Farr High School

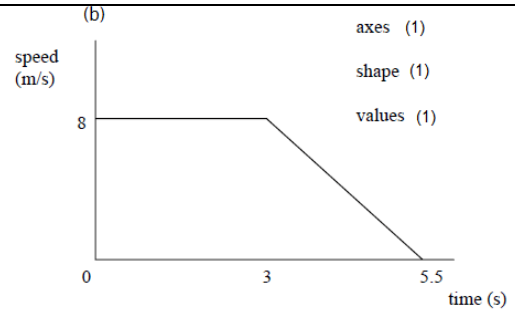
NATIONAL 5 PHYSICS

Uni

Dyna

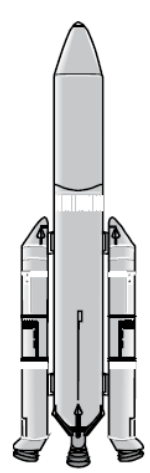
ANSWERS

Exam Questions

VELOCITY AND DISPLACEMENT				
1		D	1	
2		B	1	
3		D	1	
4		E	1	
5		B	1	
6		E	1	
7		E	1	
8		C	1	
VELOCITY TIME GRAPHS				
1	(a)	It is accelerating OR Speeding up (NOT 'going down the flume')	1	DO NOT accept "goes faster"
	(b)	distance = area under graph (1) = (½ x 7.5 x 5) + (20 x 5) (1) = 18.75 + 100 = 118.75 m (1)	3	(0) marks for d = vt Can award (1) for implied relationship if addition of areas is attempted No significant figure penalty (exact answer)
	(c)	a = (v-u)/t (1) a = 10/5 (1) a = 2.0 ms^{-2} (1)	3	
2		d = area under graph (1) d = (0·5 × 9 × 2) + (10 × 9) + (0·5 × 9 × 1) (1) d = 9 + 90 + 4·5 d = 103·5 m (1)	3	
3	(a)	(b)  	3	
	(b)	distance = area under graph (1) = (8 × 3) + (½ × 2·5 × 8) (1) = 34m (1)	3	
4		distance = area under graph (1) = (½ x 4 x 5) + (8 x 5) + (½ × 6 x 4.5) (1) = 63.5m (1)	3	
5	(a)	distance = area under graph (1) = (½ x 240 x 16) + (480 x 16) + (½ × 480 x 16) (1) = 13440 m (1)	3	
	(b)	v = d/t (1) = 13440/1200 (1) = 11.2 ms^{-1} (1)	3	
6	(a)	0.6 s	1	
	(b)	distance = area under graph (1) = (8 x 0.6) + (½ × 8 x 2.2) (1) = 13.6 m (1)	3	

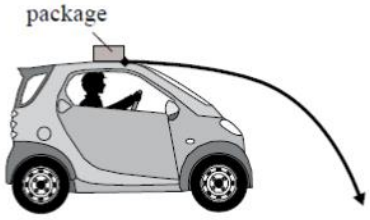
ACCELERATION				
1	(a)	a = (v-u)/t (1) = (18-0)/15 (1) = 1.2 m s^{-2} (1)	3	If wrong values extracted from graph then (1) MAX for equation deduct (1) for wrong/missing unit Do not accept a = v/t as wrong equation- stop marking and award (0) marks
	(b)	s = area under graph (1) = (1/2 x 15 x 18) + (50 x 18) (1) = 1035 m (1)	3	If wrong substitution then (1) MAX Deduct (1) for wrong/missing unit.
	(c) (i)	• (wear) tight fitting clothes • Crouch • (wear) streamlined helmet • Streamlined shoes • Solid wheels	1	Question refers to the cyclist in picture so answer should refer to this Not: 'Pushes forward'
	(ii)	• Tyres • (handle) grips • Brakes • Shoes on pedals • Saddle	1	Not: Wheels
2		B	1	
3		B	1	
4		a = $\frac{v - u}{t}$ (1) = $\frac{0 - 8}{2.5}$ (1) = -3.2 m s^{-2} (1)	3	
5	(a)	a = $\frac{v - u}{t}$ (1) = $\frac{11 - 0}{5.8}$ (1) = 1.9 m s^{-2} (1)	3	If wrong values extracted from graph then (1) MAX for equation. If t = 6 then wrong substitution award (1) mark max Deduct (1) for wrong/missing unit. Do not accept a = v/t as this is the wrong equation - stop marking and award (0) sig. fig. range 1–4 1·9, 1·90, 1·897, 2
	(b)	displacement = area under graph (1) = ½ x (11 x 5·8) + (11 x 6) (1) = 31·9 + 66 = 97·9 m (1)	3	Any attempt to use s = vt applied to the graph is wrong physics (0) marks. If first time ≠ 5·8 then (1) mark max for implied equation. sig. fig. range 1–3 97·9, 98, 100

