Summer practise questions

Year 11 into year 12

Name: ______________________

Class: ______________________

Date: ______________________

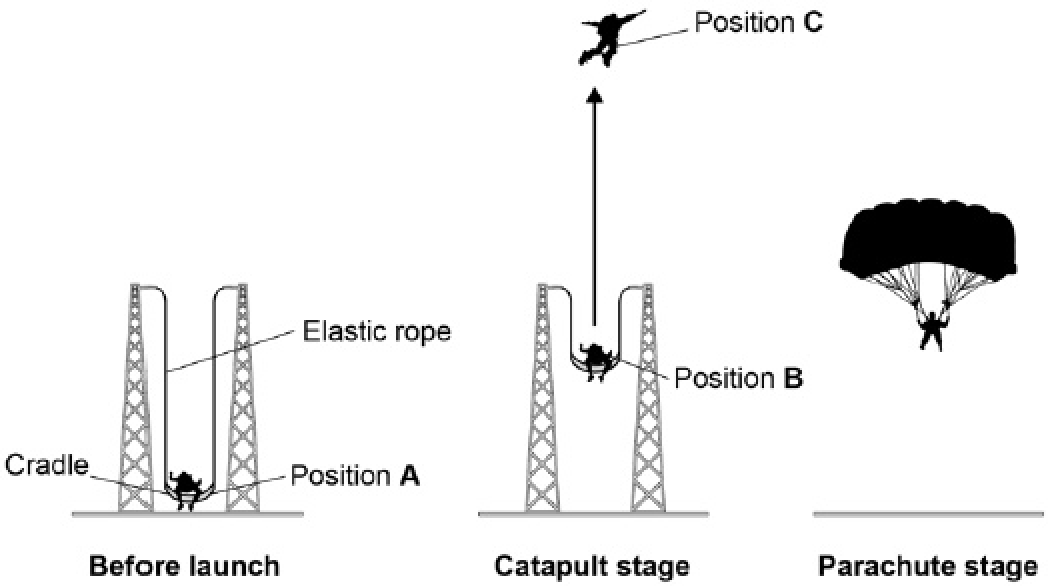
Time:

Marks: **111 marks**

Comments:

1 The diagram shows the stages of an extreme sport called 'human catapult'.

- A person lies in a cradle which is held to the ground.
- The cradle is released.
- The person is launched vertically into the air by an elastic rope.
- The person then parachutes back to the ground.



(a) In position **A** there is a store of elastic energy.

Position **C** is the person's maximum height.

Describe the energy transfers from position **A**, through position **B**, to position **C**.

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(3)

(b) In the last few metres of his descent during the parachute stage, the person travels at a terminal velocity.

Explain why.

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(2)

(c) When stretched in position **A**, the elastic rope stores 25 000 joules.

The elastic rope behaves like a spring, with a spring constant of 125 N/m

Calculate the extension of the elastic rope.

Use the Physics Equations Sheet.

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Extension of elastic rope = ____________________ m

(4)

(d) The vertical velocity of the person at position **B** in the diagram is 26 m/s

The vertical velocity at position **C** is 0 m/s

Calculate the distance between position **B** and position **C**. Ignore the effect of air resistance.

Use the Physics Equations Sheet.

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Distance = ____________________ m

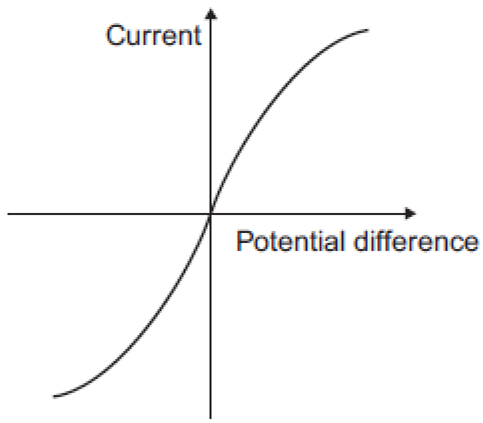
(4)

(Total 13 marks)

2 The current in a circuit depends on the potential difference provided by the cells and the total resistance of the circuit.

