Our Dynamic Universe Homework One (Target mark 13 out of 16)

1. Explain the difference between a scalar quantity and a vector quantity.

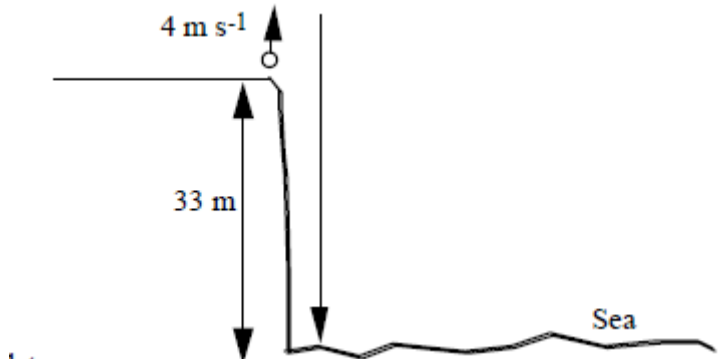
(2)

2. A cyclist completes two laps of a 300m track. What are her distance travelled and her displacement when she completes the second lap?

(2)

3. A ball is thrown upwards from the edge of a cliff as shown below. The ball travels 7m upwards before falling towards the sea. What is the ball's distance travelled and displacement when it reaches the sea?

(3)



4. During a Physics experiment a pupil walks 12m due south followed by 5m due west followed by 8m due north. Find the total distance walked by the pupil and her displacement from her starting point.

(3)

5. In the previous question the total distance was walked in a time of 15seconds. Calculate the girl's:

a) Average speed

(3)

b) Average velocity.

(3)

Our Dynamic Universe Homework Two (Target mark 11 out of 12)

1. By drawing a table, classify the following quantities as vectors or scalars:
speed, velocity, displacement, distance, time, acceleration

(2)

2. What is meant by an acceleration of $3ms^{-2}$?

(1)

3. A body starts from rest and reaches a speed of $4ms^{-1}$ after travelling with a constant acceleration in a straight line for 2seconds. Calculate the body's acceleration

(3)

4. A spaceship accelerates from rest at $10ms^{-2}$ for 2minutes. Calculate how far the car travels in this time.

(3)

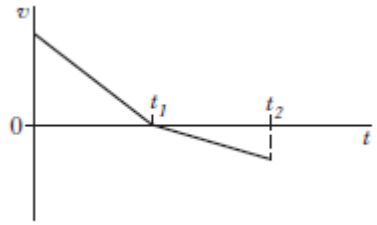
5. A car accelerates at $2ms^{-2}$ and increases its speed from $2ms^{-1}$ to $10ms^{-1}$. Calculate how far the car travels in this time.

(3)

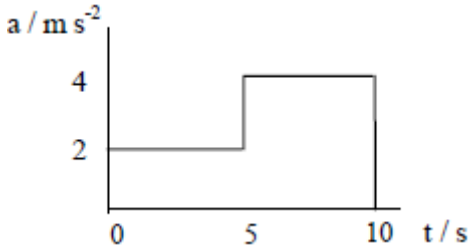
<u>Our Dynamic Universe Homework Three</u> (Target mark 7/10)

1. The velocity – time graph of a body is shown below. Draw the corresponding acceleration – time graph. Labels are required for both axes. You must use a ruler.

(3)



2. The graph below shows how the acceleration of an object varies with time. The object started from rest.



a) Draw the displacement – time graph for the first 5seconds.
b) Draw the velocity – time graph for the whole 10seconds of the motion. You must use a ruler.

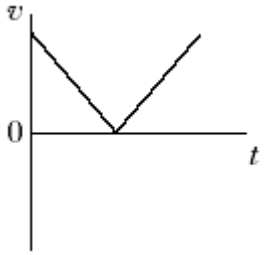
SHOW ALL WORKING. NUMERICAL VALUES ARE REQUIRED ON ALL AXES.