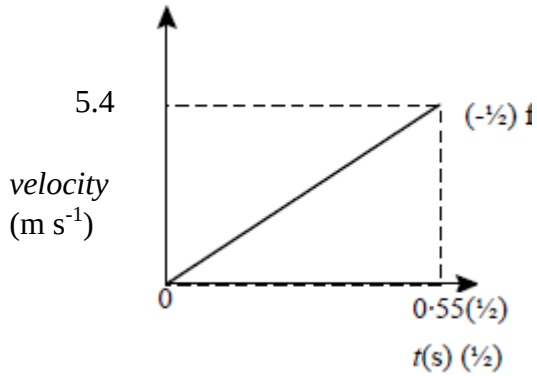
6	(a)	$a = \frac{v - u}{t}$ (1) $= \frac{3 - 0}{5}$ (1) $= 0.6\ m\ s^{-2}$ (1)	3	
	(b)	There is an unbalanced force/friction, (1) this acts against the motion. (1) (must have some mention of opposing the motion) Ignore mention of component of weight	2	
7		$a = \frac{v - u}{t}$ (1) $= \frac{70 - 0}{2}$ (1) $= 35\ m\ s^{-2}$ (1)	3	
8		$a = \frac{v - u}{t}$ (1) $= \frac{5 - 0}{4}$ (1) $= 1.25\ m\ s^{-2}$ (1)	3	

NEWTON'S LAWS				
1	(a)	(i) If A exerts a force on B, B exerts an equal but opposite force on A. Or To every action (force) there is an equal and opposite reaction (force)	1	Must show a good attempt at stating Law
		(ii) Engine/exhaust gases pushed down(A on B); gases push rocket up (B on A)	1	Must refer to engine/exhaust gases
	(b)	$F_{UN} = ma$ (1) $8200000 = 2 \cdot 05 \times 10^6 \times a$ (1) $a = 4\ ms^{-2}$ (1)	3	
2		D	1	
3		A	1	
4	(a)	 thrust/engine force (½) for correct label and direction (½) for correct label and direction Weight/ Force due to gravity/ Gravitational pull	1	Must have correct label and direction. Accept: • Upthrust • Upward thrust • Upwards force • Force of gravity on the rocket • Force of gravity Do not accept: • Gravity alone,
	(b) (i)	W = mg (1) = 3·08 x 10^5 x 9.8 (1) = 3·02 x 10^6 N (1)	3	