(a) **Figure 1** shows the graph of current against potential difference for a component.

Figure 1



What is the name of the component?

Draw a ring around the correct answer.

diode **filament bulb** **thermistor**

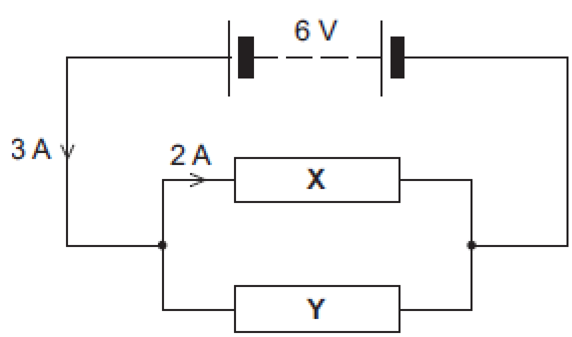
(1)

(b) **Figure 2** shows a circuit containing a 6 V battery.

Two resistors, **X** and **Y**, are connected in parallel.

The current in some parts of the circuit is shown.

Figure 2



(i) What is the potential difference across **X**?

Potential difference across **X** = ________________ V

(1)

(ii) Calculate the resistance of **X**.

___

___

Resistance of **X** = ________________ Ω

(2)

(iii) What is the current in **Y**?

Current in **Y** = ________________ A

(1)

(iv) Calculate the resistance of **Y**.

___

Resistance of **Y** = ________________ Ω

(1)

(v) When the temperature of resistor **X** increases, its resistance increases.

What would happen to the:

- potential difference across **X**
- current in **X**
- total current in the circuit?

Tick (✓) **three** boxes.

	Decrease	**Stay the same**	**Increase**
Potential difference across **X**			
Current in **X**			
Total current in the circuit			

(3)

(Total 9 marks)

3 A light dependent resistor (LDR) is connected in a circuit.

(a) Draw the circuit symbol for an LDR.

(1)

(b) A student investigated the relationship between current and potential difference for an LDR.

How should the student have connected the ammeter and voltmeter in the circuit?

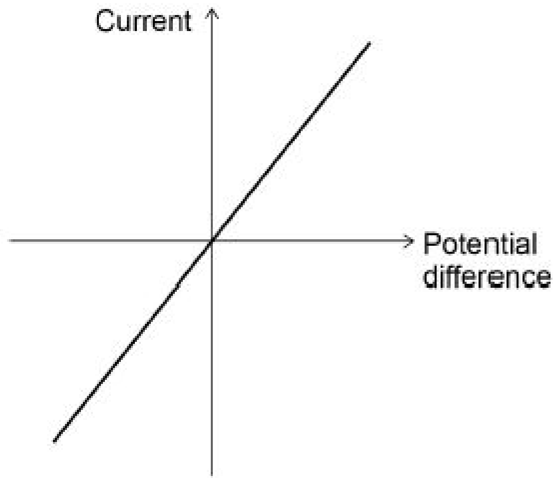
Tick **one** box.

Ammeter	**Voltmeter**	
in parallel with LDR	in parallel with LDR	☐
in parallel with LDR	in series with LDR	☐
in series with LDR	in parallel with LDR	☐
in series with LDR	in series with LDR	☐

(1)

The diagram below shows a sketch graph of the student's results.

The LDR was in a constant bright light.



(c) The student concluded that the current in the LDR is inversely proportional to the potential difference across the LDR.

Explain why the student's conclusion is incorrect.

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(2)

(d) The student repeated the investigation with the LDR in constant dark conditions.

Sketch on the diagram above the graph for the LDR in constant dark conditions.

(2)

The LDR was placed near a light source.

The following results were recorded:

potential difference = 5.50 V

current = 12.5 mA

(e) Write down the equation that links current, potential difference and resistance.

____

(1)

(f) Calculate the resistance of the LDR.