(7)

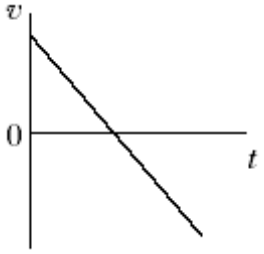
Our Dynamic Universe Homework Four (Target mark 11 out of 13)

1. A ball is thrown vertically upwards and falls back to Earth. Neglecting air resistance, which velocity-time graph, A or B, represents its motion? Explain your answer

Graph A



Graph B



(3)

2. A food aid package is dropped from a hovering helicopter. The package drops 60m on to the ground below. Calculate the final velocity of the package when it reached the ground.

(3)

3. A stone is thrown vertically down a well at $4ms^{-1}$. Calculate the time taken for the stone to reach the water surface 48m below its starting point.

(4)

4. A ball is thrown vertically and reaches a maximum height of 12m above its starting point. Calculate the ball's initial velocity.

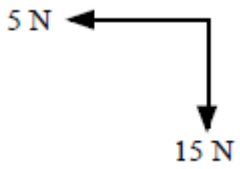
(3)

Our Dynamic Universe Homework Five (Target mark 17 out of 20)

1. Two girls push a car of mass 1500kg. Each girl supplies a force of 40N and the force of friction is 50N. Calculate the acceleration of the car.

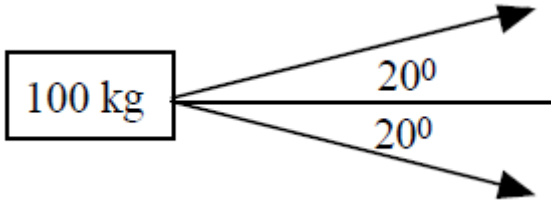
(4)

2. Calculate the magnitude and the direction of the resultant vector produced by these two forces.



(2)

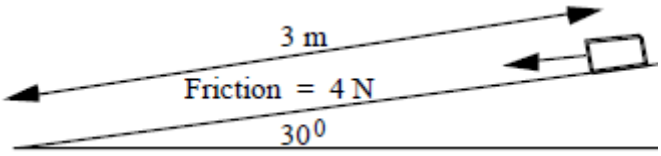
3. A crate is being pulled along a rough surface by two ropes at the angles shown.



When the crate is moving with a constant velocity, each rope supplies a force of 170N. Calculate the force of friction on the crate.

(4)

4. A wooden block of mass 2.9kg is placed on a slope as shown below. The force of friction up the slope is 4N.



a) Calculate the force acting onto the slope.

(3)

b) Calculate the force acting down the slope.

(3)

c) Calculate the acceleration of the block when it slides down the slope.

(4)

Our Dynamic Universe Homework Six (Target mark 18 out of 22)

1. The handbrake of a car (mass1000kg) fails when parked on a hill. If its speed at the bottom of the 40m hill is $10ms^{-1}$, ignoring the effects of friction, calculate the:

a) Kinetic energy at the bottom of the hill.

(3)

b) Potential energy of the car when it is parked.

(1)

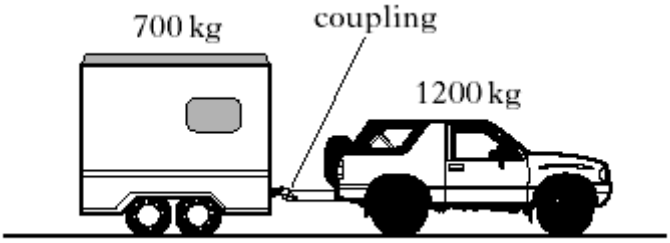
c) The height of the hill where the car is parked.

(3)

2. A 1.2kg ball is dropped from a window 6m onto the ground below. The effects of air resistance may be ignored. **Without using the equations of motion**, calculate the speed of the ball just before it strikes the ground.

(4)

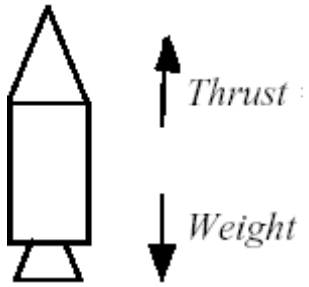
3. A car is towing a horsebox as shown below. They have an acceleration of $2ms^{-2}$



If the frictional forces acting on the horsebox are 500N, calculate the tension in the coupling.