	(ii)	Fun = 3352 000 – 3020 000 = 332 000 (N) (1) F = ma (½) (1) 332 000 = 3.08 x 10^5 x a (1) a = 1.08 m s^{-2} (1)	4	or consistent with answer in 13(b)(i) If arithmetic error can be seen in subtraction to get Fun then deduct (1) mark. Candidate can still get next (3) marks. **If no subtraction is attempted** and 3352000 or answer from 13(b)(i) is used in calculation for acceleration then (1) MAX for equation. sig. fig. range 2–5 1.1, 1.08 , 1.078, 1.0779
	(c)	It moves with constant speed in the horizontal direction (1) while accelerating due to the force of gravity in the vertical direction (1)	2	Answer should be based on the following two points: • statement relating to horizontal motion: eg 'ISS moves forward' OR curvature of the earth, OR 'surface curves away'. (1) • statement relating to vertical motion eg 'falling (towards the Earth)', or force of gravity (1) Accept: • pull of gravity NOT 'gravity' alone
	(d) (i)	The astronaut is falling (towards Earth) at the same rate as the ISS OR The astronaut is in freefall	1	Answer must refer to the astronaut. Do not accept: a straight statement of Newton III
	(ii)	The astronaut exerts a force against the wall and the wall exerts an equal and opposite force against the astronaut (causing him to move)	1	Answer must refer to the astronaut. Do not accept: a straight statement of Newton III
5		E	1	
6		D	1	
7		C	1	

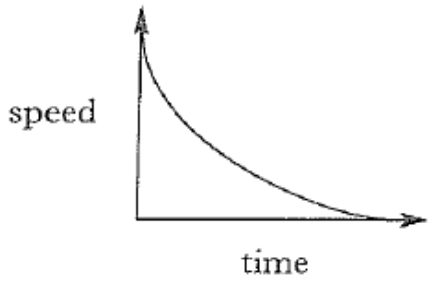
8	(a)	BC and DE	1	Both parts needed Do not accept single letters e.g. B and D **NOT** 'where graph is flat/horizontal' **NOT** 'where speed is constant'
	(b) (i)	$W = m \times g$ (1) $= 90{\cdot}0 \times 10$ (1) $= 900$ N (1)	3	Accept g = 9·81:W = 883 N 2 – 5 sig fig {880, 883, 882·9, 882·90} Accept g = 9·8: W = 882 N 1 – 4 sig fig {900, 880, 882, 882·0}
	(b) (ii)	$F_{res} = F_u - F_d$ (1) $= 958{\cdot}5 - 900$ $= 58{\cdot}5$ N (1) $a = Fres/m$ (1) $= 58.5/90.0$ (1) $= 0{\cdot}65$ ms^{-2} (1)	5	Accept answer for weight from b(i) for W = 880 a = 0·87 ms^{-2} for W = 882 a = 0·85 ms^{-2} for W = 882·9 a = 0·84 ms^{-2} for W = 883 a = 0·839 ms^{-2}
9	(a)	Scale diagram (1) 1131N (1) **OR** Resultant = $\sqrt{(800^2 + 800^2)}$ (1) = 1131N (1)	2	
	(b) (i)	$W = mg$ (1) $= 180 \times 10$ (1) = 1800 N (1)	3	
	(b) (ii)	resultant = 2700 - 1800 = 900 N (1) $a = F/m$ (1) $= 900/180$ (1) $= 5$ ms^{-2} (1)	4	
10		$Ew = F \times d$ (1) $Ew = 300 \times 1{\cdot}5$ (1) $Ew = 450$ J (1)	3	
11		$a = F/m$ (1) $= 150/75$ (1) $= 2$ ms^{-2} (1)	3	
12	(a)	$a = (v-u)/2$ (1) $= (70 - 0)/2$ (1) $= 35$ ms^{-2} (1)	3	
	(b)	$F = ma$ (1) $= 28\,000 \times 35$ (1) = 980 000N (1)	3	
	(c)	additional force required = total force – aircraft thrust(1) = 980 000 – 240 000 = 740 000N (1)	2	
13		B	1	
14		two forces: air resistance and weight (1) balanced (1)	2	