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Resistance = ____________ Ω

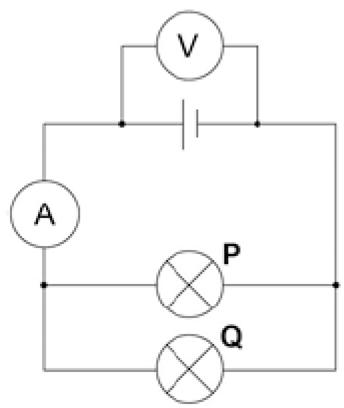
(4)

(Total 11 marks)

4 **Figure 1** shows a circuit diagram containing two identical lamps arranged in parallel.

The reading on the ammeter is 186 mA.

Figure 1



(a) Which statement about the current through the lamps is true?

Tick **one** box.

The current through both lamp **P** and lamp **Q** is **0.093 A** ☐

The current through both lamp **P** and lamp **Q** is **0.186 A** ☐

The current through both lamp **P** and lamp **Q** is **0.93 A** ☐

The current through both lamp **P** and lamp **Q** is **1.86 A** ☐

(1)

(b) One of the lamps breaks and is not replaced.

Which statement about the current in the other lamp is true?

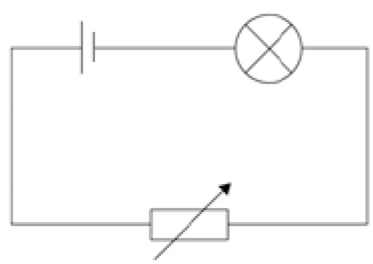
Tick **one** box.

The current through the lamp is **0.093 A**	☐
The current through the lamp is **0.186 A**	☐
The current through the lamp is **0.93 A**	☐
The current through the lamp is **1.86 A**	☐

(1)

(c) **Figure 2** shows a circuit that can be used to alter the brightness of a lamp.

Figure 2



The resistance of the variable resistor is increased.

What effect will this have on the brightness of the lamp?

Explain your answer.

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(2)

(d) When the potential difference across the lamp is 3.3 V, the current is 0.15 A.

Write down the equation that links current, potential difference and resistance.

Equation ___

(1)

(e) Calculate the resistance of the lamp.

____

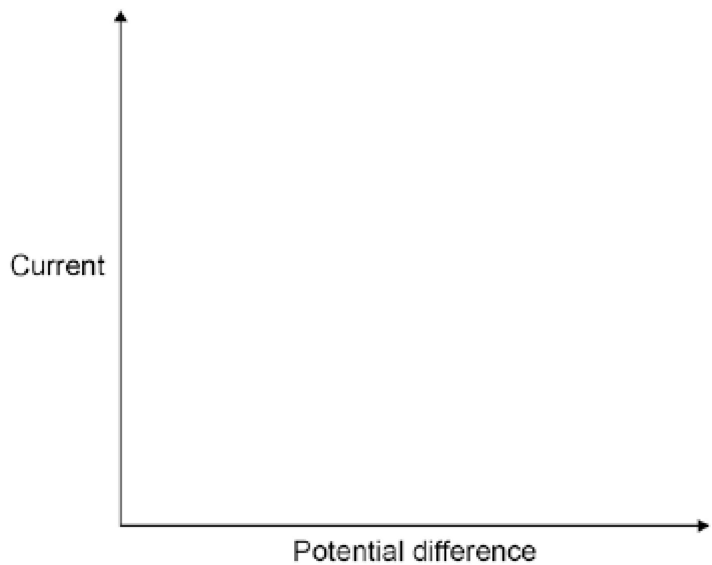
____

____

Resistance = ________________ Ω

(3)

(f) Sketch a current–potential difference graph for a filament lamp.