(4)

4. A space probe, mass 800kg, takes off on its flight from Venus by using a thrust (upward force) of 20,000N. (Gravitational field strength of Venus = $8.8Nkg^{-1}$)



Calculate:
a) The weight of the space probe on Venus.

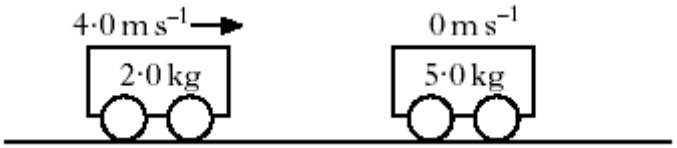
(3)

(b) The initial acceleration of the space probe.

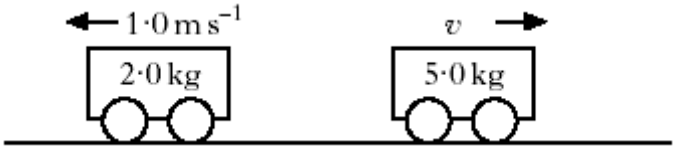
(4)

Our Dynamic Universe Homework Seven (Target mark 11 out of 13)

1. A 2.0kg trolley travels in a straight line towards a stationary 5.0kg trolley as shown.



The trolleys collide. After the collisions the trolleys move as shown below.



a) Calculate the speed of the 5.0kg trolley after the collision.

(3)

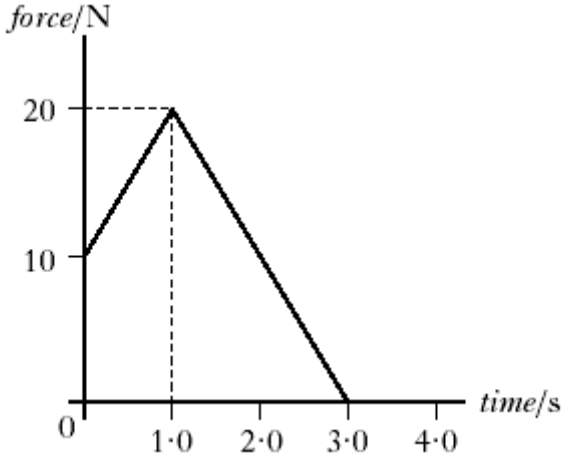
b) By calculation, show that the collision is inelastic.

(4)

2. A firework (mass 1kg) is designed to split in two when it is stationary at its highest point. If one piece (mass 600g) continues upwards at $5ms^{-1}$, calculate the velocity of the other piece which travels downwards.

(3)

3. The graph shows the force on an object of mass 4.0kg.



Calculate the impulse applied to the object.

(3)

Our Dynamic Universe Homework Eight (Target mark 17 out of 21)

1. An object is released from an aircraft travelling horizontal at $1000ms^{-1}$. The object takes 40seconds to reach the ground.

a) Calculate the horizontal distance travelled by the object.

(3)

b) Calculate the vertical velocity of the object just before impact with the ground.

(3)

c) Calculate the height at which the object was released from the aircraft.

(3)

2. A missile is launched at 60^0 to the ground with a velocity of $40ms^{-1}$.

a) Calculate the horizontal component of the missile's velocity.

(1)

b) Calculate the vertical component of the missile's velocity.

(1)

c) Calculate the time to reach the maximum height.

(3)

d) Calculate the maximum height reached by the missile.

(3)

e) Calculate the maximum horizontal range of the missile.

(4)

Our Dynamic Universe Homework Nine (Target mark 8 out of 10)

1. "Satellites float in space." Discuss.

(3)

2.

a) Copy and complete the following table by inserting the terms shown below to replace A, B and C.

natural satellite planet star

Body	Gravitational Field Strength (Nkg^{-1})
A	280
B	5.0
C	1.6

b) Explain your choice for the "star" in part a).

(2)

3.

a) State Newton's Law of Universal Gravitation.

(1)

b) What is value of "G" in Newton's Law of Universal Gravitation?

(1)

c) Calculate the force of attraction between Planet A (mass $6.0 \times 10^{24}kg$) and Planet B (mass $4.9 \times 10^{24}kg$) which are separated by a distance of 4.0×10^7km.