PROJECTILE MOTION				
1	(a)		1	(1) mark or zero. Sketch should show a reasonable **curve** from the package (to ground level). Straight line – zero marks.
		It moves with constant velocity in the horizontal direction (1) while accelerating due to the force of gravity in the vertical direction (1)	2	Answer should be based on the following two points: • Statement relating to horizontal motion, eg 'package moves forward', or 'package continues at a constant velocity' (1) • Statement relating to vertical motion eg'package falls towards the road/Earth', or 'force of gravity acts/pulls downwards' (1) **Not** an answer referring to 'gravity' alone.
	(b)	$g = 9.8$ (m s^{-2}) (1) data $a = \frac{v - u}{t}$ (1) $9.8 = \frac{v (– 0)}{0.55}$ (1) $v = 5.4$ m s^{-1} (1) If incorrect relationship stated (eg $a = v/t$, $v = at$ *or* $v = gt$) stop marking and award (0) marks but can still get (1) for data. Candidates who start with $v = 0{\cdot}55 \times 9.8$ have not shown an incorrect relationship so should not be penalised eg $v = 0{\cdot}55 \times 9.8$ (1) for implied formula, (2) for substitution & data mark $v = 5{\cdot}4$ m s^{-1} (1)	4	(1) data mark for correct selection of ***g*** from table. Accept 5.39

2	(a)	s = vt (1) 11 = 20 x t (1) = 0·55 s Accept 0·6 s (1)	3	
	(b)	a = $\frac{v - u}{t}$ (1) 9.8 = $\frac{v - 0}{0.55}$ (1) v = 5.4 m s^{-1} (1)	3	
	(c)		2	Figures on axis must be consistent with parts (a) and (b) above s vs t → No marks
	(d)	s = area under graph **or** $s = \bar{v}t$ **(1)** s = ½ x 0.55 x 5.4 s = $\frac{(5.4)}{2}$ x 0.55 (1) s = 1·5 m s = 1·5 m (1)	3	Must be $s = \bar{v}t$ No other symbols
3	(a) (i)	s= vt (1) s = 2 × 0·76 (1) s = 1·52 m (1)	3	
	(ii)	a = $\frac{v - u}{t}$ (1) 9.8 = $\frac{v - 0}{0.76}$ (1) v = 7.45 m s^{-1} (1)	3	

	(b) (i)	Same	1	Must have explanation to get first mark
	(ii)	All objects fall with the same (vertical) acceleration.	1	Will take the same time to reach the water
4		C	1	
5		D	1	
6		$a = (v - u)/t$ (1) $10 = (v - 0)/0.2$ (1) $v = 2\ ms^{-1}$ (1)	3	
7	(a)	Answer should be based on the following two points: statement relating to vertical motion, eg 'falling (towards the moon)', or force (of gravity) (1) statement relating to horizontal motion, eg 'probe moves forward', or curvature of Ganymede, eg 'surface curves away' (1)	2	NOT 'gravity' alone
	(b)	Newton III: The thrusters force gas one way (1) So the gas exerts an equal and opposite force on the probe.(1)		Explanations in terms of Newton I and Newton II are also acceptable. Newton I: mention of balanced forces (1) would not slow down/indication of constant speed (1) Newton II: unbalanced force (1) in the opposite direction/opposing motion (1) Quoting NI, NII or NIII alone is insufficient, the answer must relate to the thrusters/probe
8		A	1	
9	(a)	$d = v \times t$ (1) $= 30 \times 6$ (1) $= 180m$ (1)	3	
	(b)	$a = \frac{v - u}{t}$ (1) $4 = \frac{v\ (-0)}{6}$ (1) $v = 24ms^{-1}$ (1)	3	
10	(a)	$d = v \times t$ (1) $= 4{\cdot}8 \times 0{\cdot}65$ (1) $= 3{\cdot}12$ m (1)	3	
	(b)	$a = \frac{v - u}{t}$ (1) $10 = \frac{v - 0}{0.65}$ (1) $v = 6{\cdot}5$ m/s (1)	3	
11		C	1	
SPACE EXPLORATION				
1	(a)	Eyepiece magnify (1)	1	Both correct
	(b)	Objective collect light (1)	1	Both correct