(1)

(Total 9 marks)

5 Speed and velocity are different quantities.

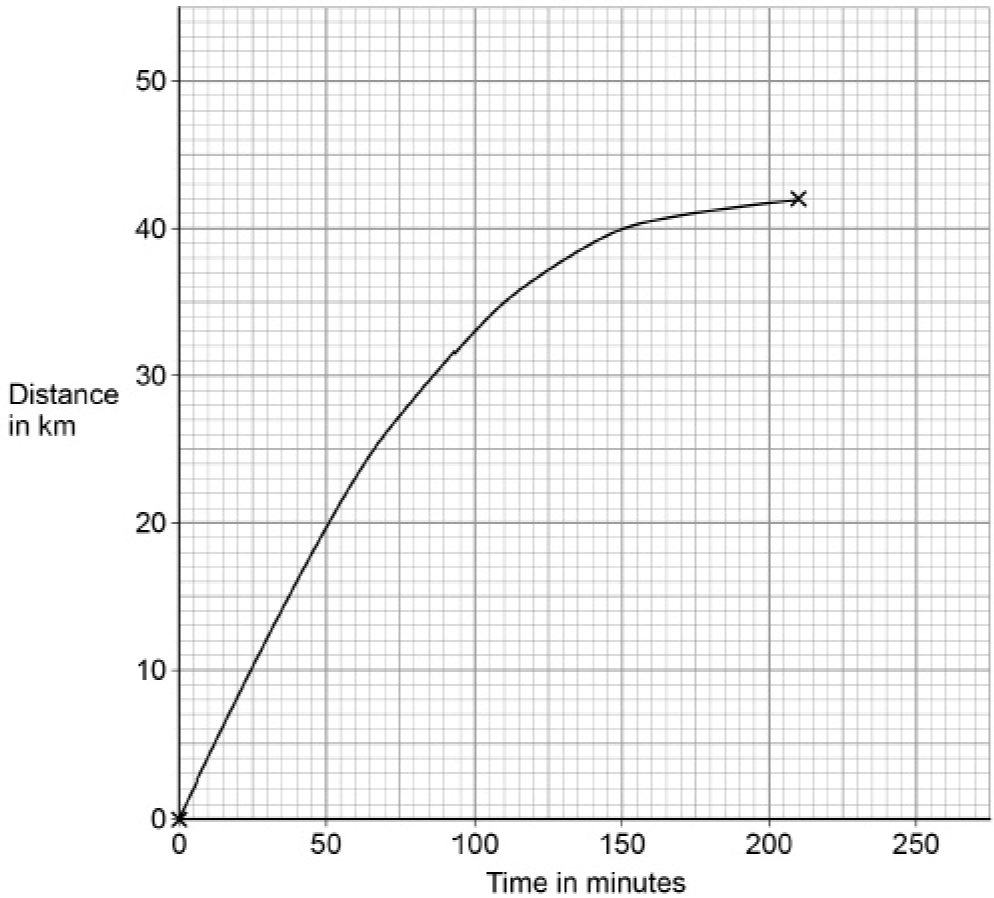
(a) Complete the sentences.

Velocity is a ____________________ quantity.

The velocity of an object is its speed in a given ____________________.

(2)

The graph shows a distance-time graph for an athlete in a race.



(b) Determine the distance of the race and the time taken for the athlete to complete the race.

Use the graph.

____

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Distance = ______________________

Time = ______________________

(1)

(c) Describe how you can use the graph to determine the velocity of the athlete 20 minutes after the start of the race.

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(3)

A car following the race accelerates at a constant rate in a straight line.

The velocity of the car increases from 4.9 m/s to 6.4 m/s in 3.00 minutes.

(d) Calculate the acceleration of the car.

Give your answer to 3 significant figures.

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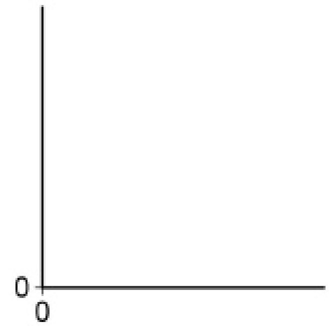
Acceleration = ____________________ m/s^2

(4)

(e) Sketch a velocity-time graph to represent the acceleration of the car in part (d).



