with constant speed **[1]** as there is zero resultant force acting on him. **[1]**

3 (a) **Accept any of the below. Award [1] for mass, [1] for weight.**

Mass	Weight
Amount of matter in a body	Gravitational force exerted on an object
Has only magnitude, i.e. a scalar quantity	Has both magnitude and direction, i.e. a vector quantity
Remain constant regardless of the gravitational field strength of the location	Will vary according to the gravitational field strength of the location

(b) M = (0.92)(200) **[1]**
= 184 g
= 0.184 kg **[1]**

(c) Mass of beaker with oil = 3.0 / 10 **[1]**
= 0.3 kg **[1]**

Mass of empty beaker = 0.3 – 0.184
= 0.116 kg **[1]**

4 The centre of gravity of the toy dragonfly is located below the mouth of the toy dragonfly ***OR*** The line of action of the weight passes through the fingertip, pivot for the toy dragonfly. **[1]**

As the perpendicular distance of the weight from the pivot is zero, zero moment is produced about the pivot. **[1]**

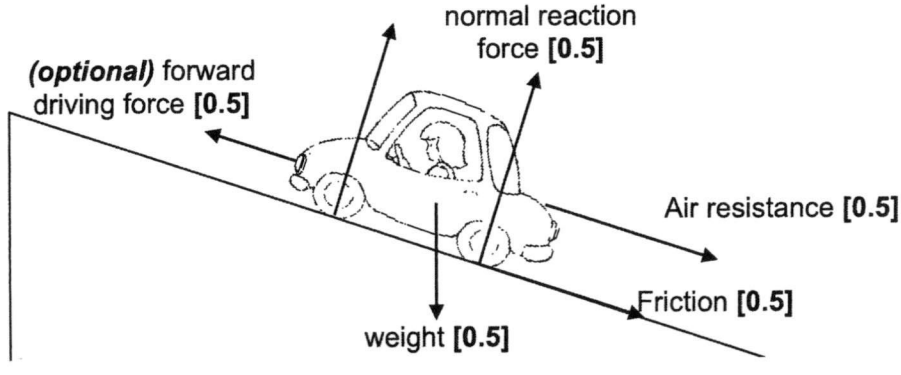
5 **(a)** (12)(F) = (1)(6.3) **[1]**
= 0.525 N **[1]**

(b) 0.24 cm^2 = 2.4 × 10^{-5} m^2
P = 6.3 / (2.4 × 10^{-5}) **[1]**
= 262 500 Pa **[1]**

note: credit given for correct area or application of p = F/A stating 6.3N and calculated area

(c) Use a steel rod with a sharper/pointed end. **[1]**
This decreases the contact area of the rod with the piece of wood. **[1]**
Hence, pressure exerted on the piece of wood increases. **[1]**

6



7 (a) Metal is a good conductor of heat **[0.5]** When scooping, it is able to conduct heat from the hand to the ice cream **[0.5]**.

note: conducts heat from surroundings not accepted

(b) The scoop lose heat to the ice cream after every scoop. **[1]**
The scoop gains heat when it is placed into water, **[1]** and is able to melt the ice-cream easier during scooping. **[1]**

8 (a) Solid **[1]**

(b) 89 °C **[1]**

(c) (i) Particles vibrate about their fixed positions. **[1]**

note: a fixed position is <u>not</u> accepted.

(ii) Particles move among / slide past one another **[1]**

(d) No. **[0.5]** At BC, thermal energy absorbed is used to overcome t ntermolecular bonds between its particles **[1]**
instead of raising its temperature ***OR*** increasing the kinetic energy of its particles **[0.5]**

(e) The particles of substance X are closer to one another in liquid state than in gaseous state ***OR*** particles per unit volume of substance X in liquid state is higher than that in gaseous state. **[1]**

For the same volume, mass of liquid will be greater than volume of gas
a fixed mass for substance, volume of liquid will be smaller than volume of gas. **[1]**

ection C [20 marks]

9 (a) (i) Energy cannot be created or destroyed. It can only be converted from one form to another or transferred from one object to another. **[1]**
Total energy of the system remains constant. **[1]**

(ii) Gravitational potential energy
Energy. **[1]**

(b) (i) $KE = \frac{1}{2}(2000)(7.0)^2$ **[1]**
$= 49\,000$ J **[1]**

(ii) $49\,000 = (2000)(10)(h)$ **[1]**
$h = 2.45$ m **[1]**

(iii) $P = 49\,000 / 6$ **[1]**
$= 8\,170$ J **[1]**

10 (a) Radiation. **[1]** Outer space is made up of a vacuum and not a material medium. Conduction and radiation requires a material medium for the transfer of thermal energy ***OR*** Radiation is the only heat transfer process that can take place in vacuum / the absence of a material medium. **[1]**

(b) Black surface is a good absorber of radiant heat. **[0.5]** this allows higher rate of absorption of radiant heat. **[0.5]**

note: black 'colour' instead of 'surface' not penalised

(c) To increase the surface in contact with the black base **[0.5]** and this allows higher rate of absorption of radiant heat. **[0.5]**

(d) Hot water in the water pipe which is less dense rises up the pipe. **[0.5]** The hot water loses thermal energy to the cold water in the tank. **[0.5]** The cold denser water in the water pipe sinks to replace the hot water in the solar collector. **[1]** This sets up convection currents in the solar collector. **[1]**

(e) Smooth surface. **[1]** Smooth surface is a poor emitter of radiant heat. **[0.5]** and this minimise heat loss to the surrounding. **[0.5]**

(f) The layer of polystyrene foam contains pockets of air. **[0.5]** These pockets of air acts as an good insulator (or poor conductor) and minimises heat loss to the surrounding by conduction **[0.5]**