COSMOLOGY				
1	(a)	s = vt (1) = 3 x 10^8 x (1 x 365 x 24 x 60 x 60) (1) + (1) = 9.4608 x 10^{15} m	3	**NOT a standard (3)marker** (1) for initial equation (1) for speed of light (1) for correct substitution of time **No** marks for final answer-given Unit not required but deduct (1) if wrong Accept the number 31536000s in place of (1 x 365x 24 x 60 x 60)
	(b)	Different frequencies/ wavelengths /signals require different detectors/telescopes OR Certain detectors/telescopes cannot pick up certain frequencies/wavelengths/signals OR Different signals have different frequencies/ wavelengths	1	Accept: • Different telescopes detect different signals Do not accept: • 'Different types of signals'- **unless** mentioned along with different wavelengths/frequencies/telescopes/ detectors. • "types of radiation" – ambiguous – could be α or β • Any mention of sound "types of wave" or "wave" – too vague
2	(a)	(visible) Light	1	
	(b)	Different types of radiation have different properties/wavelengths/frequencies	1	
	(c)	At the focus	1	Accept diagram with light rays shown
	(d)	Arecibo (1) Larger dish can detect more waves (1)	2	
3	(a)	distance travelled by light in one year	1	
	(b) (i)	different detectors (1) are required for different radiations/ frequencies/wavelengths (1)	2	
	(b) (ii)	C A B (1) or (0) accept: X-ray Visible Infrared	1	
	(b) (iii)	G-M tube OR photographic film	1	
4	(a)	(Radio waves are) longer/greater/bigger/larger OR light has a shorter wavelength	1	NOT 'wider'
	(b)	Aerial OR Radio telescope	1	NOT satellite dish NOT telescope (on its own)
	(c)	Different frequencies/wavelengths/signals require different detectors/telescopes OR Certain detectors/telescopes can't pick up certain frequencies/wavelengths/signals	1	eg different telescopes detect different signals NOT 'types of wave' or 'waves' – too vague NOT 'types of radiation' – ambiguous could be alpha or beta Any mention of sound – 0 marks
5		Cadmium and mercury	1	Both required
6		Helium and nitrogen	1	Both required
7		information about atoms (or elements) present OR age of star OR distance to star OR speed of star OR type of star OR temperature of star	1	Accept: gases (identified) OR chemicals (identified) OR 'what it is made of' Do not accept: position OR radiation

VARIOUS				
1	(a)	(i) Acceleration is the change of velocity (not speed) in unit time	1	Need to be indication of time requirement.
		(ii) Direction of satellite is (continually) changing **OR** Velocity of satellite is (continually) changing **OR** There is an unbalanced (not 'resultant') force on the satellite	1	
	(b)	F = 12 - 2 = 10 N (1) F = ma (1) 10 = 50 x a (1) a = 0·2 m s^{-2} direction is right (1)	4	No attempt to calculate F => (1) for formula
2	(a)	a = (v-u)/2 (1) a = (6-0)/60 (1) a = 0.1 ms^{-2} (1)	3	
	(b)	s = area under graph (1) = (0·5 × 60 × 6) + (40 × 6) (1) = 420 m (1)	3	
	(c)	v = s/t (1) = 420/100 (1) = 4.2 ms^{-1} (1)	3	
	(d)	W = mg (1) = 400 × 10 (1) = 4000 N (1)	3	accept 9.8 and 9.81 for 'g' which give 3920 N and 3924 N
	(e)	F = ma (1) = 400 × 0·1 (1) = 40 N (1) Upward force = 4000 + 40 = 4040 N (1)	4	must be consistent with (a) and (d)
3	(a) (i)	800N	1	
	(a) (ii)	a = (v – u)/t (1) = (7 – 5)/12 (1) = 0.17 ms^{-2} (1)	3	Accept 0.2, 0.167
	(a) (iii)	F = ma (1) = 400 x 0.17 (1) = 67 (N) (1) Forward force = 800 + 67 (1) = 867 N (1)	5	
	(a) (iv)	Distance = area under graph (1) = ½ x 8 x 7 (1) = 28m (1)	3	
	(b) (i)	Time will be longer	1	
	(b) (ii)		1	Straight line NOT acceptable Ignore any values on graph No labels on axes acceptable but wrong labels is not