(2)

(f) At the end of the race the car is travelling at 5.2 m/s

The brakes are applied causing the car to slow down and stop.

The brakes apply a constant force of 855 N in the opposite direction to the car's motion.

The mass of the car is 950 kg

Calculate the braking distance travelled by the car.

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Braking distance = ____________________ m

(6)

(Total 18 marks)

6 When two objects interact, they exert forces on each other.

(a) Which statement about the forces is correct?

Tick (✓) **one** box.

	Tick (✓)
The forces are equal in size and act in the same direction.	
The forces are unequal in size and act in the same direction.	
The forces are equal in size and act in opposite directions.	
The forces are unequal in size and act in opposite directions.	

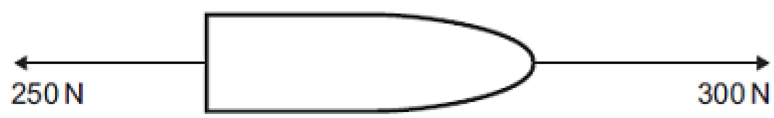
(1)

(b) A fisherman pulls a boat towards land.

The forces acting on the boat are shown in **Diagram 1**.

The fisherman exerts a force of 300 N on the boat.
The sea exerts a resistive force of 250 N on the boat.

Diagram 1



(i) Describe the motion of the boat.

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___

(2)

(ii) When the boat reaches land, the resistive force increases to 300 N.
The fisherman continues to exert a force of 300 N.

Describe the motion of the boat.

Tick (✓) **one** box.

Accelerating to the right ☐

Constant velocity to the right ☐

Stationary ☐

(1)

(iii) Explain your answer to part **(b)(ii)**.

___

___

___

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(2)

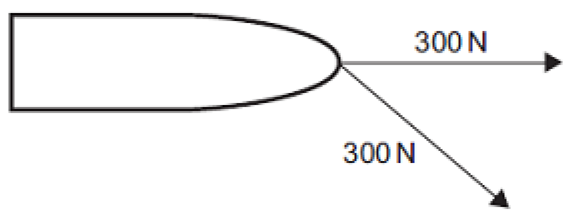
(iv) Another fisherman comes to help pull the boat. Each fisherman pulls with a force of 300 N, as shown in **Diagram 2**.

Diagram 2 is drawn to scale.

Add to **Diagram 2** to show the single force that has the same effect as the two 300 N forces.

Determine the value of this resultant force.

Diagram 2



Resultant force = ____________________ N

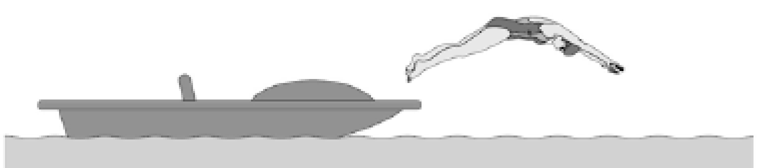
(4)

(Total 10 marks)

7 A swimmer dives off a boat.

Look at **Figure 1**.

Figure 1



(a) What **two** factors determine the momentum of the swimmer?

1. ___

2. ___

(2)

(b) What is the unit of momentum?

Tick **one** box.

- J / s ☐
- kg m / s ☐
- N m ☐
- m / s^2 ☐

(1)

(c) The boat was stationary.

As the swimmer dives forwards, the boat moves backwards.

Use the idea of conservation of momentum to explain why the boat moves backwards.

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(4)

(d) Explain what would happen to the motion of the boat if there were more people on the boat when the swimmer dived off.

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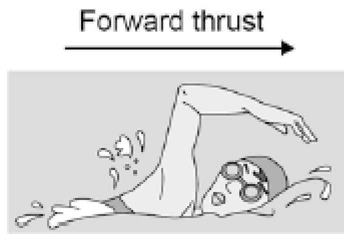
(2)

(e)



The swimmer's speed increases as she swims away from the boat.

The swimmer has a top speed.

Explain why.