(3)

Our Dynamic Universe Homework Ten (Target mark 8 out of 10)

1. What is the approximate minimum speed, in ms^{-1}, at which relativistic effects start to be noticed?

(1)

2. Which relativistic effects are described by?
a) "the time observed be a stationary observer is longer than the time experienced in the moving frame of reference"

(1)

b) "the length measured by a stationary observer is shorter than the length measured by an observer in the moving frame of reference"

(1)

3. Calculate the Lorentz factor for an object moving at 0.5c.

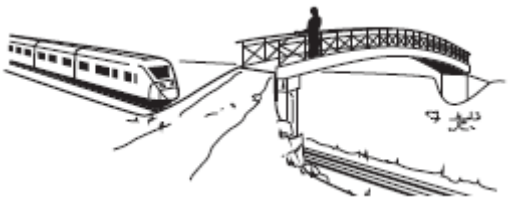
(3)

4. State the permittivity of free space and the permeability of free space. (Some research will be needed) Use these values to calculate the speed of light from the same equation as James Clerk Maxwell. (See page 64 of your textbook)

(4)

Our Dynamic Universe Homework Eleven (Target mark 9 out of 10)

1. A train is moving at a constant speed of $10ms^{-1}$, when it is seen by a stationary observer standing on a bridge.



The train driver sounds the train's horn, which has a frequency of 256Hz, as he approaches the bridge. Calculate the frequency of sound heard by the observer as the train approaches the bridge. (Speed of sound in air = $340ms^{-1}$)

(3)

2. Copy and complete the following passage.
The _____ Effect can be used on light waves as well as sound waves. By using _____ lines it is possible to carry out spectral analysis of distant stars. If the lines are moved to a _____ wavelength value then the star is moving away from us. This effect is known as _____ shift.

(4)

3. The observed wavelength of light from a distant star is 660nm. If this light has a rest wavelength of 650nm, calculate the red shift for the star.

(3)

Our Dynamic Universe Homework Twelve (Target mark 10 out of 12)

1.
a) State Hubble's constant in S1 units.

(1)

b) Given that,

$$d = v \times t \qquad \text{and} \qquad v = H_o \times d$$

Show that,

$$t = 1 / H_o$$

(2)

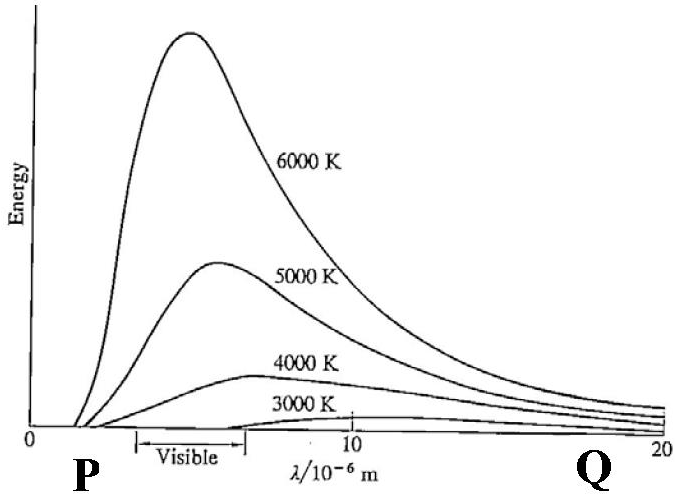
c) Use the equations in part b) to estimate the age of the Universe.

(3)

2. What type of energy is believed to be the cause of the Universe's accelerating expansion rate?

(1)

3. The graph below was obtained by measuring the energy emitted from a stellar object at different temperatures.



a) A student makes the following statement about the graph.
"The label Q represents light from beyond the violet end of the visible spectrum."
Is this statement correct? Explain your answer.
b) Use the data from the graph to copy and complete the following about stellar temperatures:-
"Stellar objects emit radiations that will have a peak wavelength that depends on their temperatures. The peak wavelength will be _____ for _____ stellar objects."

(2)

4. An expanding Universe supports the Big Bang theory. State three other pieces of evidence that support the Big Bang theory.

(3)