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(5)
(Total 14 marks)

8 Alpha particles, beta particles and gamma rays are types of nuclear radiation.

(a) Describe the structure of an alpha particle.

____

____

(1)

(b) Nuclear radiation can change atoms into ions by the process of ionisation.

(i) Which type of nuclear radiation is the least ionising?

Tick (✓) **one** box.

alpha particles ☐

beta particles ☐

gamma rays ☐

(1)

(ii) What happens to the structure of an atom when the atom is ionised?

____

____

(1)

(c) People working with sources of nuclear radiation risk damaging their health.

State **one** precaution these people should take to reduce the risk to their health.

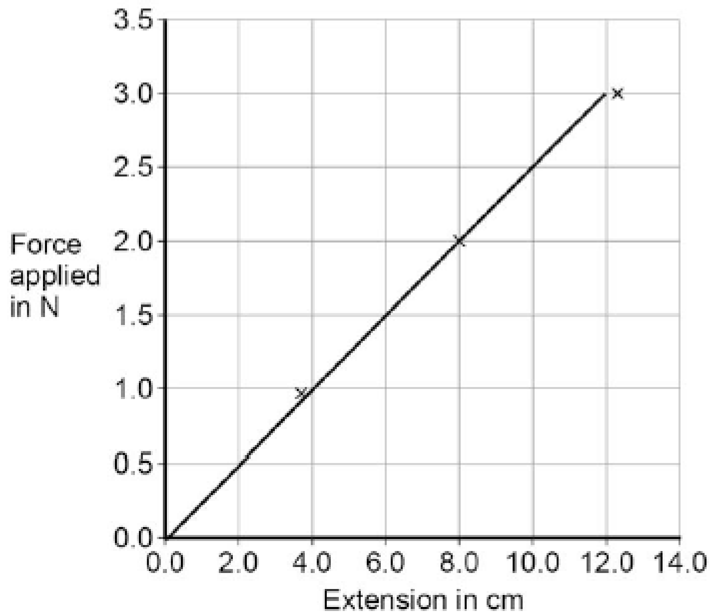
____

____

(1)
(Total 4 marks)

9 A student changed the force applied to a spring by adding weights.

The figure below shows a graph of her results.



(a) Write down the equation that links the force applied and extension for a spring.

____

(1)

(b) Identify the pattern shown in the figure above.

Explain your answer.

____

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____

(2)

(c) Give **one** way the student could improve her investigation.

____

(1)

(d) Describe the relationship between work done and elastic potential energy in stretching a spring.

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(2)

(e) Draw a line on the figure above to show the results for a stiffer spring.

Explain the reason for the line you have drawn.

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(3)

(f) Explain what would happen to the spring if the student kept adding weights?

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(2)
(Total 11 marks)

10 This question is about forces, quantities and vectors.

(a) Write down the equation that links gravitational field strength, mass and weight.

___

(1)

(b) A small ball weighs 1.4 N.

gravitational field strength, g = 9.8 N / kg

Calculate the mass of the ball.

___

___

___

Mass = ___________________ kg

(3)

(c) A white ball with mass 143 g is moving at a velocity of 7.9 m / s.

It collides with a red ball with mass of 150 g.

The red ball is stationary before the collision. The white ball stops after the collision.

Calculate the velocity of the red ball after the collision.

Give your answer to two significant figures.

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Velocity of red ball = ___________________ m / s

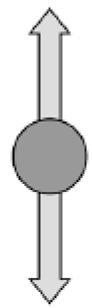
(4)

(d) The white ball is thrown high into the air.

After it is released the ball moves up and then back down in a vertical line.

The free body force diagram in the figure below shows the forces on the ball at one point in its flight.

The force arrows are drawn to scale.



Explain what is happening to the ball at this point in its flight.

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(4)

(Total 12 marks)

Mark schemes

1 (a) between **A** and **B** (the elastic store decreases and) the kinetic and gravitational stores increase

1

between **B** and **C** the kinetic store decreases and the gravitational store increases

1

the internal energy store of the surroundings increases

*allow **either***

some energy is dissipated to the surroundings

or

some energy is dissipated as heat / sound

1

(b) the weight and air resistance are equal and opposite

1

so the resultant force is zero

1

(c) $25\,000 = \frac{1}{2} \times 125 \times e^2$

1

$$e^2 = \frac{2 \times 25000}{125}$$

1

$$e = \sqrt{\frac{2 \times 25000}{125}}$$

1

e = 20 (m)

*an answer of 20 (m) scores **4** marks*

1

(d) acceleration = (–)9.8(m/s^2)

1

$0^2 - 26^2 = 2 \times (-9.8) \times s$

1

$$s = \frac{-26^2}{2 \times (-9.8)}$$

1

s = 34 (m)

allow any correct rounding of 34.489...

*an answer of 34 (m) scores **4** marks*

1

[13]

2 (a) filament bulb 1

(b) (i) 6 V 1

(ii) 3 Ω or their $\frac{(i)}{2}$ correctly calculated

allow 1 mark for correct substitution ie

6 = 2 × R

or their (i) = 2 × R 2

(iii) 1 A 1

(iv) 6 Ω or their (i) / their (iii) correctly calculated 1

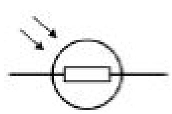
(v)

Decrease	Stay the same	Increase
	✓	
✓		
✓		

1
1
1

[9]

3 (a)



1

(b) in series with LDR   in parallel with LDR 1

(c) (graph shows) <u>direct</u> proportion 1

(because) it is a straight line through the origin

allow inverse proportion would show a curve with a negative gradient 1

(d) straight line through the origin with a positive gradient

1

current is always of smaller magnitude than line already plotted for a given potential difference

this mark only scores if first mark is awarded

1

*allow for **2** marks a straight horizontal line along the x-axis*

(e) potential difference = current × resistance

allow V = IR

1

(f) 12.5 mA = 0.0125 A

1

5.50 = 0.0125 × R

this mark may be awarded if current is incorrectly / not converted

1

$(R=)\frac{5.50}{0.0125}$

this mark may be awarded if current is incorrectly / not converted

1

(R =) 440 (Ω)

allow an answer consistent with incorrectly / not converted current

1

*an answer of 440 (Ω) scores **4** marks*

*an answer of 0.44 (Ω) scores **3** marks*

[11]

4 (a) 0.093 A

1

(b) 0.093 A

1

(c) (increasing the resistance) decreases the current

1

therefore (the lamp will be) dimmer

1

(d) potential difference = current × resistance

accept correct rearrangement with R as subject

1

(e) 3.3 = 0.15 × R

1

R = 3.3 / 0.15 (Ω) **1**

R = 22 (Ω) **1**

*allow 22 (Ω) without working shown for **3** marks*

(f) line drawn from the origin with a decreasing gradient. **1**

[9]

5 (a) vector **1**

direction

must be in this order **1**

(b) 42 km **and** 210 minutes **1**

(c) draw a tangent **1**

at 20 minutes **1**

measure the gradient of the tangent **1**

(d) 1.5 m/s **1**

180 (s) **1**

$\frac{1.5}{180}$ **1**

0.00833 (m/s^2)

*an answer of 0.00833 (m/s^2) scores **4** marks*

*an answer of 0.0083333 (m/s^2) scores **3** marks*

*an answer of 0.500 (m/s^2) scores **3** marks*

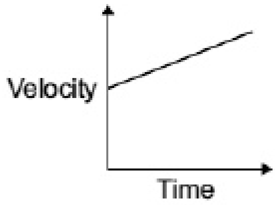
*an answer of 0.5 (m/s^2) scores **2** marks* **1**

(e) axes labelled and velocity intercept on y-axis

1

straight line with increasing gradient

an answer of:



*scores **2** marks*

1

(f) $-855 = 950 \times a$

ignore sign

1

$a = \frac{-855}{950}$

1

$a = -0.9$ (m/s^2)

1

$0^2 - 5.2^2 = 2 \times (-0.9) \times s$

($v^2 - u^2 = 2as$)

for this mark, sign of a must be opposite to sign of u, ie allow:

$0^2 - (-5.2)^2 = 2 \times 0.9 \times s$

1

$s = \frac{-27.04}{-1.8}$

ignore signs

1

s = 15.0 (m)

*an answer of 15.0 (m) scores **6** marks*

allow credit for use of a correct alternative method

1

[18]

6 (a) the forces are equal in size and act in opposite directions

1

(b) (i) forwards / to the right / in the direction of the 300 N force

answers in either order

1

accelerating

1

(ii) constant velocity to the right

1

(iii) resultant force is zero

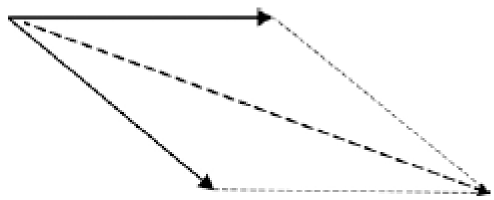
accept forces are equal / balanced

1

so boat continues in the same direction at the same speed

1

(iv) parallelogram or triangle is correctly drawn with resultant



3

value of resultant in the range 545 N – 595 N

*parallelogram drawn without resultant gains **1** mark*

If no triangle or parallelogram drawn:

*drawn resultant line is **between** the two 300 N forces gains **1** mark*

*drawn resultant line is between and longer than the two 300 N forces gains **2** marks*

1

[10]

7 (a) mass

1

velocity

1

(b) kg m / s

1

(c) momentum before = momentum after

1

and before diving in the momentum of the diver and (small) boat is zero

1

after diving the diver has forwards momentum / momentum to the right

1

therefore the (small) boat has equal backwards momentum / equal momentum to the left

1

(d) the boat moves back more slowly

1

because there is more mass (but momentum stays the same)

1

(e) as she swims there is a drag force

1

as speed increases so does the drag force

1

she accelerates less

1

drag force = thrust force

accept resultant force = 0

1

the swimmer reaches terminal velocity

1

[14]

8 (a) 2 protons and 2 neutrons

accept 2p and 2n

accept (the same as a) helium <u>*nucleus*</u>

symbol is insufficient

do not accept 2 protons and neutrons

1

(b) (i) gamma rays

1

(ii) loses/gains (one or more) <u>electron(s)</u>

1

(c) any **one** from:

- wear protective clothing
- work behind lead/concrete/glass shielding
- limit time of exposure
- use remote handling

accept wear mask/gloves

wear goggles is insufficient

wear protective equipment/gear is insufficient

accept wear a film badge

accept handle with (long) tongs

accept maintain a safe distance

accept avoid direct contact

1

[4]

9 (a) force = spring constant × extension

accept f = ke

1

(b) extension is directly proportional to the force applied

1

because it is straight line through the origin

1

(c) test a greater range of load

or

test more springs

1

(d) work done is equal to elastic potential energy

1

as long as the spring does not go past the limit of proportionality

1

(e) line extending with a greater gradient than existing line

1

a stiffer spring has a greater spring constant (k)

1

k = F / e

1

(f) the spring will be deformed

accept not gone back to original shape

1

because it has passed the elastic limit

1

[11]

10 (a) weight = mass × gravitational field strength

1

(b) mass = weight ÷ g

1

= 1.4 ÷ 9.8

1

= 0.143 (kg)

allow 0.143 with no working shown for ***3*** *marks*

1

(c) momentum = mass × velocity

momentum before = momentum after

1

143 × 7.9 = 150 × v

1

$v = \frac{143 \times 7.9}{150}$

1

= 7.5 (m / s)

*allow 7.5 (m / s) with no working shown for **4** marks*

1

*incorrect number of sig. figs max. **3** marks*

(d) ball is falling / moving down

1

at terminal velocity

1

air resistance and weight have the same magnitude / size

1

so no acceleration / constant speed

1

[12]